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American Standards
for
INDUSTRIAL CONTROL APPARATUS

APPROVED
American Standards Association
December 4, 1943



ERRATA

Par. 15-101—Should read “Contactor Ratings . . .”
Par. 15-109—Drop words “and Numbers”
Bottom page 15—Equation should be
$$I_1 \times P^2 + 0.251$$

Table on page 16—Medium Duty—Should read
“65-80”
Par. 15-126—Rise for busses, straps, ... etc.
should be “50C”
Par. 15-132—Equation should be
$$T = \frac{R}{r} (234.5 + t) - 234.5$$

Par. 15-146a—Should read “Watertight Enclosures
shall etc.”

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AMERICAN STANDARDS

For

Industrial Control Apparatus

(Adopted by the A.I.E.E. Board of Directors May 18, 1928. Revised May 22, 1942.)
(Approved by ASA as American Standard Nov. 27, 1942—Revision approved Dec. 4, 1943)

SCOPE

The standards in this section cover the following types of control apparatus.

1. Industrial motor control.
 2. Similar control used for industrial heating.
 3. Rheostats including those for generator field.
- Standards for the following types of equipment are not included:
1. Marine auxiliaries control apparatus.
 2. Marine propulsion control apparatus.
 3. Mine locomotive control apparatus.
 4. Railway control apparatus.

SERVICE CONDITIONS

15-1 Temperature and Altitude

A. Control apparatus conforming with these standards shall be suitable for carrying its rated load:

- (1) When and where the temperature of the cooling medium does not exceed 40 C.
- (2) Where the altitude does not exceed 6000 feet.

B. Control apparatus designed for operation in altitudes above 6000 feet and not exceeding 15,000 feet shall be derated as follows:

- (1) Continuous duty resistors shall be derated to 75 per cent of their normal wattage rating.
- (2) Intermittent and starting duty resistors shall be applied on a duty cycle selected on the basis of the next higher "time-on" classification.
- (3) A magnetic contactor shall be used to open the main line circuit when manually operated drum switches are used.
- (4) Auto transformers and control circuit transformers shall be derated to 75 per cent of their normal kva rating.

15-2 Unusual Service Conditions

The use of apparatus in cooling mediums having temperatures higher than 40 C or at altitudes greater than 6000 ft., should be considered as special applications.

There are further unusual conditions which, where they exist, should be subject to special consideration. Apparatus for use in such cases may require special construction or protection. Among such unusual conditions are:

- (a) Exposure to corrosive atmospheres or gases.
- (b) Operation in damp places.
- (c) Exposure to excessive dust.
- (d) Exposure to gritty or abrasive dust.
- (e) Exposure to steam.
- (f) Exposure to excessive oil vapor.
- (g) Exposure to salt air.
- (h) Exposure to vibration, shocks and tilting.
- (i) Exposure to explosive dust or gases.
- (j) Exposure to weather or dripping water.

DEFINITIONS

Classification of Controllers

15-3 Electric Controller.—An electric controller is a device, or group of devices, which serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

15-3a Basic Functions.—The basic functions of a controller are acceleration, retardation, line closing, reversing, etc.

15-4 Full-Magnetic Controller.—A full-magnetic controller is an electric controller having all of its basic functions performed by electromagnets.

15-5 Semi-Magnetic Controller.—A semi-magnetic controller is an electric controller having only part of its basic functions performed by electromagnets.

15-6 Manual Controller.—A manual controller is an electric controller having all of its basic functions performed by hand.

15-7 Drum Controller.—A drum controller is an electric controller which utilizes a drum switch as the main switching element.

Note: A drum controller usually consists of a drum switch and a resistor.

15-8 Electropneumatic Controller.—An electropneumatic controller is an electric controller having its basic functions performed by air-pressure.

15-9 Starter.—A starter is an electric controller for accelerating a motor from rest to normal speed.

15-10 Automatic Starter.—An automatic starter is a starter which controls automatically the acceleration of a motor.

15-11 Autotransformer Starter.—An autotransformer starter is a starter having an autotransformer to furnish a reduced voltage for starting. It includes the necessary switching mechanism and is frequently called a compensator or autostarter.

Classification of Switches

15-12 Switch.—A switch is a device for making, breaking or changing the connections in an electric circuit.

15-13 General Use Switch.—A general use switch is a switch intended for use in general distribution and branch circuits. It is rated in amperes and is capable of interrupting the rated current at the rated voltage.

