

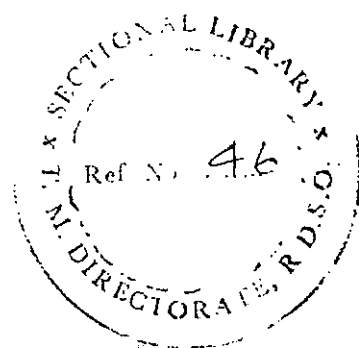
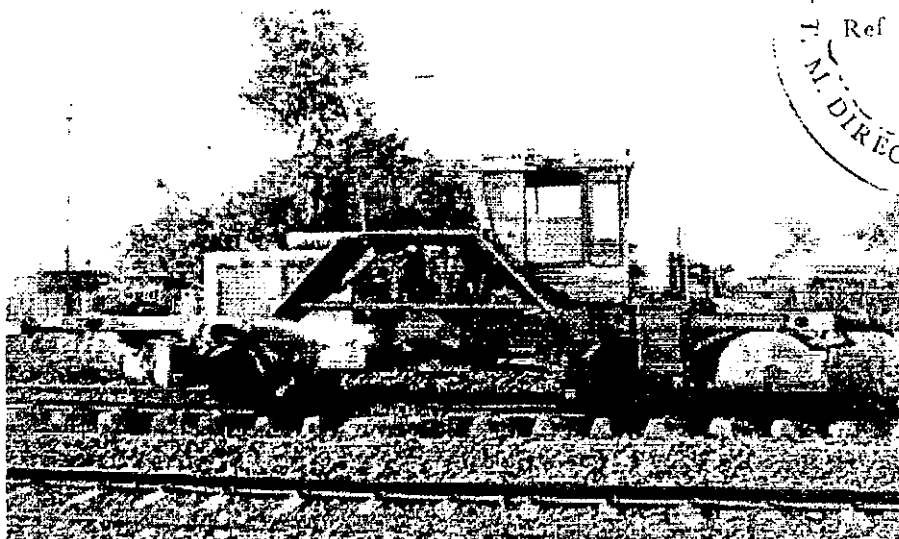
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GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TROUBLE SHOOTING MANUAL OF BALLAST REGULATING MACHINE

(Model 66-4 and 56-3)



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RESEARCH DESIGNS & STANDARDS ORGANISATION
LUCKNOW-226011

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P_R_E_F_A_C_E

About 364 On-Track Machines are presently working on Indian Railways covering different works related to track maintenance and renewals. To improve utilization of these machines, it is important to reduce their downtime and repair them in the shortest possible time. In this context, need had been felt to develop Trouble Shooting Manuals for different On-track Machines. Railway Board, vide their letter no. 96/Track-III/TK/44 dated 01.4.1999, constituted a committee of Sr. Professor / Track Machines, IRICEN / Pune, Deputy Chief Engineer / CPOH, Northern Railway, Allahabad, Deputy Chief Engineer / Track Machines, Central Railway, Jhansi and Director/Track Machines, RDSO, for preparing such manuals for track machines. The Provisional Trouble Shooting Manuals for Continuous Tamping Machine (CSM 09-32), Points and Crossing Tamping Machine (UNIMAT), Dynamic Track Stabilizer (DGS), Ballast Cleaning Machine (BCM) (Final) and Point and Crossing Changing Machine (T-28) have already been prepared and issued. This manual is also an effort in the same direction.

It is hoped that this manual will be quite useful for field staff attending break-down of machines. However, there can always be scope for improvement for which suggestions may be sent to the undersigned.

Lucknow,
May, 2001

Surendra Kumar
Executive Director/TM
RDSO/Lucknow-226011.

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EXPLANATORY NOTES

While preparing the text of trouble shooting manual of Ballast Regulating Machine the terms used and their meanings are explained below:

- CHECK** - Ensure a specific condition does (or does not) exist.
- INSPECT** - Look for damage and defects including breakage, distortion, cracks, corrosion and wear, check for leaks, security and that all items are completed.
- REPLACE** - Remove old parts and substitute with a new or overhauled or reconditioned part. Fit new or overhauled or reconditioned part in place of missing part.
- OVERHAUL** - Dismantle, examine, recondition or renew parts as necessary against given specifications, reassemble, inspect and test.

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**TROUBLE SHOOTING MANUAL OF
BALLAST REGULATING MACHINE (Model 56-4 AND 56-3).**

I. ENGINE :

Model 56-4

Cummins Model NTA 743P
Diesel engine 265 hp
@ 1800 rpm.

Model 56-3.

Cummins Model NTA 743C
Diesel engine 250 hp
@ 1800 rpm

S. No.	Faults	Probable Causes	Remedial Actions
1.	Engine does not start.	1. Emergency stop switch. 2. No fuel in the tank. 3. Shutdown mechanism stuck. 4. Air in fuel system. 5. Governor is stuck. 6. Misconnection of starting switch. 7. Faulty valve clearance.	1. Emergency stop switch should be in release position. 2. Fill fuel in the tank <i>And bleed air from fuel system as explained below:</i> i) Loosen the Bleed Plug on the fuel filter and operate the priming pump until the fuel is free from air bubbles. Tighten the bleed plug. ii) Then loosen Banjo Plug on injection pump and operate priming pump until fuel is free from air bubbles. Tighten the Banjo Plug. 3. Check shut down mechanism i) Release engine shutdown lever from stop position. ii) Check electrical shutdown circuit for proper functioning. 4. Bleed air from fuel system as explained in s. no. 1, item 2 above. 5. Replace complete fuel injector pump. 6. Check starting switch and if any misconnection is noticed, rectify it. 7. Adjust valve clearances. follow these steps i) Unscrew bolts and remove cylinder cover. ii) Crank the engine until the inlet valve is closed, then turn approximately half turn further

