इंटरनेट मानक

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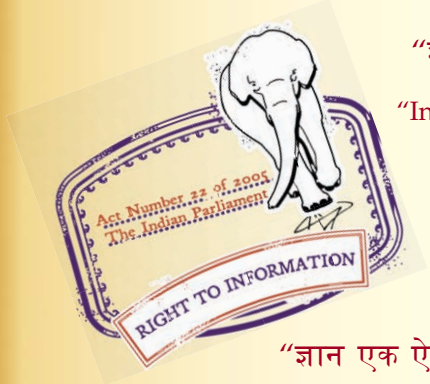
IS 15785 (2007): Code of practice for Installation and maintenance of lift without conventional machine rooms [ETD 25: Lift and Escalators]



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"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

मशीन कक्षों रहित लिफ्टों के संस्थापन तथा रख-रखाव — रीति संहिता

Indian Standard

INSTALLATION AND MAINTENANCE OF LIFT WITHOUT CONVENTIONAL MACHINE ROOMS — CODE OF PRACTICE

ICS 91.140.90

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

September 2007

Price Group 5

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Lifts and Escalators Sectional Committee had been approved by the Electrotechnical Division Council.

Conventional lift requires separate machine room and special pulley rooms, wherever needed. Modern technology shows that machines and associated parts can be located in the well, on the car or in cabinets. Need has therefore been felt to prepare this Code to regulate the installation and for safe working of 'Lifts without machine room'.

In the formulation of this Code, assistance has been derived from the following :

a) EN81-1 / Pr A2 — 2000 Safety rules for the construction and installation of lifts — Part 1: Electric lifts — A2; Lifts without machine room; Ref CEN TC10 dated 2000-01 secretariat AFNOR, and

b) European Parliament and Council Directive 95/16/EC of 29 June 1995.

This standard does not cover outline dimension of lifts wells, lift pits and other layout dimensions necessary for lift installations. These are covered in IS 14665 (Part 1) : 2000.

This standard is one of a series of Indian Standards on lifts.

Other standards published in this series are:

IS No.	*Title*
14665 (Part1) : 2000	Electric traction lifts: Guidelines for outline dimensions of passenger, goods, service and hospital lifts
(Part 2/Sec 1 and 2) : 2000	Code of practice for installation, Section 1 Passenger and goods lifts; Section 2 Service lifts
(Part 3/Sec 1 and 2) : 2000	Safety rules, Section 1 Passenger and goods lifts; Section 2 Service lifts

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 : 1960 '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.

AMENDMENT NO. 1 JUNE 2011
TO
IS 15785 : 2007 INSTALLATION AND MAINTENANCE OF LIFT WITHOUT CONVENTIONAL MACHINE ROOMS — CODE OF PRACTICE

(*Page* 2, *clause* **4.4.5**, *Title*) — Substitute '*Suspension Media*' for the existing.

(*Page* 2, *clause* **4.4.5**, *para* 4) — Substitute the following for the existing:

'Coated Steel Belts (CSB) used shall comply with Annex B. Ratio of sheave diameter to steel cord shall remain 40 : 1 and minimum factor of safety on CSB breaking strength shall be 12. Minimum 2 CSB's shall be used. Each Lift shall be provided with detection device or mechanism which will bring elevator to stop in case of elongation of belt or breakage of one belt. The device shall not be of automatic reset type and shall require intervention of competent person to reset the same.'

(*Page* 9, *Annex* B, *clause* **B-7.2.2.7**) — Add the following new clause:

'**B-7.3 Visual Check and Replacement Criteria**

CSB's shall be inspected visually. If any of the following defects are observed in visual inspection, all the CSB's shall be replaced:

- Visual damage such as a kink in CSB, exposed cords, excessive elastomeric coating wear, etc
- Steel cords, strands or wires breaking through its elastomeric coating
- Piercing of CSB by foreign object
- Damaged CSB edge where outermost cord is visible.'

(ET 25)

Reprography Unit, BIS, New Delhi, India

Indian Standard

INSTALLATION AND MAINTENANCE OF LIFT WITHOUT CONVENTIONAL MACHINE ROOMS — CODE OF PRACTICE

1 SCOPE

This standard deals with special lifts, where the hoisting machine is kept inside the shaft itself, thereby eliminating the conventional machine room. This standard is intended to help the potential users, manufacturer and the regulatory authorities who are already familiar with electric lifts complying with existing standards [*see* IS 14665 (Part 2/Sec 1 and 2) and IS 14665 (Part 3/Sec 1 and 2)] for traction lifts.

