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Part 12.2.1

Recommended Design Criteria and Functional Guidelines for Lockable Electric Motor Switch Operating Mechanism

Revised ~~2018~~ 2021 (7 Pages)

A. Purpose

This Manual Part recommends design criteria and functional guidelines for a motor driven mechanism with or without dual control for low and high voltage applications for operating and locking switches typically for main line applications and other movable apparatus such as derails and movable point frogs.

B. Design

1. Power operation (mechanism with or without dual control)

   a. Mechanism shall operate the switch points to the normal or reverse position and lock the points in these positions.

   b. Mechanism shall perform its operations in the following sequence:

      (1) Open indication circuit.
      (2) Unlock switch.
      (3) Operate switch.
      (4) Lock switch.
      (5) Close indication circuit.

   c. Test voltage for low voltage mechanism shall be 20 volts and the time of operation with this voltage at the motor terminals shall not exceed 15 s when operating under the load requirement shown in Manual Part 12.2.5 Recommended Operating Guidelines for Test Load Requirement for Power Operated Switch Mechanism nor shall it exceed 22 s at 16 volts. This test should be made with all parts of the mechanism adjusted as recommended by manufacturer for use in normal service.

   d. Test voltage for high voltage mechanism shall be 110 volts and the time of operation with this voltage at the motor terminals shall not exceed 4.5 s when operating under the load requirement shown in Manual Part 12.2.5 nor should it exceed 5 s at 99 volts. This test should be made with all parts of the mechanism adjusted as recommended by manufacturer for use in normal service.

   e. Under ambient temperature of +70 °F (21 °C) low voltage mechanisms with 20 volts at the motor terminals, and high voltage

mechanisms with 110 volts at the motor terminals shall be capable of pulling 3,800 lb (1724 kg) at end of stroke without damage. Friction clutch, if used, may be adjusted higher than normal for this test.

2. Hand-throw operation only (dual-control mechanisms only).

   a. To change from power to hand-throw operation, the selector lever shall perform functions in the following sequence:

      (1) Open control circuits.

      (2) Operate spring clutch so it can engage the hand-throw lever when the lever is aligned with position of the mechanism, and disengage motor mechanism after it engages the hand-throw lever.

      (3) Unlock the hand-throw lever.

   b. Mechanism operated by the hand-throw lever shall move the switch points to the normal or reverse position and secure or lock the points in these positions.

   c. To change from hand-throw to power operation, the selector lever shall perform functions in the following sequence:

      (1) Check that the hand-throw lever is in one or the other extreme position and lock it in that position.

      (2) Operate spring clutch so it can engage motor operating mechanism when teeth align, and disengage hand-throw lever after the clutch engages the motor mechanism.

      (3) Close control circuits.

3. Mechanism~~.~~

   a. Mechanism and circuit controlling devices shall be enclosed in a weatherproof case that is capable of withstanding all of the stress requirements identified in this Manual Part and is designed for mounting on two tie supports. The cover of the case should be removable. Covers shall be equipped with fastenings for a padlock. When opened, case design should permit access to all parts. Means for readily draining oil and water accumulations should be provided.

b. Mechanism and case shall be designed so that the lock rods may be readily removed. Ends of plunger or locking dogs and holes or notches in lock rod shall have square edges. Such holes or notches shall be not more than 1/8 in (3.18 mm) wider than the plunger (unless Non-Floating Lock Rod Method is required by the railroad switch adjustment procedure; refer to Manual Parts on Recommended Design Criteria for Adjustable Lock Rods, 12.2.15 and 12.2.16). For normal lock position, the locking dog of switch-and-lock movement shall enter the normal lock rod 1/2 in (12.7 mm) or more before circuit controller can indicate locked position. At end of stroke, this locking dog shall travel an additional 1/2 in (12.7 mm) or more beyond the normal lock rod to complete its stroke. For reverse lock position, the locking dog shall enter the reverse lock rod to 1/2 in (12.7 mm) or more before the circuit controller can indicate locked position. At end of stroke, this locking dog shall travel an additional 1/2 in (12.7 mm) or more beyond the reverse lock rod to complete its stroke.

c. Mechanism case should be provided with wire entrance of ample size, conveniently located for access to binding posts and/or terminal blocks and fittings to protect wires.

d. Mechanism should be designed to be stopped, reversed, or obstructed at any point of its movement without damage.

e. Mechanism shall be designed to have the switch points move to the normal or reverse position and lock before the indication for these positions can take place.

f. Circuit controlling device shall be designed in order that its operation will be dependent upon and follow the movement of the mechanism.

g. Point detector shall be dependent upon and follow the movement of the switch point. When the switch point is open 1/4 in (6.35 mm) or more where latch-out device is not used, and 3/8 in (9.53 mm) or more where latch-out device is used; the connection to the switch point shall be adjusted so that the circuit controller contacts will not assume the position corresponding to switch point closure.

h. Mechanism shall be designed to hold switch points in locked position in the event of failure of power supply.

i. ~~j.~~ Mechanism shall be designed to prevent movement due to vibration or external force applied to the connections.

