



BR935A
September 1971

**Specification for Miniature Tractive Armature
D.C. Magnetically Latched Neutral Line Relay,
Plug-in Type for Railway Signalling Purposes**

British Railways Board



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Specification for Miniature Tractive Armature D.C. Magnetically Latched Neutral Line Relay, Plug-in Type for Railway Signalling Purposes

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Amendments

Amd. No.	Date	Text Affected
1	Dec 1971	Clause 18.2 (a)
2	May 1972	Clause 11.6
3	May 1972	Clause 4.11
4	July 1976	Clause 6.11
5	Sept 1981	Appendices A1, B1 & B2 Clause 22.3

Foreword

This specification supersedes all previous issues. It is issued by:-

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BRITISH RAILWAYS BOARD

B.R. SPECIFICATION 935A

(Superseding B.R. Specification 935)

FOR

MINIATURE TRACTIVE ARMATURE D.C. MAGNETICALLY LATCHED
NEUTRAL LINE RELAY, PLUG-IN TYPE FOR RAILWAY
SIGNALLING PURPOSES

1. FOREWORD

- 1.1 The relays covered by this specification are for use where a self-latching relay with separate releasing winding is required.
- 1.2 These relays must not be used to break circuits in which the energy dissipated at the contact exceeds the limit given in clause 12.1. In general, this means that equipment such as lever locks must be spark quenched.

2. SCOPE

- 2.1 This specification relates to design requirements for miniature tractive armature D.C. relays of the plug-in type for use in railway signalling circuits. The design is such that once the armature is attracted it is held in the full operate position by magnetic means after the operate coil is de-energised until released by energisation of a second independent winding.

3. DEFINITIONS

- 3.1 For the purpose of this specification the following definitions shall apply :-

Operate

That condition of the relay when all front contacts are just made.

Full Operate

That conditions of the relay when the armature has completed its maximum travel.

3. DEFINITIONS (Contd).

<u>Release</u>	That condition of the relay when all front contacts have opened.
<u>Full Release</u>	That condition which the relay assumes when de-energised and released from the operated position.
<u>Front Contact</u>	A contact which is made when the relay is or has been energised.
<u>Back Contact</u>	A contact which is made when the relay is in the full release position.
<u>Contact Element</u>	The contact piece which is attached to a contact spring.
<u>Contact Spring</u>	The spring strip to the end of which the contact element is secured.
<u>Operate Winding</u>	A winding which when energised at the appropriate voltage will cause the armature to move to the full operate position.
<u>Magnetic Latch</u>	A permanent magnet so arranged in the magnetic circuit to hold the relay in the full operate position.
<u>Release Winding</u>	A winding which when energised at the appropriate voltage will neutralise the latching magnet and cause the armature to release.
<u>"Cut-off" Contact</u>	A front contact permanently wired in series with the release coil such that this coil cannot be energised unless the relay armature is in the operate position.
<u>D.C.</u>	Current from a battery or smoothed rectified A.C. with a ripple content not exceeding 1.25% r.m.s.

4. GENERAL

- 4.1 The complete assembly shall consist of two mains parts, viz :-
- (a) A relay
 - (b) A plugboard into which a relay is plugged.
- 4.2 The relay shall be designed to have minimum bulk and weight consistent with the prime necessity for safety and reliability, and its construction shall be such as to minimise accidental damage sustained during transit or installation.
- 4.3 The relay shall include a rigid baseplate which shall form part of the plug-socket inter-connection between the relay and its plugboard.

- 4.4 The relay shall be enclosed in a cover which shall be so constructed that the relay shall be clearly visible for inspection. A retaining device shall be provided for the cover such that the cover cannot be removed without breaking a seal.
- 4.5 There shall be a minimum clearance of 0.125" between the cover and any moving part of the relay. The material of the cover and construction of the relay shall be such that the application of a force of 30 lbs. at any point on the surface of the cover of the assembled relay shall not result in its deflection to an extent sufficient to interfere with the operation of the relay. The material shall be of such resilience that after removal of this force it shall restore to its normal condition. The cover shall be free from detrimental warping which may reduce this clearance, either from temperature or moisture changes or long term ageing or release of locked up stresses.
- 4.6 The cover and baseplate of the relay when assembled shall be dustproof.
- 4.7 Surface leakage distances shall not be less than 0.125" internal and 0.25" external. Parts of the relay enclosed when the relay is attached to its plugboard may be regarded as internal.
- 4.8 There shall be a minimum of 0.015" clearance between any moving part and any other part which might interfere with its correct operation and the design must be such that this clearance is maintained throughout the rated life of the relay.
- 4.9 A retaining clip as indicated in Appendix 'B2' shall be provided to hold the relay securely in its plugboard without the possibility of the electrical connections becoming disconnected.
- 4.10 The male portion of each inter-connection shall make a positive sliding contact with the female portion.
- 4.11 The permanent relay rack wiring to the plugboard shall be terminated either by soldering or crimping to a connector which shall allow up to a maximum of two wires to be connected to each termination. The maximum size of wire to be accommodated will be of overall diameter not greater than 3.4 mm. and a conductor diameter of 1.0 mm. The connector shall be positively locked into the plugboard but shall be capable of being released and withdrawn to permit easy disconnection.

