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मानक

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IS 14418 (1996): Bulk Handling Equipment - Ship Loader - Rail Mounted - Design, Manufacture and Erection - Code of Practice [MED 7: Material Handling Systems and Equipment]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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डिजाइन, निर्माण और स्थापन — रीति संहिता

Indian Standard

**BULK HANDLING EQUIPMENT — SHIP
LOADER — RAIL MOUNTED — DESIGN,
MANUFACTURE AND ERECTION —
CODE OF PRACTICE**

ICS 53.040 : 53.080

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

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Bulk Handling Systems and Equipment Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

Ship loaders consist of a system of belt conveyors and extendable boom which extends up to the complete width of the ship/bulk carrier. These loaders are used for loading ships with loose bulk materials such as ores, coal, etc. These machines are complementary to ship unloaders covered by IS 13082 (Part 1) : 1991 'Bulk handling equipment — Ship unloader — Gantry mounted grab type — Code of practice for design, manufacture and erection : Part 1 Mechanical and structural requirements', IS 13082 (Part 2) : 1991 'Bulk handling equipment — Ship unloader — Gantry mounted grab type — Code of practice for design, manufacture and erection : Part 2 Electro-mechanical requirements' and IS 13082 (Part 3) : 1991 'Bulk handling equipment — Ship unloader — Gantry mounted grab type — Code of practice for design, manufacture and erection : Part 3 Information to be supplied by the purchaser and the manufacturer'.

This standard on ship loaders has been formulated to cover the mechanical, structural and electrical requirements. Information that is required to be exchanged between purchaser and manufacturer or supplier for a proper design or selection of the ship loader is covered in IS 13685 (Part 1) : 1993 'Bulk handling equipment — Ship loader — Data sheet for selection : Part 1 Information to be supplied by the purchaser' and IS 13685 (Part 2) : 1993 'Bulk handling equipment — Ship loader — Data sheet for selection: Part 2 Information to be supplied by the manufacturer/supplier'.

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.

Indian Standard

BULK HANDLING EQUIPMENT — SHIP LOADER — RAIL MOUNTED — DESIGN, MANUFACTURE AND ERECTION — CODE OF PRACTICE

1 SCOPE

This standard covers mechanical, structural, electrical, inspection and testing requirements relating to the design, manufacture and erection of rail mounted ship loader.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

SECTION 1 MECHANICAL AND STRUCTURAL REQUIREMENTS

3 DESIGN REQUIREMENTS OF SHIP LOADER MECHANISM

3.1 General

3.1.1 The main construction of ship loader consists of:

- a) Drive mechanism;
 - 1) Gantry long travel,
 - 2) Boom cross travel,
 - 3) Boom conveyor,
 - 4) Boom luffing,
 - 5) Rail clamping and
 - 6) Cable reeling drum (CRD).
- b) Machinery house;
- c) Gantry;
- d) Tower structure/boom;
- e) Boom locking arrangement;
- f) Tripper car;
- g) Discharge mechanism;
- h) Operator's cabin;
- j) Communication and controls; and
- k) Auxiliary and accessories;
 - 1) Dust control system, and
 - 2) Counterweight.

3.1.2 The ship loader shall be designed to take care of main, additional and special loads in accordance with IS 13148 : 1991.

3.1.3 The ship loader shall be designed and manufactured to take care of the variations in the height of deck above water level for the specified parameters and tidal variations.

3.1.4 The material of construction of the various parts of the loader shall be suitable to handle the material specified and also corrosive conditions existing in port areas.

3.1.5 Safety Against Overturning

The safety against overturning shall be in accordance with 11 of IS 13148 : 1991.

3.1.6 Safety Against Drifting

Safety against drifting shall be in accordance with 12 of IS 13148 : 1991.

3.1.7 Safety Against Movement Due to the Wind

Independent of the stability against overturning, a check shall be made that the ship loader cannot be set in motion by maximum wind increased by 10 percent. This check shall be carried out, assuming a coefficient of friction equal to 0.14 for braked wheels and a resistance to rolling of 35 N/10 kN for unbraked wheels mounted on anti-friction bearings or of 100 N/10 kN for bushed wheels. For the design of clamps, the coefficient of friction between the clamps and the rails shall be taken as 0.25. Local push button stations shall be provided near all drives for repair and maintenance.

3.2 Operating Requirements

3.2.1 Where so specified/required, the operation of the various controls shall be automatic/semi-automatic/manual. Programmable logic controls (PLC) are recommended for automatic and semi-automatic mode of operation. However, in all cases manual override facility shall be provided. All operations of the ship loader including its long travel shall be controlled from the operator's cabin,

3.2.2 The operator's cabin shall be pressurized so as to prevent ingress of dust for which a minimum water pressure of 5 mm water gauge shall be maintained inside the cabin. Keeping in view operator's comfort, 15 air changes per hour shall be provided inside the cabin.

3.2.3 Dust control system shall be provided so that the dust exit to atmosphere shall not exceed

150 mg/m³ or the maximum statutory provisions for pollution control whichever is less. The dust so collected shall be fed back to the conveyor system of the ship loader.

3.2.4 In case of wind velocity exceeding 72 km/h, an audio-visual signal shall be given by the anemometer. At 90 km/h, the total power shall be cut off and automatically, the hydraulic rail clamps along with brakes shall get operated and applied to all motions.

3.2.5 All limit switches shall be provided with additional back up switches and all brakes shall be fail safe type.

3.2.6 Provision shall be made to have two way communication between the ship loader operator and central control room. If so specified, suitable communication system shall also be provided between the ship loader operator and local personnel.

3.2.7 Smoke/heat detectors and fire extinguishers shall be provided at suitable locations.

3.2.8 Adequate illumination shall be provided near all drives, working/maintenance area of the machine, material discharge points, MCC rooms, platforms and walkways, staircases, ladders, etc, to enable operation/maintenance of the equipment. Sufficient number of emergency lights shall be provided at control room, exit points, ladders, etc, so that during power failure essential activities like switching off the controls and exit of personnel is possible.

