

INSPECTION & MAINTENANCE

OF

RADIAL GATES, VERTICAL LIFT GATES

&

ELECTRICALLY OPERATED FIXED HOISTS

&

GANTRY CRANES

**GENERAL INSTRUCTIONS FOR INSPECTION AND MAINTENANCE OF
GATES & HOISTS.**

(A) RADIAL GATE:

- (I) Inspection of gate shall include all the components of the gate including its leaf assembly, vertical/Horizontal stiffeners, Horizontal girders, inclined arms, Yoke/Trunnion girders, trunnion assemblies, side guides, sill beams, wall plates etc.
- (II) A cursory inspection of the gate along with the hoist shall be carried out daily to ensure that there is no unusual happening.

(B) Monthly Inspection:

- (1) Seals shall be inspected for leakages. Locations of excessive leakages shall be recorded for taking remedial measures. Weeping or slight flow in localized area will not require immediate remedial measures.
- (2) The excessive or widespread leakages, if any shall be repaired to engineer-in-charge and remedial measures like tightening of bolts are carried out. Further adjustment is carried out during annual maintenance.
- (3) If leakage is so much excessive that immediate repair is considered necessary, the stop log gates shall be dropped and seals are repaired or replaced.

NOTE: - During monsoon period, stop log gates shall NEVER be lowered in spite of heavy leakage through seals.

- (4) Remove all dirt, grit etc. from trunnion assembly and lubricate trunnion bearings of the gate with suitable water resisting grease as recommended by bearing manufacturers.

(C) Quarterly Maintenance

The inspection of following components and their maintenance shall preferably be carried out once in three months but not less than thrice in a year including pre monsoon and post monsoon maintenance.

(1) Inspection of Trunnion blocks assembly and its anchorages:

- (i) All the nuts and bolts of Trunnion block assembly and its anchorages shall be checked for tightness.
- (ii) Check all the welds for soundness and rectify defects.
- (iii) Check whether the Yoke girder and thrust block is covered on nor. If not, cover it with mild steel plates.
- (iv) Cover the trunnion pin with anti corrosive jelly.

(2) Inspection of Gate Structures:

- (i) Check all the welding for soundness and rectify defects.
- (ii) Check welding between arms and horizontal girders as well as between latching bracket and skin plate with the help of magnifying glass for cracks/defects and rectify the defects.
- (iii) Clean all drain holes including those in end arms and horizontal girders.
- (iv) Check all the nuts and bolts and tighten them.
- (v) Check upstream face of skin plate for pitting, scalling and corrosion. Scaling be filled with weld and grinded. Corroded surface shall be cleaned and painted. In case of gates which cannot be raised every quarter, these can be carried out in annual maintenance.

(3) Annual Inspection and Maintenance:

The annual Inspection shall be combined with one of the quarterly inspections and in addition to those required in quarterly inspection, the following shall also be carried out:

- (i) All the sill beams and wall plates shall be inspected for crack, pitting etc. and defects shall be rectified.
- (ii) The guide roller pins shall be lubricated.
- (iii) Check the condition of wire rope and if poor replace.
- (iv) Adjust the rope tension of wire rope if unequal.
- (v) Check the condition of rubber seal, adjust at locations of leakages. If damaged, replace the seals.
- (vi) Grease the wire rope.
- (vii) Check the condition of rubber seals. All bolts and nuts holding rubber seals shall be tightened. If rubber seal is damaged, replace the seal.

MAINTENANCE:

As per IS: 10096 (part3)

- a) Defective welding should be chipped out and it should be rewelded duly following the relevant codal provisions.
Damaged nuts, bolts, revets, screws etc. should be replaced.
Any pitting should be filled up by welding and finished by grinding if necessary.
- b) The gate leaf, exposed embedded metal parts, hoists and hoist supporting structure etc., should be thoroughly cleaned and repainted when required keeping in view the original painting system adopted and as per the guidelines contained in IS: 14177.
- c) Trunnion bearing should be greased wherever required. Keeping trunnion bearings in perfect working condition is very important. All other bolted connections should also be checked up for proper tightness.
- d) Bolts and trunnion bearing housing should be tightened wherever required.
- e) The seals of the gate should be checked for wear and tear and deterioration. These should be adjusted/replaced as and when necessary.
- f) The wall plates, sill beams shall be checked and repaired if necessary.
- g) Wire ropes should be properly lubricated.
- h) Oil level in the worm reduction unit should be maintained by suitable replenishment. Oil seals should also be replaced if required. Lubrication of other parts of hoists such as chains, position indicators and limit switches should also be done.
- i) The stroke of the brake should be reset to compensate for lining wear. Worn out brake linings should be replaced in time.
- j) Flexible couplings should be adjusted if required.