2 REFERENCES

The following standards are necessary adjuncts to this standard:

IS No.	*Title*
1356 (Part 1) : 1972	Electrical equipment of machine tools: Part 1 Electrical equipment of machines for general use (*second revision*)
8216 : 1976	Guide for inspection of lift wire ropes
14665 (Part 2/Sec 1 and 2) : 2000	Electric traction lifts: Code of practice for installation, operation and maintenance, Section 1 Passenger and goods lifts; Section 2 Service lifts
(Part 3/Sec 1 and 2) : 2000	Safety rules, Section 1 Passenger and goods lifts; Section 2 Service lifts
(Part 4/Sec 1-9) : 2001	Components

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 14665 (Part 2/Sec 1) shall generally apply.

3.1 No Machine Room — This special elevator does not need a separate machine room.

3.2 Machinery — Equipment traditionally placed in the machine room. Cabinet(s) for control and drive system, lift machine, main switch(es), governor and means for emergency operations.

3.3 Machinery Space — Space(s) inside or outside of the well where the machinery as a whole or in parts is placed.

3.4 Pulley Space — Space(s) inside or outside of the well where pulleys are placed.

4 CONSTRUCTION, INSTALLATION, PROTECTION AND MAINTENANCE OF LIFTS WITHOUT MACHINE ROOM

4.1 Every lift and part thereof shall be of sound material of sufficient rating and construction and sufficient mechanical strength for the purpose for which it is intended and shall be installed, protected, operated and maintained in such manner so as to prevent danger.

4.2 Protection is defined as preventing damage to the personnel using the elevator and maintaining the lift.

4.3 All materials used in lifts shall conform to the latest standards, wherever applicable.

4.4 Construction

4.4.1 *Lift Machine*

Each elevator should have a machine of its own. The lift machine can be operated by an electric motor. The speed reduction/control can be either by mechanical gears or by electrical means.

4.4.2 *Braking System*

4.4.2.1 *General provisions*

a) The lift shall be provided with a braking system which operates automatically:
   1) in the event of loss of the mains power supply; and
   2) in the event of the loss of the supply to control circuits.

b) The braking system shall have an electro-mechanical brake (friction type), but may, in addition, have other braking means (for example, electric).

4.4.2.2 *Electro-mechanical brake*

a) This brake on its own shall be capable of stopping the machine when the car is travelling downward at rated speed and with the rated load plus 25 percent. In these conditions the retardation of the car shall not exceed that resulting from the operation of the safety gear or stopping on the buffer.

   All the mechanical components of the brake which take part in the application of the braking action on the drum or disc shall be

installed in two sets. If one of the components is not working a sufficient braking effort to slow down the car, travelling downwards at rated speed and with rated load shall continue to be exercised.

Any solenoid plunger is considered to be a mechanical part, any solenoid coil is not.

b) The component on which the brake operates shall be coupled to the traction sheave or drum or sprocket by direct and positive mechanical means.

c) A continuous flow of current is required to hold off the brake when the lift is in normal use.

d) The interruption of this current shall be effected by at least two independent electrical devices, whether or not integral with those, which cause interruption of the current feeding the lift machine. If, whilst the lift is stationary, one of the contactors has not opened the main contacts, further movement of the car shall be prevented at the latest at the next change in the direction of motion.

e) When the motor of the lift is likely to function as a generator, it shall not be possible for the electric device operating the brake to be fed by the driving motor.

f) Braking shall become effective without supplementary delay after opening of the brake release circuit.

NOTE — The use of a diode or capacitor connected directly to the terminals of the brake coil is not considered as a means of delay.

g) Any machine fitted with a manual emergency operating device (*see* **5.1.1**) shall be capable of having the brake released by hand and require a constant effort to keep the brake open.

h) The brake shoe or pad pressure shall be exerted by guided compression springs or weights.

j) Band brakes shall not be used.

k) Brake linings shall be incombustible.

4.4.3 *Lift Car*

The lift cars and frames wherever provided shall meet the requirements specified in IS 14665 (Part 4/Sec 3).