4 DRIVE MECHANISM

4.1 Long Travel

4.1.1 The ship loader shall be carried on double flanged track wheels arranged for uniform distribution of loads. The travel motion shall comprise requisite number of motors, suitably synchronized. Each corner of the ship loader shall be provided with resilient buffers to absorb the impact.

4.1.2 Safety stops shall be fitted on the rail tracks to limit the travel in addition to limit switches provided.

4.1.3 Minimum 50 percent of wheels in each wheel bogie shall be driven. Rail sweeps to clear rails shall be provided in front of outer wheels. Buffers shall be provided on both sides of the carriage.

4.1.4 Jacking pads shall be provided for removal and changing of the wheels.

4.1.5 The rail gauge shall be decided after taking into consideration the technical parameters, design and the suitability of the machine.

4.2 Boom Cross Travel

Trolley for boom cross travel shall be of robust design and mounted on wheels with antifriction bearings. Suitable take-up device shall be provided for keeping the rope in tension in case of rope driven mechanism. Alternatively, self driven type trolley may be provided. The trolley frame shall be fitted with drop stop to prevent damage in the event of axle failure. Resilient buffers shall be provided to each corner of the trolley arranged to engage with stops attached to boom.

4.3 Boom Luffing

The luffing of the cantilever boom shall be with the help of winches/hoists/hydraulic mechanism. Suitable slow speed devices shall be provided during starting and also just before the boom is latched automatically through a mechanical device. A positive limiting device shall be provided such that the luffing movement of the boom shall be possible only when the trolley and the operator's cabin are brought to the predetermined positions beyond the hinge point inside the tower.

4.4 Operator's Cabin

4.4.1 Operator's cabin with all necessary controls for performing the various operations shall be located in such a manner as to ensure complete view of the operations. Equalizing arrangements, if required, for cabin may be gravity hanging type or hydraulically operated.

4.4.2 The cabin shall be of adequate size to permit entry of and house all the required control equipment and may contain ample room for its adjustment and repair.

4.4.2.1 Control facilities for the following shall be provided in the cabin:

- a) Loader travel (additional facility shall be provided to carry out operations from the wharf also)
- b) Trolley travel
- c) Cabin lighting
- d) Dust control system
- e) An emergency stop button to switch 'off' all loader motions. This shall not interrupt power to the auxiliary circuits, lighting, signals, etc.

4.4.3 Indicators and alarm for main supply, control supply, motions, wind pressure, phase failure, etc, shall be provided in the operator's cabin.

4.4.4 The cabin shall be provided with glazed windows on all sides to give operator an unobstructed view of the operations and for moving the ship loader tower. Electrically operated wipers for the

glass windows shall be provided to improve visibility during rains.

4.4.5 The cabin shall be furnished with sufficient facilities for comfortable seating of the operator with height adjustment. The cab shall be fully insulated and shall be equipped with wall mounted electric motor driven ventilating fan with gravity type louvers. (See also 3.2.2 and 8.1).

4.4.6 A signal horn controlled from the operator's cabin shall also be provided on the stacker.

5 GENERAL REQUIREMENTS

5.1 A machinery house accommodating drive mechanisms for operating trolley travel, boom luffing and electrical equipment like switch gears, motor control centre, transformer, etc, shall be provided. Adequate space for maintenance and also maintenance facilities like hoist shall be provided inside machinery house.

5.2 Wire Ropes and Rope Drums

Wire ropes shall conform to IS 2266 : 1989 and shall be of best plough steel. Factor of safety shall be as per IS 3177 : 1977. Rope drums and sheaves shall conform to the requirements laid down in IS 3177 : 1977.

5.3 Bearings

All bearings shall be protected against dust and grit. Allowance shall be made for impact and side thrust. Wherever necessary spherical seatings and separate thrust bearings of suitable dimensions shall be used. Antifriction bearing used shall have minimum life of 50 000 working hours.

5.4 Coupling

Flexible couplings shall be of steel or cast iron of suitable grade to withstand transmission of maximum torque developed and shall be sized/selected accordingly. For boom conveyor, high speed coupling shall be fluid coupling in case of motor rating of 30 kW and above.

5.5 Shafts

5.5.1 Shafts and axles shall have sufficient strength, rigidity and adequate bearing surfaces. Shafts subjected to cyclic loading shall be designed for fatigue life also.

5.5.2 All shafts shall be made of carbon or alloy steel. Keyways and splines shall conform to relevant Indian Standards.

5.6 Gears and Gearboxes

Gears in power operated motion shall be machine cut/ground and shall conform to relevant Indian

Standards. Gear boxes shall have built in lubrication system either splash or force fed type.

5.7 Track Wheels

5.7.1 Track wheels may have cylindrical or tapered (conical) treads, double flanged or with any other means as and where necessary, to guide the ship loader effectively and to prevent derailment. The wheels shall be mounted in such a manner as to facilitate removal and replacement.

5.7.2 The track wheels shall be of steel (cast or forged) or have steel tyres shrunk on and registered. The steel of track wheels shall not contain more than 0.060 percent either of sulphur or of phosphorus. The wheel shall be suitably hardened.

5.7.3 Wheel Size

5.7.3.1 To determine the size of a rail wheel, the following checks shall be made :

- That it is capable of withstanding the maximum transverse and vertical load to which it shall be subjected, and
- That it shall allow the appliance to perform its normal duty without abnormal wear.

5.7.3.2 Diameter of wheels

The tread diameters of wheels shall preferably be standardized to sizes specified in IS 1136 : 1990 commencing at 150 mm, in order of preference specified therein.

