



**2x800 MW SINGRAULI PROJECT  
SPECIFICATION FOR  
OPERATION & MAINTENANCE**

**DOUBLE GIRDER TG HALL EOT CRANES**

**SPECIFICATION No: XX-XX-XXX-xxx-xxx**

**REV. 00**

**DATE:**

**Brief:** Two (2) nos. EOT Cranes along with common lifting beam have been envisaged for erection of turbo-generators and their auxiliaries in TG Hall.

The scope of supply of the EOT cranes along rail and DSL, maintenance tools & tackles, first fill of lubricants & consumables along with spares for erection and commissioning, spares for operation & maintenance and touch up paint is with the crane supplier.

After supply of the above cranes, their erection and commissioning after load testing shall be carried out by the contractor having the scope of E&C thereof. Erection & commissioning of EOT Crane shall include transportation from BHEL Yard, Assembly, erection, touch up painting, carrying out load testing, commissioning, obtaining clearance certificate for operation of crane/s from the concerned competent authority as per extant Government Norms/ Statutory body during commissioning.

The crane supplier shall provide Supervision services during erection & commissioning.

Guarantee Period by Crane supplier: 36 months from the date of load test of respective cranes

Crane supplier shall also provide Healthiness check service (quarterly) of crane/s during guarantee period.

**SCOPE OF OPERATION AND MAINTENANCE SERVICE OF EOT CRANES**

**(1) Operation and Maintenance service** including manpower, crane operator, general lubricants (over and above mentioned in Annexure B: Spares for Operation and Maintenance spares) till handing over of EOT Cranes to End Customer shall be in bidder's scope.

1. Manual for operation & maintenance is attached as Annexure A. The described procedure is for reference only to understand the extent of scope of work. Project specific manual from the crane vendor shall be furnished to the successful bidder for carry out the operation and maintenance services.
2. Spares for Operation and Maintenance shall be supplied by Crane supplier as per Annexure B. During general / breakdown maintenance, the bidder shall install such spares under guidance of BHEL/Crane supplier. Available Operation and Maintenance spares shall be issued by BHEL as and when required. Any replacement of parts, damaged due to faulty operation and/or poor maintenance shall be under scope of the bidder.
3. Annual testing/statutory clearance (as required) from the concerned competent authority as per extant Government Norms/ Statutory body till the time of final handing over to End Customer shall be in the scope of the bidder. Slings and Cradle for Annual testing/statutory clearance (as required) during operation & maintenance period is in bidder's scope. Collecting the test load at site within a radius of 1-2 kms from BHEL's storage to final testing area of crane and returning to store shall be under bidder's scope of work. Alternatively, bidder can use water balloons with load cell for testing.

**(2) Exclusions:**

1. Unloading, & storage.
2. Cradle for load testing.
3. Sling for load testing.
4. Dead load for load testing in case load testing done through cradle.



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5. Spares for Operation and Maintenance

**(3) List of Enclosures:**

1. Annexure A: Manual for operation & maintenance.
2. Annexure B: Spares for Operation and Maintenance spares.

# **ANNEXURE A**

## **OPERATION AND MAINTENANCE MANUAL (FOR REFERENCE)**

# INDEX

TOPIC	PAGE NO.
1. Operation Instructions	1
2. Permissible Wear	3
3. Safe Hoisting Practices	6
4. Hand Signals	8

## OPERATION INSTRUCTIONS

### **1. Inspection before Operation :**

Check the following, thoroughly, to ensure that the Crane is finally ready for trial runs.

- 1.1 The gear boxes are filled with recommended lubricants, up to the maximum level marked on the respective dip sticks.
- 1.2 All points requiring lubrication are well lubricated.
- 1.3 Open reduction gears wherever used, are properly greased with the recommended lubricant.
- 1.4 The wire rope is properly greased.
- 1.5 Check buffers, and end stoppers are properly assembled.
- 1.6 Check all nuts and bolts, especially the girder-end carriage and joint bolts, machinery foundation bolts, wire rope-clamp bolts, to ensure that they are fully tightened.
- 1.7 Release the Brakes of each Motion manually and ensure that all motions are free. Set the brakes.

### **2. Preparation for Operation :**

The crane is operated by manipulating the controllers for each motion. Before charging the D.S.L. complete the following routine checks.

- 2.1 Check cable interconnections as per wiring diagrams.
- 2.2 Check for loose connections.
- 2.3 Carry out insulation resistance test.
- 2.4 Remove Power Circuit Fuses in the Main Panel, and switch on the main Isolator. Check the control circuit for proper operation. Operate the controller step by step, and check the sequence of Operation.

## 2

- 2.5 Switch off the main isolator. Replace the Power fuses. Ensure that all the over load relays are set for the full load currents of the respective Motors, as metioned on the name Plates.
- 2.6 Switch on due Power.
- 2.7 In case any mechanism is provided with more than one drive, decouple the Motors and check their direction of rotation. Ensuring all motors are rotating in the same direction, couple the motors to the gear boxes,
- 2.8 Check the direction of each motion, with respect to the movement of the controller handle.
- 2.9 Try all the motion on no load.
- 2.10 Set all the limit switches and check their functioning.
- 2.11 Check the brakes and set them.

### **3. Trial Operation :**

The Crane is now ready for Load-Testing. Load test should be conducted as follows:

- 3.1 Check the gantry girder joints and the rail clamping.
- 3.2 Operate individual motions on No-Load. Record the Motor currents.
- 3.3 Take 50% of the rated Load. Operate the motions. Follow the same procedure by taking 100% load. Record the currents.
- 3.4 On 100% load record the speeds of each motion.
- 3.5 Position the load at the centre. Remove the hook from the slings. Take the trolley to one extreme end. Note down the height from some fixed point on the floor at the centre of the span. Now bring the trolley to the centre of the span. Sling the load and lift the load to clear the floor. Once again note the height from the centre of the span, to the fixed point on the floor. The difference in these two readings will give the deflection of the girder on full load. If this is within the permissible limits, load the Crane to 125% of the rated load.
- 3.6 Check all the motions for over load. It is not necessary to record any readings. Only ensure that the individual motions perform under overload conditions.