The car frame may be integrated with the car enclosure.

4.4.4 *Over Speed Governor (OSG)*

The requirement specified in IS 14665 (Part 4/Sec 4) shall apply.

The over speed governor shall be accessible and reachable from outside the well. This requirement does not apply, if the following three conditions are fulfilled:

a) Tripping of the over speed governor is effected by means of a remote control, except cableless, from outside the well whereby an involuntary tripping is not affected and the actuation device is not accessible to unauthorized persons;

b) Over speed governor is accessible for inspection and maintenance from the roof of the car or from the pit; and

c) After tripping automatically, the over speed governor returns into the normal position, as the car, is moved in the upward direction.

However the electrical parts may return into the normal position by remote control from the outside of the well which shall not influence the normal function of the over speed governor.

4.4.5 *Suspension Ropes*

Round steel wire rope or synthetic rope or coated steel belts can be allowed for suspension of the car and counterweight.

Steel wire ropes shall conform to IS 14665 (Part 4/ Sec 8).

Synthetic ropes used shall comply with Annex A. Ratio of sheave diameter to diameter of rope shall be minimum 25:1 and minimum factor of safety on rope breaking strength will be 16.

Coated steel belts (CSB) used shall comply with Annex B. Ratio of sheave diameter to steel chord will remain 40:1 and minimum factor of safety on CSB breaking strength will be 12.

4.4.6 *Guide Rails and Guide Shoes*

Guide rails and guide shoes shall generally conform to IS 14665 (Part 4/Sec 2).

4.4.7 *Car Doors, Landing Doors and Locking Devices*

The requirements specified in IS 14665 (Part 4/Sec 6) shall apply.

4.4.8 *Terminal Stopping and Final Limit Switch*

Every lift shall be provided with upper and lower final limit switches arranged to stop the car automatically within the limits of top car clearance and bottom car run by from any speed attained in normal operation. Such limit switches shall act independent of normal limit switches, wherever provided.

4.4.9 *Main Switch*

Each lift shall be provided with a main switch and shall conform to IS 14665 (Part 2/Sec 1).

This switch shall be located :

a) in the cabinet for control, except if this is mounted in the well, or

b) at the emergency and test panel (s) when the cabinet for control is mounted in the well. If the emergency panel is separate from the test panel, the switch shall be at the emergency panel.

If the main switch is not easily accessible from the cabinet for control, then the cabinet shall be provided with an isolating switch.

4.5 Installation and Maintenance

4.5.1 *Access*

Access to the interior of the machinery and pulley spaces shall be,

a) capable of being properly lit by a permanent electric light fixture(s); and

b) easy to use in complete safety in all circumstances without necessitating entry into private premises.

4.5.2 *Machinery Inside the Well*

4.5.2.1 *General provisions*

a) Machinery spaces inside the well shall be so constructed to withstand the loads and forces they are intended to be subjected.

b) In the case of wells partially enclosed at the exterior of buildings the machinery shall be suitably protected against environmental influences.

c) Provision should be given to access the machine for maintenance purpose either from car top or otherwise.

4.5.2.2 *Dimensions of working areas inside the well*

a) The dimensions of working areas inside the well shall be sufficient to permit easy and safe working on equipment, especially the electrical equipment.

1) A clear horizontal area in front of the control panels and the cabinets. This area is defined as follows:

i) Depth, measured from the external surface of the enclosures, at least 0.70 m; and

ii) Width, the greater of the following values : 0.50 m or the full width of the cabinet or panel.

2) A clear horizontal area of at least 0.50 m × 0.60 m for maintenance and inspection of moving parts at points where this is necessary and, if need be, manual emergency operation.

b) The clear height for movement shall not be less than 1.80 m.

c) There shall be a clear vertical distance of at least 0.30 m above rotating parts of the machine. This requirement does not apply if these parts are directly located below the well ceiling.

4.5.2.3 *Working areas in the car or on the car roof*

a) If maintenance/inspection work on the machinery is to be carried out from inside the car or from the car roof, the following applies:

1) Any kind of uncontrolled and unexpected car movement resulting from maintenance/inspection that can be dangerous to persons carrying out maintenance/inspection work shall be prevented by a mechanical device and electrical device.

