BS EN 50578:2013

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Railways applications — Direct current signalling relays

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The UK participation in its preparation was entrusted to Technical Committee GEL/9/1, Railway Electrotechnical Applications - Signalling and communications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 75609 2

ICS 93.100

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2013.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50578

June 2013

ICS 93.100

English version

Railways applications - Direct current signalling relays

Applications ferroviaires - Relais de signalisation à courant continu

Bahnanwendungen - Gleichstrom-Signalrelais

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 50578:2013 E

Contents

Foreword

This document (EN 50578:2013) has been prepared by SC 9XA, "Communication, signalling and processing systems", of Technical Committee CENELEC TC 9X, "Electrical and electronic applications for railways".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-05-20
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2016-05-20

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Introduction

This European Standard gives a set of generic and specific requirements for direct current signalling relays.

This European Standard introduces a set of recommendations and requirements for signalling relay characteristics, construction, magnetic system, contacts and insulation. Requirements are coordinated with present international standards on all-or-nothing relays.

1 Scope

This European Standard gives requirements for direct current relays intended for safety-related applications in railway signalling installations.

This European Standard is applicable to monostable relays. However it can also be used as a guide for other relays such as with bistable relays.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50124-1, *Railway applications — Insulation coordination — Part 1: Basic requirements — Clearances and creepage distances for all electrical and electronic equipment*

EN 50125-3:2003, *Railway applications — Environmental conditions for equipment — Part 3: Equipment for signalling and telecommunications*

EN 60664-1, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests (IEC 60664-1)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
all-or-nothing relay
electrical relay, which is intended to be energised by a quantity, the value of which is either within its operative range or effectively zero

Note 1 to entry: "All-or-nothing relays" include both "elementary relays" and "time relays".

[SOURCE: IEC 60050-444:2002, 444-01-02]

3.2
armature
moveable part of a relay that controls contact members

3.3
bistable relay
electrical relay which, having responded to an energising quantity and having changed its condition, remains in that condition after the quantity has been removed; a further appropriate energisation is required to make it change its condition

[SOURCE: IEC 60050-444:2002, 444-01-08]

3.4
bounce time
for a contact which is closing/opening its circuit, time interval between the instant when the contact circuit first closes/opens and the instant when the circuit is finally closed/opened

[SOURCE: IEC 60050-444:2002, 444-05-04]

3.5
break contact (for elementary relays)
contact which is open when the relay is in its operate condition and which is closed when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-18]

3.6
change-over contact
combination of two contact circuits with three contact members, one of which is common to the two contact circuits; such that when one of these contact circuits is open, the other is closed

[SOURCE: IEC 60050-444:2002, 444-04-19]

3.7
contact gap
gap between the contact points when the contact circuit is open

[SOURCE: IEC 60050-444:2002, 444-04-09]

3.8
contact member (for elementary relays)
conductive part designed to co-act with another to close or open the output circuit

[SOURCE: IEC 60050-444:2002, 444-04-05]

3.9
contact force
force which two contact members exert against each other at their contact points in the closed position

[SOURCE: IEC 60050-444:2002, 444-04-10]

3.10
contact point
part of a contact member at which the contact circuit closes or opens

[SOURCE: IEC 60050-444:2002, 444-04-06]

3.11
contact wipe
relative rubbing movement of contact points after they have touched

[SOURCE: IEC 60050-444:2002, 444-04-12]

3.12
drop-away current
maximum current through the coil that, starting from the nominal current value, produces the opening of all the make contacts

3.13
electromechanical relay
electrical relay in which the intented response results mainly from the movement of mechanical elements

[SOURCE: IEC 60050-444:2002, 444-01-04]

3.14
elementary relay
all-or-nothing relay which operates and releases without any intentional time delay

[SOURCE: IEC 60050-444:2002, 444-01-03]

3.15
make contact (for elementary relays)
contact which is closed when the relay is in its operate condition and which is opened when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-17]

