Identical Items "Boilerplate" for All Relay Manual Parts in Section 6
Revised 2023 (10 Pages)

A. Purpose

This Manual Part recommends specific detail requirements representing current signal practice for new relays and for replacement relays in existing installation when general renewal or replacement is to be made.

B. Mounting

1. The top plate shall be of phenolic, or other approved material, which shall have adequate mechanical and dielectric strength and insulating qualities. Bosses shall be provided on the upper side of the top plate for all openings through it and properly proportioned for the binding post, screw or other device to prevent seepage into the relay.

2. The cores and armature supports shall be so mounted that the position of the cores relative to each other, to the armature supports, and to the fixed part of the contacts shall be maintained.

3. The parts mounted on the top plate shall be sealed to prevent moisture entering the enclosure containing the moving parts. The compound used shall conform to Manual Part 15.2.3 Recommended Developmental Criteria and Functional Guidelines for Insulating Material for Filling and Sealing Recesses in Signal Apparatus.

C. Armature Supports

1. Armature trunnions shall be hard-drawn bronze or nickel-silver of nominal 18% nickel. They shall be cylindrical, not less than 1/16 in (1.6 mm) in diameter, and 3/32 in (2.4 mm) long.

2. The neutral armature trunnions shall be hardened rust-resisting polished steel or nickel-silver, of nominal 18% nickel. They shall be cylindrical, not less than 1/16 in (1.6 mm) in diameter, and 3/32 in (2.4 mm) long.

3. The polar armature trunnions shall be hard-drawn bronze or nickel-silver of nominal 18% nickel. They shall be cylindrical, not less than 1/16 in (1.6 mm) in diameter and 3/32 in (2.4 mm) long.

4. Armature trunnions, when used, shall be hard-drawn bronze or nickel-silver of nominal 18% nickel. They shall be cylindrical, not less than 1/16 in (1.6 mm) in diameter and 3/32 in (2.4 mm) long.

5. Armature trunnions, when used, shall be stainless steel, nominal 30% copper nickel alloy, or hardened rust-resisting polished steel. They shall be cylindrical, not less than 0.1 in (2.5 mm) in diameter and 1/8 in (3.2 mm) long.

6. Armature bearings shall be of different material than the trunnion, either hard brass, hard-drawn bronze, or nickel-silver of nominal 18% nickel. They shall be cylindrical and provide for not less than 1/16 in (1.6 mm) nor more than 3/32 in (2.4 mm) bearing surface at each end of the armature. They shall be not less than 0.001 in (0.025 mm) nor more than 0.004 in (0.1 mm) larger in diameter than the trunnion.

7. The neutral armature bearings shall be either hardened rust-resisting polished steel of different temper than trunnion, or nickel-silver of nominal 18% nickel. They shall be cylindrical and provide for not less than 1/16 in (1.6 mm) nor more than 3/32 in (2.4 mm) bearing surface at each end of the armature. They shall be not less than 0.001 in (0.025 mm) nor more than 0.004 in (0.1 mm) larger in diameter than the trunnion.

8. The polar armature bearings shall be of different material than the trunnion, either hard brass, hard-drawn bronze or nickel-silver of nominal 18% nickel. They shall be cylindrical and provide for not less than 1/16 in (1.6 mm) nor more than 3/32 in (2.4 mm) bearing surface at each end of the armature. They shall be not less than 0.001 in (0.025 mm) nor more than 0.004 in (0.1 mm) larger in diameter than the trunnion.

9. Armature bearings, when used, shall be of different material than the trunnion, either hard brass, hard-drawn bronze or nickel-silver of nominal 18% nickel. They shall be cylindrical and provide for not less than 1/16 in (1.6 mm) nor more than 3/32 in (2.4 mm) bearing surface at each end of the armature. They shall be not less than 0.001 in (0.025 mm) nor more than 0.004 in (0.1 mm) larger in diameter than the trunnion.

10. Armature bearings, when used, shall be one of the materials specified in Section C.5 not of the same material as that used for the trunnions of the same relay. They shall be cylindrical and provide for bearing surface not less than 3/32 in (2.4 mm) nor more than 5/32 in (4.0 mm) in length at each end of the armature. They shall be not less than 0.001 in (0.025 mm) nor more than 0.004 in (0.1 mm) larger in diameter than the trunnion.