2) When the car is blocked against all movement it shall be possible to leave the working area easily and safely.

b) Any necessary devices for emergency operation and for dynamic tests (such as brake tests, traction tests, safety gear tests, buffer tests or tests of ascending car over speed protection means) shall be arranged so that they can be operated from outside of the well.

4.5.2.4 *Ventilation*

The machinery spaces shall be suitably ventilated. The electric equipment of the machinery shall be protected as far as it is reasonably practicable from dust, harmful fumes and humidity.

4.5.2.5 *Lighting and socket outlets*

The working area and machinery spaces shall be provided with permanently installed electric lighting on the basis of at least 200 lux at floor level.

4.5.2.6 *Handling of equipment*

One or more metal supports or hooks with the indication of the safe working load, as appropriate, are provided in the machinery spaces, conveniently positioned to permit the hoisting of heavy equipment.

4.5.3 *Machinery Outside of the Well*

4.5.3.1 *General provisions*

Machinery spaces outside of the well shall be so constructed to withstand the loads and forces to which they are intended to be subjected.

4.5.3.2 *Machinery cabinet*

a) The machinery shall be located inside a cabinet; and

b) The machinery cabinet shall consist of imperforate walls, floor, roof and lockable door(s).

4.5.3.3 *Working area*

The working area in front of a machinery cabinet shall comply with the requirements according to **4.5.2.2.**

4.5.3.4 *Ventilation*

The machinery cabinet shall be suitably ventilated. It shall be such that the machinery is protected as far as it is reasonably practicable from dust, harmful fumes and humidity.

4.5.3.5 *Lighting and socket outlets*

The inside of the machinery cabinet shall be provided with permanently installed electric lighting on the basis of at least 200 lux at floor level.

The switch placed inside close to the door(s), at an appropriate height, shall control lighting of the cabinet.

4.5.4 *Devices for Emergency and Tests*

4.5.4.1 In the case of machinery inside the well, the necessary devices for emergency and tests shall be provided on a panel(s) suitable for carrying out from outside of the well all emergency operations and any necessary dynamic tests of the lift. These devices shall be inaccessible to unauthorized persons.

If the emergency and tests devices are not protected inside a machinery cabinet, they shall be enclosed with a suitable lockable cover.

4.5.4.2 The panel(s) shall,

a) include the emergency operation devices;

b) have equipment which enables dynamic tests to be carried out; and

c) be provided with an opening for a direct observation of the lift machine or with display devices, which inform about :

1) Direction of movements;

2) Reaching of an unlocking zone; and

3) Speed of the lift, except it is automatically limited up to 0.63 m/s.

4.5.4.3 The panel(s) shall be lit by a permanently installed electric lighting on the basis of at least 50 lux on the level of the panel(s).

A switch placed inside or close to the panel shall control lighting of the panel(s).

4.5.4.4 In front of the panel(s) a free horizontal area of minimum 0.50 m × 0.60 m with a minimum height of 2 m, shall be available for emergency and tests operations.

4.5.4.5 *Control panel*

a) The control panel should be installed near the hoisting equipment either inside the shaft or outside;

b) The control panel should be accessible from the landing for maintenance purposes;

c) Adequate safety measures should be provided to control unauthorized access;

d) Adequate illumination should be provided for the control panel for easy maintenance. Illumination should be available even when there is no power supply. Minimum of 50 lux illumination should be provided for the control panel; and

e) The requirements specified in IS 14665 (Part 4/Sec 9) shall generally apply.

4.5.5 *Over Speed Governor (OSG)*

The over speed governor should be installed without hindrance to the movement of the car.

For maintenance purposes the over speed governor should be accessible from the car top or otherwise.

5 OPERATING AND SAFETY DEVICES

5.1 Emergency Operation

5.1.1 If the manual effort required to move the car in the upward direction with its rated load does not exceed 400 N the machine shall be provided with a manual means of emergency operation allowing the car to be moved to a landing. If the means for moving the car can be driven by the lift moving, then it shall be a smooth, spokeless wheel.

5.1.2 If the means is removable, it shall be located in an easily accessible place in the machinery space. It shall be suitably marked if there is any risk of confusion as to the machine for which it is intended.

If the means is removable or can be disengaged from the machine, an electric safety device shall be actuated, at the latest when the means is coupled with the machine.

