

**SPECIFICATION FOR ELECTRO-PNEUMATIC CONTACTORS
FOR USE ON ELECTRIC LOCOMOTIVES**

0. FOREWORD:

- 0.1 The Electro-Pneumatic (E-P) Contactors complete with arc-chutes and auxiliary switches covered by this specification are required for use in 25 KV AC, 50Hz, Single Phase Electric Locomotives.
- 0.2 Assistance has been taken from IEC-77-Rules for Electric Traction Equipment, in preparation of this specification.
- 0.3 Any deviations from the standards laid down with a view to improve the performance, utility and efficiency of the equipment to reduce the cost of the equipment will be given due consideration provided full particulars with justification are furnished by the tenders. However, no deviation in the specified overall and mounting dimensions, mode of electrical and pneumatic connections will be allowed.

1. SCOPE

This specification covers the manufacture and supply of Electro-Pneumatic (E-P) contactors for use on 25 KV. AC, 50Hz Single Phase Electric Locomotives of Indian Railways. The details are furnished as follows.

<u>Item</u>	<u>Description</u>	<u>Circuit where used</u>
I	Motor contactor for Traction Motor	High Voltage D.C. pulsating current
II	Shunting contactor for Field Weakening	High Voltage D.C. pulsating current.
III	Braking excitation contactor for excitation to the main fields of Traction Motor during Rheostatic Braking	High Voltage A.C. 50Hz

2. COVERING SPECIFICATION FOR MATERIALS / COMPONENTS

All materials and components, except hardware items, used in manufacture shall comply with the relevant International standards or the national standards of the country of origin unless otherwise specified. The hardware items shall conform to the International standards, ISO profiles.

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नवीन टण्डन (DY. C. E. E. (TMD))	No. 4TES.110.001 DATE : 30. 4. 81

Signature Not Verified

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Date: 2022.04.26
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Location: New Delhi

3. SERVICE CONDITIONS

3.1 Ambient temperature - The general ambient temperature of air will be varying from 0°C to 60°C with relative humidity varying upto 100%.

3.2 Maximum altitude - 1000 metres above mean sea level.

3.3 VIBRATIONS AND SHOCKS

The equipment shall be of robust design for traction duty and shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below.

(a) Maximum vertical acceleration - 1.0 g

(b) Maximum longitudinal acceleration due to shock - 3.0 g

(c) Maximum transverse acceleration - 1.0 g

3.3.1 The vibrations are of sine wave form and the frequency 'f' of vibration is between 1 Hz and 50 Hz. The amplitude 'a', expressed in millimeters is given as a function of 'f' by the equations

$$a = \frac{25}{f} \text{ for values of } f \text{ from 1 Hz to 10 Hz}$$

$$a = \frac{250}{f^2} \text{ for values of } f \text{ exceeding 10 Hz and up to 50 Hz.}$$

(g being the value of acceleration due to gravity)

3.3.2 In the direction corresponding to the longitudinal movement of the vehicle, the equipment is subjected for 2 mm to 50 Hz vibrations of such value that the maximum acceleration is equal to 3g (amplitude a=0.3 mm)

3.4 The locomotive shall be required to operate in heavy rain and areas with dusty storms. The equipment compartment of locomotive itself may have some oil fumes. The design of the equipment shall take due account of all these factors.

4. RATINGS

4.1 Type - Single pole air break electro pneumatic contactor.

4.2 Rated voltage of operating coil 110V D.C.

4.3 Normal operating voltage range 70V to 125V

4.4 Rated operating pneumatic pressure 7 Kg / Cm²

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4.5 Normal operating pneumatic pressure range

5Kg/Cm² to 9Kg/Cm²

4.6 Main contacts

4.6.1 Item I - Motor Contactor

Voltage 1270V D.C. pulsating continuous

1800V D.C. pulsating Maximum

1500A ALT-①

Current ~~1000A~~ D.C. pulsating continuous

4.6.2 Item II- Shunting Contactor

Voltage 1270V D.C. pulsating continuous

1800V D.C. pulsating Maximum

Current 325A D.C. pulsating Continuous

4.6.3 Item III - Braking Excitation contactor

Voltage 75V A.C. Maximum.

However, the potential with respect to earth of the circuit in which the contactor is connected is 2100V A.C. maximum.

Current 850A A.C. 50Hz

4.7 Auxiliary contacts

i) Continuous rating

1A at 110V D.C.

ii) Make rating

5A at 110V D.C.

iii) Break rating for
Cyclic duty

0.5A inductive load

(L/R = 40 ± 5 ms) for 2 lakh make & break operations at 110V D.C.

iv) Maximum break rating

3A inductive load at 110V D.C. (L/R=40 ± 5 ms)

Note: Contact ratings are corresponding to ambient conditions specified in clause 3

5. General Design Aspects

5.1 General features

5.1.1 Material shall be suitable for the particular application and capable of passing the appropriate test.

5.1.2. High quality material shall be used for a high reliability in operation. All wear parts shall be easily replaceable.

5.1.3 The contactor shall allow for clear arrangement, easy and secure maintenance of components and shall be so designed and constructed that mechanical

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shock or external vibration shall not operate or damage it.

5.1.4. All nuts and screws shall be securely locked and shall not loosen in service due to Vibration or other causes as normally met in traction duty.

5.1.5. All components, both separately and in combination shall be either resistant to corrosion or be so chemically treated as to resist corrosion.

5.1.6. The material used as insulation for terminals and other components shall be tough, incombustible and non hygroscopic and shall withstand the service condition specified in clause 3.

5.2. Main contacts

5.2.1. The main pole shall have antiwelding contacts for long contact life and the contact system shall be designed to virtually eliminate contact bounce.

5.2.2. The moving contact of the contactor shall be carried on suitable bearings to avoid any sluggish operation. The upper contact shall be fixed.

5.2.3. Compression spring shall be mounted on the moving contact to give requisite contact pressure. The spring shall be of rust proof material and designed so that it shall not be subjected to any deformation and loss of spring pressure during service.

5.2.4. Flexible shunt connections should be multistranded, flexible enough with adequate current carrying capacity and with brazed joints mechanically strong to withstand vibration & shocks.

5.2.5. The contact system design shall be such that when the contacts make, there is a certain amount of relative movement of 'wipe'.

5.2.6. Both fixed and moving contacts shall be accessible from front for quick inspection maintenance and replacement.

5.3. Arc Chute

5.3.1. The contacts shall be shrouded with suitable arc chute and magnetic blow out arrangement for quick and intensive arc quenching to prevent high loss of contact material during breaking of currents.

5.3.2. Arc chute material shall be tough, incombustible, self extinguishing, non hygroscopic with good arc resistant properties. The material should also have high resistance to heat and high dielectric strength. The mounting arrangement of the Arc chute should be such as to satisfactorily withstand service condition mentioned clause 3.

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- 5.3.3. The side gap between main contacts and arc chutes shall be at least 1.5 to 2mm to ensure free movement of moving contact inside the arc chute.

5.4. Auxiliary Contacts:

- 5.4.1. The contactors item I and III shall be provided with a block of auxiliary contacts having 2 normally open and 2 normally closed pairs of contacts. Contactor item II in its present application does not require any auxiliary contacts. However suitable provision should be made for mounting of auxiliary contacts on contactor item II at a later date. The auxiliary contacts will be operated by the moving mechanism of the contactor.
- 5.4.2. The design of the contact assembly shall be such that any NO or NC contacts can be converted to NC or NO contacts respectively to suit the circuitry arrangement on the Locomotive.
- 5.4.3. The contact springs shall be of suitable material and designed so that they shall not be subjected to any deformation and loss of spring pressure during service.
- 5.4.4. Contact elements shall be firmly secured so that they shall not shift or become loose during service.
- 5.4.5. If twin contact elements are employed, these shall be co-planar and shall make or break contact simultaneously.
- 5.4.6. Contacts shall be readily visible from the front.
- 5.4.7. Contact fingers shall be made of such material and so proportioned that they will not flex appreciably under operating condition in other words they shall not be loaded beyond half of their elastic limit. Movements of the contacts shall ensure self aligning, self cleaning and wiping action.
- 5.4.8. The assembly shall be designed so as to reduce contact chatter, bounce and hesitation to a minimum on closure of the contact elements, which shall establish steady contact condition when the contactor is energised.
- 5.4.9. The minimum contact pressure on the auxiliary contact shall be 25 ± 5 gms and shall maintain its accuracy during normal life of the contacts.
- 5.4.10. The contact gap shall not be less than 3 mm.

5.5. Blow out coils / cores

- 5.5.1. The blow out coils shall be manufactured out of bright annealed electrolytic copper strips. These shall be varnished/ painted to protect them atmospheric conditions.

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5.5.2 The cores of blow out coils and the magnetic circuits components of contactors item I and II can be from solid metal. The core and magnetic components for contactor item III shall be laminated as this contactor is required to work in A.C. Circuit.

5.6. Coils

5.6.1 In the construction of operating coil, either class E or class B insulating materials shall be used. The winding shall conform to IS: 4800 (Part V -1968).

5.6.2 The coils shall be ~~pro~~ protected chemically and physically from injury caused by vibrations.

5.6.3 The coils shall be vacuum impregnated and baked for tropical condition and further treated so as to make the surface smooth and impervious to moisture under all service conditions. Materials used for impregnation and insulation of coils shall be chemically and physically stable for service conditions stipulated in clause 3.

5.6.4 Insulating material used for fillers in winding the coils shall be chemically neutral.

5.6.5 Coils shall be such that they will be able to carry 150% of the rated current continuously and 200% of the rated current for four hours without injurious heating under specified service conditions.

5.6.6. The ~~term~~ terminals of the coil shall be of robust design to prevent any movement while tightening a crimped lug of 3mm² copper cable.

5.6.7 It should be possible to operate the equipment manually without electric Control supply for the purpose of maintenance, inspection and testing.

5.7. Terminals

5.7.1 The terminals intended for external electrical connections shall be arranged according to Drawing No. 4TWD.112.043, Alt.2, 4TWD.111.034 Alt.1, 4TWD.113.061 Alt.2 enclosed. No deviation from the arrangement shown in the drawings can be permitted.

5.7.2 The terminals for 110V D.C. central connection should be suitable for crimped 3mm² copper cable.

5.7.3 Terminal shall be such that they cannot turn or be displaced when connecting screws are tightened.

5.7.4 No contact pressure shall be transmitted through insulating materials and gripping of the conductors shall take place between metal surfaces.

5.8. Pneumatic connection

5.8.1 The pneumatic connection arrangement should strictly conform to drawing Nos 4TWD.112.043, Alt.2, No. 4TWD.111.034 Alt.1, 4TWD.113.061 Alt-2 enclosed. No deviation can be permitted.

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5.9. Overall dimension and mounting dimension

- 5.9.1 The maximum allowable dimension (W, X, Y, Z) and mounting dimension shall strictly conform to Drawing Nos. 4TWD.112.043 Alt-2, 4TWD.111.034 Alt-1, 4TWD.113.061 Alt-2 enclosed for motor, shunting and braking excitation contactors respectively.

No deviation can be permitted.

5.10 Clearance and creepage distance

- 5.10.1 Clearance and creepage distance shall be adequate and shall comply with the recommendations of IEC-225-1-1967.

6. Temperature Rise

- 6.1 The maximum temperature rise permissible on the various components shall not exceed the following values:

Coil	55°C for Class-E Insulation 65°C for Class-B Insulation
Fixed Contact	60°C
Mobile Contact	60°C
Flexible Connection	72°C
Blow out coil	85°C
Mobile Contact Lever	80°C
Blow out core assembly (In case contactor item III)	100°C

7. Enclosure

- 7.1 The auxiliary interlocks shall be preferably provided with a totally dust proof and heat resistance, robust, transparent cover to preclude ingress of dust. The contactor shall be in open execution.

-8. Schedule of particulars .

The schedule of particulars of the contactor given below shall be furnished with the tender.

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SCHEDULE OF PARTICULARS OF PNEUMATIC CONTACTORS1. GENERAL FEATURES

- Name of the manufacturer
- Type of contactor (include drawing and literature)
- Overall dimensions (with drawing)
- Weight of the contactor and its centre of gravity in mounted position
- Mounting arrangement (with drawing)
- Arrangement of terminal connections (with drawing)
- X Type of enclosure for auxiliary contacts and its material specifications
- Test reports with relevant specification of the materials used in the fabrication of the following components
 - a) Pneumatic system
 - b) Main and auxiliary contacts
 - c) Arc chutes
 - d) Blow out coil
 - e) Shunts
 - f) Enamelled wire of coil
 - g) Coil insulation
- X Auxiliary contact arrangement (NO and NC)
- Rated insulation voltage

2. DETAILS OF MAIN CONTACTS

- Contact pressure
- Contact gap
- Contact wipe
- Contact thickness and wear limits
- Rating of contacts in terms of current, voltage and number of operations for the following type of service.
 - a) Continuous duty
 - b) Maximum make duty
 - c) Maximum break duty
- Normal life in terms of on load operations, frequency of operating cycles per hour and load factor for continuous duty and intermittent duty.

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