

Indian Standard

BUREAU OF INDIAN STANDARD

IS 17900: LIFTS FOR THE TRANSPORT OF PERSONS AND GOODS:

PART 7: LIFTS FOR SPECIAL APPLICATIONS:

SECTION 2: RACK AND PINION LIFTS USED IN UNDER-CONSTRUCTION BUILDINGS

IS 17900: व्यक्तियों और वस्तुओं के परिवहन के लिए लिफ्ट
भाग 7: विशेष अनुप्रयोगों के लिए लिफ्टें
अनुभाग 2: निर्माणाधीन इमारतों में प्रयुक्त रैक और पिनियन लिफ्ट

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FOREWORD

This Indian Standard (Part-7-2) will be adopted by the Bureau of Indian Standards after the draft finalized by the Lifts, Escalators and Moving Walks Sectional Committee had been approved by the Electrotechnical Division Council.

This draft Indian Standard is a part of series of Indian Standards on ‘Lifts for the transport of persons and goods.’ Other parts of this series of standards cover various requirements like specifications for planning and selection, guide for inspection and maintenance of lifts, lifts for special applications, dumbwaiters etc. Parts 1, 2, 3 and 6 of this series of standards are being published as Indian Standards and other parts of this series are under development

This standard specifies requirements for the Rack and Pinion type of Temporary Lifts that are used during construction stage in under-construction buildings to transport instructed people who are authorized to enter the site, tools and materials used for construction of the building. In case of Rack and Pinion type of Temporary Lifts used in Under-Construction-Buildings, full compliance with IS 17900-1 and IS 17900-2 is required; however certain exemptions as detailed in this standard can be granted. As a consequence, such lift shall not be accessible to general public unless the lift fully complies with both IS 17900-1 & IS 17900-2 as well as other statutory requirements.

This standard is not applicable to the Rack & Pinion Lifts permanently installed in any location.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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IS 17900: Lifts For The Transport of Persons and Goods:

Part 7: Lifts for Special Applications:

Section 2: Rack and Pinion Lifts Used in Under-Construction Buildings

1 SCOPE:

This standard specifies requirements for the Rack and Pinion type of Temporary Lifts that are used during construction stage in under-construction buildings to transport instructed people who are authorized to enter the site, tools and materials used for construction of the building. In case of Rack and Pinion type of Temporary Lifts used in Under-Construction-Buildings, full compliance with IS 17900-1 and IS 17900-2 is required; however certain exemptions as detailed in this standard can be granted. As a consequence, such lift shall not be accessible to general public unless the lift fully complies with both IS 17900-1 & IS 17900-2 as well as other statutory requirements.

This standard is not applicable to the Rack & Pinion Lifts permanently installed in any location.

2 REFERENCES:

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

<i>IS No.</i>	<i>Title</i>
16814: 2021	Safety of Machinery — Safety Distances to Prevent Hazard Zones Being Reached by Upper and Lower Limbs (<i>First Revision</i>)
17900 (Part 1): 2022	Lifts for the transport of persons and goods: Part 1 Safety Rules
17900 (Part 2): 2022	Lifts for the transport of persons and goods: Part 2 Design rules, calculations, examinations, and tests of lift components.
17900 (Part 3, Section 2): 2023	Lifts for the transport of persons and goods: Part 3 Specifications for planning and selection: Section 2: Goods lift
17900 (Part 5): 2023	Lifts for the transport of persons and goods: Part 5: Guide for Inspection of Lifts

17900 (Part 6): 2022	Lifts for the Transport of Persons and Goods Part 6 Guide for Maintenance of Lifts
IS/IEC 60529	Degrees of protection provided by enclosures (IP CODE)
IS 4460	Gears – Spur and Helical Gears – Calculations of load capacity

3 TERMINOLOGY:

For the purpose of this standard, definitions given below and those given in IS 17900 Part 1, IS 17900 Part 2 shall apply.