11. Armature bearing shall be of the manufacturer's standard trunnion, rocker bearing or hinged spring type.

12. Armature of the rocker bearing or hinged spring type shall be held in place in such a manner as to permit free movement throughout its normal stroke,

but to prevent its being displaced by ordinary handling, shipment or service. Bearings or hinged springs shall be of corrosion-resistant material and of such design and material as to withstand the effect of continued and severe vibration in service.

13. Trunnions and bearings for armature shall fit rigidly in their supports and be suitably secured and constructed so that they cannot exert pressure on the armature.

14. The end play of the armature shall be not less than 0.010 in (0.25 mm) and not more than 0.020 in (0.50 mm).

15. The end play of the neutral armature shall be not less than 0.010 in (0.25 mm) and not more than 0.020 in (0.50 mm).

16. The end play of the polar armature shall be not less than 0.003 in (0.08 mm) and not more than 0.007 in (0.18 mm).

17. Stop pins shall be metallurgically and mechanically compatible with mating surface for their intended use.

D. Air Gap

1. Minimum physical air gap of 0.013 in (0.33 mm) shall be provided by stop pin or pins; approximately 1/8 in (3.2 mm) in diameter. The position with relation to the cores shall be so fixed and located that the stop or stops engage either the core or the armature near the edge farthest from the bearing and, where a single stop is used, midway between the bearings. If the armature trunnions are adjustable, the stop or stops shall engage the armature or core not less than 1/32 in (0.80 mm) nor more than 1/4 in (6.35 mm) from the edge farthest from the bearings.

2. Minimum physical air gap for the neutral armature of 0.013 in (0.33 mm) shall be provided by stop pin or pins; approximately 1/8 in (3.2 mm) in diameter. The position with relation to the cores shall be so fixed and located that the stop or stops engage either the core or the armature near the edge farthest from the bearing and, where a single stop is used, midway between the bearings. If the armature trunnions are adjustable, the stop or stops shall engage the armature or core not less than 1/32 in (0.80 mm) nor more than 1/4 in (6.35 mm) from the edge farthest from the bearings.

3. Non-adjustable safety stop pins shall be provided, protruding not less than 0.010 in (0.25 mm) from the upper side of armature and so located as to prevent the possibility of the armature coming closer than 0.010 in (0.25 mm) to the core faces at any point.

4. Non-adjustable safety stop pins shall be provided for the neutral armature, protruding not less than 0.010 in (0.25 mm) from the upper side of armature and so located as to prevent the possibility of the armature coming closer than 0.010 in (0.25 mm) to the core faces at any point.

5. Minimum physical air gap for polar armature shall be as follows:

   a. For relays with two normal and reverse polar contacts shall be 0.013 in (0.33 mm) between armature and neutral cores and maintained by stop pins approximately 1/8 in (3.2 mm) in diameter.

   b. For relays with four normal and reverse polar contacts shall be 0.006 in (0.15 mm) between armature and neutral cores and maintained by stop pins approximately 1/8 in (3.2 mm) in diameter.

   c. For all relays shall be 0.015 in (0.38 mm) between armature and permanent magnet pole.

6. Minimum physical air gap for the auxiliary or holding armature of 0.002 in (0.05 mm) shall be provided by non-adjustable stop pin or pins approximately 1/8 in (3.2 mm) in diameter.

7. Air gap for electronically controlled relay:

   a. Minimum physical air gap of 0.010 in (0.25 mm) shall be provided by stop pin or pins approximately 1/8 in (3.2 mm) in diameter. The position with relation to the cores shall be so fixed and located that the stop or stops engage either the core or the armature near the edge farthest from the bearings, and where a single stop is used, midway between the bearings. If the armature trunnions are adjustable, the stop or stops shall engage the armature or core not less than 1/32 in (0.80 mm) nor more than 1/4 in (6.35 mm) from the edge farthest from the bearings.

   b. Non-adjustable safety stop pins shall be provided protruding not less than 0.006 in (0.15 mm) from the upper side of armature and so located as to prevent the possibility of the armature coming closer than 0.006 in (0.15 mm) to the core faces at any point.