### 3

- 3.7 From the records, see the currents drawn by each motor and set the overload relay at this point.
- 3.8 The Crane is now commissioned and ready for Regular Service

#### 4. PERMISSIBLE WEAR

Part	Description	Permissible wear limits (decrease in size)
Gears	- First pair of gearing  - Other gears	10% of tooth thickness on the p.c.d.  20% of tooth thickness on the p.c.d.
Wheels	- Flanges  - Tread	50% of full size  30% of full size.. When the difference in diameter between right side and left side wheels exceeds 1.5%, re-machine to rectify.
Sheaves	Groove dia	50% of wire rope diameter.
Brake lining	Thickness	50% of full size.
Wire Rope	No. of breakage of steel wires	10% of total strand per every 300mm length over the entire length

**5. How to start the Crane.**

- a) Check Crane and Crane track way for any obstructions.
- b) Release all locking devices.
- c) Check all lubricating points for required quantity of lubricants.
- d) Ensure that no items are lying loose on the Crane and trolley.
- e) See that all controllers are in the neutral position.
- f) Switch "ON" Crane protective gear.
- g) Check signal and warning devices.
- h) Check brakes and limit switches for their proper functioning.

***NOW THE CRANE IS READY FOR OPERATION.***

**6. How to Stop the Crane:**

- a) Run the empty hook and trolley into the specified resting position.
- b) Bring the Crane to access point.
- c) Set all control gears in neutral position.
- d) Trip working lights.
- e) Trip protective gear.
- f) Trip and lock isolating switch.
- g) Lock operator's cabin.
- h) Actuate locking devices, if any.



**7. Procedure for replacement of worn out wire rope.**

- (a) Lower the hook block assy completely on the floor.
- (b) Unscrew the wire rope clamps on the rope drum.
- (c) Rotate the rope drum slowly by inching / jogging, to pay out the balance wire rope wounded on the drum.
- (d) Pull the wire rope from bottom, top & equalizing pulley.

**8. Handling of steel wire rope.**

During periodic inspections, it is necessary to thoroughly check and tighten the fastening of wire rope ends on the drum and other places. To avoid ultimately wear of wire ropes, they should be coated with special rope grease heated to approximately 60° C, so as to ensure complete penetration of grease into the spaces between strand wires, at least once in every six months time.

For the first application prior to coating the rope, use a wire brush to remove the dirt and wash the rope with kerosene if it has been laid on unmettled floor.

## SAFE HOISTING PRACTICES

Hand operated and electric hoist and trolleys of all types are designed with the safety of the operating personnel first in mind. Your own safety and that of your fellow workers will be assured when overhead materials handling equipment is used as recommended by the manufacturer. Dis-regarding such recommendations endangers life and property. Following are the basic rules worthy of your careful considerations and attention.

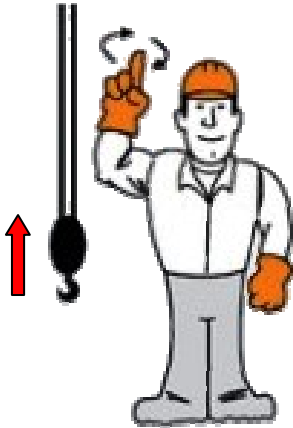
1. **DO NOT LOAD BEYOND THE RATED CAPACITY** - The immediate danger is the possible failure of some load carrying parts. Overloading might also start a defect which could lead to some future failure even at less than rated capacity.
2. **DO NOT USE ANY OVERHEAD MATERIALS HANDLING EQUIPMENTS FOR HANDLING PERSONNEL.**
3. **CONDUCT A PERIODIC VISUAL INSPECTION FOR SIGNS OF DAMAGE OR WEAR.**  
Particular attention should be paid to the cable or cabin and hook. If the cable or cabin show signs of wear or damage or hook is distorted or opened, call it to the attention of the safety engineers before loading the hoist.
4. **DO NOT USE HOISTING CABLES OR CHAINS AS A SUBSTITUTE FOR SLINGS.**  
Use slings only. Cable or chain slings should be of proper size and type for load handling- never uses slings showing physical damage of any degree.
5. **WHENEVER THE HOIST IS LOWERED IN SUCH A MANNER AS TO TAKE THE LOAD OFF THE WIRE ROPES** the operator should determine, before again making a lift if the wire rope is properly reeved on the drum.
6. **STAND CLEAR OF ALL LOADS** - If you must travel a load over the heads of other personnel, give ample warning of your intention before you move.
7. **ALWAYS "INCH" THE HOIST INTO THE LOAD. RUNNING INTO** the load at full speed imposes excessive overload on the hoist and could result in failure of parts and / or supporting structure. This is particularly true with high hoisting speeds.
8. **LIMIT SWITCHES ARE FOR EMERGENCY USE ONLY** and should not be tripped

during normal operations. If it is necessary to travel to the limit, use extreme caution and approach the limit in slow speed or by "inching" Do not leave hook block in contact with limit switch at the end of the operation.

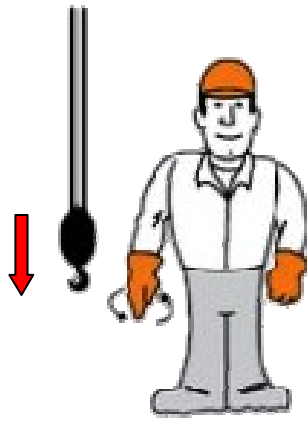
9. **BE SURE THE HOIST RAISES AND LOWERS PROPERLY WHEN THE CORRESPONDING PUSH BUTTONS ON CONTROL LEVERS ARE OPERATED-**

A reversal of direction indicates a phase reversal in the current conductor, the reversal of the rope on the drum or an interchange of wires on the push button- any of which would cause the limit switch to be in-operative. DO NOT, UNDER ANY CIRCUMSTANCES, operate the equipment until the trouble has been found and corrected.