- 3.1 Rack and pinion lift:** Lift which uses a toothed rack and pinion as the load suspension system.
- 3.2 Guides:** Rigid elements which determine the travel way of the cage.
- 3.3 Mast:** Structure that supports and guides the cage
- 3.4 Mast section:** Indivisible piece of mast, between two adjacent mast joints
- 3.5 Mast tie:** Connection system between the mast and any building structure, providing lateral support for the mast.
- 3.6 Well:** total space which is travelled by the cage and its load
- 3.7 Overspeed safety device:** Mechanical device for stopping and maintaining stationary the cage in the event of overspeed.

4 SAFETY REQUIREMENTS:

The Rack and Pinion type of Temporary Lifts used in Under-Construction Buildings shall comply with IS 17900-1 & IS 17900-2 except as noted hereunder & may be inspected as per IS 14665-5 as applicable & maintained as per IS 17900-6.

- 4.1** The minimum factor of safety to be used for design of rack & pinion lifts shall be 12.
- 4.2** The structure of the hoist shall be designed and constructed in such a way that its strength is satisfactory under all intended operating conditions, including erection and dismantling.
- 4.3** The lift shall conform to the capacity and the class-of-loading requirements as specified in 5.4.2 of IS 17900 Part1 and IS 17900 Part 3 Section 2 and shall be designed accordingly.
- 4.4** To determine the forces produced in normal running of the lift, the sum total of the travelling load shall be multiplied by the impact factor 1.2 to take into consideration hard braking due to electric safety device actuation or by an accidental interruption of the power supply.
- 4.5** Motors, electrical control equipment, and other equipment used in conjunction with the elevator shall be permitted to be located on the car. A controller so located shall be available to and used only by inspectors, maintenance personnel, and repair personnel.

- 4.6 A rack-and-pinion machine and its controls located on the car top shall be protected by a noncombustible enclosure to prevent accidental contact.
Openwork noncombustible enclosure material shall be permitted provided it rejects a ball 50 mm in diameter. The electrical switchgear shall be at least IP 54 protected.
- 4.7 Access shall be provided to the rack-and-pinion machine for maintenance. The car roof may be provided with a suitable trap door of size 0.4 m x 0.6 m minimum, with a door opening outside, for this purpose.
- 4.8 Access panels to rack-and-pinion control equipment may be located in the car.
- 4.9 The access panel and the trap door in the car roof shall be kept closed and locked. The electric contact shall be designed to prevent operation of the rack-and-pinion machine when the access panel/trap door is open. The lock shall be operable by a special key. The key shall be available to, and used only by authorized personnel e.g.; inspectors, maintenance personnel, and repair personnel.

4.10 Cage

- 4.10.1 Deviating from 5.4.3.1 of IS 17900 Part 1, enclosures shall be of metal with or without perforations.
- 4.10.2 Perforated portions of the enclosures shall reject a ball 25 mm in diameter and be guarded to prevent straight-through passage.
- 4.10.3 Deviating from clause no. 5.4.3.2.3, 5.4.3.2.4, and 5.4.3.2.5 of IS 17900-1, glass shall not be used in lift cars, except for the car lights and accessories necessary for the operation of the car.
- 4.10.4 The cage roof shall be designed to withstand a load of at least 3.0 kN placed on the least favourable square area of 1.0 m². The roof shall also withstand a load of 1.2 kN applied on any area of 0.1 x 0.1 m.
- 4.10.5 The cage roof shall be provided protections as per 5.4.7.2 of IS 17900 Part 1.
- 4.10.6 The cage shall be provided with effective devices which retain the cage to the cage-guides in the event of the normal guide shoes or rollers failing.
- 4.10.7 The cage shall be provided with mechanical means to prevent it from running off the guides. These means shall be in work as well during normal operation as during erection, dismantling and maintenance.
- 4.10.8 The cage shall be provided with effective means to both detect an unsecured mast section and prevent the cage from driving onto this section or to ensure the cage cannot become detached from the secured mast section.
- 4.10.9 The floor of the cage shall be designed to withstand the forces according to the loading method and be slip resistant (e.g., chequered plate) and be free draining.

4.11 Wind Pressure:

4.11.1 The wind pressure shall be taken into account while designing the elevator as per good engineering practices for the following three operating conditions, taking into account the geographical location of the lift and the height above ground.

- a) In service
- b) Out of service
- c) Installation and dismantling.