5.1.3 It shall be possible to check easily whether the car is in an unlocking zone. This check may be made, for example, by means of marks on the suspension or governor ropes (*see also* **4.5.4.2**).

5.1.4 If the effort defined in **5.1.1** is greater than 400 N, a means of electrical emergency operation shall be provided in accordance with **5.2**.

This means shall be located in the machine room, in the machinery cabinet or in the emergency and test panel(s) (*see* **4.5.4**).

5.2 Control of Emergency Electrical Operation

5.2.1 If a means of emergency electrical operation is provided an emergency electrical operation switch shall be installed. The machine shall be supplied from the normal mains supply or from the standby supply, if there is one.

5.2.2 The following conditions shall be satisfied simultaneously :

a) Operation of the emergency electrical operation switch shall permit the control of car movement by constant pressure on buttons protected against accidental operation. The direction of movement shall be clearly indicated;

b) After operation of the emergency electrical operation switch, all movement of the car except that controlled by this switch shall be prevented.

c) The emergency electrical operation switch shall render inoperative by itself or through another electric switch the following electric devices :

1) Those mounted on the safety gear;
2) Those of the over speed governor;
3) Final limit switches; and
4) Those mounted on the buffers, if any.

d) The emergency electrical operation switch and its push-buttons shall be so placed that the machine can be observed directly or by display devices.

e) The car speed shall not exceed 0.63 m/s.

5.3 Emergency Alarm Device

An intercom system, or similar device, powered by the emergency supply shall be installed between inside the car and the place from which the emergency operation is carried out if the travel exceeds 30 m or if a direct acoustic communication between the car and the place from which the emergency operation is carried out is not possible.

6 DIMENSIONAL TOLERANCES

Lift car area shall conform to IS 14665 (Part 3/Sec 1). Car dimensions and lift well dimensions shall be agreed mutually between the supplier and the customer.

ANNEX A

(*Clause* 4.4.5)

SYNTHETIC ROPES FOR LIFTS

A-1 REQUIREMENTS

The general requirements for synthetic ropes for suspension on passenger lifts comply within the scope of IS 8216 and IS 14665 (Part 4/Sec 8).

A-2 ROPE PARAMETERS

A-2.1 Type Designation : SR 60/SR80

SR60 : Synthetic Rope Lay Length outer : 60 mm

SR80 : Synthetic Rope Lay Length outer : 80 mm

A-2.2 Nominal Diameter of Rope (Internal) d_i — 10.8 mm.

A-2.3 Nominal Diameter of Rope (External) d_a — 12 mm.

A-2.4 Rope Lay — sZ.

A-2.5 Rope Construction — 1 + 5 + (5 + 5) + 18

1 + 6 + (6 + 6) + 13

A-2.6 Lay Length Ratio — 1.58 – 1.78

A-2.7 Number of Indicator Strands — 6-9 in the outer layer

A-3 PARAMETER OF MATERIAL

A-3.1 Rope

A-3.1.1 *High Tensile Fibres*

Material	— Kevlar 49 Twaron 1055
Tensile strength (N/mm^2)	— 2 800 N/mm^2
Ultimate elongation (percent)	— 2.4
Young's modulus (N/mm^2)	— 124 000

Filament diameter (μm)	— 12
Number of filaments/yarn	— 1 000
Number of yarn/strand	— 5-13

A-3.1.2 *Indicator Strands*

Material	— Tenax HTA with Aramid fibre part
Tensile strength (N/mm^2)	— 4 200
Ultimate elongation (percent)	— 1.2-1.68
Young's modulus (N/mm^2)	— 236 000

A-3.1.3 *Intersheath*

Material	— Elastoilan 1185A10 (FHF) self-extinguish
Tensile strength (N/mm^2)	— 35
Ultimate elongation (percent)	— 600

A-3.1.4 *Outersheath*

Material	— Elastoilan 1154D10 (FHF) self-extinguish	Elastoilan 1185A10 (FHF) self-extinguish
Tensile strength (N/mm^2)	— 45	35
Ultimate elongation (percent)	— 400	600