5. DIMENSIONS

- 5.1 The dimensions of the relay and plugboard shall be in accordance with Appendices 'A1', 'A2' and 'B1'.
- 5.2 The retaining clip is to be in accordance with Appendix 'B2'. The handle of the relay shall be such that with the relay in position on its plugboard the total force exerted by the clip on the handle shall be not less than 20 lbs. and shall not exceed 50 lbs.
- 5.3 Relays with the same coding must be interchangeable.

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6. MATERIALS

- 6.1 All materials used in the construction of the relay and plug-board shall comply with the appropriate British Standard specification unless otherwise stated.
- 6.2 No materials shall be used in the construction of the relay and plugboard which would cause alteration in performance during storage life, except as provided for in clause 16.1, or which are not capable of maintaining all their essential electrical and mechanical properties during rated service life.
- 6.3 All non-metallic materials used in the relay and plugboard shall be non-hygroscopic, self-extinguishing, free from detrimental warping, deformation, or embrittlement and, when transparent, permanently so, over the external temperature range -40°C . to $+60^{\circ}\text{C}$. when the relay is continuously energised at 20% above rated voltage.
- 6.4 All insulating materials in contact with current carrying parts of the relay and plugboard shall comply with the following test :-
- Two $\frac{1}{4}$ " diameter electrodes shall be placed $\frac{1}{8}$ " apart on a sample of the material, which is at a temperature of not more than 20°C . The sample shall then be transferred to a test chamber having a temperature of 30°C . and a humidity of 85%. The insulation resistance measured at a voltage of 500 v D.C. between the electrodes shall not then fall below 1 ~~megohm~~ while the sample remains in the test chamber for a period of not less than 15 seconds.
- 6.5 No materials shall be used in the construction of the relay and plugboard which are capable of supporting growth of mould, or which are subject to deterioration by exposure to sunlight.
- 6.6 All parts, both separately and in combination, shall either be resistant to corrosion or be so treated as to resist corrosion. Dissimilar metals used in contact with each other shall be so chosen or protected as to minimise the effect of electro-chemical action.
- 6.7 All materials used in the construction of the relay and plug-board or for the impregnation of coils, etc., shall be chemically and physically inert over the temperature range specified in clause 6.3.
- 6.8 All soldered joints in conductors shall be made with soft solder. Non-corrosive flux shall be used in making all soldered joints and after completion of the soldering operation, any excess flux shall be removed.
- 6.9 All screwed fastenings shall be securely locked to prevent movement in service. Mechanical means which do not abrade the surface and produce loose pieces of material shall be used to secure all pins, nuts, screws, etc., against working loose.
- 6.10 Screw threads in parts fabricated of materials which do not lend themselves to successful tapping shall be formed in metal bushes.

7. MOUNTING

- 7.1 The plugboard shall be so designed that when each connector is inserted all live metallic parts are shrouded against accidental contact even when the relay is removed.
- 7.2 The spring tags on the relay shall be so constructed that in the event of the relay being plugged into a plugboard having maximum tolerances, they shall afterwards make effective contact if the relay is later plugged into a plugboard having minimum tolerances.
- 7.3 A registration device shall be provided to prevent an incorrectly coded relay being plugged into a particular plugboard. That portion of the registration device carried on the relay shall be incapable of alteration without breaking a seal and shall be adequately protected against accidental breakage liable to permit the relay to be plugged into the wrong plugboard. The schedule of codes is shown in Appendix 'D'.
- 7.4 The code pins on the relay must not extend beyond the joint face and may be up to 1/16" short of this.
- 7.5 The electrode potential of the material forming that part of the plugboard connector which makes contact with the spring tags of the relay shall lie between the values of -0.55v. and +0.10v. as measured against a saturated calomel electrode in sea water at 25°C.

8. LIFE

- 8.1 The rated life of the relay shall be taken as 10^6 cycles under specified conditions of operation where one cycle consists of an operation followed by a release. The rate of operation shall be taken as 250 cycles daily.
- 8.2 The relay shall be considered as having a possible period of up to 3 years in reasonable storage conditions prior to being brought into use without verification or examination and without any adverse effects on its rated life.

9. MAGNETIC CIRCUIT

- 9.1 All parts forming the magnetic circuit of the relay, i.e. armature, yoke, permanent magnet and core, shall be of suitable quality magnetic material so as to ensure consistent performance.

10. ARMATURE SUPPORTS

- 10.1 The armature shall be positively located so as to prevent any displacement other than that required for the proper operation of the contacts.