5.7.3.3 The minimum tread diameter of the wheel may be calculated from the formula given below :

$$D = \frac{2W}{a}$$

where

D = tread diameter of wheel in mm,

W = wheel load in kg, and

a = full width of rail head (face-to-face) including radii in mm.

5.7.4 Flanges

The dimensions of flanges of track wheels shall be not less than the values given in Table 1. The thickness of flanges of non-guiding wheels if flanged may be less than the values given in Table 1 as may be determined by the ship loader manufacturer.

5.8 Bolts, Nuts, Screws and Washers

5.8.1 All bolts and set screws in rotating parts shall be locked. Bolts in tension shall be avoided wherever possible.

5.8.2 Tapered washers and tapered pads shall be provided on underside of steel sections with tapered flanges and shall be tack welded in place.

5.8.3 All bolts and nuts shall preferably be in accordance with IS 1364 (in five parts) and IS 1367 (in eighteen parts). Black bolts and nuts shall not be used. Alternatively, friction grip fitted bolts may be used where necessary for proper assembly.

5.8.4 Washers shall conform to IS 2016 : 1967, IS 5372 : 1975 and IS 5374 : 1975 as appropriate.

Table 1 Flange Dimensions
(Clause 5.7.4)

All dimensions in millimetres.

Diameter of Wheels	Depth of Flange	Thickness of Guiding Wheel at Flange Base
Up to and including 300	15	15
Over 300 and including 500	20	20
Over 500 and including 1 000	25	25
Over 1 000	30	30

5.9 Brakes, Rail Clamps and Anchors

5.9.1 Electro-mechanical (electro-magnetic)/electro-hydraulic brakes of adequate capacity shall be provided for all motions/motors in addition to emergency brakes for hoist hold and hydraulic rail clamps. All brakes shall be of fail safe type. Smooth braking shall be ensured for hoisting and trolley travel.

5.9.2 Rail clamps shall be provided and they shall be capable of holding the ship loader in position during maximum wind velocity under storm conditions.

5.9.2.1 The brakes shall come in automatic operation from the anemometer.

5.9.2.2 For design of clamps, coefficient of friction between the clamp and rail shall be taken as 0.25.

5.9.2.3 Electrical rail clamps shall automatically clamp whenever the power supply to the LT motors of the ship loader is cut off.

5.9.3 In addition, anchoring device shall be provided to positively arrest the travelling motion of the ship loader under storm conditions.

5.9.4 In case of winch operated luffing arrangement, boom luffing brakes shall be capable of taking 150 percent of respective full load motor torque.

6 GANTRY AND TOWER STRUCTURE

6.1 The gantry and tower structure shall be designed to take care of the operational requirements including ease of access and maintenance.

The members of the structure shall be designed in accordance with IS 13148 : 1991 to take care of prevalent environment conditions.

6.2 Safe means of access shall be provided to the operator's cabin and to every place where any person engaged on the inspection, repair and lubrication of the ship loader shall be called upon to work. Adequate hand holds and footholds shall be provided where necessary. Hand holds and access openings shall be as per relevant Indian Standard where available.

6.3 Every platform shall be securely fenced with double tiered guard rails having a minimum height of 1.1 m and toe boards, unless parts of the ship loader structure provide safety. The platform shall be of sufficient width to enable normal maintenance work to be carried out safely. On bridge platform, which shall not be less than 0.75 m in width, the hand rails shall be provided along the full length of the outer edge. A toe plate shall be provided on all platforms to prevent rolling down of materials from platforms.

6.4 Ladders

Sides of the ladders shall extend to a reasonable distance above the platforms or other reliable hand holds shall be provided. Ladders shall, if possible, slope forward. Vertical ladders, exceeding 3 m in length, shall be provided with safety cages.

7. DISCHARGE MECHANISM

7.1 Discharge chute shall be provided with required liner plates.

7.2 Adequate care shall be taken to avoid fouling of the discharge chute with skirt board provided on the boom conveyor during luffing motion.

7.3 If required, suitable liner(s) shall be provided for handling abrasive material inside the discharge chute.

8 PRESSURIZATION AND DUST COLLECTION

8.1 Pressurization

Pressuring system shall be provided to create a minimum pressure of 5 mm water gauge and 15 air changes per hour in the machinery house and operator's cabin. All electronic controls provided shall be housed in an airconditioned space.

8.2 Dust Control System

8.2.1 The dust control system shall be capable of collecting effectively the dust which is raised from the receiving chute but excluding the discharge point of the boom conveyor. Facility shall be

provided to convey the dust collected to the material discharge point.

8.2.2 Maximum permissible dust loading from the system shall be not more than 150 mg/m^3 or the minimum statutory provisions for pollution control whichever is less. Protection against fire hazard shall be provided for the dust collection system when handling hazardous materials.

9 SAFETY REQUIREMENTS

9.1 The ship loaders shall comply with the relevant safety regulations under the Factories Act 1948, Indian Electricity Rules and other Statutory Rules, Regulations, Acts, etc, as applicable.

9.2 Following essential safety features shall be specifically provided:

- a) Fire extinguisher and smoke detector alarm system,
- b) Buffers,
- c) Limit switches,
- d) Anemometer,
- e) Safety interlocking,
- f) Rail clamps and anchoring devices,
- g) Audio visual alarm, and
- h) Guards and cages.

10 LUBRICATION

10.1 Provision shall be made for lubricating all bearings which shall be easily accessible from the working platforms of the loader. Centralized lubrication system conforming to IS 8593 (in three parts) shall be preferred.

10.2 If deemed necessary, provision shall be made at the bearings to vent excess lubricant pressure.

10.3 Lubricating nipples, pipes and adapters shall generally comply with relevant Indian Standards.

10.4 A lubricating chart shall be provided indicating all the lubricating points, the type of lubricant and recommended frequency of lubrication.

11 POWER FEEDING ARRANGEMENTS

11.1 Power feeding to the ship loaders shall be through cable reeling drums (CRD) with trailing cable arrangements. Separate drums for power and control cables shall be provided. The feeding of the cables to CRD shall be properly guided through cable guides to prevent the trailing cable from falling on the track rails or getting entangled with fixed structures. Cable tray may be provided below the CRD along its path to prevent cable lying on the ground. However, the provision of cables tray system shall be optional and is not required in case level ground/floor is available below CRD for each cable to lie.

11.2 Safety limit switches/devices to prevent over stretching of cable at the feeding point on the ground shall be provided.

12 WEATHER PROTECTION AND PAINTING

12.1 All electrical, structural and mechanical equipment shall be adequately protected from weather. All weatherproof covers shall be easily removable.

12.2 The ship loaders work in the corrosive atmosphere prevailing near sea-shores as well as in the atmosphere containing dust particles of the material. The ship loader shall be provided with two coats of anti-corrosive primer after suitable surface preparation and final two coats of finish paint to suit the operating and environmental conditions as specified by the purchaser.

13 LOAD TESTS

13.1 Prior to being placed in service, the ship loader shall be tested under overload conditions as given in 13.1.1 and 13.1.2.

13.1.1 *Dynamic Test*

The dynamic test shall be carried out with a load of 120 percent of the safe working load. All motions shall be carefully operated in turn, without checking speeds or temperature rises in the motors.

13.1.2 *Static Test*

The static test shall be carried out with a load equal to 140 percent of the safe working load. This test shall be carried out under still conditions and consists of hoisting the safe working load to small distance above the ground and then adding the required surplus without shock.

NOTES

1) The values given for these test loads represent minimum requirements. Where Legislation/Rules or any other statutory Acts or Regulations call for higher values, these shall be complied with.

2) When making these tests, it is customary to measure the deflection of the structure of a loader. In case, the user wishes to impose a deflection limit, he shall specify this in his call for tender/enquiry.

13.2 *Acceptable Tolerances*

Acceptable tolerances on trolleys, and tracks shall be as given in 13.2.1 to 13.2.13.

13.2.1 The trolley rail-centre distance 's' shall not differ from the nominal dimension by more than $\pm 3 \text{ mm}$ as shown in Fig. 1.

13.2.2 The difference in height of two opposite points of the trolley track perpendicular to the travel direction of the trolley shall not exceed 0.15 percent of the trolley rail-centre distance, with a maximum of 10 mm as shown in Fig. 2.

13.2.3 Trolley rails shall be laid in a way that the running surface perpendicular to the direction of the rail is horizontal and that the greatest unevenness of the bearing surface is not more than ± 3 mm for rail-centres up to 3 m as shown in Fig. 3.

13.2.4 The centre of the trolley rail shall not diverge from the centre of the rail girder web by

more than half the thickness of the rail girder web as shown in Fig. 4.

13.2.5 For lateral straightness of trolley rail, the centre axis of the trolley rail shall not diverge from the theoretical centre axis of the rail by more than ± 1.0 mm on a rail length of 2 m. There shall be no misalignments at rail joints (see Fig. 5).

13.2.6 The axis of the wheel axle bores shall be within an angular deviation in the horizontal plane of ± 0.04 percent from its theoretical position (see Fig. 6).

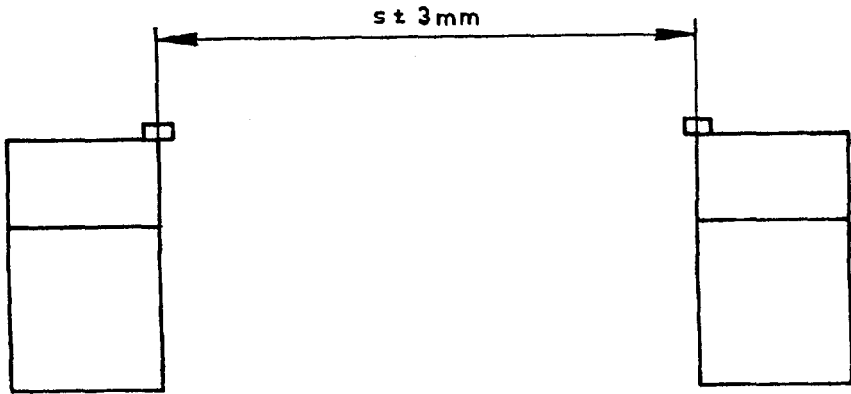


FIG. 1 TROLLEY RAIL DISTANCE

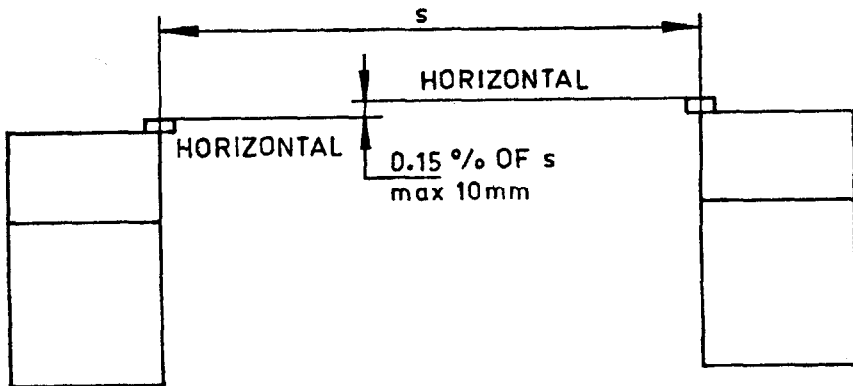


FIG. 2 HEIGHT DIFFERENCE OF TROLLEY

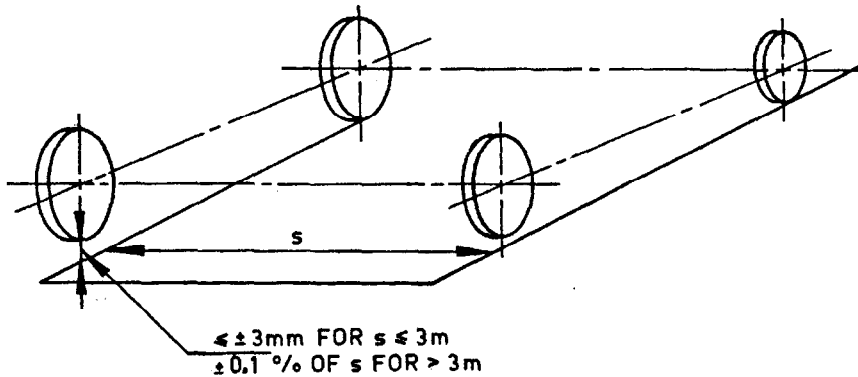


FIG. 3 RUNNING SURFACE OF TROLLEY RAILS

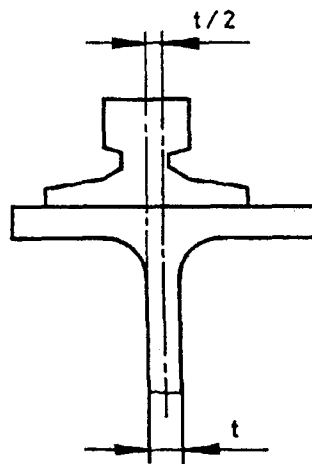


FIG. 4 CENTRE OF TROLLEY RAIL

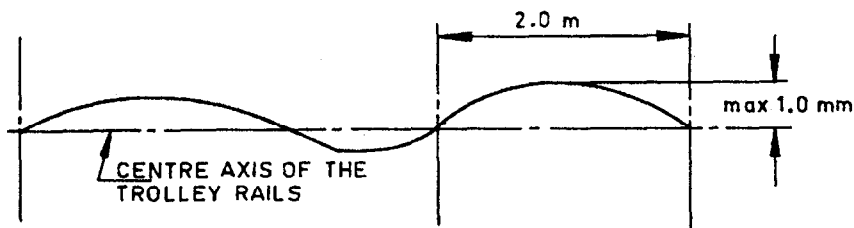


FIG. 5 LATERAL STRAIGHTNESS OF TROLLEY RAIL

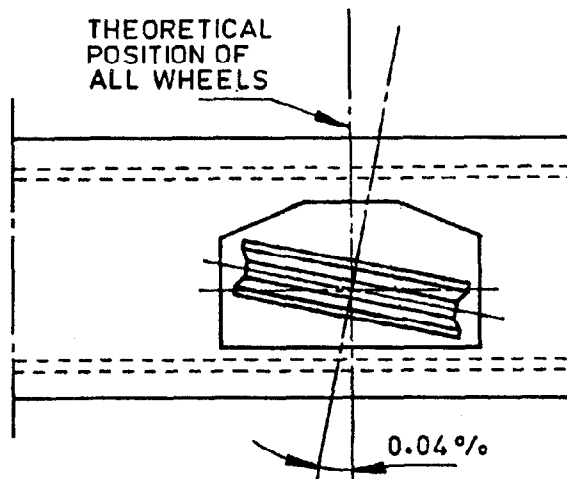


FIG. 6 AXIS OF WHEEL AXLE BORES

13.2.7 The axle bores of the wheels opposite to each other and if wheels are mounted in bogies, the axis of the bogies pins of the unwrapped trolley and unloader bridge shall have an alignment divergence in the vertical plane, less than 0.15 percent, maximum 2 mm of the trolley wheel centre distance (see Fig. 7).

13.2.8 The centres of wheels rolling on a common rail shall not diverge more than ± 1 mm from the rail centre (see Fig. 8).

13.2.8.1 For bushed wheels the above tolerances apply with the wheels in a central position between the wearing plates at either side of the wheel boss.

13.2.9 If horizontal guide rollers are used, the centre of the distance between guide rollers at one corner shall not deviate more than ± 1 mm from the centre axis of the rail (see Fig. 9).

13.2.10 The diameter tolerance of the wheel shall correspond to 'h9' as per IS 919 (Part 1) : 1993.

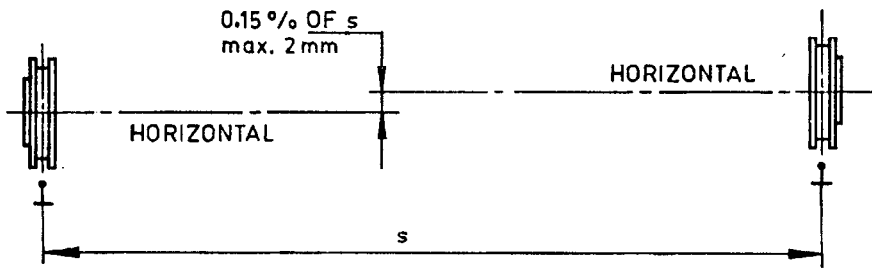


FIG. 7 AXLE BORES OF WHEELS

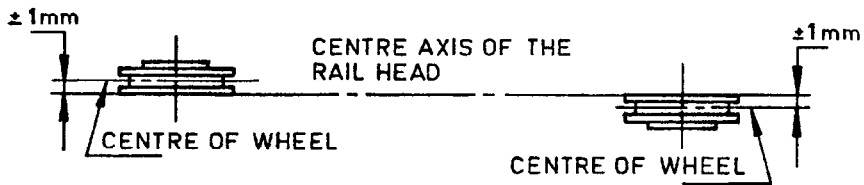


FIG. 8 CENTRES OF WHEELS OF SAME RAIL

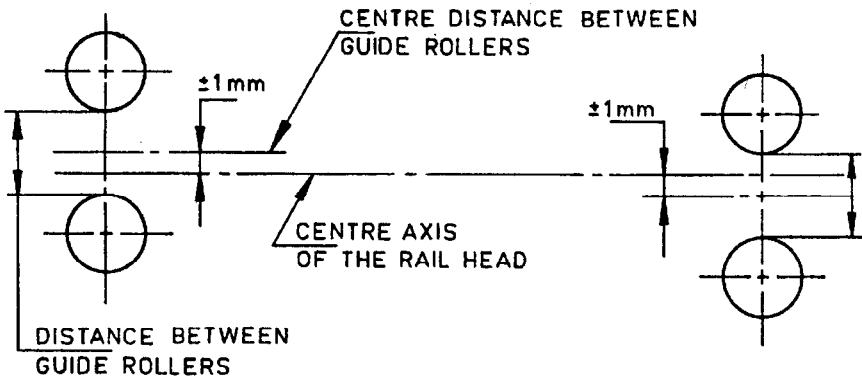


FIG. 9 CENTRE DISTANCE BETWEEN GUIDE ROLLERS

13.2.10.1 If runner wheel speeds are synchronized by an electrical shaft, tighter tolerances may be required. These shall have to be determined from case-to-case.

13.2.10.2 The above tolerance apply to non-driven wheels also as the wheels shall have to be interchangeable.

13.2.11 Recommended tolerances for loader tracks are given below. These tolerances apply to new loader tracks. If, in the course of use, these tolerances are exceeded by 20 percent, the track shall be re-aligned. In case the travelling behaviour is noticeably deteriorating, it may be necessary to re-align the track; even if the tolerance excess has not reached 20 percent.

The greatest divergence 'Δ s' from the span 's' in metres is:

$$\text{for } s \leq 15 \text{ m : } \Delta s = \pm 3 \text{ mm}$$

$$\text{for } s < 15 \text{ m : } \Delta s = \pm [3 + 0.25 (s - 15)] \text{ mm} \\ (\text{maximum } \pm 25 \text{ mm}).$$

13.2.11.1 If horizontal guide rollers are provided on one rail only, the tolerances for the other rail only (rail without guide rollers) may be increased to three times the above values, but shall not exceed 25 mm.

13.2.11.2 It is assumed that with the trolley positioned in the centre of the span, the deflection of both rail tracks shall be approximately equal.

13.2.11.3 The greatest permissible tolerance of the upper edge of the rail shall be ± 10 mm from the theoretical height position. The theoretical height is either the horizontal position or, if applicable, the theoretical camber curve. The height position of the two rails may show a divergence of 10 mm. The curvature in a longitudinal direction may, at each point of a measured length of 2 m, not exceed a rise of ± 2 mm.

13.2.12 The inclination of the rail rolling surface shall not exceed the following values as compared with the theoretical position (see Fig. 10):

Longitudinally : 0.3%

Laterally : 0.3%

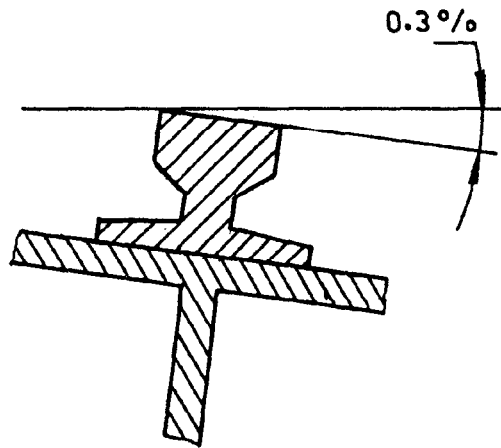


FIG. 10 INCLINATION OF RAIL

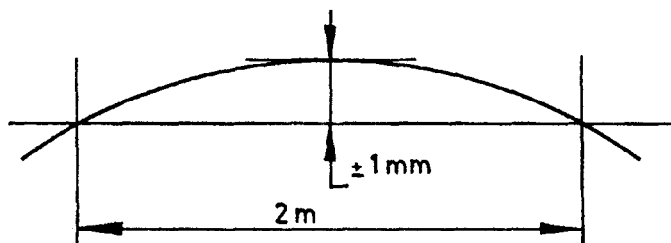


FIG. 11 TOLERANCE ON TOTAL LENGTH OF RAIL

13.2.13 For the total length of rail, the maximum lateral tolerance from a straight line shall be ± 10 mm. The curvature at the longitudinal rail axis in a horizontal direction shall not exceed a lateral deviation of ± 1 mm measured at 2 m rail length (see Fig. 11).

13.2.13.1 For loaders guided on both sides by horizontal rollers, the above values shall be valid for the rail surfaces of the horizontal rollers.

13.2.13.2 For loaders guided on one rail only the requirement for the straightness of the non-guiding rail may be lowered.

13.2.14 For the values in 13.2.1 to 13.2.13, no account has been taken for misalignment at the rail joints. It is recommended to use welded rail joints.

SECTION 2 ELECTRICAL REQUIREMENTS

14 GENERAL

14.1 The loader shall be complete with all electrical accessories required for its safe, smooth and efficient operation.

14.2 Only non-hygroscopic materials shall be used for insulation.

14.3 Electrical system offered shall be suitable for the power supply system fault level at that point.

14.4 Electrical installation work shall be carried out through licensed electrical contractors, holding valid contractor's licenses issued by the concerned Statutory Authority and also conforming to relevant standards of individual electricals located in the machine.

14.5 All electricals shall be mounted on anti-vibration pads.

15 ENCLOSURES

15.1 All electrical equipment shall be properly enclosed or protected to suit the environmental conditions and to prevent inadvertent or accidental contact.

15.2 All enclosures shall preferably be of cast iron or cast aluminium. Wherever sheet steel has to be used, the thickness of the metal shall not be less than 2 mm where enclosures are housed inside a covered area. All exposed outside panels shall have a metal thickness of not less than 3.15 mm.