A-3.2 Traction Sheave

Shape of traction sheave groove	— U (semicircular)
Traction sheave material	— Gray cast iron
Minimum ratio of diameter (D/d) =	— 25
Groove angle (δ)	— 50 °
Groove radius (R)	— d_a [y (0.53 < y < 0.55)]
Angle of wrap	— $\alpha \geq 458 \left(\frac{l_2}{d_T}\right)$

d_T Traction sheave diameter

A-3.3 Coefficient of Friction for Traction Sheave Objective Evidence

Material of the outer sheath	Elastoilan 1154D10 FHF self-extinguish	Elastoilan 1185A10 FHF self-extinguish
Loading	$\mu = 0.20$	$\mu = 0.26$
Emergency stopping	$\mu = \frac{0.20}{1+\frac{v}{50}}$	$\mu = \frac{0.26}{1+\frac{v}{50}}$
Hoisting the lift car	$\mu = 0.33$	$\mu = 0.43$

A-3.4 Deflection Pulley

Deflection pulley material — Polyamide or Gray cast iron

Minimum ratio of diameters — D/d = 25

A-3.5 Rope End Connection

Asymmetrical rope socket, constructed as follows :

a) Construction shall be same as of wedge clamp for overhead equipment,

b) Socket angle = wedge angle,

c) 19° ≤ socket angle/wedge angle ≤ 23°, and

d) Dead end of rope secured with a wire rope grip intended for producing temporary rope-termination, shall be subject to safety requirements (wire rope grip not passed over load-bearing rope fall).

A-3.6 Rope Safety Calculation

The rope safety factor shall be 16.

ANNEX B

(*Clause* 4.4.5)

ELASTOMERIC COATED STEEL BELTS FOR LIFTS

B-1 REQUIREMENTS

The general requirements for elastomeric coated steel chorded belts for suspension and compensation applications on passenger and freight lifts for various constructions is written in SI units.

B-2 TERMS

B-2.1 Description of Terms

B-2.1.1 *Steel Chord*

An assembly of steel strands each comprising several steel wires. The strands are helically laid around a central core strand.

B-2.1.2 *Coated Steel Belt (CSB)*

A belt comprising several steel chords arranged in parallel, and molded within an elastomeric casing.

B-2.2 Belt Grade

A level of requirement of the breaking force of the elastomeric coated steel belt, which is designated by a number.

B-3 DIMENSIONAL CHARACTERISTICS

B-3.1 For the Steel Chords

B-3.3.1 *Chord Diameter*

The diameter of a circle that circumscribes the cross section of a chord. This diameter is used for evaluating diameter ratios.

B-3.3.2 *Chord Lay Length*

That distance measured parallel to the longitudinal belt axis, in which the outer strands of the chord make one complete turn about the axis of the chord.

B-3.3.3 *Number of Strands in a Chord*

B-3.3.4 *Number of Steel Wires in a Strand*

B-3.3.5 *For the Molded CSB*

B-3.3.5.1 *Number of steel chords in a CSB*

B-3.3.5.2 *Chord pitch*

The spacing between adjacent chord center lines in the CSB.

B-3.3.5.3 *CSB width*

The larger dimension of the cross-section of the molded belt.

B-3.3.5.4 *CSB thickness*

The lesser dimension of the cross-section of the molded belt.

B-3.4 Mechanical Properties

B-3.4.1 *Steel Chord Tensile Strength*

The ratio between the minimum force obtained in a tensile test to the sum of the cross sectional areas of the wires in the chord.

B-3.4.2 *CSB, Minimum Breaking Force*

Specified value which the actual (measured) breaking force must meet or exceed in a prescribed tensile test.

B-3.4.3 *CSB Stretch (Extension)*

B-3.4.3.1 *Constructional stretch*

Amount of extension which is attributed to the initial bedding down of the wires within strands and the strands within the chords due to belt loading.

B-3.4.3.2 *Elastic stretch*

Amount of recoverable extension which follows Hooke's law, within certain limits due to application of load.

B-3.4.3.3 *Permanent stretch*

Non-elastic, non-recoverable extension.

B-4 MATERIAL

B-4.1 Steel wire used in chord construction may be carbon or alloy steel manufactured to meet the tensile strength properties and durability requirements specified by the CSB manufacturer, or user.

B-4.2 Steel wires or chords may be plated with corrosion reducing materials as required by the CSB manufacturer or user.

B-4.3 Elastomeric casing material may be polyurethane or other suitable material which meets the durability, flexibility and traction requirements specified by the CSB manufacturer or user.

B-5 CSB PROPERTIES AND TOLERANCES

B-5.1 Classification

CSB shall be classified by the width and thickness, number of chords, chord diameter, and casing material.

B-5.2 Chord Core

Chords should normally be constructed with a steel core unless specified otherwise. Other cores should be the subject of agreement between the supplier and the purchaser.

B-5.3 CSB Grade

Belt grade shall be based on the minimum breaking load expected in a tensile test.

B-5.4 Chord Lay

The chord lay shall be specified between the purchaser and the manufacturer.

B-5.5 CSB Mass

The belt mass shall be specified in kg/m by the manufacturer.

B-5.6 Belt Length

The actual length of belt supplied expressed in metres shall be specified by the manufacturers subject to tolerances agreed upon by the manufacturer and the purchaser.

B-5.7 Dimensional tolerance of the CSB shall be specified between the purchaser and the manufacturer.

B-6 TESTING AND COMPLIANCE

B-6.1 General

Coated steel belts manufactured in accordance with this standard, where applicable, shall be capable of meeting all the appropriate requirements as specified in **B-5**. The manufacturer shall be able to demonstrate compliance with this standard by either :

a) Testing each production length in accordance with **B-5**, or

b) Where the rope manufacturer operates a quality assurance system complying with ISO 9002 and independently verified by an approved body, sampling tests may be undertaken to verify compliance with requirements. The sampling programme shall meet the following minimum requirements:

   1) For each size and grade of a given CSB construction the manufacturer shall be able to present evidence from testing of at least three production lengths representing the current design. The purpose of these tests is to prove the design, materials and methods manufacture.

   2) Future production lengths shall be deemed to comply when,

      i) Manufacturer has successfully completed the tests in **B-1**; and

      ii) Periodic breaking force tests are successfully completed from a sample of production lengths in accordance with the following :

      For classes, grades and breaking forces as specified in the appropriate part of this specification, a sample for breaking force testing shall be taken from a minimum of every twentieth production length.

B-7 LIFT CYCLE

B-7.1 Replacement Due to Damage

The CSB shall be replaced when load carrying chords are damaged by an exterior source. Damage to the elastomeric molded casing is not a requirement for replacement, as long as load carrying strands have not been severed.

B-7.2 Replacement Due to Wear

Replacement due to wear shall be considered in one of two categories: normal wear of the CSB elastomeric casings and fatigue limit of the load carrying strands. If any one belt is replaced due to wear, the complete set of similarly utilized belts on that elevator shall be replaced.

B-7.2.1 *Elastomeric Molded Casing Wear*

The CSB shall be replaced if the elastomeric casing, through wear or damage, results in any single strand of any chord being exposed to wear.

B-7.2.2 *Fatigue Life Limit*

The CSB shall be replaced if the fatigue limit is reached.

The fatigue life limit shall be established by one of the following methods:

B-7.2.2.1 The specification of a cycles of use based criterion for retirement of the CSB's specific to the application, and based upon test data.

B-7.2.2.2 The specification of a time-period of use based criterion for retirement of the CSB's. Such a time period shall be based upon cycles of operation and load conditions specific to the application and based upon test data.

B-7.2.2.3 The criteria for retirement of the CSB shall be based upon a monitoring measurement or inspection method, which is capable of determining the condition of the steel chords. This method may be continuous or periodically applied.

B-7.2.2.4 A combined method using cycle-based (*see* **B-7.2.2.1**) or time-based (*see* **B-7.2.2.2**) retirement criteria combined with a monitoring, measurement, and inspection method (*see* **B-7.2.2.3**) shall be permitted. The criteria shall be based upon test data.

B-7.2.2.5 The lift manufacturer shall establish the fatigue limit (in terms of cycles, time, monitoring, measurement), to ensure that the residual strength of the CSB is not less than 60 percent of the minimum breaking strength.

B-7.2.2.6 The method of fatigue limit determination shall be indicated on a belt identification tag, on the belt itself, or other visible place in close proximity to the terminiations.

B-7.2.2.7 When a continuous operating fatigue monitoring systems is installed, a self-test or automatic diagnostic indication shall be provided as part of the fatigue monitoring system. Should the system become inoperative, the lift shall not be permitted to re-start after a normal stop at the designated landing.

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