

## **1. Scope.**

This standard covers the design, construction, installation, operation, maintenance and testing of the chair lift system for the transportation of persons in mines.

## **2. Design, construction and safety provisions of the Man riding chair lift system:**

Every part of the system shall be of good construction, suitable material, of adequate strength and free from visible defect and shall be properly maintained. Every Man riding chairlift system and each of the accessories thereof shall so far as is practicable be constructed of non-inflammable material and any inflammable material, if used, shall be shrouded with a suitable non-inflammable covering.

No part of the equipment/ machine (e.g., fan hubs, fan blades) shall be made of light metals or its alloys which causes incendive sparking due to impact or friction.

### **Drive station:**

- 2.1 The drive station shall be firmly connected to a rigid foundation and shall be so designed, constructed and maintained that with the power provided, the transportation of persons can be carried out with ease, regularity and safety.
- 2.2 The drive station consisting of a drive unit, electrical systems, power pack and wire rope etc. shall not be a source of danger to the passengers and chair lift operator. The passenger entrance shall not cross the path of the travel without ensuring proper safety, to avoid any possible accident to the passengers.
- 2.3 A suitable provision shall be made at prime mover or its controls to prevent reverse motion of prime mover.
- 2.4 Drive station shall be fitted with speed indicator at a suitable location for easy monitoring by operator.
- 2.5 Drive station shall be provided with a suitable over speed tripping device.
- 2.6 The chair lift operator shall be located such that he will have clear view of the driving machinery and instrumentation. The controls and communicating devices will be within his reach.
- 2.7 Adequate and suitable type fire extinguishers shall be kept available at the drive station.
- 2.8 A suitable fencing and gate with interlock to stop the system shall be provided at drive station to avoid entry of unauthorized persons.

### **Power pack:**

- 2.9 The Hydraulic power pack shall be consisting of suitable variable displacement hydraulic pump with seals compatible with the fire resistant hydraulic fluid and directly driven by adequately rated electric motor with cooling system.

The following safety features shall be provided in the hydraulic power pack:

- (a) Pressure relief valves to relieve pressure beyond rated working pressure
- (b) Tripping at low oil level
- (c) Tripping on low oil pressure
- (d) Tripping if working oil temperature rises beyond 85°C
- (e) Tripping if oil filter is choked
- (f) Tripping on low booster pressure

- 2.10 The design of power pack shall be such that the speed of the rope can be adjustable from "zero to 3.0 (three) meter/second maximum".
- 2.11 A suitable hydraulic device with locking arrangement shall be provided to regulate the speed of the rope and shall be capable of maintaining the constant speed of the system.
- 2.12 A suitable hydraulic device shall be provided such that the variation of the speed of rope during acceleration or deceleration (start/stop) shall not give any sign of discomfort to the passengers.
- 2.13 An efficient cooling system shall be provided to maintain the hydraulic oil temperature within limits.

**Drive unit and sheave:**

- 2.14 The drive unit shall be made of steel of adequate strength, consisting of drive sheave driven by high torque hydraulic motor and provided with spring applied hydraulically released (SAHR) brake for smooth, efficient and safe operation of the system. The drive unit shall be mounted on robust and rigid base frame made of steel section of adequate strength and suitably fenced.
- 2.15 The diameter of driving sheave shall be not less than 80 times the diameter of wire rope. Drive sheave shall be provided with liner made of bronze and rubber/polyurethane material, having adequate coefficient of friction. The diameter of return sheave shall not be less than the distance between two ropes. Return sheave shall be provided with liner made of rubber/polyurethane material.
- 2.16 The sheave, on which carrying rope is supported, shall be made of carbon steel casting and conforming to IS 1030-1998 or its revised version. They shall be mounted on suitable bearings with proper locking.
- 2.17 The speed of rope shall be maintained constant irrespective of any load conditions. The variation of speed in the most unfavorable conditions shall not exceed  $\pm 5$  percent.
- 2.18 Power to drive sheave shall be stopped automatically when any brake is applied or any tripping device is activated.
- 2.19 The contact angle of the rope on the drive sheave shall be designed such that even in most unfavorable combination of circumstances the required power is transmitted to the rope.
- 2.20 The material specification of sheave are given at **Annexure-A**

**Brakes:**

- 2.21 The system shall be provided with service brake and an emergency brake. Each of these brakes shall be able to ensure the safe stopping of the system under most unfavorable conditions of loading.
- 2.22 The service brake shall be inbuilt in the closed loop hydraulic system consisting of the high torque hydraulic motor and the swash plate type pump. The service brake shall be capable of resisting the outside forces actuated by the loaded chair lift system on the drive sheave.
- 2.23 The emergency brake shall be a spring applied hydraulically released (fail safe type). In case of any failure in the system, springs shall actuate the brake and stop the drive sheave.
- 2.24 The factor of safety of all vital components forming the brakes shall not be less than 3.0 (three).

### **3. Embarking and disembarking stations:**

- 3.1 Embarking and disembarking stations shall be provided at drive station, intermediate station and return stations.
- 3.2 Both Embarking and disembarking stations shall have horizontal gradient and adequate length. It shall be suitable to easily engage and disengage chairs with persons from the rope.
- 3.3 Over travel limit switches shall be provided on either end of run so as to stop the system, if any chair reaches such limits.
- 3.4 Adequate number of stretchers shall be kept available at return/intermediate stations to carry the injured persons comfortably by the chairlift system.
- 3.5 Push button switch with locking arrangement shall be installed at drive station, return station, intermediate stations and at other suitable locations to stop the system completely in case of emergency as well as to facilitate maintenance of the system.

### **4. Chairs:**

- 4.1 The chair shall be ergonomically designed and provided with a cushioning seat (probably with back rest) to give comfort to the passenger(s) throughout the travel period.
- 4.2 A suitable device to prevent backward movement of the chair shall be provided, wherever required.
- 4.3 A secondary gripping provision in the four-roller assembly or any other suitable arrangement shall be provided to avoid uncontrolled movement of chair due to failure of rubber chuck in the four-roller assembly.
- 4.4 Number(s) shall be legibly marked on the chairs and suitably arranged at every station for easy access to the passenger(s).

### **5. Route and profile of the roadway:**

- 5.1 The centre line of the roadway should be straight as far as possible. However, horizontal deflection/ vertical deflection of the travel may be permitted with curve station/deflection pulleys respectively provided that the load on the pulley satisfies the requirements.
- 5.2 The route shall facilitate and allow persons to get down easily from chairs in case of power failure or due to any other reason.
- 5.3 The total load on the rope shall be uniformly distributed all along the rope.
- 5.4 In order to ensure free movement of passengers, the following clearances shall be provided:
  - a. From side : 0.8m (min)
  - b. From top of the chair seat to floor : 1.0 m (Max)
  - c. Centre to centre of rope : 1.2 m (min)
- 5.5 Along the line, the distance between the two paths of travel of rope shall be such as to avoid contact between persons swung by 12 deg. towards one another.
- 5.6 The minimum distance between two persons traveling along the line of path shall not be less than the maximum distance between two consecutive pulley stations. The same shall be ensured by any suitable device or mechanism.
- 5.7 Roof bolt system, wherever adopted, shall withstand a minimum of 7 Tonnes anchorage test.

- 5.8 Gradient of the road way shall be smooth as far as possible and shall not be more than 1 in 4.

**Pulley stations:**

- 5.9 The pulley station / suspension tubes shall be fixed in the roof with suitable roof bolts or to the goal posts with suitable fasteners.
- 5.10 All the pulleys and its liners shall be designed such that chair can pass over the pulleys smoothly without any jerk to passenger(s).
- 5.11 The diameter of the deflection sheaves, used for diverting the rope horizontally for more than  $5^{\circ}$ , shall not be less than 50 times the diameter of wire rope to minimize the flexure loads on the rope.
- 5.12 All pulleys shall be mounted on suitable sealed bearings.

**Rope Guiding:**

- 5.13 The load on rope shall be equally distributed on carrying pulleys by maintaining gradual change in deflection of rope and by maintaining only one person between two pulley stations.
- 5.14 The rope shall be aligned using pressing pulleys such that it shall be in the centre of each carrying pulley.
- 5.15 The depression pulleys shall be provided to align the rope in such a way that the rope shall not leave the line of path.

**Crossing:**

- 5.16 The chair lift system shall not foul or interfere with any other transport system such as conveyors, haulages etc as far as possible. In case of any unavailability of interference, adequate precautions shall be taken to avoid any fouling of one system with the other. A suitable fool-proof system shall be provided at such junctions.

**6. Curve station:**

- 6.1 Curve station shall be designed as per the given angle with suitable deflection pulleys and railing arrangement so that the chair with passenger(s) shall move freely without getting down from the chair in both the travelling directions.
- 6.2 Pulleys are to be provided such that load will be distributed equally. Number of pulleys shall be provided depending upon the angle of the curvature to minimize the flexure loads on the rope and wear and tear of pulleys.
- 6.3 Curve station shall be designed considering passenger(s) safety and convenience. It shall be suitable to easily engage and disengage chairs with passenger(s) from the rope and glide smoothly over the curved rail with rated speed without any jerky moments.
- 6.4 Suitable guards with interlocking shall be provided wherever required, to avoid injuries to persons during maintenance and other works.

**7. Rope Tensioning and Anchoring Device:**

- 7.1 The carrying rope shall be kept under tension at one end by counter weight type or any suitable type of tensioning arrangement.
- 7.2 The tensioning tower in which the counter weights travel (in pit or construction above the ground) shall be protected from water and properly

fenced. The free movement of the counter weight shall be ensured at all times.

- 7.3 The travel of the counter weight shall be determined taking in to account the maximum variation due to the sag of rope.
- 7.4 All the foundations of tensioning device, anchorage clamps etc., be of adequate strength.
- 7.5 Over stretch device (Limit switches) shall be incorporated in the tensioning tower to stop the system in the event of rope stretches beyond the present limit or snapping of the rope.
- 7.6 Scaling arrangement shall be provided on the tensioning tower to indicate/measure the moment of counter weight due to sag of rope.
- 7.7 Limit switch on return pulley shall be provided to trip the system in the event of slackness of the bearing of the pulley.

## **8. Wire Rope:**

- 8.1 The wire rope shall be of approved by Chief Inspector of Mines and shall conform to IS 1855:2003 or its revised version with minimum size of 16mm diameter, construction of stranded 6x7, galvanized, non lubricated and fiber core. The fiber core shall conform to IS 1804:2004 or its revised version.
- 8.2 The minimum breaking load of wire rope shall not be less than ten times the maximum pulling load by the system. The same rope shall be used for tensioning arrangement also by haulage.
- 8.3 Care shall be taken to avoid any twisting or kinking of the rope while un-reeling of rope during installation.
- 8.4 In-situ Non-Destructive Test of all vital components of man raiding chair lift system along with wire rope shall be tested once in every six months conforming to BIS/ISO/any internationally accepted standards at any Government approved laboratory or a test house accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories) subject to confirmation of its ability to conduct such tests. The testing laboratory shall have valid NABL accredited certificate for the purpose and testing personnel having valid competency level-II certificates for NDT issued from Indian Society for Non – Destructive Testing (ISNT)/American Society for Non – Destructive Testing (ASNT) and test reports certified by Competency level –III person issued from ISNT/ASNT, which may be accepted by Chief Inspector of Mines on the basis of the authenticity/legitimacy of the test house.

### **Splices :**

- 8.5 All splices shall be made by authorized personnel. The splicing length shall be conformed to IS 5245-1:1969 or its revised version (The length to be taken for splicing shall be not less than 960 times the diameter of the rope).
- 8.6 Only one spliced joint along closed loop framed by the carrying rope is desirable. However if the length of the rope way exceed 1.0(one) kilo-meter, two splice joints may be permitted.

### **Rope life and discarding factors:**

- 8.7 The life of rope shall be fixed by manager in consultation with engineer and in any case it shall not be more than 2 years and the norms of discarding of the rope shall conform to DGMS Tech. Cir. 77/1963 or its revised version along with following additional conditions:

- a. Reduction in diameter of the rope is 10% of the original diameter when new, anywhere along the length of the rope.
- b. Broken wires with in any one strand exceed 15% of the total no. of wires in that strand.

## **9. Communication and signaling:**

- 9.1 Care shall be taken to ensure that the communication and signaling cables do not come into contact either with personnel riding on chair or rope or into contact with other cables and apparatus even under adverse conditions. These cables shall be connected in such a manner to avoid interference with the ropes to ensure the safety and smooth operation.
- 9.2 Adequate precautions shall be taken to prevent the communication and signal cables do not come into contact with other cables and electrical apparatus. Precaution shall be taken to prevent against danger from lower voltage cables to charge with higher voltage cables, by leakage or contact.
- 9.3 Pull cord switches shall be provided with indication lamp installed all along the chair lift system at an interval of 45meters, so that the system can be stopped from any point.
- 9.4 In order to have better communication, loud hailing communication system (page phones) shall be provided for every 200meters.
- 9.5 Pre-start warning alarm shall be of Audio-visual type and provided all along the roadway, to warn the persons. The pre start alarm shall give warning signal for at least 10 seconds before every start of the rope movement.
- 9.6 Signaling arrangement shall be such that signals can be passed from any point along the road way.

## **10. Electrical:**

- 10.1 The electrical equipment for chair lift system shall be selected in accordance with IS 9559:1980 or its revised version. For use in belowground coal mines, all electrical equipments associated with the man-riding car system shall be of flameproof construction & intrinsically safe or intrinsically safe as per requirement, and such equipment/ apparatus shall comply to relevant applicable standards and duly approved by Chief Inspector of Mines.
- 10.2 All electric lighting fixtures shall be of flameproof construction. Provided that, the lighting fixtures may be of increased safety enclosure type 'e' in first degree gassy mines at locations other than return airways and in-bye of the last ventilation.
- 10.3 No part of the structure or frame of the metallic body shall form a part of the electrical circuit or be connected to the electrical circuit.
- 10.4 All parts of the electrical equipment shall be robust, totally enclosed and have mechanical strength to withstand rough usage.
- 10.5 All conductors shall be adequately insulated, protected and maintained in such a manner as to prevent leakage or sparking.
- 10.6 All live parts shall be properly enclosed to prevent sparks, short-circuits etc, when persons coming into contact accidentally with them, and shall be maintained in such a manner that there remains no possibility of inadvertently coming in contact with metallic structures or frames of the system.
- 10.7 The relevant provisions of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010 as amended from time to

time shall be complied in all matters relating to the installation, operation and maintenance of the equipment.

- 10.8 The cables shall comply to the provisions of the DGMS Tech. Circular (Electrical) Approval No. 12 dated 25.05.2015 and corrigendum vide DGMS Tech. Circular (Electrical) Approval No. 01 dated 19.02.2016 or its revised version in addition to the special requirements, if any, specifically for safe operation of the equipment.
- 10.9 All electrical equipment associated with the chairlift system shall be checked by electrical supervisor of the mine and the observations shall be recorded daily in a bound register kept for the purpose or in electronic form with due authentication.

#### **11. General conditions:**

- 11.1 Adequate lighting arrangement shall be provided all along the road way.
- 11.2 The speed of rope shall be fixed by Manager in consultation with engineer and original equipment manufacturer.
- 11.3 Adequate number of competent persons including fitter, electrician, operator, rope splicer, and supervisors (Electrical, Mechanical & Mining) etc. shall be appointed.
- 11.4 An engineer shall be authorized to hold charge of man riding chairlift system, and to be responsible for its installation, maintenance and safe working.
- 11.5 Regular inspections of the system i.e., shift wise, daily, weekly, monthly, half yearly etc., as per required original equipment manufacturer manual, shall have to be carried out by a competent person appointed by the manager of the mine and results are to be recorded in a soft copy/bound pagged book.
- 11.6 The Performance report of the man riding chairlift system shall be recorded as per **Annexure-B** and the same shall be kept available at Mine office along with test certificates of rope and vital components.
- 11.7 All fire resistant high pressure hydraulic hoses shall comply to the general order No. DGMS/Mech/Technical Cir.(Approval)/04 dated 13.02.2015 or its revised version and fire resistant hydraulic fluids shall comply to the general order No. DGMS/Mech/ Technical Cir.(Approval)/02 dated 13.02.2015 or its revised version issued by this Directorate.
- 11.8 All technical circulars/guidelines issued from this Directorate from time to time in the interest of safety shall be complied.
- 11.9 The Chief Inspector of Mines may by an order in writing and subject to such condition as may be specified therein require any modifications or additional requirements to be included in this standard on merit of the case.

<b>BIS NO. (or its revised version)</b>	<b>TITLE</b>
IS 210:2009	Grey iron castings
IS 1030: 1998	Carbon steel casting for General Engineering purpose
IS 1570:1978 (Part 1)	Schedule for wrought steels Part 1 Steels specified by tensile and/or yield properties
IS 1804:2004	Steel wire Ropes-Fiber main cores.
IS 1855:2003	Standard steel wire ropes for winding and man riding haulages in mines.
IS 1904 : 1986	Code of practice for design and construction of foundations in soils General requirements
IS 2062 : 2011	Hot rolled medium and high tensile structural steel
IS 3973 : 1984	Code of practice for the selection installation and maintenance of wire ropes.



**PERFORMANCE REPORT OF MAN RIDING CHAIR LIFT SYSTEM**

Date of Inspection:

**Mine:****Area:**

Sl.No.	DESCRIPTION	STATUS
1.	Name of the Manufacturer	
2.	Location (From- To)	
3.	Date of commissioning	
4.	Dgms approvalno.	
5.	Permission No.	
6.	Valid up to:	
7.	Length of travel (m) and Max. Gradient	
<b>8</b>	<b>PUMP STATION</b>	
a)	Hour meter reading	
b)	Ref.No. of Electric Motor	
c)	Coupling	
d)	Fastening/Mounting of motor	
e)	Oil leakage	
f)	Boost pressure (MPa)	
g)	Working pressure (MPa)	
h)	Oil cooler	
i)	Oil condition/ WorkingTemp.	
j)	Oil level/ Previous Oil Change HMR	
k)	Oil filter Condition	
l)	Vibration if any	
<b>9</b>	<b>DRIVE UNIT</b>	
a)	Drive Unit Motor seepage (lpm)	
b)	Outer leakage of Oil	
c)	Speed Indicator	
d)	Brake Piston Dimension: When Released (in mm) When Applied (in mm)	
e)	Foundation of frame and Fastenings of drive unit	
f)	Brake Test Result (Braking distance)	
g)	Condition of Drive Sheave lining	
h)	Clearance between drive sheave and Drive Frame	
i)	Condition of Brake Pads	
j)	Clearance between Brake Pads and Drive sheave face	

k)	Condition of Bearing	
<b>10</b>	<b>EMBARKING AND DIS-EMBARKING STATION AT DRIVE UNIT</b>	
a)	Condition of Lining of pulleys	
b)	Bearings of pulleys	
c)	Embarking rail with starting device	
d)	Disembarking rail with back run stop device	
e)	Fastening of complete construction	
f)	Stability/Vibration of the structure	
<b>11</b>	<b>GATE WAY AREA</b>	
a)	Number of Curve stations	
b)	Number of Intermediate stations	
c)	Safety provisions at Intermediate stations	
d)	Fastening/Stability of all stations	
e)	Safety distance in all respects	
f)	Lining of pulleys	
g)	Roll bearing of pulleys	
h)	Stability/Vibration of the Curve station	
<b>12</b>	<b>EMBARKING AND DIS-EMBARKING STATION AT RETURN UNIT</b>	
a)	Condition of Lining of pulleys	
b)	Bearings of pulleys	
c)	Embarking rail with starting device	
d)	Disembarking rail with back run stop device	
e)	Fastening of complete construction	
f)	Stability/ vibration of the structure	
<b>13</b>	<b>RETURN STATION AND TENSIONING TOWER</b>	
a)	Condition of Lining of return pulley	
b)	Bearing of return pulley	
c)	Rope, return pulley and tensioning rope directions(In the same plane or not)	
d)	Suspension at trolley	
e)	Rollers of trolley	
f)	Condition of rails and suspensions	
g)	Alignment of counter weight	
h)	Condition of tensioning rope and rope clamps	
i)	Stability of tensioning tower	
j)	Max. travel of counter weights	
<b>14</b>	<b>CHAIRS</b>	
a)	Total no. of Chairs in operation	
b)	Numbering of all chairs & History book	
c)	Rollers of Suspension assembly	

d)	Bush bearing and Shaft of Suspension Assembly	
e)	Average life of Rope Chuck	
f)	Chair suspension and Seats	
g)	Max. clearance between chair and floor	
<b>15</b>	<b>Rope</b>	
a)	Original rope size	
b)	Name of Rope manufacturer	
c)	Rope changed on date (Life obtained)	
d)	Actual rope size and %reduction	
e)	Condition of rope	
f)	No. of joints	
g)	Spinning of Rope	
h)	NDT of Rope	
<b>16</b>	<b>ELECTRICAL CONTROL DEVICES</b>	
a)	Proper function of start and stop device	
b)	No. of pull cord switches	
c)	Over speed tripping device (Location of input)	
d)	Right position and function of counter weight limit switches	
e)	Proper function of audio visual alarm	
f)	Lighting arrangements at Pump station and other stations	
g)	Accessibility of controls to Operator	
h)	Proper function of page phones	
i)	Provision of Pull cord switches along the total length of travel	
<b>GENERAL CONDITIONS</b>		
Condition of Floor along the travel		
Condition of Roof and Sides along the travel		
Separate SOPs circulated		
NDT (Test report no and Date) Attach the copy of test report		
No. of Authorized Fitters		
Name of the Authorized Engineer		
History of Accidents if any		
Overall Performance		
Any other information:		

Name and Signature  
of Service Engineer

Name and Signature of  
Survey officer

Name and Signature of  
Mine Engineer

Name and Signature  
of Mine Manager

Name and Signature of  
Agent

**Therefore, all are requested to give comments/observation if any through email mentioned below on or before 17.03.2018.**

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