15.2.1 All joints in enclosures shall be made dust-proof by gaskets of high quality non-deteriorating rubber or other suitable material.

15.3 Bare conductors, if used as bus wires, shall be located so as to prevent any form of accidental contact. The execution shall ensure complete safety

and wherever necessary, metallic screens shall be employed.

15.4 Flame proof/increased safety enclosures shall be provided for electrical equipments wherever required.

15.5 Wherever it is necessary for an electrical equipment to be adjusted or inspected while in service, necessary clearances from live parts may be provided to ensure safety in operation.

15.6 All enclosures of electrical equipments shall be given two coats of anti-corrosive epoxy paint over two coats of primer suitable for epoxy.

15.7 Various control gears like contactors, relays, control transformers, etc, shall be housed in dust proof, damp proof and vermin proof protective panels having doors interlocked with the supply control switches. Space heaters shall be provided for the panels.

16 POWER SUPPLY ARRANGEMENTS

16.1 Power supply shall be controlled by a circuit breaker from which power shall be taken to the loader through suitable collector systems such as cable reeling drum, etc.

16.2 It shall be possible to trip the circuit breaker from the machinery house of the loader.

16.3 Circuit breaker to isolate the main supply to the loader shall be provided. It shall be possible to switch off this breaker from the operator's cabin.

16.4 A plug and socket arrangement shall be provided to connect up the loader's current collecting arrangements (power and control).

16.4.1 In case of plug and socket arrangement, power socket shall be interlocked so that the plug can be withdrawn only when the circuit breaker/isolating switch is 'OFF'.

16.5 External control links shall be taken out of the loader using a current collection system similar to that for power. This system may carry the communication links also.

17 POWER TRANSFORMERS

Power transformers if provided shall be dry type. These shall have overload, voltage and temperature protection.

18 MOTORS

18.1 To select a motor, the following shall be established:

- a) The maximum torque required to produce motion in the most unfavourable case.
- b) That it shall allow the loader to perform its normal duty without abnormal wear.

18.2 AC motors shall be of totally enclosed, fan-cooled weather protected, hose-proof design (IP-55 degree of protection) with at least class B insulation and shall be suitable for crane duty.

18.2.1 AC motors shall have overload and short circuit protection.

18.3 DC motors shall have at least IP-23 enclosure for indoor duty and IP-55 enclosure for outdoor duty.

18.4 The motor shall have at least the following cyclic duty factors:

Trolley travel	60 percent
Other motions	40 percent

18.4.1 Motors shall have built-in thermistors with alarm, and shall have space heating elements either heating or space heater elements as specified.

18.5 Thyristor drives if provided shall have current limitation, speed limitation, overload protection, short circuit protection and fuse protection and preferably rated for Class 4 duty.

19 RESISTORS

Resistors if provided, shall be intermittent rated for Class 4 duty and shall be suitable for the climatic conditions and the corrosive atmosphere described elsewhere. Stainless steel resistance grids shall be preferred.

20 CABLES

20.1 All power cables shall be PVC insulated, armoured and PVC sheathed, flexible type preferably with copper conductor. However trailing cables shall have copper conductors only. All control cables shall be 2.5 mm² copper.

20.2 Power and control cables shall be protected with HRC fuses/circuit breakers.

20.3 The sizes of the cables shall be so chosen that they are rated to carry the full load current continuously after allowing for necessary derating factors for the conditions of installation, and also so that the voltage drop in cables shall not exceed 3 percent during running.

20.4 All cables shall be neatly clamped at suitable intervals.

20.5 All cables shall be terminated by suitable cable glands.

20.6 Metallic conduits shall be provided wherever necessary for the protection of the cables.

20.7 Power and control cables to the operator's cabin shall be provided with a loop to take care of movement of cabin during luff operations.

20.8 Electrical circuits may be printed/painted/pasted at the inside of control panel covers.

21 EARTHING

21.1 The loader shall be earthed through shoes rubbing on the rails. In addition, the connection between the circuit breaker and the loader shall have a fourth conductor to be used as an earth connection. The earth connection shall be linked to the earth connection of the main circuit breaker.

21.2 Double earthing shall be provided for all equipments.

22 LIGHTING

22.1 The loader shall be provided with suitable illumination to ensure good lighting at all places.

22.2 Flood lights shall be provided at the following points:

- a) On the apron for the operator to see the operation during the night.
- b) In front and rear portions of the loader to properly light the tracks during loader travel in the night.

22.3 All lighting circuits shall be protected with HRC fuses and shall be controlled by one main switch-fuse in addition to separate circuit control switches.

22.4 Battery operated emergency lights shall be provided at strategic locations. These shall be the automatic type. The light shall automatically come 'ON' when normal power supply fails and shall go 'OFF' automatically when normal supply comes back. The unit shall incorporate a trickle charger for keeping the battery on charge. The battery shall be rated for at least 30 minutes operation.

22.5 Air-craft warning/aviation lights shall be provided on the loader if required by any Statutory Authority for which separate battery units with chargers shall be provided.

22.6 All light fittings shall be mounted on shock absorbers.

22.7 Low voltage (24V) plug socket outlets, with hand lamps and sufficient lengths of cables, shall be provided.

23 CONTROLS

A safe low voltage shall be employed for the controls. This shall be from the secondary winding of an isolating transformer; one terminal of this supply shall be earthed and the contactor and the relay coils shall be connected to this terminal.

24 INTERLOCKS

24.1 Necessary interlocks for the safe and smooth operation of the loader shall be provided.

24.2 'Forward' and 'Reverse' contactors shall be interlocked electrically and preferably mechanically as well.

25 PROTECTION

25.1 In case of wind speed beyond preset level, an audio-visual alarm shall be given in operator's cabin to enable the operator to stop the operation of the machine. If the operation is not stopped, automatic cut-off of power supply shall be effective beyond a preset higher wind speed.