S. No	Faults	Probable Causes	Remedial Actions
			iii) The feeler gauge of 0.69mm & 0.36mm should pass between the rocker lever and the cross head for the exhaust and intake valve with suction consequently. This will be done by loosening the lock nut and readjust by means of setting screws. Renew gasket, sealing ring of cylinder head cover.
			iv) Tighten the lock nut and recheck the valve clearances with the prescribed feeler gauge mentioned in sl.(iii).
	8. Not de-clutched.	8. De-clutch where possible.	
	9. Wrong SAE grade of engine oil or poor quality of oil.	9. Use the lube oil of recommended grade.	
	10. Weak batteries.	10. Check electrolyte level in the batteries. Terminals should be clean and the charging system should be working. Over-aged batteries should be replaced.	
	11. Injectors not properly functioning.	11. Remove faulty injectors and get it overhauled / calibrated or alternatively replace it with new one.	
	12. Valves not seating properly.	12.i) Check the valve springs and replace the broken spring if any. ii) Lap the valves. iii) Lap the valve seat, if required.	
	13. Too much fuel in engine or flooded engine.	13.i) Clean fuel return pipe. ii) If return pipe is already clean, calibration of fuel pump may be defective that should be got calibrated.	
	14. Starter defective or starter relay defective or pinion does not engage.	14. Check, rectify or replace, if required.	

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S. No	Faults	Probable Causes	Remedial Actions
		<p>15 Ignition key 'ON' and starter switch operated but engine is not cranking.</p>	<ol style="list-style-type: none"> 1. Electrical supply is not reaching the starter. Check electrical circuit from the starter solenoid. 2. Electrical supply is reaching but the starter solenoid not operating. Solenoid coil is open circuit. Replace the starter. 3. Solenoid is operating but pinion is not throwing forward or rotating. Starter coil may be burnt. Replace the starter. 4. Pinion is throwing forward and getting engaged with the starter ring but the engine is not cranking due to. <ol style="list-style-type: none"> a. Starter clutch assembly defective. Replace the starter. b. Battery is weak and is not able to supply the required current. Get charged the battery or replace it. c. Engine may be seized. This can be checked by removing the starter assembly and cranking the engine manually. If engine is not cranking then seek expert advice.
		<p>16 Ignition key is 'ON' and engine is cranking but not getting start when starter key is operated</p>	<ol style="list-style-type: none"> 1. Starter is not giving the required RPM to start the engine due to wear starter /battery or both. Replace as per requirement. 2. Emergency stop switch is pressed. Release the switch. 3. No oil in fuel tank. Fill up the tank. 4. Fuel pump coupling is damaged. Replace the coupling. 5. Fuel pump may be defective. Replace the pump.

S. No.	Faults	Probable Causes	Remedial Actions
2.	Engine started but shutting down.	<ol style="list-style-type: none"> 1. Air in fuel system. 2. PIP governor not functioning properly. 3. Dirty fuel filter. 4. Dirty air cleaner filter. 5. Engine safety system malfunctioning (low lub. Oil, Hyd. Coolant temp., Hyd/Lub oil temp.) 	<ol style="list-style-type: none"> 6. Incorrect fuel injection timing is to be adjusted by engine expert. 7. Incorrect tappet clearance, same is to be adjusted. 1. Bleed fuel system. 2. Replace fuel pump. 3. Replace filter. 4. Clean/Replace filter. 5. Check and attend the failure.
3.	Engine stops Suddenly during run.	<ol style="list-style-type: none"> 1. No fuel. 2. Air in the fuel system. 3. Valve clearances are not proper. 4. Governor is stuck up. 5. Overheating of Engine 6. Fuel filter / fuel pre-filter contaminated. 7. Shut down circuit fails. 8. Lube oil pressure too low. 	<ol style="list-style-type: none"> 1. Fill fuel in the tank and follow steps same as 1(2). 2. Bleed air from fuel system as explained in steps of para 1(2) above. 3. Adjust the valve clearances as explained in 1.7(iii). 4. Governor needs repairs/overhauling in work shop. 5. Take remedial action same as 1(5). 6. Check / clean/replace as per need. 7. Check and repair the faulty circuit. 8. i) Check lube oil pump. ii) V-belt for lube oil pump may be broken. Change with new one. iii) Wrong grade of lube oil. Use Proper grade of oil.
4.	Engine misfiring.	<ol style="list-style-type: none"> 1. Dirty fuel filter. 2. No / less fuel in tank. 3. Air in fuel system. 	<ol style="list-style-type: none"> 1. Check fuel filters and replace if necessary- 2. Fill fuel in the tank and follow steps same as 1(2). 3. Bleed air from the system, same as 1(2).

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S. No	Faults	Probable Causes	Remedial Actions
		4. Faulty Injector / Injection line leaky.	4. Remove the faulty injector and get it overhauled / calibrated. Alternatively, replace the faulty injector with new one.
		5. Faulty valve clearance.	5. Adjust valve clearances.
		6. Fuel injection timing improper.	6. Correct the timings or call the service engineer.
5.	Excessive black smoke at idle.	1. Restricted fuel lines 2. Plugging of injector spray holes. 3. Cracked injector body 4. Long idle period. 5. Gasket blow-by or leakage. 6. Broken or wrong piston rings. 7. Injectors needs calibrations.	1. Check the fuel lines. 2. Injectors needs cleaning 3. Replace the broken one. 4. Do not run the engine at idle speed for long period 5. Replace the defective gasket 6. Use the piston rings of standard part no. from engine manufacturer 7. Get the engine calibrated through specified agency
6.	Excessive white smoke at idle	1. Poor quality of fuel. 2. Cracked injector body 3. Coolant temperature low. 4. Long idle periods. 5. In correct valve and injection timing.	1. Use proper grade of fuel. It will be better if fuel is tested chemically 2. Replace the cracked one 3. During winter season top up the radiator with boiled water to keep the water temperature normal. 4. Do not run the engine at idle speed for long periods. 5. Get the injector calibrated and called the engine service engineer for setting of valve and injection timing
7.	Excessive smoke under load	1. Restricted air in take. 2. Dirty turbo charger compressor. 3. Poor quality of fuel. 4. Restricted fuel lines.	1. Clean the air filter or replace if required 2. Get it clean 3. Same as 6(1). 4. Check the fuel lines and clean it as per requirement.