15-14 Isolating Switch.—An isolating switch is a switch intended for isolating an electric circuit from the source of power. It has no interrupting rating and is intended to be operated only after the circuit has been opened by some other means.

15-15 Motor-Circuit Switch.—A motor-circuit switch is a switch intended for use in a motor branch circuit. It is rated in horsepower and is capable of interrupting the maximum operating overload current of a motor of the same rating at the rated voltage.

15-15a Operating Overload.—Operating overload is the overcurrent to which electric apparatus is subjected in the course of the normal operating conditions that it may encounter.

Note 1: The maximum operating overload is considered to be six times normal full-load current for alternating-current industrial motors and control apparatus; four times normal full-load current for direct-current industrial motors and control apparatus used for reduced-voltage starting; and ten times normal full-load current for direct-current industrial motors and control used for full-voltage starting.

Note 2: It should be understood that these overloads are currents that may persist for a very short time only, usually a matter of seconds.

15-16 Drum Switch.—A drum switch is a switch in which the electric contacts are made on segments or surfaces on the periphery of a rotating cylinder or sector, or by the operation of a rotating cam.

15-17 Master Switch.—A master switch is a switch which dominates the operation of contactors, relays or other magnetically operated devices.

15-18 Control Cutout Switch.—A control cutout switch is a switch that isolates the control circuit of an electric controller.

15-19 Contactor.—A contactor is a device for repeatedly establishing and interrupting an electric power circuit.

15-20 Magnetic Contactor.—A magnetic contactor is a contactor actuated by electromagnetic means.

15-21 Electric Contact.—Electric contact is the junction of conducting parts permitting current to flow.

15-22 Contacts.—Contacts are conducting parts which coact to complete or to interrupt a circuit.

15-23 Auxiliary Contacts.—Auxiliary contacts of a switching device are contacts in addition to the main circuit contacts and function with the movement of the latter.

RESISTORS

15-24 Resistance.—Resistance is the (scalar) property of an electric circuit or of any body that may be used as part of an electric circuit which determines for a given current the rate at which electric energy is converted into heat or radiant energy and which has a value such that the product of the resistance and the square of the current gives the rate of conversion of energy.

In the general case, resistance is a function of the current, but the term is most commonly used in connection with circuits where the resistance is independent of the current.

15-25 Resistor.—A resistor is a device, the primary purpose of which is to introduce resistance into an electric circuit.

15-26 Resistive Conductor.—A resistive conductor is a conductor used primarily because it possesses the property of high electric resistance.

15-26a Constant Torque Resistor.—A constant torque resistor is a resistor for use in the armature or rotor circuit of a motor in which the current remains practically constant throughout the entire speed range.

15-26b Fan Duty Resistor.—A fan duty resistor is a resistor for use in the armature or rotor circuit of a motor in which the current is approximately proportional to the speed of the motor.

15-27 Rheostat.—A rheostat is an adjustable resistor so constructed that its resistance may be changed without opening the circuit in which it may be connected.

15-28 Current Limiting Resistor.—A current-limiting resistor is a resistor inserted in an electric circuit to limit the flow of current to some predetermined value.

Note: A current-limiting resistor, usually in series with a fuse or circuit breaker, may be employed to limit the flow of circuit or system energy at the time of a fault or short-circuit.

Kinds of Protection

15-29 Undervoltage Protection (Low-voltage Protection).—Under-voltage or low-voltage protection is the effect of a device operative on the reduction or failure of voltage to cause and maintain the interruption of power in the main circuit.

15-30 Under-voltage Release (Low-voltage Release).—Under-voltage or low-voltage release is the effect of a device operative on the reduction or failure of voltage to cause the interruption of power in the main circuit, but not to prevent the reestablishment of the main circuit on return of voltage.

15-31 Overload Protection.—Overload protection is the effect of a device operative on excessive current, but not necessarily on short-circuit, to cause and maintain the interruption of current flow to the device governed. (See 15-15a).

15-32 Open-Phase Protection.—Open-phase protection is the effect of a device operative on the loss of current in one phase of a polyphase circuit to cause and maintain the interruption of power in the circuit.

15-32a Phase Undervoltage Protection.—Phase undervoltage protection is the effect of a device operative on the reduction of voltage in one phase of a polyphase circuit to cause and maintain the interruption of power in the circuit.

15-33 Phase-Reversal Protection.—Phase-reversal protection is the effect of a device operative on the reversal of the phase sequence in a polyphase circuit, to cause and maintain the interruption of power in the circuit.