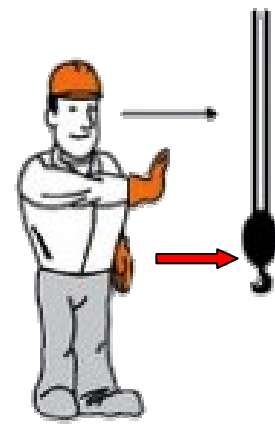
10. **CENTRE THE HOIST OVER THE LOAD BEFORE LIFTING-** Do not side pull or end pull.
11. **KNOW THE HAND SIGNALS FOR** hoisting cross travel and crane travel of working with cab operated hoists and cranes. Operators should accept the signals of only those persons authorised to give them.
12. **DO NOT LEAVE THE LOAD SUSPENDED IN THE AIR UNATTENDED.**
13. **DO NOT JOG CONTROLS UNNECESSARILY.** Hoist motors are generally high torque, high slip types. Each start causes an inrush of current greater than the running current and leads to overheating and, burn out, if continued in excess.

**HOIST**

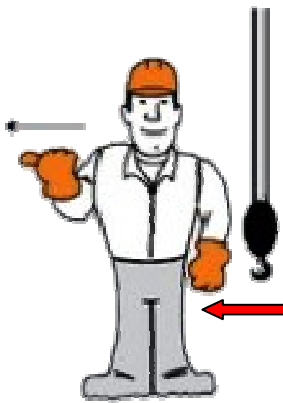
WITH FOREARM VERTICAL, FOREFINGER POINTING UP, MOVE HAND IN SMALL HORIZONTAL CIRCLE.

**LOWER**

WITH ARM EXTENDED DOWNWARD. FOREFINGER POINTING DOWN, MOVE HAND IN SMALL HORIZONTAL CIRCLE.

**BRIDGE TRAVEL**

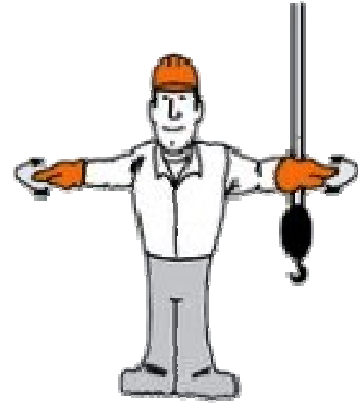
WITH ARM EXTENDED FORWARD, HAND OPEN AND SLIGHTLY RAISED, MAKE PUSHING MOTION IN DIRECTION OF TRAVEL.

**TROLLEY TRAVEL**

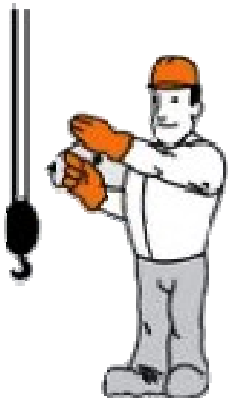
PALM UP, FINGERS CLOSED THUMB POINTING IN DIRECTION OF MOTION. JERK HAND HORIZONTALLY.

**STOP**

ARM EXTENDED, PALM DOWN, HAND POSITION RIGIDLY.

**EMERGENCY STOP**

ARM EXTENDED, PALM DOWN, MOVE HAND RAPIDLY RIGHT AND LEFT.

**MOVE SLOWLY**

USE ONE HAND TO GIVE HOIST MOTION SIGNAL AND PLACE OTHER HAND MOTIONLESS IN FRONT OF HAND GIVING THE MOTION SIGNAL.

# HAND SIGNALS

# **MAINTENANCE MANUAL**

# **I N D E X**

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# INSTALLATION AND MAINTENANCE

## 1) MECHANICAL COMPONENTS

**Gear Boxes :** Gears are to be inspected at least every six months. When inspecting the gears, it is necessary to check the condition of working surface, degree of tooth wear, and correctness of meshing. The condition of the surfaces of meshing should be taken care of, especially at the beginning of reduction gear operation.

Appearance of pitting, i. e. chipping of metal particles (tooth surface layer fatigue) should not serve as a cause for stopping the reduction gear operation, provided the pitting does not cover more than 20 percent of tooth working surface.

Proper operation of the transmissions may be determined by sound, the gear must not hum sharply or produce knocks. The setting of gears on the shaft should also be checked, play and axial shifting in no case being allowed. It is essential to check the condition of reduction gear fastenings and gear case flange joints. Gear case flanges should not leak. Each time the reduction gear has been uncovered and repaired, records should be made in a special sheet which is to be kept together with the crane certificate.

Oil level in any case should stay between the notches on the measuring rod. The first change of oil in the gear case takes place after 400 hours of operation. The recommended lubricating oils are indicated in the lubricating chart given at the end of the operating and maintenance instructions.

**Wire ropes :** During periodic inspections, it is necessary to thoroughly check and tighten the fastening of wire rope ends on the drum and other places. To avoid ultimately wear of wire ropes, they should be coated with special rope grease heated to approximately 60° C, so as to ensure complete penetration of grease into the spaces between strand wires, at least once in every six months time.

For the first application prior to coating the rope, use a wire brush to remove the dirt and wash the rope with kerosene if it has been laid on unmettled floor.

**Antifriction bearings :** While inspecting the bearing, it is essential to check the reliability to fastening of their housings to the steel structure of the bridge or frame, the tightness of cap contact the condition of packing and the amount of lubricant in the bearing.

The temperature of bearing during normal operation must not exceed 60° C. Overheating of bearing may be caused by soiling, by an insufficient or over sufficient quantity of lubricant or by the incorrect mounting. Squeaking of bearing indicates that there is insufficient lubricant in them, that the cage is damaged or that the rotating parts are rubbing against the housing. These defects should be overcome to increase the life of bearing.

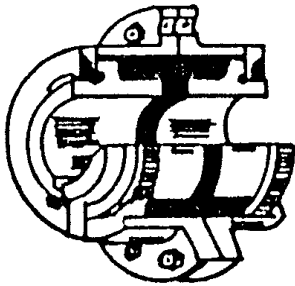
**Drum and Pulleys :** During inspection of the rope drum and pulleys one must check conditions of the surface of grooves and flanges, proper functioning of the lubricating system, free turning of pulley on their axles, reliability of fastening of bearing and axles.

**Track wheels :** The runner wheels should have neither cracks nor worn out collar rims and their rolling surface should be clean of hollows, dents and should not have traces of considerable wear

If flange wear exceeds 40% of the original size, the wheels should be replaced.