Continued

10. ARMATURE SUPPORTS (Contd).

- 10.2 The armature shall be held in place in a manner which permits free movement throughout the normal stroke. There shall be no displacement of the armature as a result of the tests carried out under clause 20.1.
- 10.3 In relays fitted with pivot bearings the armature pivots and bearings shall be of dissimilar materials possessing high resistance to corrosion under service conditions, shall fit rigidly in their supports, and be suitably secured and so constructed that they cannot restrict the desired motion of the armature.
- 10.4 In relays fitted with pivot bearings the armature pivots and bearings shall be cylindrical, and the bearings shall be not less than 0.002 inch nor more than 0.004 inch larger in diameter than the pivots. The end play of the armature shall be not less than 0.01 inch and not more than 0.02 inch.
- 10.5 The design must be such that the breaking of a pivot shall not allow any front contact to close irregularly.

11. COILS

- 11.1 Two electrically separate windings are to be provided as follows :-
- (a) An operate winding which shall be capable of continuous energisation.
 - (b) A release winding which will release the armature provided that the operate winding is de-energised and which is internally wired in series with a 'cut-off' contact in the position B7/8.
- 11.2 Each coil winding shall be formed preferably from one continuous length of conductor. If joints are necessary between coil conductors, these shall be securely soldered and efficiently insulated.
- 11.3 No conductor of a smaller diameter than 4 mils (42 swg) shall be used for the operate coil winding or smaller than 3.2 mils (44 swg) for the release coil winding.
- 11.4 The coil resistance shall not vary from the nominal value by more than $\pm 10\%$ measured at 20°C.
- 11.5 Coil impregnation is not mandatory, but if carried out, attention is drawn to paragraph 6.7.
- 11.6 The coil of a single wound relay is to be connected to terminals R1 and R2 and the coil of the second winding, when provided, would be connected to terminals R3 and R4, the connections to be so made that the coils would assist with like polarities on terminals R1 and R3. The contact prongs in positions R3 and R4 must always be provided.

11. COILS (Contd.)

- 11.7 Each coil shall be so fixed as to prevent movement with respect to its core.

12. CONTACTS

- 12.1 Contact ratings shall be as follows :-

All contacts shall be capable of carrying 3 amps continuously, front contacts being considered with the relay in the full operate position without injurious effect to the contact.

Over the rated life of the relay each contact shall be capable of making and breaking a 12 volt circuit having a resistive load with a switch-on surge of 5 amperes, dropping to a maximum steady value of 2 amps after a further 100 mS (equivalent to a normal lamp circuit for a SL17 lamp).

Over the rated life of the relay, each contact shall be capable of making and breaking the current in an unquenched circuit consisting of three parallel connected relays of a type covered by this specification.

- 12.2 Each contact pair shall consist of at least one domed element.

- 12.3 Front contacts shall be non-fusible and back contacts may be metal/metal, subject to the provisions of clause 14.7.

- 12.4 After a contact pair has been loaded to the requirements of clause 12.1 over the period of rated life of the relay, contact pressures shall not be less than 50% of those stipulated in clause 15.1 and there shall remain a minimum distance of 0.020" between the metal element of the contact and the metal support of the associated non-fusible element.

13. CONTACT EQUIPMENT

- 13.1 The standard contact equipment shall be as shown in the following table and they shall be disposed in accordance with Appendix 'C'.

Number of independent contacts	
Front	11
Back	4

N.B. Contact B7/8 (not included in above) is internally wired in series with the release winding and is not available for external connection and must comply with the conditions of clauses 14 and 15.

14. CONTACT ASSEMBLIES

- 14.1 Contact springs shall be formed in such a way that their main axes lie at not more than 45° from the direction of rolling.
- 14.2 The design shall be such that springs shall not be subjected to any twist about their longitudinal axis.
- 14.3 Contact elements shall be firmly secured so that they will not become loose in service, and the material used for this purpose shall be such as not to cause corrosion. They shall not be out of centre with respect to each other by more than 0.02". When the contact is fully closed the point of contact shall not be nearer to the edge of either element than half the distance from that point to the centre of that element.
- 14.4 When the last back contact is just broken all front contacts must be open by at least 0.015" and vice versa.
- 14.5 All similar contacts, i.e. either front or back, shall function approximately simultaneously when the relay is operated or released.
- 14.6 If twin contact elements are employed, these shall be coplanar and shall make or break contact approximately simultaneously.
- 14.7 In the event of any back contact remaining permanently closed as a result of fusion or locking, it shall not be possible for any front contact on the relay to close when the relay is energised at up to 35% in excess of the nominal voltage. Alternatively, back contacts must be non-fusible.
- 14.8 The relay shall be designed so as to reduce contact chatter bounce and hesitation to a minimum on closure of the contact elements concerned. When the relay is energised at rated voltage, or released, the contact elements shall establish steady contact conditions in not more than 20 mS after the initial contact closure.
- 14.9 Contacts of the non-fusible type shall be so designed that they cannot become mechanically locked or fused to the metal element by abnormal flow of current, and the formation of metal elements shall be such that they will not undercut the non-fusible element by continual rubbing.
- 14.10 The contact tag of the spring shall be composed of unplated phosphor bronze.

15. CONTACT PRESSURE

- 15.1 The minimum contact pressures shall be as follows :-
- Front contacts : One ounce when in the full operate position.
- Back contacts: One half ounce when metal/metal.) when in full
One ounce when metal/non-fusible) release position.