Relay Nomenclature

- 15-34 Relay.**—A relay is a device that is operative by a variation in the conditions of one electric circuit to effect the operation of other devices in the same or another electric circuit.

Note: Where relays operate in response to changes in more than one condition, all functions should be mentioned.

- 15-35 Current Relay.**—A current relay is a relay which functions at a predetermined value of current. It may be an overcurrent relay, an undercurrent relay or a combination of both.

- 15-36 Overload Relay.**—An overload relay is an overcurrent relay (see 15-16a, 15-31 and 15-35).

- 15-37 Voltage Relay.**—A voltage relay is a relay which functions at a predetermined value of voltage. It may be overvoltage relay, an undervoltage relay or a combination of both.

- 15-38 Differential Relay.**—A differential relay is a relay which functions by reason of the difference between two quantities of the same nature such as current or voltage, etc.

Note: This term includes relays heretofore known as "ratio balance relays," "biased relays" and "percentage differential relays."

- 15-39 Frequency Relay.**—A frequency relay is a relay which functions at a predetermined value of frequency. It may be an overfrequency relay, an underfrequency relay or a combination of both.

- 15-40 Phase-Sequence Relay (Phase-Rotation Relay).**—A phase-sequence relay is a relay which functions in accordance with the order in which the phase voltages successively reach their maximum positive values.

- 15-41 Open-Phase Relay.**—An open-phase relay is a relay which functions by reason of the opening of one or more phases of a polyphase circuit, when sufficient current is flowing in the remaining phase or phases.

- 15-42 Step-Back Relay.**—A step-back relay is a relay which operates to limit the current peaks of a motor when the armature or line current increases. A step-back relay may, in addition, operate to remove such limitation when the cause of the high current has been removed.

- 15-43 Notching.**—Notching is a qualifying term indicating that a predetermined number of separate impulses is required to complete operation.

- 15-44 Inverse Time.**—Inverse time is a qualifying term indicating that there is purposely introduced a delayed action, which delay decreases as the operating force increases.

- 15-45 Definite Time.**—Definite time is a qualifying term indicating that there is purposely introduced a delay in action, which delay remains substantially constant regardless of the magnitude of the quantity that causes the action.

- 15-46 Instantaneous.**—Instantaneous is a qualifying term indicating that no delay is purposely introduced in the action of the device.

- 15-47 Automatic.**—Automatic means self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength; not manual, without personal intervention.

Note: Remote control that requires personal intervention is not automatic, but manual.

- 15-48 "Normally Open" and "Normally Closed".**—The terms "Normally Open" and "Normally Closed" when applied to a magnetically operated switching device, such as a contactor or relay, or to the contacts thereof, signify the position taken when the operating magnet is de-energized. These terms apply only to non-latching types of devices.

Enclosure of Control Apparatus for Protection of Persons

- 15-49 Classification of Enclosures.**—Enclosures for the protection of persons are classified as follows:

Class I: A solid enclosure without slot or other opening.

Class II: A solid enclosure except for a slot for the operating handle or openings for ventilation or both.

Class III: Wire mesh, perforated screens or grill work.

Protection of Apparatus by Construction

- 15-50 Tight (As a Suffix).**—Apparatus is designated as watertight, dust-tight, etc., when so constructed that the enclosing case will exclude the specified material.

- 15-51 Resistant (As a Suffix).**—Apparatus is designated as moisture-resistant, fume-resistant, etc., when so constructed, protected or treated that it will not be injured readily when subjected to the specified material or condition.

- 15-52 Dust-tight.**—Dust-tight means so constructed that dust will not enter the enclosing case.

- 15-53 Driptight.**—Driptight means so constructed or protected as to exclude falling moisture or dirt.

- 15-54 Gastight.**—Gastight means so constructed that the specified gas will not enter the enclosing case under specified conditions of pressure.

- 15-55 Water-tight.**—Water-tight means provided with an enclosing case which will exclude water applied in the form of a hose stream for a specified time as shown in Rule 15-146a.

- 15-56 Submersible (Immersible).**—Submersible means so constructed that it will operate successfully when submerged in water under specified conditions of pressure and time.

- 15-59 Moisture-Resistant.**—Moisture-resistant means so constructed or treated that it will not be injured readily by exposure to a moist atmosphere.

- 15-60 Fume-Resistant.**—Fume-resistant means so constructed that it will not be injured readily by the specified fumes.