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**Specification for Miniature Twin Tractive Armature
A.C. Immune D.C. Biased Neutral Line Relay Unit, Plug-in
Type, for Railway Signalling Purposes**

British Railways Board

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Amendments

Amd. No.	Date	Text Affected
1 & 2		Incorporated in Text
3	July 1976	Clause 6.11
4	May 1977	Table of operating voltages
5	Sept 1981	Clause 18.1 Operating values
6	Sept 1982	Clause 18.1 Operating values SUPERSEDES 5

NOTE

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

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BRITISH RAILWAYS BOARD

B.R. SPECIFICATION 961

FOR

MINIATURE TWIN TRACTIVE ARMATURE A.C.
IMMUNE D.C. BIASED NEUTRAL LINE RELAY UNIT,
PLUG-IN TYPE, FOR RAILWAY SIGNALLING
PURPOSES

1. FOREWORD

- 1.1 The twin relay unit covered by this specification may be used for all applications in which the present A.C. immune D.C. biased neutral line relays covered by B.R. Specification 932A are employed, provided that their characteristics are suitable.
- 1.2 Units to this specification shall consist of two relays which, in effect, are electrically and mechanically independent, housed in a single enclosure to the dimensions of a single relay to B.R. Specification 932A. Each of the relay will always have the same nominal characteristics.
- 1.3 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 twin tractive armature A.C. immune D.C. biased neutral line relays of the plug-in type for use in railway signalling circuits.

3. DEFINITIONS

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

<u>Operate</u>	That condition of a relay when all front contacts are just made.
<u>Full Operate</u>	That condition of a relay when the armature has completed its maximum travel.
<u>Release</u>	That condition of a relay when all front contacts have opened.
<u>Full Release</u>	That condition which either relay assumes when de-energised.
<u>Front Contact</u>	A contact which is made when its relay is energised.
<u>Back Contact</u>	A contact which is made when its relay is de-energised.
<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>L.H. Relay</u>	The relay which is on the left-hand side when viewed from the front in its working position.
<u>R.H. Relay</u>	The relay which is on the right-hand side when viewed from the front in its working 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 main parts, viz:-
 - (a) A twin relay unit containing two similar relays.
 - (b) A plugboard into which the unit is plugged.
- 4.2 The unit shall be designed to have a 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 unit shall include a rigid baseplate which shall form part of the plug-socket inter-connection between the unit and its plugboard.
- 4.4 The unit shall be enclosed in a cover which shall be so constructed that the relays 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.

GENERAL (cont'd)

- 4.5 There shall be a minimum clearance of 0.125" between the cover and any moving part of the relays. The material of the cover and construction of the unit shall be such that the application of a force of 30 lbs at any point on the surface of the cover of the assembled unit shall not result in its deflection to an extent sufficient to interfere with the operation of the relays. 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 unit, 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 unit enclosed when the unit 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 unit.
- 4.9 A retaining clip, as indicated in Appendix 'B2' shall be provided to hold the unit 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 3.4mm, and a conductor diameter of 1.12mm. The connector shall be positively locked into the plugboard but shall be capable of being released and withdrawn to permit easy disconnection.

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5. DIMENSIONS

- 5.1 The dimensions of the twin relay unit 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 unit shall be such that with the unit in position on its plugboard the total force exerted by the clip on the handle shall not be less than 20 lbs and shall not exceed 50 lbs.
- 5.3 Units with the same coding must be interchangeable.

6. MATERIALS

- 6.1 All materials used in the construction of the twin relay unit and plugboard shall comply with the appropriate British Standard Specification unless otherwise stated.
- 6.2 No materials shall be used in the construction of the unit 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 unit 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 both relays are continuously energised at 20% above rated voltage.
- 6.4 All insulating materials in contact with current carrying parts of the relays 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 500V. 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 unit and plugboard which are capable of support of 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 the materials used in the construction of the unit and plugboard 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.