S. No.	Faults	Probable Causes	Remedial Actions
		5. Fuel pump calibration in correct	5. Get the fuel pump calibrated through specified agency.
		6. Injector needs calibration	6. Get the injector calibrated through the specified agency.
		7. Engine due for overhaul	7. Get the engine overhaul through service engineer of engine manufacturer
8.	Engine speed irregular.	1. Air in fuel system	1. Bleed air from fuel system
		2. Governor stuck up	2. Governor needs repair. Call the service engineer of engine manufacturer
		3. In correct fuel pump calibration	3. Get the fuel pump calibrated
		4. External/internal fuel leakage.	4. Check leakage and prevent it.
9.	Engine run - ning too hot.	1. Coolant level too low.	1. Check coolant level and top up with coolant upto the mark in the filler neck .
		2. Oil cooler/cooling fins choked.	2. Clean oil cooler/cooling fins with recommended chemicals.
		3. Radiator dirty.	3. Clean the radiator.
		4. V-Belt for water Pump broken/ loose.	4. Tighten the loose V-belt within 12.5 mm deflection at center or replace if broken.
		5. Radiator fan belt Broken .	5. Replace the same.
		6. Radiator fan bearing damaged.	6. Replace the damaged bearing.
		7. Thermostat defective.	7. Thermostat to be attended by representative of OEM.
		8. Faulty valve clearances.	8. Adjust valve clearance same as 1.7(iii).
		9. Water pump defective.	9. Water pump to be attended by representative of OEM.
		10. Incorrect fuel injection timing.	10. Get the fuel pump attended by OEM.
		11. Oil level too low or high.	11. Keep the oil level within limits.
		12. Air cleaner Contaminated.	12. Clean/Replace.
		13. Turbocharger defective.	13. Replace.
		14. Engine overloaded.	14. Engine should run within prescribed load

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S. No	Faults	Probable Causes	Remedial Actions
10	Engine Knocking	<ol style="list-style-type: none"> 1. Incorrect injector setting or defective injector. 2. Damage to piston/piston rings/liners 3. Connecting rod bearing damaged 4. Injector pipe leaking 5. Fuel pre-filter/fine filter contaminated. 6. Incorrect tappet clearance. 7. Faulty damper/flywheel balance. 8. Fuel pump calibration incorrect. 	<ol style="list-style-type: none"> 1. Remove the faulty injector and get it reset or alternatively replace it with new one. 2. Call in the service engineer for replacement of the damaged items. 3. Replace connecting rod bearing. 4. Replace the damage one. 5. Check/clean/replace. 6. Adjust tappet clearance as indicated in sl.1.7(iii). 7. If the movement of damper/flywheel is eccentric replace the same. 8. Get the fuel pump calibrated.
11	Output of the engine too low.	<ol style="list-style-type: none"> 1. Dirty fuel filter and fuel line. 2. Air in fuel system. 3. Faulty Injector. 4. Faulty valve clearances. 5. Air filter choked. 6. Improper compression. 7. Governor sticking. 	<ol style="list-style-type: none"> 1. Replace fuel filter and clean fuel line. 2. Bleed air from system as explained in para 1(2).above. 3. Remove faulty injector and get it overhauled or alternatively replace it with new one. 4. Adjust valve clearances same as 1.7(iii) 5. Clean/Replace air filter element. 6. Engine needs repairs in work-shop. 7. Governor needs repairs in work-shop
12	Oil pressure low.	<ol style="list-style-type: none"> 1. Dirty lube oil filter. 2. Improper oil grade 3. Oil control valve not working. 4. Oil level too low 5. Excessive inclination of engine. 	<ol style="list-style-type: none"> 1. Replace the lube oil filter element. 2. Use proper grade of engine oil. 3. Call the service engineer for repair of control valve. 4. Fill the oil upto required level. 5. Adjust inclination.

S. No.	Faults	Probable Causes	Remedial Actions
		6. Dirty oil cooler 7. Excessive wear in connecting rod/ main bearing 8. Mixing of diesel or coolant in Engine oil 9. Wrong grade of oil.	6. Call in the service engineer for cleaning of the oil cooler 7. Engine needs to be overhauled in work shop. 8. same as (5) 9. Use recommended grade of oil as per weather condition.
13.	Oil film present in crank case ventilation.	1. Incorrect compression 2. Wrong grade of lube oil.	1. Engine needs repairs at work shop. OR Call in the service engineer 2. Use lube oil of proper brand and grade as recommended by the OEM.
14.	Fuel consumption too high.	1. Lube oil level too high. 2. Incorrect setting of Injector. 3. Incorrect valve and injection timing. 4. Clogged air filter. 5. Poor compression.	1. Keep the lube oil within limits. 2. Replace or overhaul faulty injector. 3. Get the timing reset. 4. Clean air filter/replace. 5. Call the service engineer. Engine needs repairs in work shop.

