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Committee Room 13

BRITISH STANDARD 142 : 1942

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Electrical Protective RELAYS

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BRITISH STANDARD SPECIFICATION FOR

ELECTRICAL PROTECTIVE RELAYS

FOREWORD

The present revision represents a complete redraft of the Specification, the previous issue (1927) having become out of date, owing to the advance in the art. Provisions for many new types of relay have been included, such as for distance relays, open and reverse phase-sequence relays, etc. An attempt has been made to sub-divide the so-called instantaneous relays into classes according to their speed of operation. The requirement as regards the capacity of relays to withstand sudden overloads has been extended.

The range of settings which may be regarded as normal, that is, as involving no special design of relay, are given for each type, and in addition, a number of recommended settings are included in an Appendix.

A recommended characteristic curve connecting time and current for relays having an inverse time-lag with definite minimum has been introduced for the first time. It was not found possible, at the present stage, to include it in the body of the Specification, as an obligatory feature, but it is hoped when new relays are designed, the recommended characteristic curve will always be adopted.

SCOPE

This Specification is a revision of B.S. 142:1927, 'Electrical Protective Relays,' and applies to relays which serve to protect electrical plant in the event of abnormal conditions therein. It does not apply to relays used for regulation or control purposes, nor to direct-acting under-voltage attachments or direct-acting over-current trip coils for circuit-breakers and the like.

SPECIFICATION

DEFINITIONS

1. The following definitions have been adopted for the purposes of this Specification.

(a) *Relay*. A device by means of which one electrical circuit is indirectly controlled by a change in the same or in another electrical circuit. A relay may consist of a single element (e.g. an over-current relay consisting of a solenoid element or an induction element), or of

two or more elements which together provide the desired characteristics (e.g. a directional over-current relay comprising a directional element in combination with an over-current element).

Unless the context shows otherwise, the term relay includes these various elements, together with $\frac{1}{2}$ v resistors, choke coils or other components essential to its correct operation, and whether contained in the same case or not, but excludes current and voltage transformers and other apparatus which may be necessary to form a complete protective scheme.

(b) *Protective relay*. A relay which serves to protect electrical plant in the event of abnormal conditions therein, by causing such plant to be disconnected automatically from the source of supply.

Where the term relay is used in this Specification a protective relay as herein defined is to be understood.

(c) *Relay elements*. (i) *Main element*. That part of a relay which responds directly to the changed conditions in the protected circuit.

(ii) *Supplementary element*. That part of a relay which, used in conjunction with the main element, modifies its characteristics or settings or renders it inoperative.

(iii) *Auxiliary element*. That part of a relay which assists the main element in the performance of its functions and which operates in response to the closing or opening of the contacts of the main element.

(d) *Rated current and rated voltage*. The value of the current or voltage marked on the relay as that upon which its performance is based.

NOTE. The rated current and/or voltage of a relay is usually equal to the normal full load current and/or system voltage of the circuit, or to the rated secondary current and/or voltage of any current or voltage transformers used with it.

(e) *Relay settings*. In general the expression 'current setting,' 'time setting,' 'voltage setting' or the like denotes the value ascribed by the maker to that setting, and is usually marked on the relay. Settings may be expressed as direct values, multipliers, or percentages of a rated value.

(f) *Operating value*. The limiting value of the operating quantity sufficing to cause the relay to carry out its prescribed function.

(g) *Re-setting value*. The limiting value of the operating quantity sufficing to cause the relay to return to the non-operated condition.

(h) *Contact current*. The current in the circuit which is controlled by the relay contacts.

(i) *Contact voltage*. The voltage of the circuit from which the contact current is derived.

CLASSIFICATION

FUNCTIONAL CHARACTERISTICS

2. The functional characteristics of a relay are classified as follows :

- (a) *Current relays*, which operate at a predetermined value of current. These include over-current and under-current relays.
- (b) *Voltage relays*, which operate at a predetermined value of voltage. These include over-voltage and under-voltage relays. Under-voltage relays which are not intended to operate until the voltage has fallen to about half its rated value are known as *no-voltage relays*.
- (c) *Power relays*, which operate at a predetermined value of power. These include over-power and under-power relays.

(d) *Directional relays*. (i) *Alternating current*, which operate in accordance with the phase relation between alternating quantities and include :—

Relays in which the maximum torque is exerted when the current and voltage are in phase and which are not compensated for fall of voltage (sometimes known as reverse-power relays) ;

Relays in which the maximum torque is exerted when the current and voltage have a predetermined phase-displacement other than zero ;

Relays belonging to either of the above categories but compensated for fall of voltage. (Sometimes known as *reverse-current relays*.)

Relays in which the maximum torque is exerted when two currents or two voltages are in phase.

(ii) *Direct current*, which operate in accordance with the direction of the current and are usually of the permanent-magnet moving-coil pattern.

(e) *Frequency relays*, which operate at a predetermined frequency. These include over-frequency and under-frequency relays.

(f) *Temperature relays*, which operate at a predetermined temperature in the apparatus to be protected.

NOTE. Requirements for frequency relays and temperature relays are not included in this Specification.

(g) *Differential relays*, which operate according to the scalar or vectorial difference between two quantities such as current, voltage, etc.

(h) *Open-phase relays*, which operate when one or more lines of a polyphase circuit are interrupted.

(i) *Open-phase and reverse phase-sequence relays*, which operate if one or more lines of a polyphase system are interrupted, or if the phase-sequence is reversed. If voltage-operated, they may also operate on a fall of voltage.

(j) *Unbalanced-phase relays*, which operate when the currents (if current-operated) or voltages (if voltage-operated) of a polyphase system are unbalanced.

(k) *Distance relays*, which operate in accordance with the 'distance' between the relay current transformer and the fault, the 'distance' being measured in terms of resistance, reactance or impedance. These relays may be grouped as follows :

- (i) *Definite-distance type*, which operate if the distance of the fault is less than a given value, and
- (ii) *Time-distance type*, in which the time-lag depends upon the distance of the fault.

The characteristic curve connecting distance and time in relays of the time-distance type may take the form of either a stepped line or a continuous sloping line, whether straight or curved.

CONSTRUCTIONAL CHARACTERISTICS

3. The constructional characteristics of a relay are classified as follows :

(a) *Solenoid relays*, depending upon the movement of an iron core in an axial direction within a solenoid.

(b) *Armature or moving-iron relays*, depending upon the movement of an iron armature.

(c) *Permanent-magnet moving-coil relays*, depending upon the movement of a coil in the air-gap of a permanent magnet.

(d) *Electrodynamic relays*, depending upon the movement of a coil in an electromagnetic field.

(e) *Induction relays*, depending upon currents induced in a movable conducting member.

(f) *Motor-pattern relays*, depending upon the rotation of a motor armature.

(g) *Thermal relays*, depending upon the action, on some heat-responsive medium, of heat generated by the passage of an electric current.

TIME CHARACTERISTICS

4. The time characteristics of a relay are classified as follows :

(a) *Instantaneous*. A relay is said to be instantaneous if its operation is not purposely delayed. Instantaneous relays are further classified as :

Class I. Operating in more than 0.1 second but not more than 0.3 second (corresponding to 5 and 15 cycles, respectively, at 50 cycles per second).

Class II. Operating in more than 0.01 second but not more than 0.1 second (corresponding to 0.5 and 5 cycles, respectively, at 50 cycles per second).

Class III. Operating in not more than 0.01 second (corresponding to 0.5 cycles at 50 cycles per second).

NOTE. Class III usually involves the use of a thermionic device and does not come within the scope of this Specification.

(b) *Definite time-lag*. A relay is said to have a definite time-lag if