3.16
monostable relay
electrical relay which, having responded to an energising quantity and having changed its condition, returns to its previous condition when that quantity is removed

[SOURCE: IEC 60050-444:2002, 444-01-07]

3.17
nominal current
current passing through the coil of the relay when the coil is supplied with nominal voltage

3.18
operate condition (for elementary relays)
for a monostable relay, specified condition of the relay when it is energised by the specified energising quantity and has responded to that quantity; for a bistable relay, the condition other than the release condition as declared by the manufacturer

[SOURCE: IEC 60050-444:2002, 444-02-02]

3.19
pick-up current (compression)
minimum current through the coil that, starting from a null value, is necessary to move the armature from the release position to the operate position and apply the specified contact force, closing all the make contacts

3.20
pick-up current (service value)
minimum current through the coil that, starting from a null value, is able to move the armature closing all the make contacts

3.21
relay with forcibly guided (mechanically linked) contacts
elementary relay with at least one make contact and at least one break contact and including mechanical measures to prevent any make contact(s) and any break contact(s) being in the closed position simultaneously

[SOURCE: EN 50205:2002, 3.3]

3.22
release condition (for elementary relays)
for a monostable relay, specified condition of the relay when it is not energised; for a bistable relay, one of the conditions, as declared by the manufacturer

[SOURCE: IEC 60050-444:2002, 444-02-01]

4 Classification

The requirements of the various categories of signalling relays required to guarantee installation with the degree of reliability and safety desirable for operating purposes, depend on the functions to be fulfilled by the relays and the type of circuit with which they are to be used.

Bearing in mind these characteristics, a distinction may be made between the following types of signalling relays:

- Type N (non-proved relays)

  Relays themselves fulfilling all the safety conditions without the aid of other relays or without control of operations in the circuit.

- Type C (proved relays)

  Relays for which the safety conditions are guaranteed by control of operations in the circuit.

5 Essential requirements of the relays and their construction

5.1 Generic requirements for signalling relays

5.1.1 Forcibly guided (mechanically linked) contacts

Signalling relays shall be equipped with forcibly guided (mechanically linked) contacts. The forcibly guided (mechanically linked) contacts shall be designed in such a way that it is ensured by mechanical means that make and break contacts can never be in the closed position simultaneously.

If one of the make contacts is closed, none of the break contacts is closed. If one of the break contacts remains closed, none of the make contacts closes (assuming that nominal power conditions apply – see also 5.6.2). Operation of forcibly guided (linked) contacts means that if, for example, any given make contact fails to open and the relay is de-energised, none of the break contacts closes. The same principle applies to the failure-to-open of a break contact with energisation of the relay, i.e. in this case, no make contact shall close (EN 50205).

5.1.2 Forcibly guided (mechanically linked) operation

The efficiency of forcibly guided (mechanically linked) contact operation shall be maintained as long as the relay operates, even when beyond the specified endurance. This applies both to loaded and unloaded contacts. Forcibly guided (mechanically linked) operation shall be maintained even if individual parts of the relay fail. Under such circumstances, it is irrelevant whether this failure is due to wear or breakage.

Use of change-over contacts is permitted for signalling relays in safety-relevant circuits.

5.2 Specific requirements

5.2.1 Relays of type N

5.2.1.1 These shall be characterised by their non-weldable make contact points, through the use of a suitable contact point material (for example, silver-carbon for which there is no risk of welding above a certain percentage of carbon), or by the introduction of special constructional conditions preventing risks of welding of the contact points (for example, fusing, contacts in series).

5.2.1.2 The relays shall open the make contacts by falling of the armature under its own weight, when the current is interrupted in the coil.

5.2.1.3 The relays may also be equipped with return springs. These return springs shall only be used to increase the contact force of break contacts and ensure that the required time parameters for the armature to fall are met. They shall not be used for the opening of the make contacts.

5.2.2 Relays of type C

This type of relay shall be that the falling of the armature of the relay is proved during operation; for this reason, no special qualities of non-weldability are required for the material that contact points are made of.