8. Air gap for electro-mechanically controlled relay:

   a. Minimum physical air gap of 0.006 in (0.15 mm) shall be provided by stop pin or pins approximately 1/4 in (6.35 mm) in diameter. Stop

pins shall be polished stainless steel co-acting with linen base laminated phenolic stop plates or when co-acting with pole faces.

b. The position with relation to the cores shall be so fixed and located that the stop or stops engage either the core or the armature near the edge farthest from and symmetrical with the bearing.

E. Flexible Connections

The flexible conductor between the binding post and contact finger shall be formed and attached so as not to affect operation of the movable elements. This conductor shall be of sufficient size to carry the maximum rated contact current or 10 amperes, whichever is greater, continuously without damage.

F. Contacts

1. Contact elements shall be so secured that they will not shift nor become loose in shipment or service.

2. Material used in affixing contact elements shall not cause corrosion.

3. Metal support of the non-fusible contact element shall not come within 1/16 in (1.6 mm) of the contact surface.

4. Contacts of the silver impregnated carbon to silver type shall be so designed that they cannot be mechanically locked or fused by lightning or by abnormal flow of current in service.

5. For front contacts of the silver impregnated carbon to silver type, the resistance of the contacts measured with 1 ampere through contacts should not in 100,000 operations (when operating 10 times per minute) average more than 0.18 ohm per contact when the relay is energized at working current and when not breaking current or when breaking non-inductive tungsten lamp load of 4 amperes ac or dc not exceeding 30 volts. The contact resistance shall be determined by taking at least 20 readings on each contact of the relay at intervals of 5,000 operations during the test. The average of all readings should be considered the contact resistance. The initial cleaned contact resistance measured with 1 ampere through contacts shall not exceed 0.09 ohm per contact when relay is energized at working current. Each contact should be designed to carry a 4 amperes non-inductive load continuously.

6. Finger contacts for the silver impregnated carbon to silver combination shall be so formed that either a flat or curved surface shall come in contact with the carbon element.

7. For contacts of the silver to silver impregnated type, the initial cleaned contact resistance measured with 1 ampere through contacts should not exceed 0.03 ohm per contact. Each contact should be designed to carry a 4 amperes non-inductive load continuously.

8. Contact fingers shall be made of such material and so proportioned that they will not flex appreciably under operating conditions.

9. The minimum front contact opening shall be 0.050 in (1.27 mm) and with front contact just closed the minimum back contact opening should be 0.020 in (0.50 mm).

10. For front, normal, and reverse contacts of the silver impregnated carbon to silver type, the resistance of the contacts measured with 1 ampere through contacts shall not in 100,000 operations (when operating 10 times per minute) average more than 0.18 ohm per contact when the relay is energized at "working current" and when not breaking current or when breaking non-inductive tungsten lamp load of 4 amperes not exceeding 30 volts. The contact resistance shall be determined by taking at least 20 readings on each contact of the relay at intervals of 5,000 operations during the test. The average of all readings should be considered the contact resistance. The initial cleaned contact resistance measured with 1 ampere through contacts shall not exceed 0.09 ohm per contact when relay is energized at "working current." Each contact should be designed to carry a 4 amperes non-inductive load continuously.

11. Contacts shall be of silver to silver type.

12. Contacts of the silver to silver type shall be designed to open and close a non-inductive tungsten lamp load of 4 amperes ac or dc per contact at not exceeding 30 volts for 500,000 operations without the average resistance per contact exceeding 0.05 ohm. The contact resistance shall be determined by taking not less than 20 readings at intervals of 5,000 operations during the test. The initial cleaned contact resistance measured with 1 ampere through contacts shall not exceed 0.03 ohm. All resistance measurements shall be taken with relay energized at “working current”. Each contact shall be designed to carry a 4 amperes non-inductive load continuously.