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S. No.	Faults	Probable Causes	Remedial Actions
15	Lube oil consumption too high	<ol style="list-style-type: none"> 1. Incorrect lube oil brand. 2. Excessive inclination of engine 3. Oil level too high. 4. External and internal Oil leaks. 5. Poor compression. 6. Broken or wrong piston rings & worn out piston/liners. 	<ol style="list-style-type: none"> 1. Use proper grade and quality lube oil as recommended by OEM. 2. Adjust inclination 3. Keep the lube oil level within limits 4. Prevent the leakage. 5. Replace compression rings or valves. Valve seats has to be lapped. 6. Engine due for top overhauling .
16.	Mixing of diesel in oil.	<ol style="list-style-type: none"> 1. External or internal fuel leaks. 2. Damaged injector O-rings. 3. Long idle periods 4. Dribbling of injectors. 	<ol style="list-style-type: none"> 1. Prevent the leakage. 2. Replace the defective one. 3. Do not run the engine at idle speed for long periods. 4. Calibrate injectors.

**I.A. POSSIBLE DISTURBANCES IN TURBO-CHARGED DIESEL ENGINES
WITHOUT BOOST PRESSURE CONTROL VALVES.**

S. No.	Faults	Probable Causes	Remedial Actions
1.	Lack of power Boost pressure	1.0 Air filter system dirty. Suction and pressure pipes deformed and /or leaking 1.1 Too high flow resistance in the exhaust gas system and/or leakage at the inlet of turbine. 1.2 Injection unit and/or fuel system defective. 1.3 Compression too low. 1.4 Charge after cooler dirty. 1.5 Turbocharger defective. Wheels rubbing on housing walls.	1.0 Examine filter system, service or replace filter if required. Check, and repair or replace pipes, tighten loose joints. 1.1 Check exhaust gas pipes, gaskets and silencers, carry out repairs required. 1.2 Check setting values and function, correct if required. 1.3 Check valves, cylinders, Pistons and piston rings, Service or replace Defective parts if required. 1.4 Clean unit and replace if Necessary. 1.5 Examine turbocharger, repair Or replace if necessary.
2.	Power and / or boost pressure too high.	Injection unit defective.	Check setting values and correct if Required.
3	Black exhaust smoke	See points 1.0, 1.3, 1.4, 1.5	See points 1.0, 1.3, 1.4, 1.5
4	Blue exhaust smoke.	1. Worn valve guides and piston rings. 2. Compressor side and /or turbine-side sealing in the turbocharger defective.	1. Measure the blow-by volume at crankcase outlet. Overhaul engine if required. 2. Examine turbocharger, repair or replace it as required.

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S. No.	Faults	Probable Causes	Remedial Actions
5.	Oil leakage at turbo-charger	<ul style="list-style-type: none"> 2. Turbocharger oil drain-pipe clogged and / or deformed. 1. Oil-feed pipe and/or oil drain pipe loose and leaking 2. Leakage at connection between compressor and bearing housings 	<ul style="list-style-type: none"> 2. Clean oil drain pipe, repair if necessary 1. Clean Turbocharger, check for leakage and rectify. 2. Repair or replace turbo-charger

IMPORTANT

IN CASE OF ENGINE FAILURE DURING TRAFFIC BLOCK WORKING.

(Make arrangement for clearing the section by asking for assisting power or by towing with other machine, if working in the same section.)

1	Machine stopped during working in block section.	<ul style="list-style-type: none"> 1. Sudden rise in Engine temperature. 2. Sudden drop in oil pressure 3. Failure of lube oil pump 	<ul style="list-style-type: none"> 1. Breakage of V-belt for water pump. Replace the broken one. 2. Level of water in radiator is too low. Top up the radiator 3. Temperature of air surrounding engine may be too high. In this case shut down the engine for a little duration. 1. Poor grade of lube oil. Use recommended grade of oil 2. Sudden heavy leakage. Prevent the leakage and refill the crank case up-to safe limit. 3. Choking of oil cooler. Cooler to be cleaned 4. Mixing of diesel may take place in crank case. Check the source of mixing and refill the crank case after draining the previous 3. Lube oil pump is to be repaired or replaced
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II. HYDRAULIC - PUMP

S. No	Faults	Probable Causes	Remedial Action
1.	Pump not delivering oil.	<ol style="list-style-type: none"> 1. Pump driven in wrong direction w.r. a-vis of shaft rotation (at the time of new pump fitment, this problem may occur) 2. Oil level too low in the reservoir (if oil level is very low, aeration may take place and pump will not deliver oil). 3. Intake filter/pipe choked 4. Air leaks in pump intake joints. 5. Broken pump shaft or rotor. 6. Pump speed too slow. (The delivery rate of discharge is prescribed at a certain rpm of engine. If engine speed becomes less than ideal speed, it may affect the proper suction of oil) 	<ol style="list-style-type: none"> 1. Check the pump rotation by hand priming. Pour the hydraulic oil into inlet port and rotate the shaft. See whether the oil is delivering through outlet port or not. If not, change the rotation according to the engine shaft rotation. 2. Check oil level in reservoir and it should be above minimum mark. If necessary, recoup the oil. 3. Clean or replace filter for proper flow of oil. 4. Pour hydraulic oil on intake joints and on observing abnormal sound, tighten the intake joint as required. 5. Remove the broken shaft or rotor. Also align the prime mover shaft 6. Pump should run at prescribed speed. Engine rpm should be checked.