**Couplings** : Flexible gear couplings and bush pin type brake drum couplings are used on cranes.

A flexible gear coupling, if properly installed and maintained will last for many years with trouble-free operations. Maintenance procedure includes periodic inspection, cleaning, lubrication and re-alignment of the connected shafts. Longer coupling life can be expected if actual misalignment is kept to minimum. It should be recognized that shaft misalignment normally Increases with time due to shifting of foundations, bearing wear, thermal expansion and dynamic deflection of connected equipments.



Maintenance procedure for floating shaft coupling is similar to that required for a standard coupling, but alignment is more difficult because of greater shaft separations.

## GEAR COUPLING

Special dial indicator arrangement to span the gap between the shaft ends or optical equipment is used. Due

to greater offset capacity, shaft alignment is not as critical as any close connected coupling, permitting a greater initial alignment error.

The following instructions must be strictly followed while installing gear couplings.

1. Unbolt and separate the two halves of the coupling.
2. Force each hub with its sleeve mounted on to shaft and key. End of each hub should come flush with end of shaft.
3. Leave gap between fixed hub faces as mentioned in table below :

[illegible]

\* Note : In case of half gear coupling the maximum gap will half.



### 3

4. Push casings apart and use a straight edge across the aligning surfaces of hubs to indicate parallel alignment. Take this measurement at every 90°.
5. To indicate an angular alignment, use a thickness guage on inside faces of the hubs so that they come parallel each other. Take this measurement at every 90°.
6. Wipe off coupling flanges, clean interior free from dirt and grit, apply adhesive cement to two surfaces and firmly bolt the flanges together with oil plugs at 1800. Fill it with oil, instead of oil a good quality grease can also be used.

Before starting, pour lubricant through oil plug. The lubricant spreads out under centrifugal pressure and reduces friction between teeth and decreases wear and thus maintenance. Lubricant should be checked to see that proper level is maintained and that lubricant is free of contamination. The oil may be replenished every three months depending upon the typical application and changes once every year.

## II) ELECTRICAL COMPONENTS

**Motors :** Electric motors should be protected against drops of water, oil etc. Terminal boxes should be carefully closed. Electric motor should be periodically inspected and cleaned. Before inspection, the motor should be cleaned of dirt and dust and slip box should be cleaned.

When checking contact rings and brush holder, it is necessary to remove metal and coal dust from the box. The rings are to be wiped with cotton cloth. If there is no dust or oil on the ring, cloth should be soaked in petrol. 'Scorched' rings can be polished with fine emery paper.

When inspecting brush holder it is required to check brushes' pressure on the rings and smoothness of arm motion. Worn-out brushes should be replaced by spare ones.

Bearings of motors should be checked and washed with petrol and lubricant changed every 8 to 12 months.

Lubricant should be added 3 to 6 months, as becomes clear in the course of operation. It should be noted that lubricant fills no more than  $\frac{2}{3}$  of grease box.

**Brakes :** Mill duty thrustor brakes are suitable for 400!440V', 3 ph, A.C. supply for a wide range of drum sizes, 160 mm to 600 mm dia.

All main parts of brakes are shown in the sketch, The base is of rigid welded construction. Brake arms are also of fabricated construction with robust design. Brake shoes are self aligning, easy removable, high grade cast iron fitted with best quality fabric linings. The operating lever is of rigid steel plate construction. The tie rod is of ample section, securely fixed in a lug and prevented from relative movement with a lock-nut. The tie rod transmits the spring force on shoes by a simple lever system. The guide rods are fixed to base / lever by suitable lugs and the springs are used depending upon the brake size and thrustor capacity so as to obtain the required braking torque.

The braking pressure to the shoes is transmitted from the springs by means of an extremely rigid and simple lever / tie rod mechanism. Braking is smooth and positive. Release of the brake shoes is effected by energizing the 3 phase thrustor which over-comes the spring force and the shoes are moved clear of the drum by the lever / arm linkage system.

Owing to the extremely rigid leverage / linkage system there is no 'dead zone' and the shoes open as soon as the thrustor operates the lever. This is evident from the general assembly drawing of the brakes. The type of linkage / lever makes adjustment very simple and assembly of these brakes is also much faster.

The improved design of the leverage system and linkage makes it possible to utilize only a 70 to 75% portion of the thrustor stroke initially i.e. at the time of commissioning the brake, when the brake lining is new. This enables a reserve for lining wear. As the lining wears out, the thrustor stroke adjusts itself automatically (by increasing) and the wear of the lining has no effect on the braking torque until the full thrustor stroke is utilized. It is only after this stage that the brake has to be re-adjusted to the original setting.

## THRUSTOR BRAKES INSTALLATION / OPERATION MAINTENANCE INSTRUCTIONS.

### 1. CONSTRUCTION:

Details of the Principal parts used in the construction of the brakes are as follows:

- a) **Base** - Rigid welded construction with accessible fixings.
- b) **Brake Arm** - Robust design of fabricated construction, jig drilled & machined to ensure interchangeability.
- c) **Shoes** - Self aligning, easily removable high grade cast iron fitted with best quality fabric lining. Designed with a large cooling surface and fitted with stops to prevent drag on drum when brake is lifted
- d) **Operating Lever** - Rigid steel plates construction with additional spacers to ensure proper movement of lever.
- e) **Tie Rod** - Of ample section, which is securely fixed in a lug and prevented from relative movement with a lock nut the Tie Rod which transmits the spring force to the shoes by a simple lever system.
- f) **Guide Rods** - These are fixed to the base/lever by suitable lugs and the springs are held in place by the guide rods and plates.
- g) **Springs** - Compression springs are vertically mounted through the guide rods and are held securely between guide plates one or more springs are used depending upon the brake size & thruster capacity so as to obtain the required braking torque.