Spec. 961 (Sheet 4).

5.
MATERIALS (cont'd)

- 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 the connector is inserted all live metallic parts are shrouded against accidental contact even when the twin relay unit is removed.
- 7.2 The spring tags on the unit shall be so constructed that in the event of the unit being plugged into a plugboard having maximum tolerances, they shall afterwards make effective contact if the unit is later plugged into a plugboard having minimum tolerances.
- 7.3 A registration device shall be provided to prevent an incorrectly coded unit being plugged into a particular plugboard. That portion of the registration device carried on the unit shall be incapable of alteration without breaking a seal and shall be adequately protected against accidental breakage liable to permit the unit to be plugged into the wrong plugboard. The schedule of codes is shown in Appendix 'D'.
- 7.4 The code pins on the unit 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 unit 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 each 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 twin relay unit 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 effect on its rated life.

Spec. 961 (Sheet 5).

9. MAGNETIC CIRCUIT

- 9.1 All parts forming the magnetic circuit of the relays, i.e. armatures, yokes and cores, shall be of suitable quality magnetic materials so as to ensure consistent performance.
- 9.2 Non-adjustable residual stop pins of non-magnetic material shall be provided which shall be so designed that each relay continues to meet the requirements of Clause 18.2 throughout its rated life.
- 9.3 The magnetic circuits may use common components, provided that the design is such as to minimise inter-action between the two relays (see Clause 18.2 (c)).

10. ARMATURE SUPPORTS

- 10.1 The armatures shall be positively located so as to prevent any displacement other than that required for the proper operation of the contacts.
- 10.2 The armatures shall be held in place in a manner which permits free movement throughout the normal stroke. There shall be no displacement of the armatures as a result of tests carried out under Clause 20.1.
- 10.3 In units fitted with pivot bearings the armature pivots and bearings shall be of dissimilar materials possessing a 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 armatures.
- 10.4 In units fitted with pivot bearings the armature pivots and bearings shall be cylindrical, and the bearings shall be not less than 0.002" nor more than 0.004" larger in diameter than the pivots. The end play of the armatures shall be not less than 0.01" and not more than 0.02".
- 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 Both relays must be capable of being continuously energised simultaneously.
- 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 S.W.G.) shall be used for coil windings.

Spec. 961 (Sheet 6).

COILS (cont'd)

- 11.4 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 Clause 6.7
- 11.6 The coils are to be connected as follows:-

Left-hand relay R2, R4
Right-hand relay R1, R3

The connections shall be such that the relays will operate when positive polarity is applied to terminals R1 and R2.

- 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 relays in the full operate position without injurious effect to the contact.

Over the rated life of the twin relay unit each contact shall be capable of making and breaking a 12 volt circuit having a resistive load with a switch-on surge of 5 amps dropping to a maximum steady value of 2 amps after a further 10ms (equivalent to a normal lamp circuit for a SL.17 lamp).

Over the rated life of the unit 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 B.R. Specification 930A.

- 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 be not 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 tables and they shall be disposed in accordance with Appendix 'C':-

L.H. Relay		R.H. Relay	
Front	Back	Front	Back
6	2	6	2
4	4	4	4
2	2	2	2

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14. CONTACT ASSEMBLIES

- 14.1 Contact springs shall be formed in such a way that their main axes lie 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 0.020". When the contact is fully closed the point of contact shall not lie 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 on each relay, 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 fusing or locking, it shall not be possible for any front contact of that relay to close when that relay is energised up to 35% in excess of the nominal voltage.

Alternatively, back contacts must be non-fusible.
- 14.8 The relays shall be designed so as to reduce contact chatter, bounce and hesitation to a minimum on closure of the contact elements concerned. When either relay is energised at rated voltage, or released, its contact elements shall establish steady contact conditions in not more than 20ms 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
One ounce when metal/non-fusible) the full
) release
) position