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S. No.	Faults	Probable Causes	Remedial Action
		7. Dirty suction filter	7. Replace the filter.
		8. Faulty suction valve	8. Repair or change the valve
		9. Air in system.	9. Discharge air from the system
		10. Pump drive inoperative	10. i) Replace the broken pump shaft ii) Replace the sheared spline iii) Change defective coupling
		11. Clutch, out of adjustment.	11. Adjust clutch.
		12. Pump is damaged	12. Replace with new one
2.	Pumps make noise	1. Aeration.	1. i) Fill the reservoir with the oil up-to required level to prevent aeration. ii) Check all connections on inlet side of pump and pour hydraulic fuel over suspected leakage. Leakage has been found, if noise stops. Fill hydraulic tank to the full mark iii) Check condition of pump shaft seal. Change, if required
		2. Restricted or partly clogged suction line, suction filter.	2. Clean or replace the filter or line.
		3. Pump running too fast.	3. Reduce speed upto prescribed limit.
		4. Coupling misaligned (Due to this, bearing may get damaged, there will be a play at shaft, abnormal sound will be observed)	4. Realign the pump shaft and prime mover shaft.
		5. Reservoir not vented properly.	5. Air breather screening element should be cleaned
		6. Suction Filter too small in size.	6. Replace by proper size of filter.
		7. Air leaks at pump intake pipe joints and air drawn through inlet line.	7. Take action as explained in s.no.1. item no. 4.

S. No	Faults	Probable Causes	Remedial Action
		Oil viscosity may change in cold climate. Oil viscosity becomes high so no free flow will take place and cavitation will occur. Pump is air bound	9. Start the engine for few minutes to warm-up the hydraulic oil used in machine for proper flow. Use only proper grade of oil.
	10. Cavitation		10. Stop the pump immediately. Bleed the pump by priming before restarting.
			10. i) Check condition of suction strainer and return line filters. Clean or change as necessary. ii) Check clogging of inlet line. Clean or change as necessary. iii) Check loose fittings on suction lines. Tighten, if required. iv) Clean hydraulic tank breather.
	11. Shaft seal leaks		11. Replace jointing or seal.
	12. Oil foams.		12. Vent the system.
	13. Casing leaks.		13. First tighten bolts, then check for cracks and sealing.
	14. Vane spring broken.		14. Change spring.
	15. Pump or motor part defective.		15. Replace defective parts.
	16. Pump or motor stressed.		16. Check mounting alignment. Tighten bolts uniformly.
	17. Foreign bodies in suction line		17. Remove foreign bodies, if needed flush the system.
	18. System dirty.		18. Flush the system.
	19. Sharp bends in suction line.		19. Eliminate or reduce number of bends in suction line.
	20. Oil temperature too high		20. Check circuit for this cause. Oil cooler may be ineffective. Rectify the failure
	21. Boost pump failed		21. Check boost pump.
	22. Resonance through tank.		22. Change the position of tank and install sound damping means.
	23. Erroneous suction hose		23. Change suction hose.
	24. Vibration in system		24. Check unusual occurrence in the system.

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S. No.	Faults	Probable Causes	Remedial Action
Pump or Motor overheats	<p>25. Pump worn or damaged.</p> <ol style="list-style-type: none"> 1. Wrong oil grade 2. Oil speed in system too high. 3. Oil level too low 4. Pump or motor rotor groove worn out 5. Radial or axial loading too high. 6. Initial speed rises. 7. Inadequate cooling 8. Cooling system is dirty. 9. Differential pressure too low. 10. Pressure too high. 	<p>25. Pump should be overhauled or replaced</p> <ol style="list-style-type: none"> 1. Fill oil as recommended. 2. Install pipes of greater nominal size 3. Fill the oil upto safe level 4. Change pump or motor parts 5. Limit to acceptable amount. check alignment. 6. Check max. pressure. if needed increase pump size and install pipes of larger nominal bore 7. Increase cooling capacity. 8. Establish cause and repair the defect. 9. Increase pressure setting of relief valve. 10. Reduce pressure setting. 	
	<ol style="list-style-type: none"> 11. Wrong type of pressure valve. 12. Faulty operation in system. 13. Wrong seals. 14. Filter dirty or too small. 15. Pump running speed high. 16. Cavitation 17. Oil foams. 18. Venting dirty. 19. System contaminated. 20. Sharp bends in suction line. 21. Boost pump failed. 	<ol style="list-style-type: none"> 11. Replace by appropriate type of valve. 12. Check circuit & modify the system. 13. Replace by suitable seals. 14. Clean filter or replace by larger type. 15. Reduce speed. 16. Bleed the system. 17. Vent system. 18. Clean vents 19. Flush system or if needed pickle and flush out. 20. Eliminate bends or at least reduce them. 21. Establish cause and repair defect. 	
4 Pump develops No pressure	<ol style="list-style-type: none"> 1. Wrong pressure setting. 2. Pressure valve sticks 	<ol style="list-style-type: none"> 1. Modify the pressure setting. 2. Repair defect. 	

S. No.	Faults	Probable Causes	Remedial Action
		<ul style="list-style-type: none"> 3. Leakage in system. 4. Pump shaft broken. 5. System contaminated. 6. Wrong gaskets and seal. 	<ul style="list-style-type: none"> 3. Replace defective parts. 4. Replace shaft. 5. Flush system completely. 6. Replace seals and gaskets.
5.	Speed loss on Pump.	<ul style="list-style-type: none"> 1. Inlet pressure too low. 2. Outlet pressure too high. 3. Port plate does not make contact. 4. Oil temperature too high. 	<ul style="list-style-type: none"> 1. Increase pressure. 2. Check system pressure. 3. Disassemble motor and repair. 4. Check circuit.
6.	Pump does not work.	<ul style="list-style-type: none"> 1. Torque too low. 2. Oil spill at motor. 3. 'O' Ring on port plate defective. 4. Inadequate pump delivery. 5. Too much play in the shaft. 	<ul style="list-style-type: none"> 1. Increase pressure setting. 2. Check ball valve. Check if port plate is in contact. 3. Replace 'O' Ring. Check if stroke is defective. 4. Repair pump or change for larger delivery. 5. Replace bearing.
7.	Hydraulic fluid overheated.	<ul style="list-style-type: none"> 1. System pressure is too high. 2. Dirty fluid 3. Fluid level is low. 4. Hydraulic fluid of incorrect viscosity. 5. Faulty cooling system. 6. Hydraulic fluid by passing internally due to worn pump, valve, motor and cylinder 	<ul style="list-style-type: none"> 1. Adjust the pressure gauge to the required pressure. 2. Clean or change filters and strainers. 3. Fill up the fluid to full mark. 4. Check fluid for proper viscosity. If, change of fluid is required, flush the entire system and change filter before adding fresh fluid. 5. Check oil cooler for trash on outside cooling surfaces. Clean with air pressure or steam pressure. 6. Overhaul or replace faulty components.