### 2. INSTALLATION:

Before energizing the thruster brake, oil should be filled in the thruster to the required level. ( oil used is Transformer oil to BS 148/IS 335 or equivalent )

### 3. BRAKE MOUNTING & ALIGNING:

- a) Tie rod ( turn buckle provided for adjusting the thrust or stroke should be loosened before mounting the brake on the foundation.
- b) Foundation plate of the brake should be checked for proper leveling & centring of the brake to be done with respect to the brake drum. Fit the brake with foundation bolts provided. Shims or spacers to be used to match center height.
- c) Adjust the tie rod such that the gap between drum & shoes of the brake is 1.5 mm. Uniform gap between drum and shoes can be achieved with the adjusting bolts. Thrustor should be "ON" during adjustments.
- d) It is desirable to tighten the tie rod turn buckle so that the thrustor comes to rest at a position which is approximately 25% of the full stroke above the lowest level. This is termed as "Pre Stroke".
- e) The Uniform gap between drum and brake shoe can be obtained by adjusting the Stopper which is fitted behind the brake shoe.
- f) The spring length should be reset and adjusted to confirm to the spring over cup Length mentioned on Name Plate.

### 4. OPERATION:

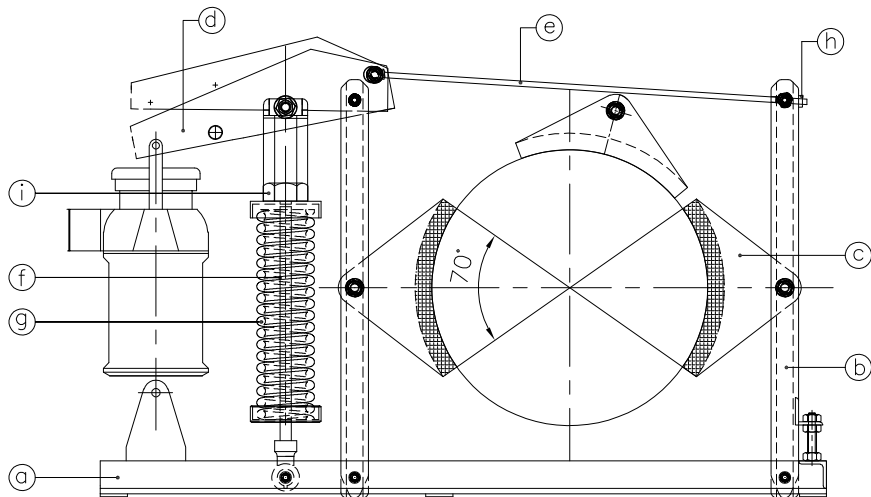
- a) The braking pressure to the shoes is transmitted from the springs by means of an extremely rigid and simple lever/tie rod mechanism. Braking is smooth and positive. Release of the brake shoes effected by energizing the 3 phase thrustor which overcomes the springs force and the shoes are moved clear of the drum by the lever/arm linkage system.
- b) Owing to the extremely rigid leverage/linkage system there is no "Dead Zone" and the shoes open as soon as the thrustor operates the lever. This is evident from the general assembly drawing of the brake. The type of linkage/lever makes adjustment very simple and assembly of these brakes is also much faster.

**5. MAINTENANCE SETTING:**

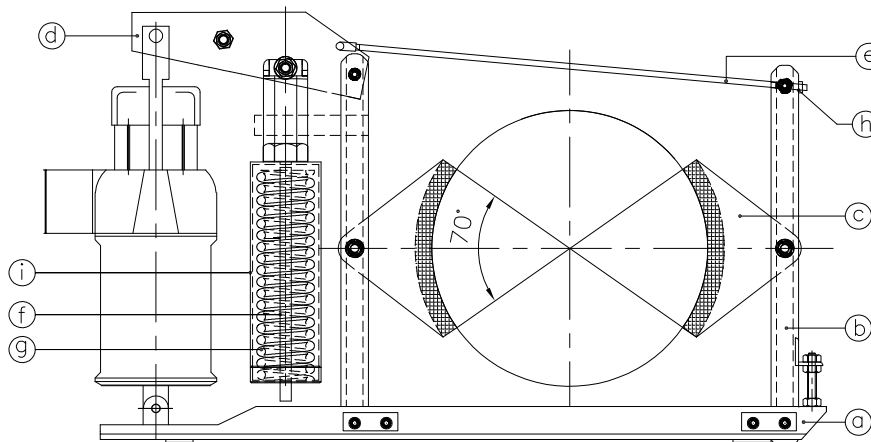
- a) The improved design of the leverage system and linkage makes it possible to Utilize only a portion ( 70 to 75%) of the thruster stroke initially ( at the time of commissioning the brake ) when the brake lining is new. This enables a reserve for lining year, by setting the thruster with a pre stroke of 25%. This is achieved by tightening the tie rod/turn buckle, as already described under 3 (d).
- b) As the lining wear out, the thruster stroke adjusts itself automatically. (by increasing ). The wear of the lining has no effect on the braking torque even though the full thruster brake has to be readjusted to the original setting.
- c) It is only necessary to tighten the turn buckle on tie rod nuts to restore the thruster to its original position, as described in 3 (d). This also restores automatically the spring setting/brakes torque to the original value. The shoe clearances are to be checked and equalized, if necessary.
- d) The angle of the brake shoe being 70° simplifies the replacement and maintenance of the brake shoe's at site.
- e) The springs are vertically mounted and the setting has been so adjusted that even an appreciable wear of the lining does not have any appreciable effect on the braking torque. If the lining wear is excessive the braking torque undergoes a slight reduction and this can be compensated by resetting the r rings to its original value by means of the adjusting nut which are readily accessible.

**6. RENEWAL / REPLACEMENTS :**

When the brake lining is worn out for more than half the original thickness, it is necessary to replace the lining. It is simpler to remove the complete shoe & fit a new (spare) shoe with readily fitted lining. The old brake shoe can be relined separately.



**GENERAL ARRANGEMENT OF 300-600 MM Ø MILL DUTY THRUSTOR OPERATED BRAKE**



**GENERAL ARRANGEMENT OF 100-250 MM Ø MILL DUTY THRUSTOR OPERATED BRAKE**

- |                   |                    |                 |                    |
|-------------------|--------------------|-----------------|--------------------|
| a- BASE           | c- BRAKE SHOE      | f- GUIDE ROD    | i- SPRING PRESSURE |
| b- BRAKE ARM      | d- OPERATING LEVER | g- SPRINGS      | ADJUSTING NUT      |
| (MAIN & SIDE ARM) | e- TIE ROD         | h- TIE ROD NUTS |                    |

## 9

**Resistance box :** Connections to resistors are exposed to alternate heating and cooling

of resistor units, which tends to loosen the bolts and nuts that hold them tight.