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j. Mechanism in locked position shall be capable of withstanding stress equivalent to a thrust of 20,000 lb (~~9072 kg~~88.96 kN) either on the switch operating or locking connection.

k. Mechanism without dual control shall be designed to permit operation by use of hand crank.

(1) Crank contact shall be provided to prevent motor from operating while crank is inserted and until such contact has been reset.

(2) Crank opening should have - weatherproof cover attached on the outside and equipped with suitable fastenings for application of purchaser's padlock.

(3) Crank shall be furnished as an independent part of the mechanism.

l. Hand-operating and selector levers of a dual-control mechanism and their connections shall form an integral part of the switch operating mechanism.

m. Hand-operating lever of a dual-control mechanism shall be located on side of mechanism away from the track. Selector lever shall be marked Power or Motor, and Hand.

n. Dual-control mechanism should be provided with latch stands for normal and reverse positions of levers and shall have provision for a padlock.

o. Mechanism and case shall be designed for right or left-hand operation and be interchangeable in the field.

p. Mechanism should be designed so that all unused openings are securely closed and rod openings can be fitted with optional hoods to prevent interference from foreign objects and adverse weather conditions.

q. Circuit controller shall be housed ~~in a separate compartment of the mechanism case, which is non-sweating and dust-proof and have a separate cover.~~to provide a non-sweating and dust-proof environment.

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r. Contact members shall be made of corrosion resisting metal of sufficient mechanical strength and current-carrying capacity to properly operate with the circuits used.

s. Movement of the contact members shall have a wiping action to ensure good electrical conductivity.

t. Point detectors shall be provided with contacts required to control switch indicating relays or inputs into a microprocessor-based wayside controller.~~.~~

u. Operating rod should have a stroke of at least 6 ~~in (~~in (15.2 cm).

4. Motor

a. Motor shall be enclosed in a weatherproof case and the cover shall be equipped with a fastener for a padlock. When opened, case design should permit access to terminals, commutator and brushes, or their equivalent.

b. Motor shall be attached to, be part of, and be removable from the mechanism.

c. Motor shall be provided with wire entrance of ample size, conveniently located for access to binding posts and/or terminal blocks, and arranged to protect wires from mechanical injury.

5. Bearings~~.~~

a. Bearings should be made for proper and convenient lubrication of mechanism.

b. Motor should be designed to prevent lubricant from contacting brushes, commutator or windings.

c. Exposed oil holes shall be suitably protected.

C. Wiring

1. Internal wiring should be neatly arranged and placed in ducts or channels of ample capacity forming an integral part of the apparatus.

2. Wire for internal wiring should be insulated and of strands of tinned or leaded copper not larger than No. 27 AWG (0.102 mm^2) wire. The circular

mil should not be less than No. 14 AWG (2.08 mm^2) wire. Suitable wire termination should be provided on each end of wire.

3. Wiring diagram or instruction pamphlets shall be provided with each machine.

4. All internal wires shall be clearly and permanently identifiable at each termination point.

D. Wire Connections

1. Binding posts shall conform to Manual Part 14.1.11 Recommended Design Criteria for Binding Posts, Nuts & Washers, Detail & Assemblies.

2. Terminal blocks shall conform to Manual Part 14.1.2 Functional/Operating Guidelines for Solderless Screw-Type or Screwless Spring-Type Terminal Blocks for Use in Wiring Signal Apparatus with Copper Wire Only.

3 Binding posts and terminal blocks for external wires should be located adjacent to wire inlet, and duct spaces provided.

E. Finish

1. Metal parts shall be protected against corrosion except where such protection will interfere with the proper functioning of the part. Zinc plating shall not be used on current-carrying parts.

2. Material used for protection against corrosion shall neither soften nor flake under ordinary conditions between temperatures of -40°F (-40 °C) and +185 °F (85 °C).

F. Painting

Painting shall conform to Manual Part 1.5.10 Recommended Instructions for Painting and Protective Coatings.

G. Coil Insulation

Coils shall conform to Manual Part 15.2.4 Recommended Selection and Application Criteria of Insulating Materials Used in Coils for Magnetic Assemblies and in Other Electrical Devices.

H. Dielectric Requirements

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Dielectric requirements shall conform to Manual Part 11.5.1 Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment, Class A Roadbed.

I. Identification

1. Mechanism should be plainly marked with manufacturer's references.

2. Magnet coils and resistors should be plainly marked with manufacturer's references.