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S. No.	Faults	Probable Causes	Remedial Action
Bearing failure		<ol style="list-style-type: none"> 1. Chips or other contaminants in bearing 2. Coupling misalignments 3. Inadequate lubrication. 4. Pump running too fast 5. Excessive or short loads (Excessive loads due to operating pressure may damage the bearing). 	<ol style="list-style-type: none"> 1. Replace bearings and check intrusion of contaminants. 2. Align prime mover shaft via a vis-pump. 3. Lubricate system properly 4. Adjust speed of prime mover 5. Reduce operating pressure.

III. HYDRAULIC - RELIEF VALVE

S. No.	Faults	Probable Causes	Remedial Actions
1.	Erratic pressure.	<ol style="list-style-type: none"> 1. Foreign material in the oil 2. Wrong poppet valve or seat in upper stage. (oil from pilot stage will go to tank due to worn poppet valve or seat and pressure will drop). 3. Piston sticking in main body 	<ol style="list-style-type: none"> 1. Drain the oil, clean the tank and refill with clean oil 2. Replace poppet valve or seats as required. 3. Clean piston after dismantling. Check free movement after re-assembling.
2.	Low pressure or no pressure.	<ol style="list-style-type: none"> 1. Valve improperly adjusted. 2. Vent connection is open (at the time of starting the work, if vent remain open, then oil will go to the tank and no pressure will develop). 3. Balance hole in main piston choked. 4. Poppet in cover not seating. (So, oil continuously goes to tank line and pressure drops). 5. Broken or wear spring in upper state (oil pushes the poppet easily and goes to tank. So, pressure drops). 6. Dirt, chip etc. keeps valve partially open. 	<ol style="list-style-type: none"> 1. Adjust valve by adjusting knob to proper pressure setting. 2. Plug the vent connection. 3. Remove piston and clean the orifice. Clean the tank and replace hydraulic oil. 4. Check the poppet condition. If required, replace it. 5. Replace the spring and again set the pressure with adjusting knob. 6. Clean the complete valve.

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S. No	Faults	Probable Causes	Remedial Actions
	1. Relief valve noise or chatter.	<ol style="list-style-type: none"> 1. High relief setting through valve. 2. Distorted control fitting 3. Worn poppet or seat in cover 4. Vent line too long 5. Valve pressure setting too close to that of another valve in circuit. 	<ol style="list-style-type: none"> 1. Check valve flow rating. Replace with larger valve if necessary. 2. Replace spring 3. Replace poppet or seat 4. Replace restrictions e.g. needle valve or orifice. Plug in vent line next to the relief valve. 5. Set relief valve pressure at least 150 PSI higher than other valves in circuit
4.	Valve do not function	<ol style="list-style-type: none"> 1. Spool sticks. 2. Water condensation in system. 3. Oil temperature too high. 4. Oil speed too high. 5. Internal leakage. 6. Tank line under high pressure. 7. Control line dirty. 	<ol style="list-style-type: none"> 1. Clean stuck spool. 2. Check condensed water. 3. Check the function of oil cooler and clean the radiator fins. 4. Check speed of the pump. 5. Prevent leakage. 6. Check pressure in tank line. 7. Clean lines properly.
5	Valve heating over-	<ol style="list-style-type: none"> 1. System pressure too high. 2. Dirt in the system. 3. Spool sticks. 4. Spool defective 	<ol style="list-style-type: none"> 1. Adjust spring pressure 2. Clean the system. 3. Check and clean spool. 4. Check and replace spool, if defective.

IV. HYDRAULIC - UNLOADER VALVE

S. No.	Faults	Probable Causes	Remedial Actions
1.	Low or no pressure.	<ol style="list-style-type: none"> 1. Orifice of main piston clogged. 2. Vent connection open to tank. 3. Safety valve set at zero setting. 4. Broken or weak spring. 5. Worn ball or seat in upper stage. 	<ol style="list-style-type: none"> 1. Clean the orifice. 2. Plug the vent connection. 3. Set the safety valve at proper pressure. 4. Replace the spring. 5. Replace the ball or seat.
2.	Fails to completely unload pump.	<ol style="list-style-type: none"> 1. Valve pressure setting too high. 2. Valve spool binding in body. 3. Incorrect assembly. 4. Nil or low nitrogen pressure in the accumulator. 5. Punctured bladder. 	<ol style="list-style-type: none"> 1. Set proper pressure of valve (130 and 140 bar). 2. Clean the spool and oil in the tank. 3. Assemble as per proper drawing. 4. Check pressure and recharge the accumulator (80 to 85 bar). 5. Change the bladder.