4.11.2 Installation is prohibited if wind velocity is higher than 12.5 m/s.

4.11.3 Normal operation is prohibited if wind velocity is higher than 20 m/s.

4.12 Car Doors:

Provided that the lift speed is not more than 1m/s, deviating from clause no. 5.3.1.2 of IS 17900-1, car doors shall be solid or collapsible type or openwork construction that will reject a ball 25 mm in diameter. Collapsible car gates shall be of a design that, when fully closed (extended position), will reject a ball 60 mm in diameter. All doors including their tracks shall withstand a thrust of 345 N applied normally at any point excepting any vision panel without permanent deformation and without the doors being sprung from their guides. For collapsible doors, this thrust may be applied at points on two adjacent pickets so as to divide the load equally. Each car door or gate shall be equipped with an electric contact conforming to the requirements of clause no. 5.3.13 of IS 17900-1; and a lock conforming to 5.3.9.2 of IS 17900 Part 1 if the car door of the lift faces an unenclosed portion of the well during the travel of the car. Operation of the car shall not be possible if the car door is not closed and locked.

4.13 Car Frames and Platforms

The car frame and platform shall be designed to satisfy loading methods employed (refer IS 17900 Part 3 Section 2) and shall be as per good engineering practices.

4.14 Car Safeties and Speed Governor

The car shall be provided with a rack-and-pinion safety.

The rack-and-pinion safety is an integrated unit consisting of a freely rotating safety pinion, a governor, and a safety device. The device has a shaft with a centrifugal weight and a pinion constantly engaged with the rack fixed on the hoist mast. When the centrifugal weight gets activated due to over speed, the brake cone is screwed-in against a brake lining inside the safety housing and the hoist is brought to a smooth stop.

The rack and pinion safety shall comply to the following:

4.14.1 The triggering speed of the safety device shall not exceed the hoists rated speed by more than 0,4 m/s.

4.14.2 The safety device shall be placed inside the car, completely independent from the drive unit with one pinion engaging the rack.

4.14.3 Safety hooks shall be provided which shall prevent the pinion of the safety device from disengagement with the rack in case of failure of the guide roller.

Heels on the safety device plates shall keep the pinion of the safety device constantly engaged with the rack on the hoist mast even in case a counter roller or a guide roller on the cage comes off.

4.14.4 The power to the drive motor shall be cut off on or before the activation of the safety device.

4.14.5 The safety device shall be operational at all times, including erection, dismantling and during resetting after being triggered. No regular drive components with the exception of the rack shall be used for the overspeed safety device.

4.14.6 The safety device shall be able to stop and maintain the stopped cage with 1,3 times the rated load.

Safety device retardation with any load in the cage up to the rated load shall be between 0,05 g and 1,0 g with no peak exceeding 2,5 g for more than 0,04 s. These values may be exceeded if the safety device triggers before the resetting operation is completed

4.14.7 Under all conditions of loading excluding overload, when the safety device(s) operates, the floor of the cage shall not incline by more than 5 % from its normal position and shall recover without permanent deformation.

4.14.8 To determine the forces produced by an operation of the overspeed safety device, the sum total of the travelling load shall be multiplied by the impact factor 2,5.

4.14.9 The method for release of the safety device shall require the intervention of a competent person in order to return the hoist to normal operation.

It shall be possible to release the safety by raising the car

4.15 Car Buffers

Buffers shall conform to 5.8 of IS 17900 Part1. Kinetic energy from the drive unit etc. shall be taken into account in the design calculations.

4.16 Mast, ties

4.16.1 Guide structures and masts

4.16.1.1 The guides can be part of the mast. Guides shall be rigid.

The deflection of any part of the mast or cage shall be limited such that no collision (e.g., with the landings) can occur.

4.16.1.2 Guides or masts shall be so designed that they can withstand all load cases as stipulated above.

4.16.1.3 Connections between individual lengths of mast or guides or link arms shall provide effective load transfer and maintain alignment. Loosening shall only be possible by an intentional manual action.

4.16.1.4 Attachments of drive elements such as rack to the guide/mast shall ensure that the drive element is kept in correct position so that the stipulated loads can be transferred to the mast and that the fixings are ensured from becoming loose, e.g., use of a lock nut.