- k) Repairs and replacements of all electrical relays and controls should be attended to.
- l) Maintenance of alternative sources of Power such as Diesel Generating sets and alternative drives wherever provided should be carried out.
- m) The list of essential spare parts to be kept available should be reviewed and updated periodically. The condition of spares should be checked periodically and protective coating given for use.

VERTICAL LIFT FIXED WHEEL AND SLIDE GATES:

INSPECTIONS

GENERAL:

These gates are provided for controlling water discharges for flood control, water supply, irrigation and power generation etc. The gates shall be thoroughly inspected for cracks, defects or damages periodically. A schedule of maintenance is proposed in the following sub sections which may be adopted with modifications, if required, due to site conditions and use of gate.

1) QUARTERLY INSPECTION

- A) All welds shall be checked for cracks/ damages and defects rectified.
- B) All drain holes shall be cleaned.
 - a) If pitting is observed on surface, it shall be repaired and grounded.
 - b) The rusted parts, if observed, shall be thoroughly cleaned and repainted as per approved painting schedule.
 - c) The Wheels shall be rotated to check their free movement.
 - d) The wheel bearings and guide rollers shall be lubricated.
 - e) The seal shall be checked for damages, if needed, shall be replaced.]
 - f) All nuts and bolts shall be tightened.
 - g) The guide-assemblies, wheel-assemblies and sealing-assemblies shall be cleared off grit, sand or any other foreign material.
 - h) The wheel pin shall be coated with corrosion resistant compound.

2) ANNUAL MAINTENANCE

During annual maintenance following additional checks or maintenance shall be carried out.

- a) All the embedded parts shall be checked for defects/ damages and rectified whenever noticed.
- b) The sill beam and guides shall be cleared for all grit, sand etc.
- c) The wire rope shall be checked for equal tension. If broken strands are noticed, the wire rope shall be replaced.
- d) The wire ropes shall be greased.

2. SPECIAL MAINTENANCE:

- (I) The repainting of the gates shall be carried at intervals to be decided on the basis of painting schedule of the gates.
- (II) The inspection, testing and maintenance of the hoist shall also be carried out periodically as suggested by the hoist manufacturer. The salient procedure has been described in a separate section.

MAINTENANCE [as per IS: 7718]

- a) Any weld that might have become defective should be chipped out and remade following the relevant codal provisions.
Damaged nuts, bolts, rivet screws etc should be replaced without delay.
- b) The gate slot and platform should be cleaned periodically. Scales formed over the embedded parts should be removed. All bottom corners should be cleaned and accumulations removed. Anchorages and concrete around anchorages should be checked for any development of cracks or slackness etc and repairs should be attended immediately.
- c) The gate leaf should be thoroughly cleaned and repainted as and when necessary according to the procedure or guidelines- indicated in IS: 14177 or as per the recommendations of the paint manufacturer.
- d) Rubber seals should be ground if necessary to keep it in one alignment. All nuts and bolts fixing the seal to the gate should be tightened uniformly. Seals, if found damaged or found leaking excessively should be adjusted, repaired or replaced as considered necessary.
- e) Gate roller bearings and guide roller bushes should be properly lubricated. Whenever necessary these should be opened for rectifications of defects and after cleaning and lubrication should be refitted. These may be replaced if repairs are not possible.
- f) Hoisting connection of the gate leaf should be lubricated where necessary and defects if any should be rectified.
- g) All nuts, bolts, check nuts and cotter pins of the lifting devices should be checked periodically.
- h) All components should be greased and lubricated. Recommended and approved oils and grease only should be used.
- i) Appropriate remedial measures should be taken so that the salient dimensions mentioned in clauses 9.2.1.2 and 9.2.2.6 and alignment of components mentioned in clause 9.2.1 of IS 7718 are set right. Appropriate repairs should also be carried out where excessive pitting and other surfaces are damaged are noted.
- j) Roller assembly should be adjusted by the eccentricity arrangement to ensure all rollers rest uniformly on the track plates particularly in the closed position of the gate.
- k) Where filling valves are provided as part of the gate structure, all the nuts, bolts, check nuts etc should be checked periodically. It shall also be ensured that the filling valves completely shut –off the passage of water when the load is removed. The springs and other components shall be checked periodically and replaced if necessary.