5.3 Mechanical construction of the signalling relays

5.3.1 Connecting devices

The connecting devices for relays of the plug-in type (or groups of connectable relays) shall be constructed so that it is not possible for any errors in assembly or connection to occur (e.g. protection against coding errors).

5.3.2 Materials

Sufficient space shall be left between the moving parts of the relays and the detachable case or cover of the relay (or group of relays), to avoid interfering with its operation.

The material, the shape, arrangement and control of the contacts shall be chosen to guarantee normal and safe operation specified in environmental conditions including transport.

5.4 Environmental conditions

5.4.1 General

The relays shall comply to EN 50125-3 regarding environmental conditions.

5.4.2 Vibrations and shocks

In addition to the compliance to EN 50125-3, for type N relays the following requirement applies. When in the normal position, a relay shall still function correctly when subjected to sinusoidal vibrations applied either in the direction of movement of the armature or in the direction of movement of the contacts, in which the oscillations have a frequency of between 5 Hz and 22 Hz and a maximum amplitude of 1 mm, together with a frequency of between 22 Hz and 50 Hz and an acceleration of 2 g. Closed contacts shall not open longer than the bounce time and open contacts shall not close on their own, whether the relays are energised or not.

If the signalling relays do not comply with these requirements it is allowed to take special measures, for example spring suspension of the relay, groups of relays or framework.

For type C relays, EN 50125-3:2003, 4.13, can be used. The values specified for use in 1 m to 3 m shall be used even when outside this area.

5.5 Magnetic system

5.5.1 General

The travel of the moving armature can be limited by means of stops of energised and de-energised positions. If stops are used these elements shall be made of anti-residual and anti-corrosive material.

During the entire service life prescribed, the air gap, in the energised position of the relay, shall not be less than 0,1 mm, to avoid residual sticking of the armature. A smaller dimension is allowed, if the air gap is completely filled with non-residual material, as long as the requirements of 5.5.3 have been met.

5.5.2 Requirements for new relays

The choice of material and the construction shall guarantee the following:

- The pick-up current shall not exceed a given value and the drop-away current shall not fall below a given value.

- The factor K for all new relays of a given type shall not vary by more than ± 15 % in relation to that obtained from the quotient of the values fixed for the drop-away current and the pick-up current

  with

$$K = \frac{I_d}{I_p}$$

  where

  I_d is drop-away current;

  I_P is pick-up current (service value).

5.5.3 Functioning during service

During the minimum mechanical service life (10 x 10^6 movements without contact load), the following variations can be accepted in relation to the initial value:

- a maximum increase of 10 % in the pick-up current (service value),
- a maximum decrease of 15 % of the drop-away current,
- a maximum decrease of 20 % of the factor K.

The drop-away current is measured after magnetising of the relays by a current equivalent to 2,5 times the nominal current. In addition, when a current equivalent to 2,5 times the nominal current energises the relay and the reverse pick-up current is measured, the latter shall not exceed 110 % of the pick-up current.

Alternatively the degradation of the pick-up current (service value) and drop away current can be given as an absolute value. These values shall be specified and considered as a safety value and during lifetime may never be exceeded.

5.6 Design of insulation

5.6.1 General

Design of insulation with regard to electrical stress and environmental conditions, as well as insulation tests shall be carried out according to EN 60664-1. Compliance to EN 50124-1 shall be satisfied depending on application relay specifications (i.e. connection to outdoor or indoor circuit allowed, working voltage, pollution).

5.6.2 Overvoltage

Overvoltage category III to EN 60664-1 shall apply when determining the clearances between the following voltage-carrying, electrically-conducting parts:

- the various windings of a coil,
- the windings of the coil and the other parts of the relay,
- the contacts themselves,
- the contacts and earth.

NOTE Overvoltage category III applies to equipment in fixed installations, and for cases where a higher degree of availability of the equipment is expected.