25.2 Shunt and series limit switches shall be provided for all motions. The shunt switch shall operate first and if the motion fails to stop, series limit switch shall act. Additional limit switches shall be provided for long travel, trolley travel, cabin travel, etc.

25.2.1 Instead of shunt and series limit switches, mechanical end-limit switches may be provided. The pre-limit switch shall act first to trip the motor end-limit switch, the breaker on the secondary side of the transformer shall get tripped. For the trolley an additional pre-limit switch shall be provided ahead of the two limit switches mentioned above.

25.3 Phase failure relay shall be provided to trip the main circuit breaker.

25.4 A warning audio alarm shall be given automatically during long travel operation.

26 AIR CONDITIONING

In the interest of long life and reliable operation, electronic components and other components sensitive to temperature, humidity and dust, shall preferably be located in air-conditioned space(s).

27 LIFT

An electrically operated lift is recommended.

28 COMMUNICATION FACILITIES

Inter-communication facility within the loader structure is recommended.

29 AUTOMATION

Where considered essential, automation may be provided to reduce physical and psychological stress of operator. Provision shall be kept for overriding automation.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
919 (Part 1) : 1993	ISO system of limits and fits: Part 1 Basis of tolerances, deviations and fits (<i>second revision</i>)	1367 (Part 5) : 1980	Technical supply conditions for threaded steel fasteners: Part 5 Mechanical properties and test methods for set screws and similar threaded fasteners not under tensile stresses (<i>second revision</i>)
1136 : 1990	Preferred sizes for wrought metal products (<i>first revision</i>)		
1364 (Part 1) : 1992/ ISO 4014 : 1986	Hexagon head bolts, screws and nuts of product grades A and B : Part 1 Hexagon head bolts (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 6) : 1994/ ISO 898-2 : 1992	Technical supply conditions for threaded steel fasteners: Part 6 Mechanical properties and test methods for nuts with specified proof loads (<i>third revision</i>)
1364 (Part 2) : 1992/ ISO 4017 : 1988	Hexagon head bolts, screws and nuts of product grades A and B : Part 2 Hexagon head screws (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 7) : 1980	Technical supply conditions for threaded steel fasteners: Part 7 Mechanical properties and test methods for nuts without specified proof loads (<i>second revision</i>)
1364 (Part 3) : 1992/ ISO 4032 : 1986	Hexagon head bolts, screws and nuts of product grades A and B : Part 3 Hexagon nuts (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 8) : 1992	Technical supply conditions for threaded steel fasteners: Part 8 Mechanical and performance properties for prevailing torque type steel hexagon nuts (<i>second revision</i>)
1364 (Part 4) : 1992/ ISO 4035 : 1986	Hexagon head bolts, screws and nuts of product grades A and B : Part 4 Hexagon thin nuts (chamfered) (size range M1.6 to M64) (<i>third revision</i>)	1367 (Part 9/Sec 1) : 1993/ ISO 6157-1 : 1988	Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities, Section 1 Bolts, screws and studs for general applications (<i>third revision</i>)
1364 (Part 5) : 1992/ ISO 4036 : 1979	Hexagon head bolts, screws and nuts of product grades A and B : Part 5 Hexagon thin nuts (unchamfered) (size range M1.6 to M10) (<i>third revision</i>)	1367 (Part 9/Sec 2) : 1993/ ISO 6157-3 : 1988	Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities, Section 2 Bolts, screws and studs for special applications (<i>third revision</i>)
1367 (Part 1) : 1980	Technical supply conditions for threaded steel fasteners: Part 1 Introduction and general information (<i>second revision</i>)	1367 (Part 10) : 1979	Technical supply conditions for threaded steel fasteners: Part 10 Surface discontinuities on nuts (<i>second revision</i>)
1367 (Part 2) : 1979	Technical supply conditions for threaded steel fasteners: Part 2 Product grades and tolerances (<i>second revision</i>)		
1367 (Part 3) : 1991 ISO 898-1 : 1988	Fasteners — Threaded steel — Technical supply conditions: Part 3 Mechanical properties and test methods for bolts, screws and studs with full loadability (<i>third revision</i>)	1367 (Part 12) : 1981	Technical supply conditions for threaded steel fasteners: Part 12 Phosphate coatings on threaded fasteners (<i>second revision</i>)

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
1367 (Part 13) : 1983	Technical supply conditions for threaded steel fasteners: Part 13 Hot-dip galvanized coatings on threaded fasteners (<i>second revision</i>)	3177 : 1977	Code of practice for overhead travelling cranes and gantry cranes other than steel work cranes
		5372 : 1975	Taper washers for channels (ISMC) (<i>first revision</i>)
1367 (Part 14) : 1984	Technical supply conditions for threaded steel fasteners: Part 14 Stainless steel threaded fasteners (<i>second revision</i>)	5374 : 1975	Taper washers for I-beams (ISMB) (<i>first revision</i>)
		8593 (Part 1) : 1977	Recommendations for centralised lubrication as applied to plant and machinery: Part 1 Oil lubrication
1367 (Part 16) : 1979	Technical supply conditions for threaded steel fasteners: Part 16 Designation system and symbols (<i>second revision</i>)	8593 (Part 2) : 1988	Recommendations for centralised lubrication as applied to plant and machinery: Part 2 Grease lubrication
1367 (Part 18) : 1979	Technical supply conditions for threaded steel fasteners: Part 18 Marking and mode of delivery (<i>second revision</i>)	8593 (Part 3) : 1984	Recommendations for centralised lubrication as applied to plant and machinery: Part 3 Aerosole lubrication
2016 : 1967	Plain washers (<i>first revision</i>)		
2266 : 1989	Steel wire ropes for general engineering purposes (<i>third revision</i>)	13148 : 1991	Bulk handling equipment — Mobile continuous type — Rules for design of structures

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Amendments Issued Since Publication

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