ELECTRICALLY OPERATED FIXED HOISTS.

1. General Instructions;

- a) Operation of fixed hoist without lifting the gate is not possible and need not therefore be attempted. It will be possible to operate the unit and observe operation of load carrying hoist component when gate is being lifted or lowered.
- b) Never open any bolt or nut on motor, gear boxes, rope drums and other load carrying hoist components when the gate is in raised position. The gate should be fully closed or rested on the gate latches before carrying out any work on hoist components including motor and trusts brake and other electrical equipment.

- c) The periodic maintenance of commercial equipment like motors, brakes, thrusts etc. shall be carried out as per manufacturer's operation and maintenance manual. However, general maintenance schedule of motors and brakes has been described under "Maintenance of Commercial Equipment".

Daily Inspection

1. Entrance to all hoist platforms shall be kept locked. All keys shall remain with the shift supervisor.
2. A cursory daily inspection shall be made of hoist and gate to ensure that there is no unusual happening.

Monthly Maintenance:

1. Clean all hoisting equipment and hoist platform.
2. Check oil level in gearboxes and replenish wherever required with oil of proper grade.
3. Apply grease of suitable grade by grease gun through all the greasing nipples.
4. Lubricate all bearings, bushings, pins, linkages etc.
5. Check all the fuses on the power lines.
6. All bolts and nuts on gear boxes, hoist drum and shaft couplings should be checked for tightness.
7. Check the supply voltage.

Electrical Maintenance:

- a) Starters should be cleaned free of moisture and dust.
- b) Each individual contactor should be tried by hand to make sure that it operates freely.
- c) All wearing parts should be examined in order to take note of any wear which may have occurred during operation.
- d) If the contactor hums, the magnet faces should be cleaned (Blackening of contacts caused by deposition of silver due to arcing is of no importance).
- e) Examine all connections to see that no wires are broken and no connections are loose.
- f) Clean the surface of the moving armature and magnet core which comes together when the contactor closes, free of dust or grease of any kind.
- g) Examine the mechanical interlocks between the reversing contactor and see when the contact tips of one of the contactor units are touching, it is impossible to get the contact tips of the other unit to touch.
- h) The contact tips should be kept free from burns or pits by smoothening with fine sand paper or emery paper.
- i) Replace the contact tips which have worn away half-way.
- j) Do not lubricate the contacts.

Quarterly maintenance

1. Carry out all those listed for monthly maintenance.
2. Drain sample gear oil from each of the gear boxes. If excessive foreign particles or sludge is found, the gear box shall be drained, flushed and filled with new oil.
3. All the geared couplings shall be greased.

4. Raise and lower the gate by hoist motor and check for smooth, and trouble free operation of gate without excessive vibration.
5. Observe current drawn by motor at the time of lifting and check if it is more than normal. If so, stop the hoist and investigate the cause and rectify.
6. Check the condition of painting of various components and remove rust wherever noticed and repaint the portion after proper cleaning as per painting schedule.

Annual Maintenance

The annual maintenance shall be combined with one of the quarterly maintenance and in addition to those required in quarterly maintenance, the following shall also be carried out.

1. All trash, sediments and any other foreign material shall be cleared off the lifting rope and lifting attachment.
2. All ropes shall be checked for wear and tear and if broken wires are noticed, the rope shall be replaced.
3. All the wire ropes shall be checked and all visible oxidation shall be removed.
4. All wire ropes shall be greased with shell cardium compound or equivalent brand.
5. Check the overload relays for proper functioning.
6. Check all the nuts, bolts, rivets, welds and structural components for hoisting platform and its supporting structure for wear, tear and damage. All damages shall be rectified. All bolts shall be tightened. The portion with damaged painting shall be touched up.
7. Check the pulleys, sheaves and turb-buckles.
8. Raise and lower the gate for its full lift several time (at least three to four) and observe the following:
 - a. Check the limit switches and adjust for design limits.
 - b. The effectiveness and slip of the breaks shall be checked by stopping the gate in raising and lowering operations. The brakes shall be adjusted if needed.
 - c. When the gate is operated, there should not be any noise or chatter in the gears.
9. Adjust the rope tension of wires if unequal.
10. Check for all gears and pinions for uneven wear and adjust for proper contact. Grease the gears.

PAINTING

Repaint the hoist components, hoisting platform and its supporting structures after a time interval depending upon the painting schedule.

MAINTENANCE OF COMMERCIAL EQUIPMENT

Moisture, oil, dirt, grease and carbon and metallic dust are the principal causes of break down. The motors shall, therefore, be kept dry down. The motors shall, therefore, be kept dry and clean. The frequency of inspection, serving and maintenance largely depends upon the nature and periodicity of its usage and its operating conditions. The following its operating conditions. The following maintenance schedule may be adopted in general.

Quarterly Maintenance

1. Blow out windings thoroughly by clean and dry air to clear air passage in the stator and the rotor of any accumulated dirt. The air pressure shall not be too high to damage the insulation.
2. Examine earth connections and motor leads.
3. Examine motor windings for overheating
4. Examine control equipments
5. Examine starting equipment for burnt contacts
6. Check and tighten all nuts and bolts
7. Clean and tighten all terminals and screw connections all contact surfaces shall be made clean and smooth.

Half yearly maintenance

1. Lubricate the bearings
2. overhaul the controllers
3. Inspect and clean circuit breakers.
4. Wipe brush holders and check bedding of brushes.

Annual maintenance

1. Blow out windings thoroughly by clean and dry air. The pressure shall not be so high that insulation may get damaged.
2. Check the insulation resistance of the motor between any terminal and the frame which should not be less than (1000+rated H.P.) megohms. If the measured resistance is less than this value, then steps shall be taken to dry-out the motors either by passing a low voltage current through the windings or by placing the stator and rotor only in a warm dry place for a day or so.

Important The complete motor shall never be put in an oven for drying as that may melt the grease out of bearings.

- (3) Coat the windings with an approved high temperature resisting insulation enamel or varnish.
- (4) Over haul the motor, if required.
- (5) Check the switch fuse units and renew, if required.
- (6) Check resistance or earth connections.
- (7) Check air gap.

Solenoids Operated Brakes

a) Quarterly maintenance

- 1) All fixing bolts shall be checked and tightened at least once in three months.
- 2) The magnet stroke should be reset to compensate for war.
- 3) Read just the brake when the magnet stroke reaches the value given on the instruction plate.
- 4) Brake lining should be checked and replaced when required.
- 5) Examine all electrical leads and connections.
- 6) Rubber bushes or couplings should be checked and replaced if defective.
- 7) The pins should be tightened.
- 8) Brake drum shall be cleaned to remove any dust or grease.

LUBRICATION AND GREASING:

A chart showing the lubricants normally used frequency of use for spillway radial gates and vertical lift gates, hoists is appended in Annexure-II

OPERATION AND MAINTENANCE OF GANTRY CRANE

Following aspects need to be attended before crane driving operations:

- Lubrication of each part of crane
- Removal of any loose/foreign material along the rail track
- Actuating tests of limit switches
- Actuating tests of brakes.
- All fuses in the control panel should be checked and if necessary it should be replaced.
- Necessary terminal connections of motors, brakes, thrust or etc is to be checked.
- Overload relay should be checked.
- Visual inspection of wire ropes for any snapped loose wire and its proper lubrication.
- Checking of rope clamps on the drum and tightening of bolts if required.
- Gearbox assembly should not have any leakage of oil.
- Unusual noise/vibration if any should be checked and rectified before operation.