4.16.2 Mast ties

The ties shall withstand the load cases as above. Special attention shall be paid to forces generated during erection and dismantling.

4.17 Well protection and landing access

4.17.1 General

A hoist, when installed for use, shall have:

- a) base enclosure;
- b) well protection;
- c) landing gates at every point of access.

These shall prevent persons from being struck by moving parts, and from falling down the well.

4.17.2 Hoist base enclosure

4.15.2.1 The hoist base enclosure may be imperforate or openwork construction that shall reject a ball 25 mm in diameter, and shall protect all sides to a height of at least 2.0 m and shall withstand a thrust of 345 N applied normally at any point excepting any vision panel without permanent deformation.

4.15.2.2 When, for maintenance purposes, the base enclosure is accessed by the base enclosure gate, this shall be openable from the inside.

4.17.3 Emergency Doors

Emergency doors meeting the requirements of 5.2.3 of IS 17900 Part 1 shall be installed in the blind portion of the well except in elevators having a manually operated device that permits lowering the car at an automatically controlled speed to the nearest landing.

4.17.4 Landing Doors and Gates

A landing door or gate shall be provided at each landing. When closed, it shall guard the opening to its full height. Provided that the lift speed is less than or equal to 1m/s; deviating from clause no. 5.3.1.2 of IS 17900-1 the landing doors shall be solid, collapsible type, or openwork construction that shall reject a ball 25 mm in diameter. Collapsible landing gates shall be of a design that, when fully closed (extended position) shall reject a ball 60 mm in diameter.

The doors including their tracks shall withstand a thrust of 345 N applied normally at any point excepting any vision panel without permanent deformation and without the doors being sprung from their guides. For collapsible doors, this thrust may be applied at points on two adjacent pickets so as to divide the load equally. Each door or gate shall be equipped with Locking and Emergency Unlocking of landing doors as per clause no.5.3.9 of IS 17900-1. Operation of the car shall not be possible unless all the landing doors are closed and locked.

4.18 Rack-and-Pinion Driving Machine

The rack and pinion driving machine is a compact unit with two or more pinions engaged to the rack on the mast. Each pinion is fitted to a high efficiency helical gear box connected by a flexible coupling to a squirrel cage induction motor with built-in electromagnetic disc brake. The motor is started / controlled either direct-on-line (DOL) or by variable frequency control (VFC) method. The drive unit is connected to the car by pull rods. The rack and pinion driving machine shall comply with the following:

4.18.1 The pinions and racks shall be of steel for the pinion and the rack. They shall be designed to conform to IS 4460 with a minimum safety factor of 2.0 against the appropriate endurance limit. Instructions shall be available for checking tooth wear on pinion and rack.

4.18.2 Load distribution

When there is more than one drive pinion in mesh with the rack, then either a self-adjusting means shall be provided to effectively share the loading on each drive pinion or the drive system shall be so designed as to accommodate all normal conditions of load distribution between the pinions.

4.18.3 The moving parts of the driving machine shall be properly protected with solid or perforated metal that will reject a ball of 13 mm diameter and shall be securely fastened.

4.18.4 The electrical motor(s), switchgear, etc.; shall have at least IP 54 protection as per IS/IEC 60529

4.18.5 The connection between car and drive unit shall have an overload sensing system (OSS).

4.18.6 Safety hooks shall be provided underneath the drive pinion of the machine and on the car which shall prevent the pinion of the drive unit from disengagement with the rack in case of failure of the guide roller or counter roller; and thus preventing the hoist from falling off the mast should the drive pinion run off the top rack.

4.18.7 Heels on the drive unit plates shall keep the pinion of the drive unit constantly engaged with the rack on the hoist mast even in case a counter roller or a guide roller on the cage comes off.

4.18.8 Module

The rack and pinion tooth module shall be not less than:

- a) four (4) for drive systems where the counter roller or other mesh control feature reacts directly on the rack without the interposition of any other mast profiles;
- b) six (6) where the reaction of the counter roller or other mesh control feature is by means of another element of the mast which is then in immediate contact with the rack.

4.19 Braking system:

The braking system shall comply with 5.9.2.2 of IS 17900 Part 1.