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V. HYDRAULIC - MOTOR

S. No	Faults	Probable Causes	Remedial Actions
1.	Motor makes loud Noise.	<ol style="list-style-type: none"> 1. Due to cavitation (pressurized fluid is not approaching properly due to obstruction). 2. Vane spring broken. 3. Shaft seal leaks. 4. Casing leaks. 5. Oil temperature too high. 6. Motor parts defective. 	<ol style="list-style-type: none"> 1. Check flow line for obstruction and remove it. 2. Change the spring. 3. Replace the seal. 4. First tighten bolts then check for cracks and sealing. 5. Check cooling circuits. 6. Replace defective parts. Tighten bolts uniformly.
2.	Motor overheats.	<ol style="list-style-type: none"> 1. Motor is of under-capacity. 2. Rotor worn out. 3. Inadequate cooling. 4. Pressure too high. 5. Wrong seal. 	<ol style="list-style-type: none"> 1. Install motor of proper capacity. 2. Replace the rotor. 3. Check the cooling circuit. 4. Reduce pressure setting at relief valve. 5. Replace by proper size seal.
3.	Speed loss on motor.	<ol style="list-style-type: none"> 1. Inlet pressure too low. 2. Motor parts defective. 3. Oil temperature too high. 4. Outlet pressure too high. 5. Port plate does not make contacts. 	<ol style="list-style-type: none"> 1. Increase pressure by resetting relief valve. 2. Change defective parts. 3. Check cooling circuit Hydraulic oil cooler may be defective. 4. Check the system pressure. 5. Dismantle the motor and repair as per requirement.

VI. PNEUMATIC

S. No.	Faults	Probable Causes	Remedial Actions
1.	Broom lock is not in proper action.	<ol style="list-style-type: none"> 1. Broom lock 4/3 way valve no. (138038) defective 2. Oiler (no. 98208) clogged or defective. 3. Broom lock cylinder (191243) not functioning properly. 4. Seal of broom lock cylinder is leaking. 5. Internal leakage in broom lock cylinder. 6. Air is not in the reservoir. 7. Breather (no. 83705) are dusty layered. 	<ol style="list-style-type: none"> 1. Clean / replace broom lock, as necessary. 2. Clean / replace, as required. 3. Check and repair/ replace, if required. 4. Replace defective seal. 5. Check the piston and cylinder sleeve replace, if required. 6. Check the inlet line of tank and drain cock.. 7. Clean the breathers.
2.	Plow lock is not working.	<ol style="list-style-type: none"> 1. 4/3 way valve (no. 138038) is defective. 2. Lubrication is not proper. 3. Air reservoir is empty. 4. Cylinders not functioning properly. 5. Breathers are dusty. 	<ol style="list-style-type: none"> 1. Replace, if required. 2. Check for proper lubrication 3. Check the inlet line of tank and drain cock.. 4. Repair / replace, as required. 5. Clean breathers.
3.	Horns are not blowing.	<ol style="list-style-type: none"> 1. 3/2 way horn valve (no. 734534) is defective. 2. Air leakage in pipe line between reservoir and horn. 3. Horns are badly choked by dust/dirt due to dusty atmosphere during working. 	<ol style="list-style-type: none"> 1. Repair / replace, as required. 2. Check and stop the leakage. 3. Dismantle, clean and fit.
4.	Parking brake will not release with air pressure.	<ol style="list-style-type: none"> 1. Sufficient air pressure is not delivered to spring brake. 2. Defective brake spring. 	<ol style="list-style-type: none"> 1. Check air lines and connections. Tighten the loose connections. 2. Replace brake spring.

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S. No	Faults	Probable Causes	Remedial Actions
		3. Contamination in brake cylinder	3 Open , clean and fit
		4. Parking brake valve(197535)get defective.	4 Check , clean, repair/replace if required.

VII. HOSE ASSEMBLY

S. No.	Faults	Probable Causes	Remedial Actions
1.	The hose has burst and examination of the wire reinforcement after stripping back the cover, reveals random broken wires in the entire length of the hose.	This would indicate a high frequency pressure impulse condition. SAE impulse test requirements for a double wire braid reinforcement are 2,00,000 cycles of 133% of recommended working pressure. The SAE impulse tests requirement for a four spiral wrapped reinforcement (100R-9) are 3,00,000 cycles at 133% maximum operating and at +200°F (93°C).	If the extrapolated impulses in a system amount to over a million in a relatively short time a spiral reinforced hose would be the better choice.
2.	The hose has burst, but there is no indication of multiple broken wires in the entire length of the hose. The hose may have burst in more than one place.	This would indicate that the pressure has exceeded the minimum burst strength of the hose.	Either a stronger hose is needed or the hydraulic circuit has a mal-function which is causing unusually high pressure conditions.
3.	Hose has burst. An examination indicates the wire braid is rusted and the cover has been cut, abraded or deteriorated badly.	The primary function of the cover is to protect the reinforcement. Elements that may destroy or remove the hose covers are: <ol style="list-style-type: none"> 1. Abrasion. 2. Cutting 3. Battery Acid. 4. Chemical Cleaning Solutions. 5. Heat. 6. Extreme Cold. 	Once the cover protection is gone, the wire reinforcement is susceptible to attack from moisture or other corrosive matter. Hence take care of item no. 1 to 6 of para 3 mentioned in probable causes.

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S. No.	Faults	Probable Causes	Remedial Actions
4	Hose appears to be flattened out in one or two areas and appears to be kinked. It has burst in this area and also appears to be twisted.	Torquing of a hydraulic control hose will tear loose the reinforcement layers and allow the hose to burst through the enlarged gaps between the braided plaits of wire strands.	Use swivel fittings or joints to be sure that there is no twisting force on a hydraulic hose
5	Fitting blew off at the end of the hose.	It may be that the wrong fitting has been put on the hose. In the case of a crimped fitting the wrong machine setting may have been used resulting in over or under-crimping.	Check manufacturer's instructions. The hose should be installed with enough slack to compensate for the possible 4% shortening that may occur when the hose is pressurized. Recheck the manufacturer's specification and part nos.
		The fitting may have been applied improperly to the hose.	The fitting should be fixed properly.
6.	Hose is leaking at the fitting because of a crack in the metal tube adjacent to the braze on a split flange head.	Because the crack is adjacent to the braze and not in the braze this is a stress failure brought on by a hose that is trying to shorten under pressure and has insufficient slack in it to do so.	The hose assembly or change the routing to relieve the forces on the fitting.
7	The hose fitting has been pulled out of the hose. The hose has been considerably stretched out in length.	1. This may not be high pressure application hose. 2. Insufficient support of the hose. It is essential to support very long lengths of hose, especially if they are vertical.	1. Use the hose as per the pressure of fluid line. 2. All the hoses should be supported by clamping the same at proper distance giving sufficient slacks between two clamps to make up for the possible 4% shorting that could take place when the hose is pressurised

