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**Železniške naprave – Vozna sredstva – Odjemniki toka: karakteristike in preskusi –  
2. del: Odjemniki toka za mestne železnice in lahka železniška vozila**

Railway applications - Rolling stock - Pantographs: Characteristics and tests -- Part 2:  
Pantographs for metros and light rail vehicles

Bahnanwendungen - Schienenfahrzeuge - Merkmale und Prüfungen von  
Stromabnehmern -- Teil 2: Dachstromabnehmer für Stadtbahnen und Straßenbahnen

Applications ferroviaires - Matériel roulant - Pantographes: Caractéristiques et essais --  
Partie 2: Pantographes pour métros et tramways

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**Railway applications - Rolling stock  
Pantographs: Characteristics and tests  
Part 2: Pantographs for metros and light rail vehicles**

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung  
Central Secretariat: rue de Stassart 35, B - 1050 Brussels

## Foreword

This European Standard was prepared by SC 9XB, Electromechanical material on board rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50206-2 on 1999-01-01.

The following dates were fixed:

- latest date by which the EN has to be implemented  
at national level by publication of an identical national standard  
or by endorsement (dop) 2000-01-01
- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2002-01-01

Annexes designated „normative“ are part of the body of the standard.

Annexes designated „informative“ are given for information only.

In this standard, annexes A, B and C are normative and annex D is informative.

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SC9XB Note:

Clauses and subclauses subject to further change are indicated in the text by a note.

Those affected are:

- 6.4.2 Resistance to vibrations
- 6.9 Current collection tests



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## Introduction

The electrical power supply of a tractive unit is achieved by the collection of current from the contact wire by means of one or more pantograph(s), installed on the traction unit or on the vehicle.

The contact strip of the pantograph which slides along the contact wire facilitates the transmission of power.

The pantograph and the catenary form two oscillating sub-systems which can be displaced. There exists an unilateral sliding linkage between them, which shall ensure continuous contact. Their design shall allow for minimum wear of both sub-systems when used.

## 1 Scope

This standard defines the general assembly characteristics which are to be applied to pantographs, to enable current collection from the overhead line system. It also defines the tests the pantographs have to perform, excluding insulators.

This standard does not apply to pantograph dielectric tests, which are to be performed on the pantograph installed on the vehicle roof.

This standard does not apply to pantographs used on main line vehicles: these pantographs are considered in EN 50206-1.

This standard relates to conventional suspended overhead line systems and accessories. The systems (or part of them) which are rigidly suspended will require special consideration between the customer and the supplier.

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## 2 Normative references

This European Standard incorporates, by dated or undated references, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

DIN 43267	(1973)	Pantographs for electric traction, profile limiting for pantograph carbons with leading horns
EN 29 001		Quality systems - Model for quality assurance in design/development, production, installation and servicing
EN 29 002		Quality systems - Model for quality assurance in production and installation
EN 50125-1 <sup>*)</sup>		Railway applications - Environmental conditions for equipment - Part 1: Equipment on board rolling stock
EN 50126		Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS)
EN 50206-1		Railway applications - Rolling stock - Pantographs: Characteristics and tests - Part 1: Pantographs for main line vehicles

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<sup>\*)</sup> in preparation

EN 50163		Railway applications - Supply voltages of traction systems
EN 50215 <sup>*)</sup>		Railway applications - Testing of rolling stock after completion of construction and before entry into service
EN 60529	(1991)	Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)
ENV 50121 series		Railway applications - Electromagnetic compatibility
IEC 60077-1 <sup>*)</sup>		Railway applications - Electrotechnical components - Part 1: General service conditions
IEC 60077-2 <sup>*)</sup>		Railway applications - Electrotechnical components - Part 2: General rules
IEC 60494	(1974)	Rules for pantographs of electric rolling stock
IEC 61373 <sup>*)</sup>		Railway applications - Shock and vibration requirements for rolling stock equipment

### 3 Definitions

For the purpose of this standard, the following definitions apply.

#### 3.1 General

3.1.1 **supplier**: the manufacturer of the pantograph.

3.1.2 **customer**: either the operating authority or the vehicle manufacturer.

3.1.3 **pantograph** (see annex A): an apparatus that collects current on one or more contact lines. It consists of a base frame, an operating system, a frame and a collector head. It is of variable geometry. In the "operating" position, the apparatus is entirely or partly under voltage. It is electrically insulated only generally at its interfaces, on the vehicle roof. It enables current to be transmitted from the overhead line to the vehicle electrical system.

#### 3.2 Design

The following definitions are related to the sketch in Annex A, except items 9, 15, 16, 17.

3.2.1 **frame** (item 1): An articulated structure which enables the collector head to move in a vertical direction with respect to the base frame of the pantograph.

3.2.2 **base frame** (item 2): Fixed part of the pantograph which supports the frame and is mounted on insulators fixed to the vehicle roof.

3.2.3 **collector head** (item 3): Part of the pantograph supported by the frame which includes contact strips, horns and may include a suspension.

3.2.4 **contact strip** (item 4): Replaceable wearing part of the collector head which interfaces with the overhead line.

3.2.5 **horns** (item 5): Ends of the collector head which ensure smooth engagement with the contact wire.

3.2.6 **collector head length** (item 6): Dimension of collector head measured horizontally transversely in relation to the vehicle.

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<sup>\*)</sup> in preparation



**3.2.7 collector head width** (item 7): Dimension of collector head measured longitudinally in relation to the vehicle.

**3.2.8 collector head height** (item 8): The vertical distance between the lowest point of the horns and the upper most point of the contact strips.

**3.2.9 collector head pivot** (item 9): It is the pitching axis of the collector head.

**3.2.10 length of contact strips** (item 10): The total length measured transversely in relation to the vehicle.

**3.2.11 height at "lower operating position"** (item 11): Vertical distance between the pantograph mounting plane on the top of insulators and the upper surface of contact strips, the pantograph being raised to the lowest level at which it is designed to collect current.

**3.2.12 height at "upper operating position"** (item 12): Vertical distance between the pantograph mounting plane on the top of insulators and the upper surface of the contact strips, the pantograph being raised to the highest level at which it is designed to collect current.

**3.2.13 working range** (item 13): Difference between the "upper operating position" height and the "lower operating position" height.

**3.2.14 housed height:** Vertical distance between the pantograph mounting plane on the top of insulators and the upper surface of the contact strips or any other part of the pantograph structure if higher (pantograph being in the housed position).

**3.2.15 pantograph "electrical thickness"** (item 15): Vertical distance between the highest live part and the lowest live part of the pantograph at housed position.

**3.2.16 operating system** (item 16): Device which provides a force to raise or to lower the pantograph.

**3.2.17 maximum extension** (item 17): Maximum extended height to mechanical stops

**3.2.18. extension range (E):** Difference between height at upper operating position (3.2.12) and housed height (3.2.14).

### 3.3 General characteristics

All general characteristics are defined in the customer specifications. Unless otherwise specified, environmental conditions are defined in EN 50 125-1.

**3.3.1 Rated voltage, vehicle at standstill**

It is the voltage at which the pantograph is designed to function.

**3.3.2 Rated current, vehicle at standstill**

Average value of the current withstood for 30 minutes by the pantograph at standstill.

**3.3.3 Maximum current, vehicle at standstill**

Maximum value of the current withstood by the pantograph at standstill for a time given in the customer specification.

**3.3.4 Rated current, vehicle running**

Current collected via the pantograph from standstill to maximum speed of the vehicle.



### 3.3.5 Static force

The mean vertical force exerted upward by the collector head on the catenary, and caused by the pantograph raising device, whilst the pantograph is raised and the vehicle is at standstill.

### 3.3.6 Nominal static force

An average of the actual values of static forces evaluated as follows : the static forces are measured continually within the working range during raising ( $F_r$ ) and lowering ( $F_l$ ) operation. By convention, the nominal static force at any point is equal to

$$\frac{F_r + F_l}{2}$$

## 4 Technical requirements

### 4.1 Gauge

The pantograph, at housed position and operating position, shall comply with the gauge specified in the customer specifications.