5.6.3 Test voltage

Railways may decide to choose another overvoltage category keeping as a minimum a test voltage equal to 2 000 V rms at 50 Hz.

This dielectric strength may, in the case of a supply circuit not connected to earth, also be required for functional combinations (for example, groups of relays), i.e. all the output terminals of a combination are tested against earth by applying a voltage of 2 000 V rms, 50 Hz.

5.6.4 Case of a supply circuit not connected to earth

In the case of a supply circuit not connected to earth, the insulation between the various windings of a coil shall be able to withstand a test voltage of 750 V rms, 50 Hz, for one minute.

5.6.5 Pollution

Unless otherwise explicitly specified by the manufacturer, pollution degree 3 to EN 60664-1 shall be assumed for determining the creepage distances between the voltage-carrying, electrically-conducting parts.

NOTE Pollution degree 3 designates conductive pollution or dry non-conductive pollution, which can be predicted to become conductive due to condensation.

5.7 Contacts

5.7.1 Spacing

The contacts may comprise:

- single spacing with a single contact point,
- single spacing with double contact points (two contacts points in parallel),
- double spacing (two contacts in series),
- double spacing with double contact points (two set of parallel contacts points in series).

5.7.2 Break contact

If a break contact remains accidentally closed, none of the make contacts shall close, even when the relay is energised at 1,5 times its nominal supply voltage.

5.7.3 Contact heating

Adequate construction of the contacts ensures that, when in the closed position and under normal contact force, they shall not become overheated to an inadmissible extend under the effect of the specified current intensity.

5.7.4 Service life

The minimum service life under the prescribed intensity shall be 2×10^6 movements.

For specific applications a lower value is allowed, but shall be documented.

5.7.5 Minimum distance apart of the relay contact elements

5.7.5.1 The values given below shall not vary by more than 40 % during the service life, on the understanding that the distance between two make contact elements is never less than its initial value.

The values given below are distances between the contact points of the break contacts when the make contacts close and between the contact points of the make contacts when the break contacts close.

5.7.5.2 Non-weldable contact points:

- 0,5 mm when attraction of the moving armature takes place,
- 1,2 mm when attraction of the moving armature ceases.

5.7.5.3 Single or double contact points of weldable material used in equipment concerned with safety:

- 0,7 mm when attraction of the moving armature takes place,
- 1,2 mm when attraction of the moving armature ceases.

5.7.5.4 Contacts with double spacing of weldable material used in equipment concerned with safety:

- 0,5 mm when attraction of the moving armature takes place,
- 0,9 mm when attraction of the moving armature ceases.

5.7.6 Contact force

The compression force of the contacts on completion of the movement of the moveable armature shall not be less than the following:

a) Relays of type N
   1) 0,245 N (25 g) in the case of silver-carbon contact points,
   2) 0,196 N (20 g) in the case of silver-silver contact points.

b) Relays of type C
   1) 0,147 N (15 g) in the case of silver- silver contact points.

For contacts with double contact points, half the contact force suffices per contact point. For double spacing contacts, full force is necessary at each contact point.

Compression force applicable for other combination of contact material shall be specified by the product specification.

5.7.7 Self-cleaning

The minimum contact wipe of the contact shall be:

- 0,2 mm for type N,
- 0,1 mm for type C (in the case of double spacing contacts, a smaller contact wipe is considered sufficient).

5.7.8 Bounce

The following maximum bounce times are allowed on closing and opening of the contact:

- 20 ms in the case of type N,
- 10 ms in the case of type C.

Bibliography

[1] EN 50205:2002, *Relays with forcibly guided (mechanically linked) contacts*

[2] EN 61810-1:2008, *Electromechanical elementary relays — Part 1: General requirements (IEC 61810-1:2008)*

[3] IEC 60050-444:2002, *International Electrotechnical Vocabulary — Part 444: Elementary relays*

[4] UIC 736 (4th edition, June 2004), *Signalling relays*

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