13. Contacts in normal operation shall align squarely with fixed contacts and make positive low resistance contact.

14. Contact compression for front and back contacts shall be as nearly equal as practicable.

15. Contacts shall be so adjusted that with the front contacts just closing, the back contacts shall have a minimum opening of 0.018 in (0.46 mm). Where independent front and back contacts are used on the same cam, the front contacts shall open at least 0.010 in (0.25 mm) before the back contacts close.

16. All parts of the contact fingers (other than the contact point), including flexible connections and the posts to which the connectors are attached, shall be separated at least 0.1 in (2.54 mm) from any other metal or conducting part of relay.

17. Normal and reverse contacts shall have a minimum contact opening of 0.050 in (1.27 mm) with a minimum of 0.020 in (0.50 mm) with either the normal or reverse contact just closed.

18. Contacts shall be so adjusted that with the front contacts just closing, the back contact shall have a minimum opening of 0.020 in (0.50 mm). Where independent front and back contacts are used on the same actuator, the front contacts shall open at least 0.010 in (0.25 mm) before the back contacts close.

19. All parts of the contact fingers (other than the contact point), including flexible connections and the posts to which the connectors are attached, shall be separated at least 0.1 in (2.54 mm) from any other metal or conducting part of relay.

20. Polar contacts shall retain full contact pressure in last energized position when relay is de-energized after having been energized at 25% over working current.

21. Check contacts shall have a minimum opening of 0.050 in (1.27 mm) when the front contacts are closed.

22. Silver-impregnated carbon to silver-impregnated carbon front contacts shall have an initial cleaned contact resistance measured with 1 ampere through contacts of not more than 0.20 ohm when the relay is energized at its working current. Silver-impregnated carbon to silver-impregnated carbon back contacts shall have an initial cleaned contact resistance measured with 1 ampere through contacts of not more than 0.40 ohm when the relay is de-energized.

G. Binding Posts

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

2. Binding posts shall be mounted so they cannot be turned in the base or frame to which applied. They shall be properly insulated from each other and other metallic parts.

3. Binding posts supporting the fixed parts of front and back contacts shall be fastened in their supports so as to preclude adjustment of any kind without first breaking the seal of the relay.

4. Binding posts should be spaced on not less than 1 in (25.4 mm) centers.

H. Dielectric Requirements

1. Devices shall conform to Class C of Manual Part 11.5.1 Recommended Environmental Requirements for Electrical and Electronic Railroad Signal System Equipment.

   When relay is motor-operated, motor shall withstand 500 volts ac rms at 60 Hz for 1 min.

2. Material used as insulation for binding posts or contact fingers shall not be affected by moisture or by change in temperature between −40 °F (−40 °C) and +185 °F (+85 °C). If this material is other than porcelain, it shall, when made up in a standard test piece 0.125 in (3.2 mm) thick by 4 in (101.6 mm) in diameter, meet a requirement of 300 volts per mil (11.8 kV/mm).

I. Finish

1. Metal parts shall be protected against corrosion with nickel plating, or the equivalent, except where the parts used are inherently resistant to corrosion or where such protection may interfere with proper operation of the relay. Zinc or cadmium shall not be used within the enclosure of relay or on current-carrying parts.

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

J. Identification

1. The enclosure containing the moving parts of the relay shall be sealed.

2. Magnet coils and resistors shall be plainly marked.

3. Relay shall have an attached plate marked with the following information:

   a. Manufacturer's name.

   b. Manufacturer's drawing or other reference number.

   c. Resistance (Nominal).

   d. Serial number.

   e. Relay contact post designation.

   f. Operating voltage.

   g. Code rate (Nominal).

   h. Type.

   i. Frequency.

4. The enclosure shall contain test label, in a location where it cannot interfere with the operation of the relay and can be readily seen with the relay in its operating position. It shall include the following data:

   a. Serial number of relay.

   b. Nominal Resistance of coils.

   c. Minimum drop-away, maximum pickup, and working current.

   d. Normal operating voltage.

   e. Minimum operating voltage.

   f. Timing limits.

   g. Nominal flasher rate per minute.

   h. Neutral armature minimum drop-away contact pressure.

i. Neutral armature normal and reverse working.

j. Polar maximum pickup and working.

k. Nominal volts.

l. Recommended minimum operating voltage.

m. Date tested.

n. Identification of tester.