### 4.2 Extension of the pantographs

The customer specifications shall give the values in relationship with 3.2.10 to 3.2.13.. In the absence of specifications in the tender documents, when the pantograph is raising or lowering, the collector head trajectory over the working range shall be in accordance with table 1:

Table 1: Lateral deviation of the collector head

Extension Range (E)	Maximum lateral deviation to vertical line
$E < 1\text{m}$	10 mm
$1\text{m} < E < 2\text{m}$	20 mm
$E > 2\text{m}$	30 mm

### 4.3 Electric values

The supply voltages of traction systems are specified by EN 50163.

The customer specifications shall also state the duration and values of the expected overvoltages for operating and housed pantographs.

Values defined in 3.3.2. to 3.3.4. shall be given in the customer specifications.

### 4.4 Static force tolerances

Static forces measured during raising and lowering shall lie within the boundaries defined in annex B.

#### 4.5 Transverse rigidity

When a transverse force is exerted on the part of the frame which supports the collector head at the upper operating position, the deflection shall not exceed the value defined in 6.6. and no permanent deformation shall occur.

#### 4.6 Collector head

##### 4.6.1 Head profiles

The customer specification shall give values in relationship with 3.2.6. to 3.2.8. and collector head outline profiles.

##### 4.6.2 Contact strips

The wear strip material and/or the contact strip design shall be defined in the customer specifications. In the absence of customer specifications, DIN 43267 can be considered.

#### 4.7 Operating system

##### 4.7.1 General

The operating system shall be so designed that at standstill and up to the maximum speed of the traction unit any break from the contact wire will not cause permanent damage to the wire or contact strips under normal operating conditions.

The operating system shall be designed to permit the addition of a manual facility allowing operation in case of a lack of energy.

##### 4.7.2 Electrical motor

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Under environmental conditions considered in EN 50125-1, the electrical motor shall be in accordance with the requirements of IEC 60077-1 and IEC 60077-2.

In the absence of any special requirements in the customer specifications, the electrical motor shall be protected following IP 55 in accordance with the requirements of IEC 60529.

#### 4.8 Automatic dropping device (A.D.D.)

The pantograph shall be fitted with an automatic dropping device only if requested in the customer specifications.

The automatic dropping device shall initiate the immediate lowering of the pantograph in the event of collector head failure.

The A.D.D. shall not cause additional damage to the pantograph.

#### 4.9 Pantograph mass and force on the roof

The supplier of the pantograph shall specify the mass of the pantograph and the appropriate tolerance with and without insulators. Any additional external forces applied by operating system shall be defined by the supplier.

#### 4.10 Protection against corrosion

The specifications regarding the application requirements and type of corrosion protection shall be given in the customer specifications.

## 5 Marking

As a minimum the following shall be labelled on the pantograph:

- manufacturer's mark;
- pantograph type number;
- type of pantograph.

## 6 Tests

### 6.1 Categories of tests

There are four categories of tests :

- type tests;
- routine tests;
- investigation tests;
- combined tests.

The above tests are described in 6.1.1. to 6.1.4.

Annex C summarises the tests which shall be performed.

Excluding combined tests, this standard distinguishes the basic model of a pantograph from the derived model of the same pantograph. The derived model can incorporate modifications to the basic design which will be considered to be covered by the existing type tests, provided that any such changes can be demonstrated to be at least equal to the basic design through calculation or operational experience.

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#### 6.1.1 Type tests

Type tests shall be performed on a single piece of apparatus of a given design.

Equipment in current manufacture shall be considered to have satisfied the type tests and shall be exempted from them, if the manufacturer provides signed reports of type tests already made on identical apparatus constructed previously.

Supplementary type tests shall be required if they have been specified in the customer specification and after agreement with the supplier.

#### 6.1.2 Routine tests

Routine tests shall be carried out to verify that the properties of a product correspond to those measured during the type test. Routine tests shall be performed by the supplier on each equipment. For certain apparatus, after agreement between customer and supplier, routine tests may be replaced by sampling tests (tests achieved on a number of apparatus taken at random from a batch).

#### 6.1.3 Investigation tests

Investigation tests are special tests, which are supplementary, and performed on a single item in order to obtain additional information. They may be required only if they are expressly specified in the customer specifications.