II.GENERAL PRECAUTIONS TO BE TAKEN FOR OPERATION OF CRANE

- Crane should have interlocking system so that on one single operation namely hoisting, lowering forward or backward can only be affected at a time through the push button controller.
- Hoisting and lowering motion should be carried out only after the crane is securely clamped to the rails.
- Load on the crane at no time should exceed the safe working load.
- Operator should be well conversant for operating the crane for various motions of the crane and under various loading conditions. The operator should check long travel, cross travel, hoist motion etc. The operator should never use limit switches as a normal means of stopping the hoist motion. Limit switches are only emergency devices.
- No load should be left suspending from the crane.
- Crane should not have excessive side play while in motion on the gantry rail.
- Excessive sparking from any electrical devices, smoke from motors or brake drums if any should be rectified immediately.

III. PRE CAUTIONERY MEASURES:

- I) Ensure that the gates are operated by fully trained operators and that they are familiar with the operating instructions.
- II) No other person should be allowed to go near the operating mechanism without operator or his superior officer.
- III) Any unusual phenomenon such as excessive vibrations, noises, faults and damages are recorded and immediately reported to the competent authority.
- IV) Ensure limit switch arrangement is properly set.
- V) That check list on maintenance of gates is periodically signed by the inspecting authority.

- VI) Safety guards around moving parts must not be removed except during maintenance operation and with the equipment under static condition. It should be isolated electrically.
- VII) Safe and proper access to the maintenance working areas must be provided.
- VIII) When equipment is stationery, working parts may be under load, so due care must be taken before dismantling any part and when ever necessary, suitable supports should be provided.
- IX) Before equipment is put back to work, all parts should be checked thoroughly and see that they are properly assembled.

CONCLUSIONS:

1. CHECK - LIST

A check list is a list of items to be checked systematically by Engineers during inspection of hydro-mechanical equipments. It has also been referred to as an aide-memoir. The advantage of using checklists lies in the fact that by considering all points contained therein, the Engineer has not overlooked any standard which ought to be complied with at work place. Check – Lists may be descriptive checklists or corrective check lists. The check lists are enclosed as Annexure I.

A time Schedule for maintenance of all the hydro-mechanical equipment is to be prepared for each project individually based on the maintenance personnel available quantum of work involved (i.e. depending on the number of gates hoists or other hydro-mechanical equipment, age of the equipment, frequency maintenance etc.) or as per requirement by the project in charge of maintenance.

The Lubrication schedule is enclosed as Annexure II.

The maintenance schedule is enclosed as Annexure III.

A typical Quality Assurance plan is enclosed as Annexure IV.

NOTE: Check lists can be modified to suit the requirements at site.

REFERENCES:

- A) IS: 4622
- B) IS: 4623
- C) IS : 5620
- D) IS : 9349
- E) IS: 6938
- F) IS: 10096 (PART-I/Sec.1)
- G) IS: 10096 (PART -1/Sec.2)
- H) IS: 10096 PART 2
- I) IS:10096 PART 3
- J) IS: 7718
- K) IS: 7349
- L) IS: 11855
- M) IS: 14177
- N) IS: 11228

ANNEXURE – I

CHECK LIST FOR HYDRAULIC GATES

CHECK LIST FOR THE LOW HEAD SLIDE GATES/ FIXED WHEEL GATES:

Sl.No.	Item	Yes	No
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A. Hoist

- (i) Is the operation of hoist smooth?
- (ii) Whether the indicator is provided?
- (iii) Is the stop nut provided?
- (iv) Check nut and bolts of the king post
- (v) Check lubrication
- (vi) Observe the king post nut while lifting the gate
- (vii) Is correct Tommy bar used?

B. Stem Rod

- i) Are the stem rods in plumb?
- ii) Whether the guide bracket bushing touch the stem rods
- iii) Are all the flange bolts tight?
- iv) Whether the top stem rod portion is well lubricated and fitted with the indicator.