4.20 Erection, dismantling and maintenance operation

4.20.1 Control operations during erection, dismantling and maintenance shall only be possible from inside the cage or from the cage roof. Erection, dismantling and maintenance operations from inside the cage with some parts of the sides of the cage removed except for those below 1,1 m, is permitted, provided that the correct closure of these parts is checked by means of electric safety devices as per 5.11.2 of IS 17900-1 to permit normal operation of the hoist.

4.20.2 During erection, dismantling and maintenance operations the maximum cage speed shall not exceed 0,7 m/s and the movement of the cage shall remain dependent upon all safety devices as in normal operation with the following exceptions:

- a) the upper final limit- and terminal stopping switch may not be functioning, in which case alternative automatic overrun protection means, e.g., by an electrical switch, shall be taken;
- b) the landing gate switch circuits may be bridged.

4.20.3 For the erection, dismantling and maintenance operation a control device shall be provided. This device shall operate as per 5.12.1.5 of IS 17900-1.

4.21 Emergency Operation:

The hoist shall be provided with a means of emergency operation allowing the cage to be moved to a landing as per 5.9.2.3 of IS 17900 P1.

If the cage is provided with a manually operated emergency lowering device to be used by any person, it shall comply with the following:

4.21.1 the drive system brake shall be capable of being manually released from within the cage and shall require a constant effort of no more than 400 N to keep the brake open;

4.21.2 the device shall be protected from misuse, e.g., by a protective cover capable of being broken in the event of emergency;

4.21.3 the speed shall be controlled automatically and shall be less than the overspeed governor triggering speed but shall not be more than 1,0 m/s.

4.22 Terminal Stopping Devices, Operating Devices, and Control Equipment

4.22.1 Terminal Slow Down, Normal and Final Terminal Stopping Devices

Terminal slow down, normal and final terminal stopping devices shall be provided conforming to 5.12.2 of IS 17900 Part 1.

4.22.2 Operating Devices, and Control Equipment

4.22.2.1 Applicable Requirements

Operating devices and control equipment shall conform to 5.12 of IS 17900 Part 1 and to the following:

Where the rack-and-pinion machine and its controller are located on the car, the disconnecting means shall be located adjacent to the controller. Auxiliary disconnect means shall be provided at the main landing whenever the main power supply disconnect means is mounted adjacent to the controller on the car. Auxiliary disconnect means shall be accessible to authorized personnel only in order to be available for their protection and emergency use.

4.22.2.2 Permitted Voltage

Voltage permitted in control and operating circuits shall not exceed 230 V on rack-and-pinion equipment.

4.22.2.3 Emergency stop switch in car

Deviating from 5.12.1.11.3 of IS 17900 P1, emergency stop switch shall be provided in the car. When operated (“STOP” position), it shall cause the electric power to be removed from the elevator driving-machine motor and brake, and sound alarm as well. The switch shall be red in colour, and shall be conspicuously and permanently marked “STOP,”

5 MAINTENANCE:

The instruction manual shall be in accordance with IS 17900 (Part 6). It shall inform about the identification and use of the special tools.

6 EXAMINATIONS AND TESTS BEFORE PUTTING INTO SERVICE:

The manufacturer shall perform or have performed static and dynamic tests to ensure that the hoist has been correctly manufactured and assembled in order to check that all the devices provided are present and operating correctly. These tests may be carried out at the manufacturers' premises or those of his authorized representative; and at the place of use under the control of the manufacturer.

In particular the following shall be verified and recorded in a test report:

- 6.1** Limit switches for proper functioning
- 6.2** All controls for proper functioning
- 6.3** Functioning of the overspeed safety device within specified limits;
- 6.4** Triggering of overload detection device between 1.0 and 1.2 times rated load;
- 6.5** Braking system as per 6.3.1 of IS 17900 Part1;
- 6.6** Buffers as per 6.3.7 of IS 17900 Part1;
- 6.7** Gate locks for proper functioning;
- 6.8** Dynamic test at 1,1 times rated load;
- 6.9** Static test at 1,25 times rated load;
- 6.10** Electrical installation as specified in 6.3.2 of IS 17900 P1.