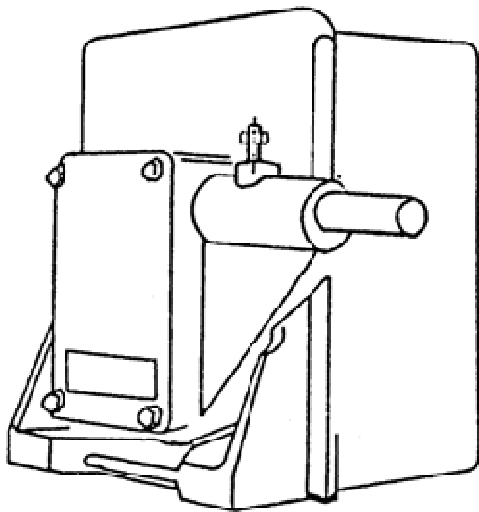
Resistor

boxes are held together by tie rods which are also subject to alternate heating and cooling.

Resistors should be checked at regular intervals for tight wire connections and tie rods, since loose joints are likely to result in local heating.

### LIMIT SWITCHES

i) **Two way Rotary Limit Switch :** Two way Rotary Geared type limit switches shown in the sketch are used on control and power circuits of reversing drives so as to limit their rotation/movement within pre-determined operating range.



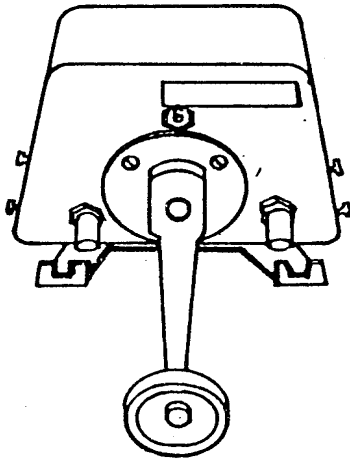
**TWO WAY ROTARY LIMIT SWITCH**

It basically consists of heavy duty worm gear drive with a ratio of 48:1 & 120:1. This worm gear unit is built into a sturdy cast housing, which is bolted to the main body of limit switch which is also cast iron. The operating shaft of the limit switch, the contacts are shields etc. are housed in a dust tight gasketed sheet steel enclosure.

The body of the contact is made of high grade melamine which is specially suitable for heavy duty. In all cranes this type of limit switch is normally used to limit motion.

If properly installed, this unit doesn't require special attention afterwards.

(11) **Two way lever type limit switch** : Two / one way lever type limit switch, as shown in the sketch, prevents over-travel and over- traverse.

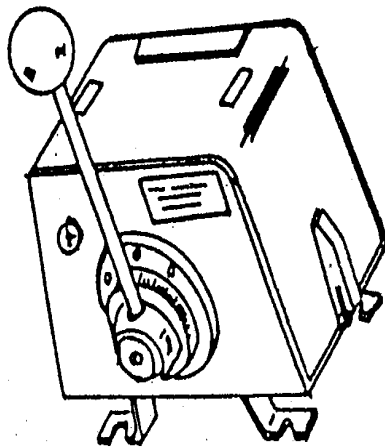


This type of limit switch normally re- mains closed and cuts off power supply to stop the motors of the crane. The limit switch operates when it reaches pre-determined position, when the lever is moved over a projecting member fixed on girder. The limit switch contacts are automatically reset when the lever re-returns to zero position due to spring action.

The housing of strong reinforced sheet steel of heavy gauge. The cam shaft is mounted on moulded bushes of synthetic material. These bush bearings do not require any lubrication. The cams are also moulded from synthetic material and are accurately cut to have an exceptionally long life.

## TWO WAY LEVER LIMIT SWITCH

**CAM / MASTER CONTROLLERS** : The construction of the Cam / Master Controllers is very much same as that of lever type limit switch. The Master controllers have more switching capacity than that of cam controllers.



The appearance and dimensions of cam or master controllers are similar. However, they can be differentiated by colours of the knobs fixed to operating handle. Master Controllers have black knobs whereas can controllers are fixed with red knob.

Normally the units may be installed in any position. For a degree of protection the units should not be subjected to excessive dust or moisture. While mounting care should be taken to see that there is sufficient clearance for bringing out and connecting the leads.

## CAM / MASTER CONTROLLER

The switching capacity of the contacts when used as master controller operation is 15 Amps, at 440 V A/c, on highly inductive loads and 2.5 amps, on 220 V, D.C. when handling inductive loads. This switching capacity is far in excess of that actually required in practice, as such, replacement of contacts, for master controllers may not be necessary.

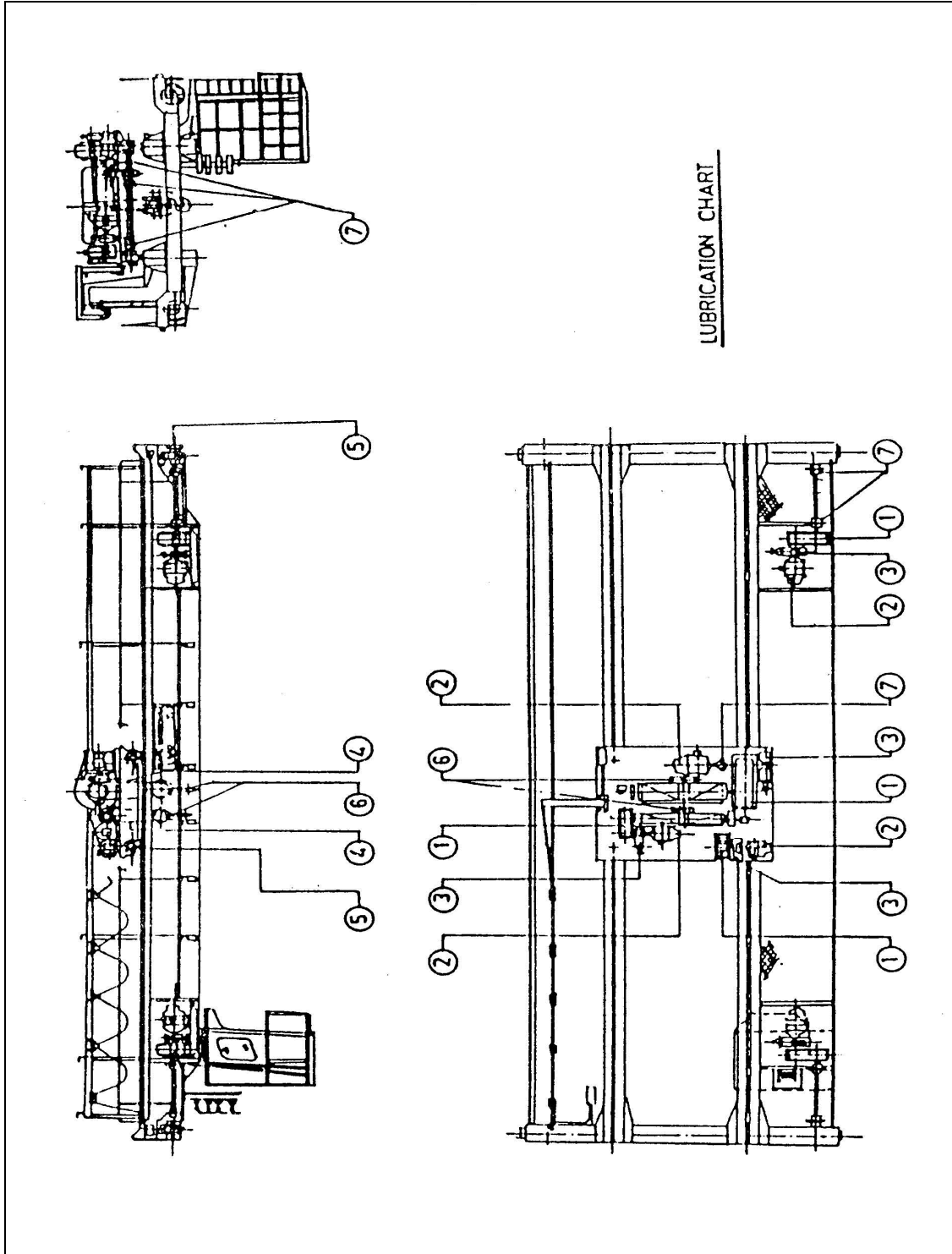


## LUBRICATION CHART

Sr.No.	Components	Description	Lubricant	Period of Lubrication
1	Gear Box	i) Checking oil level ii) Changing oil	Parathon EP 150	Once in a fortnight a) 400hrs. For new gear pinion pairs. b) 4000hrs there after (or earlier if oil becomes turbid)
2	Motor	Greasing through grease nipples	Multi Purpose Grease 2/3	Once in 6 months
3	Brake pin joints	Greasing with hands	-----  -----	By visual Inspection, when they go dry.
4	Wire rope	Applying by hand	Cardium compound	Once in 6 months
5	Bearing housing	i) With grease cups ii) With grease nipples Changing grease	Multi Purpose Grease 2/3	1 turn once in a week, Fill grease again, when grease caps are full turned
6	Grease packet units	Changing grease	-----  -----	Once or twice a year, depending on severity of duty
7	Geared Coupling	Changing grease	-----  -----	Once in 3 months

Sr.No.	EQUIVALENT LUBRICANTS	INDIAL OIL	BHARAT PTEROLEUM	HINDUSTHAN PETROLEUM
1	Grease	Servogem 2 or 3	MP-2 or 3	MP-2 or 3
2	OIL	Servomesh SP 150	MAK Industrial gear oil 150 grade	Parathon EP

Cardium Compound – Compound of any make suitable for lubrication of wire rope.



## **PREVENTIVE MAINTENANCE OF A CRANE**

### **FOLLOWING WORK SHOULD BE CARRIED OUT QUARTERLY**

Bridge Trolley wheels	Checking for wear, flat spots and cracks in flange. Ensure drive wheels are of the same diameter.
Runway	Checking alignment and elevation of gantry track. Checking rail clamp bolts.
Machine Bolts	Checking all foundation bolts of Electrical and Mechanical equipments for tightness.
Structural Bolts	Checking for tightness. They should also be checked after the first month of operation.
Rope Sheaves	Checking for wear and cracks in flanges, greasing for bearings.
Hoist Wire Rope	Checking for broken or worn connections and for lubrication.
Flexible Couplings	Checking pins and teeth for wear cleaning and greasing.
Cross-shaft Plummer Blocks	Dismantling cap. Cleaning and checking oil seals and to be packed with fresh grease.
Trolley Collectors	Checking of cable trolleys / cabling / chain. Ensuring connection of trolley wheels is kept through entire length of span.
Brakes	All Brake assembly will be checked for loose connection, earthling connection, linings for wear, leakages and adjustments to ensure brake is not rubbing the brake drum during operation. Greasing pins and operation adjustment of brakes.
Resistor Connections	Checking, tightening connections at grid joints and at cable terminations.
Control Station	Clean out control cabinets. Checking of all connection at push buttons, master controllers contact tips, cams and terminals.
Control Panels	All Control Panels will be checked for loose connection and cleaning the contactor contacts, if required will be replaced.
Electrical Motors	All motion motors connection will be checked for loose contacts in terminal box

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loose crimping of wire lugs, loose contacts on slip ring assembly with carbon brush. Earthings connection with motor.

Safety Switches	All limit switches will be checked for desired operation and limits. Emergency switches will be checked.
Main Collectors	Checking of worn collector shoes, sag in main runway wiring, ensuring contact is kept through entire length runway properly.
Electrical connections	Checking throughout electrical equipments for loose connection such as selector switches, junction boxes, min isolator switch etc.
Lubrication	All gear box and thrusters' oil level will be checked. All bearings, couplings' grease will be checked.
Testing	<p>After completion of checking and required rectification, trolley will be checked for idle operation, for brake operation, limit switch operation &amp; safety switch operation. All motor currents will be checked on no load.</p> <p>Trolley will be checked on load. Brake will be adjusted as required, motor currents will be checked and over load relay setting will be done accordingly.</p>

### **BELOW MENTIONED WORK WILL BE CARRIED OUT ANNUALLY**

Hoist Wire Rope	Checking for broken or worn connections and will be lubricated.
Gear Boxes	Oil seals will be checked, if required will be replaced. Gear and pinion teeth will be checked. Drain the oil cleaning gear box and refill fresh oil.
Motor	All motors' insulation test and meager test will be carried out.
Resistance Box	All resistance boxes' step resistance value will be checked.