VIII. ELECTRICAL

S. No.	Fault	Probable Causes	Remedial Actions.
1.	Starter not operating.	1. Battery is discharged. 2. Solenoid coil is defective.	1. Recharge the battery. 2. Replace the coil.
2.	No supply in working panel.	1. Circuit breaker CB1 is in 'OFF' position. 2. CB1 tripped. 3. CB1 is defective.	1. Put it in 'ON' position. 2. Check for overloading. 3. Replace it.
3.	Emergency pump is not working.	1. Circuit breaker CB2 is tripped. 2. CB3 is tripped. 3. Emergency pump switch is defective. 4. C / H relay K2 is defective.	1. Check wire no. 12, rectify it, if required otherwise put it in working condition. 2. Check wire no. 13 and rectify it, if required. 3. Check and replace, if required. 4. Replace with new one.
4.	Horns are not blowing.	Switch no. S-25 for left horn and S-26 for right horn are defective	Rectify / replace, as necessary.
5.	Blower is not working.	CB8 is defective	Replace the circuit breaker.
6.	Wing template is not working.	1. Relay K4 is defective. 2. CB-9 is in 'OFF' position. 3. CB9 is defective.	1. Replace the relay 2. Put it in 'ON' position. 3. Replace it.
	a) Left front in-out problem.	Switch no. S-19 is Defective.	Rectify / replace the switch.
	b) Left rear in-out problem.	Switch no. S-18 is Defective.	Rectify / replace the switch.
	c) Right front in-out problem.	Switch no. S-39 is Defective.	Rectify / replace the switch.
	d) Right rear in-out problem.	Switch no. S-40 is Defective.	Rectify / replace the switch.

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IX.GENERAL

S. No	Fault	Probable Causes	Remedial Actions.
1.	Wing template not functioning		
	a) Wing template in-out problem	<ol style="list-style-type: none"> 1. Wing in-out cylinder heavily leaking at seal 2. Pressure setting of relief valve on main control valve bank is disturbed. 3. D. C. valve for wing in-out is defective. 4. Lock valve no. 733668 is defective. 5. Double pump (45% 21GPM) no. 729343 is defective. 6. Suction strainer is clogged. 	<ol style="list-style-type: none"> 1. Replace damaged seal 2. Relief valve is to be set at 170 –175 bar. 3. Replace with new one. 4. Replace it, if necessary. 5. Repair / replace as required . 6. Clean / replace, as required.
	b) Wing up/down problem.	<ol style="list-style-type: none"> 1. Pressure setting of relief valve is disturbed. 2. Relief valve is defective. 3. D.C. valve for wing up-down is defective. 4. Double pump no 729343 is defective. 5. Suction strainer is clogged. 6. Motion control valve no. 748607 get defective. 	<ol style="list-style-type: none"> 1. - For down, relief valve should be set at 100 –110 bar. - For up, relief valve should be set at 270 – 280 bar. 2. Repair/replace with new one. 3. Replace it, if necessary 4. Repair / replace, as required . 5. Clean / replace, as required. 6. Dismantle, repair/ replace if required.
2.	Plow up/down problem.	<ol style="list-style-type: none"> 1. Seal leakage in cylinder . 2. D.C. valve for up / down is defective. 3. Suction strainer is clogged. 4. Double pump is defective 	<ol style="list-style-type: none"> 1. Check leakage and replace it, if required. 2. Repair / replace as required 3. Replace it, if necessary 4. Repair / replace, if necessary.

S. No	Fault	Probable Causes	Remedial Actions.
3.	Plow blade pivot in-out problem.	<ol style="list-style-type: none"> 1. Seal leakage. 2. Lock valve no. 733668 may be malfunctioning 3. Suction strainer is clogged 4. Double pump is defective. 5. Setting of relief valve is disturbed. 	<ol style="list-style-type: none"> 1. Check leakage and replace it, if required. 2. Clean / replace as required 3. Replace it if necessary. 4. Repair / replace, if necessary. 5. It should be set at 170 –175 bar.
4.	Broom unit		
	a) up / down problem.	<ol style="list-style-type: none"> 1. Seal is leaking heavily in cylinder(707917). 2. Pressure setting of relief valve on main control valve bank 3. D.C. valve is defective. 4. Flow divider no. 733630 is defective. 5. Double pump is defective. 	<ol style="list-style-type: none"> 1. Check the leakage and rectify it. 2. Relief valve should be set at 170 – 175 bar. 3. Dismantle, clean, repair or replace if required. 4. Dismantle, clean / replace, as required. 5. Replace it by a new one.
	b) Broom is not rotating.	<ol style="list-style-type: none"> 1. In coming pressure not approaching at Broom Motor properly. 2. Broom motor not in operation. 3. Less oil in hydraulic tank. 4. Pump not delivering oil to Broom Motor. 	<ol style="list-style-type: none"> 1. Adjust it at 135 – 145 bar. 2. Replace it with a new one. 3. Top up to the full mark. 4. Check pump and rectify accordingly.
	c) Broom sound is abnormal.	<ol style="list-style-type: none"> 1. Condition of broom dome chain. 2. Broom reel bearing. 3. Sweeping elements 4. Tightness of chain 5. Less pressure on motor. 6. Motor bearing gets worn out. 	<ol style="list-style-type: none"> 1. Grease chain properly, Replace it if necessary. 2. Grease it, if necessary 3. