

# INTERNATIONAL STANDARD

**ISO  
9851**

First edition  
1990-12-15

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## **Continuous mechanical handling equipment — Overhead electrical monorail conveyors — Definitions and safety rules**

*Engins de manutention continue — Monorails à chariots électrifiés — Définitions et règles de sécurité*



Reference number  
ISO 9851 : 1990 (E)

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9851 was prepared by Technical Committee ISO/TC 101, *Continuous mechanical handling*. It is based on the work carried out by "Section II – Continuous handling" of the European Mechanical Handling Confederation (FEM).

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# Continuous mechanical handling equipment — Overhead electric monorail conveyors — Definitions and safety rules

## 1 Scope

This International Standard defines basic terms and specifies safety rules for overhead electrical monorails for materials handling, including the tracks, supporting structure, lifting and lowering devices, the trolleys and the load-supporting devices.

It does not apply to systems driven by hand or by gravity, or to systems for conveying people, or to overhead conveyors.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1819 : 1977, *Continuous mechanical handling equipment — Safety code — General rules*.

ISO 6385 : 1981, *Ergonomic principles of the design of work systems*.

IEC 144 : 1963, *Degrees of protection of enclosures for low-voltage switchgear and controlgear*.

IEC 364 : 1970 to 1988, *Electrical installations of buildings*.

## 3 Definitions

### 3.1 Definitions relating to monorail conveyors

**3.1.1 overhead electric monorail conveyor:** Track transport system with individually suspended driver trolleys (3.1.2.1), equipped with load-supporting devices (3.1.2.2) and/or a coupling device to move idler trolleys or floor carriages on the same or a different track (3.1.3). (See figure 1.)

**3.1.2 mobile unit:** The trolley (3.1.2.1) and the load-supporting device (3.1.2.2) with or without a load. (See figure 1.)

**3.1.2.1 trolley:** A wheeled mobile assembly running on a track (3.1.3), which may consist of a driver trolley and an idler trolley, or just a driver trolley or a combination of driver trolleys and idler trolleys, connected by one or more load bars. (See figure 1.)

**3.1.2.2 load-supporting device:** The connection between the load bar and the load, which may be composed of only a sling and a load-carrying device.

**3.1.3 track:** Horizontal, vertical or inclined carrying and guiding rail, including switches and turntables.

**3.1.4 lifting and lowering device (drop sections):** Transfer device which transfers the trolley (3.1.2.1) from one level to another by vertical or inclined movement of a track element.

**3.1.5 support structure:** Suspension or support of the track (3.1.3).

### 3.2 Definitions relating to work zones and places

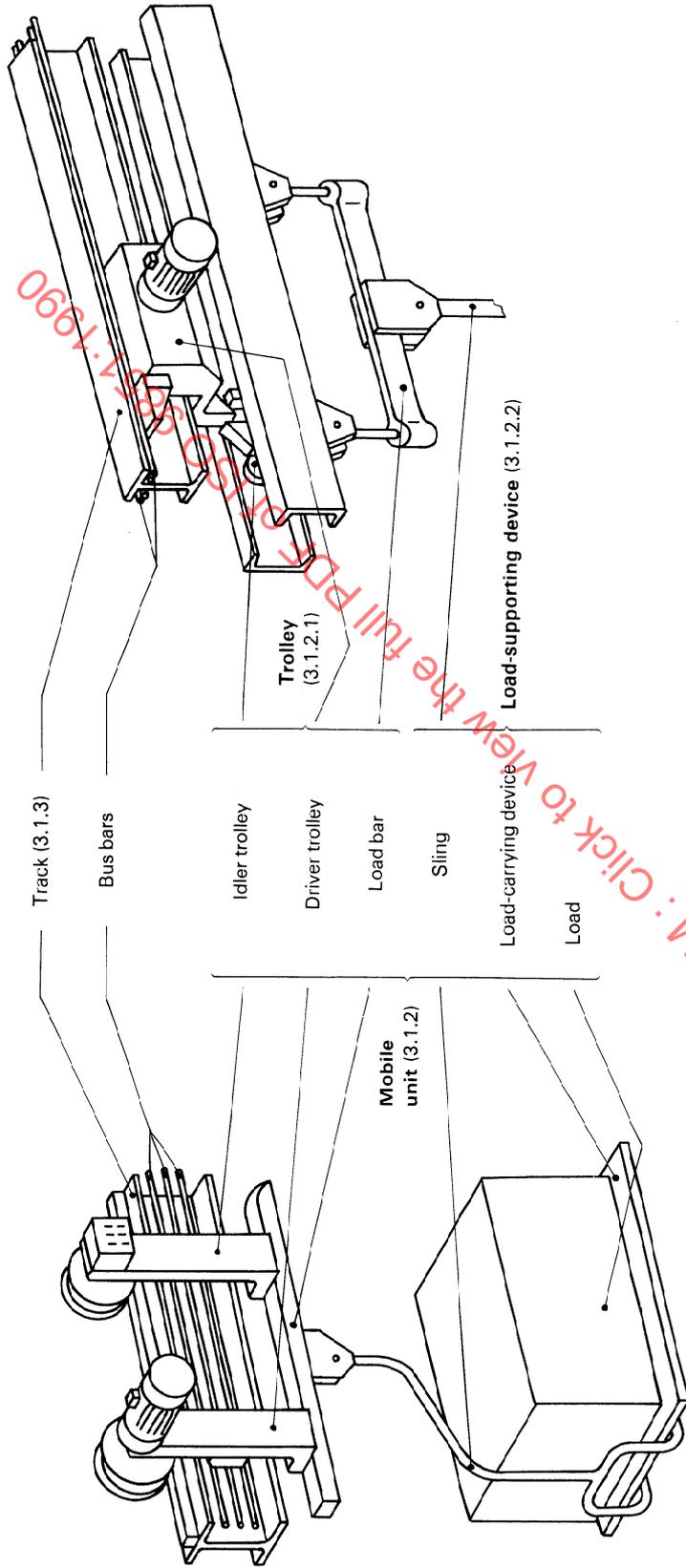
**3.2.1 travelling zone:** The volume of space swept by the mobile units (3.1.2) and their load.

**3.2.2 permanent work place:** Zone in which personnel stay for the purpose of their work. It might also include, for example, fixed gangways, landings or platforms.

**3.2.3 passageway for persons:** Zone used for the movement of persons.

NOTE — Passageways and work places may be used for both purposes. The access to a permanent work place is also a passageway.

**3.2.4 occasional access zone:** Accessible restricted zone used exclusively by authorized personnel.



a) Overhead electric monorail conveyor (3.1.1)

b) Overhead electric twin-rail conveyor

NOTE — The numbers shown in brackets refer to the corresponding definitions in clause 3.

Figure 1 — Examples of overhead electrical twin- and monorail conveyors

## 4 General safety rules

Overhead electric monorail conveyors shall satisfy the following safety rules, which apply in addition to the general safety rules specified in ISO 1819. Moreover, these devices shall satisfy the legal requirements pertaining to safety in general.

When the mobile units are fitted with lifting devices, the lifting devices shall comply with the rules specific to lifting devices.

The related equipment used to remove or return the loads and/or the load-supporting devices (for example drop sections) from or to the monorail is subject to special safety rules.

Several specifications of clause 5 refer to safety clearances; some of them are at present the subject of studies at an international level. The values given in this International Standard will possibly be modified in order to agree with the decisions adopted at an international level.

## 5 Special safety rules

### 5.1 At the construction stage (design and manufacture)

**5.1.1** The trolleys shall be designed in such a way that they cannot derail or fall off should a component break.

**5.1.2** If overhead monorails are operated within or above the working and movement zones, the design of the installation and of the mobile units shall be such that personnel are protected against transported goods overturning or falling off.

**5.1.3** The connecting devices mounted on the driver trolleys shall be designed in such a way that the idler trolleys or the floor carriages cannot become accidentally disconnected.

**5.1.4** The system shall be designed in such a way that each mobile unit can be stopped individually at any time.

**5.1.5** At the ends or at interruptions in the tracks, for instance at switches, lifting and lowering devices, etc., there shall be mechanical stops to prevent the trolley falling off at the ends of the tracks. On track ends in the service area, manually operated limit stops are allowed.

**5.1.6** In inclined travelling zones, devices such as self-retaining drives, brakes or downhill or uphill stops shall be fitted to prevent unintended forward or backward movements, even in the case of failure of the motive power.

**5.1.7** If special mobile units are used by maintenance personnel, for example for maintenance work on mechanical or electrical parts of the installation or for removing defective trolleys, they shall be fitted with at least the following devices :

- two-hand continuous-action controls;
- brakes (service brake, parking brake);
- close mesh side guard, at least 1,1 m high on the working cage, preventing passage of the hand;
- any other safety device required by national regulations.

### 5.2 At the installation stage (design, construction and commissioning)

**5.2.1** Each mobile unit in a system shall carry a distinctive mark, for example a number, a letter or colour.

**5.2.2** On each mobile unit, the maximum working load capacity, including the mass of the load-supporting device if it is removable, shall be indicated.

**5.2.3** Pinch and shear points and possible impact points as well as nip points in the working areas and passageways shall be safeguarded.

**5.2.3.1** Pinch and shear and possible impact points as well as nip points in the area of the track, for example at powered switches, turntables, supports, travelling and guiding wheels, are considered to be safe if they are positioned at least 2,5 m above the floor of the working level of personnel.

**5.2.3.2** In the travelling zone readily accessible to personnel, mobile units shall be stopped to leave a clearance in the direction of travel, between two mobile units, of at least 0,5 m up to a height of 2 m over and above the floor of the working level of the personnel.

Swinging of the mobile unit should be taken into account.

**5.2.3.3** If access to the travelling zone is prevented by protection devices, for example fences or railings, regulatory safety distances should be complied with.

The safety devices shall be interlocked with the hazardous machinery of the system within the relevant zone.

**5.2.3.4** If overhead monorails are operated within or above the work and movement zone, personnel shall be protected by suitable means against transported goods overturning or falling off.

**5.2.3.5** To protect against the dangers of lateral shear points on the side between mobile units and fixed parts of the surroundings, and between mobile units in neighbouring travelling zones, the following minimum safety clearances should be ensured up to a height of 2 m in each zone :

- 0,8 m in work zones and passageways;
- 0,6 m at least on one side in occasional access zones; this clearance of 0,6 m may be reduced to 0,5 m at the perpendicular of an obstacle less than 1 m long.

A lateral clearance of at least 1 m shall be ensured if the travelling zone passes in front of doors, portals, passages or staircases.

Normal swinging of mobile units during travelling should be taken into account.

**5.2.3.6** To protect against the dangers of horizontal shear points between the mobile units and fixed parts of the surroundings, the following minimum safety heights should be ensured :

- 0,12 m between the ground and mobile units;
- 0,5 m above parts of building or machines which are occasional access zones;
- 2,5 m when the travelling zone of the monorail is located above a permanent work place or passageways for personnel.

These safety distances need not apply when lifting and lowering is to the working level, or to transfer points.

**5.2.3.7** If access to the travelling zone during operation is prevented by safety devices or other means, safety clearances are not necessary.

**5.2.3.8** If the travelling zone of the overhead monorail, outside the working zone and passageways, must be entered, and if safety clearances do not exist, safety devices shall be provided to check the motion until all personnel have left the zone.

**5.2.4** Crossings between passageways and travelling zones of the overhead monorail shall be designed in order to ensure protection of personnel. In particular, where passageways cross travelling zones of the overhead monorail and visibility is obscured, and taking the travelling speed into account, guarding devices to control movement of personnel shall be installed, for example barriers or gates, or visual or audible warning devices shall be installed.

For travelling speeds in the area of the crossing

- > 0,5 m/s, guarding devices are necessary;
- ≤ 0,5 m/s, visible or audible warning devices are sufficient.

**5.2.5** Control stations shall be designed and placed in such a way that all control elements can be reached and operated safely. Control elements shall be clearly and durably marked, and control movement and equipment response shall correspond to the information displayed, in accordance with ISO 6385.

**5.2.6** In the work and movement zones, especially in the area of manually operated loading points, easily accessible emergency stop devices shall be installed, which can be reached fast enough to stop all movements in the section concerned quickly.

It shall be impossible to resume operation after using the emergency cut-off device without first unlocking the emergency stop switch.

**5.2.7** Protection against direct or indirect touch shall be ensured in accordance with the rules specified in IEC 364. In particular, parts bearing electric current shall be protected against direct touch by distance, obstacle or insulation.

Such protection shall be ensured to the degree of protection defined in International Standards, i.e. at least IP 23 for low-voltage switchgear and controlgear, in accordance with IEC 144.

In the case of nominal voltages up to 25 V a.c. or 60 V d.c. in wet environments, or 50 V a.c. or 120 V d.c. in dry environments, this protection against direct touch can be omitted provided the circuits comply with the requirements of IEC standards.

**5.2.8** It shall be possible to disconnect electrical devices of the overhead monorail completely from the electric mains, for example using a disconnecter.

The devices used shall be lockable in a break position to prevent the electrical supply being switched back on in error or by unauthorized personnel.

**5.2.9** If the electrical supply of an overhead monorail system is divided in several sections, it shall be possible to isolate each section separately.

**5.2.10** For maintenance work on overhead monorail systems which cannot be done from floor level, overhead working platforms shall be provided which allow safe access and allow work in such a way that personnel are not endangered.

Working platforms may be fixed in the installation, for example gangways or platforms, or may be mobile, for example aerial work platforms.

## 5.3 In use (operation and maintenance)

**5.3.1** Access to travelling zones, permanent work places, passageways and occasional access ways is forbidden to unauthorized personnel.

This prohibition shall be indicated visibly and permanently.

**5.3.2** Operation and maintenance personnel shall be trained in the work and shall be informed of the hazards of the installation.

**5.3.3** Personnel authorized in the travelling zones, permanent work zones, passageways and occasional access ways, and their vicinity, shall receive safety instructions.

These instructions shall be brought to their attention, for example, by notice boards, through instruction meetings, operating instructions handbook, etc.

**5.3.4** Maintenance work in the travelling zone of the overhead monorail shall only be carried out if it is ensured that no danger to the personnel arise from the operation of the monorail. This can be ensured for example by the electrical isolation of the whole installation, or part of it, etc.

**5.3.5** If objects are stored beside the travelling zone, a clearance of at least 0,8 m between the objects stored and moving parts of the installation should be ensured.