### **MECHANICAL TROUBLE SHOOTING CHART**


<b><u>Type of fault</u></b>	<b><u>Possible reason for fault</u></b>	<b><u>Remarks</u></b>
No motion of crane while in operation	1. Main air circuit broken off 2. Main contactor out 3. Runway collector not making contact with conductors 4. Broken wire or connection	Press, reset, clean collectors and ensure they are running on conductor wire
Hoist motion fails to operate	1. Control panel fuses out 2. Thermal relay out 3. Limit switch in open position only allowing hoist to be lowered 4. Trolley collector off wire 5. Hoist Gear train failed	} Press, re-set button. } Open up limit switch from contact. - Replace
Trolley motion fails to operate	1. Control panel fuses out 2. Thermal relay out 3. Limit switch in open position only. 4. Trolley collector off wire 5. Wheel axle broken 6. CT gear train failed	} Press, reset button. - Replace - Replace
Bridge motion fails	1. Control panel fuses out 2. Thermal relay out 3. Wheel axle broken 4. Bridge gear train failed	} Press, re-set button - Replace - Replace
Hoist motion too slow or too fast	Improper setting of brake Rotor contactor sequence interrupted Magnetic controllers accelerating contacts not operating Loose resistor leads	Readjust brake } Check control circuit - Tighten
Breaking action too slow – any motion	Magnetic brake needs adjustment Sheared bolts in cross shaft coupling Misalignment of runway rails	Brake linings worn or loose linkages Replace - Re-align
Flashing of main conductor system but no rotation	Dirty main collectors	Clean or replace

## ELECTRICAL TROUBLE SHOOTING CHART

### MANUALLY OPERATED CONTROLLERS / PENDANT PUSH BUTTON STATIONS

<u>Symptom</u>	<u>Possible Cause</u>	<u>Cure</u>
Excessive contact burning	Low contact-pressure, contact not properly aligned.	Adjustment by inspn./ check contact element & adjust star wheel lever.
Burning out resistors	Starting sequence stopped at midpoint	Instruct operator / check timer operation
Failure to pick up	Low voltage on coil	Check system
Failure to hold on	Coil burned out or wrong coil	Replace, check gap
Failure to drop out	Mechanical binding contact welded	Clean & adjust. See contacts. Check circuit.

### THERMAL OVERLOAD RELAYS

Failure to trip	<ol style="list-style-type: none"> <li>1. Wrong setting</li> <li>2. Non-functioning of auxiliary contact</li> <li>3. Mechanical bending</li> <li>4. Relay damaged by short circuits, motors and relay in different temperature &amp; loose connection.</li> </ol>	Check instruction sheets. Clean & adjust. Replace relay. Install motor and control in uniform temperature.
Trips at too low current	<ol style="list-style-type: none"> <li>1. Loose connection</li> <li>2. Heater assembled incorrectly</li> <li>3. Heater is high ambient</li> <li>4. Wrong setting</li> </ol>	 Check instruction Install relay and controller near motor or in cooler place. Set as per BOM
Trips on starting	Wrong setting	Set as per BOM
Failure to re-set	Broken mechanism	Replace relay or broken part.

**CONTACTORS**

Short contact life	<ol style="list-style-type: none"><li>1. Breaking at over current</li><li>2. Mechanical damage or defect in spring</li><li>3. Bounce on opening or closing</li><li>4. Abrasive dust</li><li>5. Low contact pressure</li><li>6. Frequent jogging (inching)</li></ol>	<ol style="list-style-type: none"><li>1. Check single phasing occurrence or not and check loose connection at motor terminals</li><li>2. Replace</li><li>3. Re-adjust contactor for "bounce" uniformly in all three phases</li><li>4. Dust tight enclosure</li><li>5. Low contacts and/or springs</li><li>6. Larger size contactor</li></ol>
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Contact chattering	Check contactor coil chamber for dust/moisture or oxidization Bad interlock connection and loose connection to coil supply	Clean the coil or replace Check and remove any loose connection
Over heating	Copper Oxide  Over load  Weak contact pressure  Poor connection	Clean lightly with emery paper/CTC liquid Reduce load or use larger control Check whether air gap between fixed and moving contacts. Replace contact spring & contacts if wearing is uneven amongst phases Tighten
Welding of contacts	1. Poor spring pressure 2. Excessive overloading  3. Repeated jogging or inching	1. Replace spring 2. Check motor current and any Loose connection. Replace contacts 3. Controllers must be derated for jogging duty due to severe strain. Advise operator to use slow speed steps instead of frequent start and steps.
<b><u>COILS</u></b>		
Coil Failure	1. Contacts not sealing  2. Oxidisation of coils or dust entering	1. Eliminate mechanical binding of contactor. Interlock not marking contact.  2. Clean or replace



## ANNEXURE B

### SPARES FOR OPERATION AND MAINTENANCE (CRANE SUPPLIER'S SCOPE)

S. No.	Operation and maintenance Spares	QTY FOR Both TG HALL DOUBLE GIRDER EOT CRANES	
a.	Gear Oil in sealed packets/containers.	60	litres
b.	Grease in sealed packets/containers.	40	kg
c.	Brake shoes	6 nos. of each size and rating	
d.	Brake liners	6 nos. of each size and rating	
e.	Brake springs	4 nos. of each size and rating	
f.	Oil seal for each gear box	6 nos. of each size	
g.	Main contactors of each rating	2	Nos.
h.	Overload relays of each rating	2	Nos.
i.	Bearing for motors of each size and rating	2	Nos.

Note:

1. Operation and maintenance spares shall be used for general/breakdown maintenance during operation and also during periodic healthiness check services (crane supplier's scope). Unused Operation & Maintenance spares, as available, during closure of punch point to facilitate handling over of cranes shall be issued by BHEL.