C. Embedded Parts

- i) Are the seal seats intact?
- ii) Have you noticed any pitting, corrosion on these parts?
- iii) Do seals indicate the normal wear and tear

D. Leaf

- a) Inspect the leaf when the water level depletes
- b) Check the leaf for the pitting and corrosion.
- c) Check the stem rod and leaf connection
- d) Check the leaf seals for the wear and tear
- e) Check if there are any foreign particles accumulated near the leaf bottom seal which may obstruct the gate closure.
- f) Does the gate seal properly seat on the embedded part seal
- g) Check the rollers for wear and tear
- h) Check the rollers properly rest & rotate on its track

E. General

- i) Are there any leakages from seals or the structure?
- ii) Check for the noise
- iii) Check for the vibrations
- iv) Check for the extra effort, if any, during its operation
- v) Does the gate close due to water pressure or needs adjustments
- vi) Are kaddi shutters provided
- vii) Is the ladder provided safely placed
- viii) Are there any beehives near the gate
- ix) Are there any poisonous snakes in the well or near the structure
- x) Are the air vent provided clear
- xi) Is the locking arrangement provided on the hoist?
- xii) Are the log books properly maintained?
- xiii) Is the maintenance properly done?
- xiv) Is any emergency plan drawn to meet the unexpected gate or dam failure?

CHECK LIST FOR RADIAL GATES

Sr.No.	Item	Yes	No
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(A) Hoist (Mech.)

- (i) Electric
- (ii) Is the motor working properly?
- (iii) Are the foundation bolts tight?
- (iv) Does it draw excess current?
- (v) Is properly earthed?
- (vi) Are all phases working?
- (vii) Is the generator set working properly?

(B) Brake

- 1) Are the brakes properly functioning?
- 2) Are they tested by lifting the gate load for few CMS?
- 3) Does it get unlocked while manual cranking?

(C) Gear Train

- 1. Is adequately lubricated?
- 2. Are any foreign particles accidentally left in the train?
- 3. Is a self locking hoist?
- 4. Is working smoothly?
- 5. Do bearing /Bushes get heated?

(D) Limit Switches

- 1. Are the switches well adjusted / maintained?
- 2. Are these tested?
- 3. Is the audio indicator fitted in case upper limit switch fails?

(E) Wire Ropes

1. Are these properly lubricated?
2. Whether these are properly clamped?
3. Is there any breakage of strand; found during inspection?
4. Have you inspected the lifting bracket?

(F) Trunnions

1. Is the pin properly lubricated?
2. Have you ensured that there are no foreign particles in between the pin end and the inside bracket face?
3. Are pin locking nuts tight?
4. Does it make any noise while in action?

(G) Anchor Bolts

1. Are all anchor bolts tight?
2. Are these well protected against aging?

(H) Seals

1. Have you checked the rubber seals for cracking / wear/tear?
2. Are the leakages if any within the permissible limit?

(I) Guide Rollers

1. Are the rollers free?
2. Are these well lubricated?
3. Are the nut and bolts tight?

(J) Welding

1. Have you inspected all important welded joints?
2. Do they show signs of distress?

(K) Embedded parts

1. Are all embedded parts checked for the corrosion / pitting?
2. Do they need anti corrosive treatment?

(L) GATE ASSEMBLY

1. Are gate parts free of rusting and corrosion?
2. Are all drain holes clear /
3. Are all nut and bolts tight?
4. Does the gate leaf vibrate while opening and closing?
5. Are there any jerks while lifting or closing the gate?

(M) PAINTING

1. Does the gate need painting?
2. Are any signs of corrosion?
3. Is Ph value of water checked?

(N) INSPECTION

1. Was detailed inspection carried out by the inspection wing?
2. Are points raised in the inspection complied?

(O) General

1. Are stop log gates provided /
2. Are the ladders provided are properly placed and safe?
3. Are there any beehives on or near the gate?
4. Is the structure inhibited by snakes /
5. Is the locking arrangement for the gate provided?
6. Are the log book and other record properly maintained?
7. Are you aware of the emergency plan in the event of the gate/dam failure

REMEMBER DAM SAFETY IS IN YOUR HAND

The check list given below shows the points to be checked by the engineer in charge at least once a year.

- (a) Name of the Project
- (b) Name of the Officer
- (c) Date of inspection
- (d) Water level above the sill
- (e) Date of last inspection

INSPECTION CHECK LIST

Yes No

1. Is the gate operator trained?
2. Whether gate is maintained properly?
3. Whether any trouble was noticed in the gate operation on last one year?
4. Is the maintenance programme for the gate chalked out?
5. Is the log book and order book properly maintained?
6. Whether any complaints received from villager due to the faults in gate operation?
7. Are defects if any, reported to the Mechanical Engineer?
8. Are recommended tools, lubricants and spares maintained at the site?

ANNEXURE – II
LUBRICATION SCHEDULE

Sl. No.	Part to be lubricated	Mode of Lubrication	Lubricant	Frequency
1	Trunnion pin bush bearing	Prssure grease gun	Servo gear-20 bearing grease or	Once in three months as per site conditions.
2	Gate wheel bearings	Pressure grease gun	Servo gear-20 bearing grease or	Once in three months as per site conditions.
3	Guide rollers	Pressure grease gun	Bearing Grease	Once in three months as per site conditions.
4	Hoisting wire rope	Hand applied	Servo gear-120 or Cardium Compound	Once in a year before monsoon sets in
5	Worm reducer	Oil bath	Servo HP-30	Indicator level to be maintained always.
6	Spur Gear Bearings	Pressure grease gun	Bearing Grease	Once in three months as per site conditions.
7	Line shaft bearings	Pressure grease gun	Bearing Grease	Once in six months as per site conditions
8	Gear Wheels	Hand applied	Chassis Grease	Once in six months as per site conditions
9	Drum shaft	Pressure grease gun	Chassis Grease	Once in three months as per site conditions.

10	Lifting Arrangement and buckles	Hand applied	M.P Grease	Once in six months as per side conditions
11	Hand operation mechanism and other relating parts	Hand applied	Servolin - 140	Once in three months as per site conditions.

ANNEXURE – III

**CHART FOR MAINTENANCE SCHEDULE FOR GATES
(IS: 7718/IS:10096 Part III)**

Sl. No	Quarterly	Every Year	Every three years	Every six years
1	General cleanliness of embedded parts, Gate hoist components	In addition to Quarterly maintenance schedule the following are to be checked	In addition to yearly maintenance schedule, the following are to be checked	Check welds for damages at
2	Check for oil level in worm reducers	Check the tightness of foundation bolts of Motors, worm reducers, Plummer blocks, coupling joints	Check the condition of wire rope, pulleys, sheaves, limit switch, brakes and gear wheels	a)Skin plate joints b)Tee girders to horizontal girders c)Horizontal girder to arm d)Arm bracings e)Horizontal girder bracings. f)End boxes g)Gate stiffeners.
3	Greasing of pulleys and pins	Check for smooth operation of gate by raising and lowering	Check gate seals for damages	Check wheel assemblies for any a) Breakage b) Freezing c) Corrosion d) Misalignment
4	Trunnion pin, Rope drum hoists, Gear wheels, Hand operation of shaft, guide rollers, Gate wheels.	Check for condition of painting of all components	Check seal for bolts for damages	Check for sill beam, side gude, roller tracks for damages, corrosion, pitting.
5	Check for operation of brakes			Check hoist bridge for foundation bolts for tightening

6	Check for loose electrical connections			
7	(In case of fixed wheel gates) 1. Wheels are to be greased properly 2. Movement of wheels should be smooth and it can be rotated by hand			

**ANNEXURE - IV
(Clause :9.1, IS:7718)**

Typical Quality Assurance Plan for Manufacture, erection and periodical Maintenance

Project: _____ **Type of Gate:** _____
Manufacture: _____
Purchaser: _____
Agreement No: _____

Sl.No	Component	Characteristics	Type of Check	Quantity of Check	Acceptance norm
1	RAW MATERIALS				
1.1	Hot rolled plates, section and rolled rounds.	Physical properties	Verification of material testing certificate	1 per batch	As per relevant Indian standard
1.2		Chemical properties	-do-	-do-	-do-
1.3		Dimensional check	Measurements	Random/full	IS 1852
1.4		Ultrasonic check for Laminations	UT Examination	100%	Level III, IS 3664
2	CAST STEEL - Items				
2.1	Gate rollers, Guide roller Assembly, Gear wheels	Physical properties	Mech. Test with bar	1 per heat	As per relevant Indian standard
2.2		Chemical properties	Chemical analysis	-do-	-do-
2.3		Heat treatment	Heat chart	-do-	-do-
2.4		Dimensions	Measurements	100%	-do-
2.5		UT testing	UT Ex.	-do-	IS 3664
2.6		Hardness	Hardness	As specified in App. Drg.	Tolerance 10
3	FORGINGS				
3.1	Rollers and pins	Physical properties	Verification of material testing certificate	Entire Lot	As per relevant Indian standard
3.2		Chemical properties	-do-	-do-	-do-
3.3		Bend test	-do-	-do-	-do-
3.4		Heat treatment	Heat chart	-do-	-do-
3.5		Dimensions	Measurements	100%	No significant defect
4	STAINLESS STEEL				
4.1	Plates for seal seats, wheel tracks and pins	Physical properties	Verification of test certificate	100%	As per relevant Indian standard
4.2		Chemical properties	-do-	-do-	-do-
4.3		Hardness	Measurements	-do-	-do-
4.4		Dimensions	-do-	-do-	-do-
4.5		Surface defects	Visual inspection	-do-	Approved Drawing

4.6		U.T. tests for internal defects	UT test	-do-	Level III, IS 3664
5			RUBBER		
5.1	Rubber seals	Physical properties			
		i) Hardness after vulcanizing	Verification of test certificate	Random one for batch	IS 11885
		ii) Elongation	-do-	-do-	-do-
		iii) Tensile strength	-do-	-do-	-do-
		iv) Water absorption test	-do-	-do-	-do-
		v) Dimension	Measurements	100%	Approved Drawing
6	BOUGHT OUT ITEMS				
6.1	Bolts, nuts & bearings etc.	Hardware items	Verification of test certificate	Random	Approved Drawing
6.2		Specification and make	-do-	-do-	-do-
6.3		Dimensional check	Measurements	-do-	-do-
6.4		Physical properties	Verification of test certificate	-do-	As per approved drawings and relevant Indian Standard
6.5		Chemical properties	-do-	-do-	-do-
7	WELDING				
7.1	Fillet welds and butt welds	Weld procedure for fillet and butt welds	Verification of document	Random	IS 3658, IS 3664
7.2		Qualification of welders	-do-	-do-	IS 7318 (Part-1) & IS 822
7.3		Quality of fillet welds	Visual	-do-	No significant defects
7.4		Quality of fillet welds	Die penetration	100%	No Significant Defects
			Ultrasonic Test/Radiographic Test	10%	Level III IS3664
FABRICATION OF GATE PARTS					
8		Dimensional inspection	Measurements	Each	Approved Drawing
8.1	Skin Plate Assy. Horizontal girders, Wheels, Pins	-do-	-do-	-do-	Tolerance as per relevant Indian Standard
8.2		-do-		-do-	Tolerance as per relevant Indian Standard
8.3		Surface Finish (Machined)	Visual / Comparison with comparator	100%	Approved Drawing

9	EMBEDDED PARTS				
9.1		LH	Measurements	Each	Approved Drawing
		RH	-do-	-do-	Tolerance as per relevant Indian Standard
9.2		LH-Top	-do-	-do-	Tolerance as per relevant Indian Standard
		LH-Bottom			
9.3		RH-Top	-do-	-do-	Tolerance as per relevant Indian Standard
		RH-Bottom			
9.4		Surface Finish (Machined)	Visual / Comparison with comparator	100%	Approved Drawing
10			PAINTING		
10.1	Gates	Surface preparation	Visual	Random	Approved Drawing or technical specification
10.2		Primer Coat	-do-	-do-	-do-
10.3		Intermediate Coat	-do-	-do-	-do-
10.4		Finish Coat	-do-	-do-	-do-
10.5		Thickness of paint	Measurement with comparator	-do-	-do-
11			ERECTION		
11.1		Check for critical dimensions	Measurements	Each	Approved Drawing or technical specification
11.2		Balancing of gate	Verification	-do-	-do-
11.3		Dry test	Visual with light source	-do-	-do-
11.4		Leakage test	Visual	-do-	As per Clause 8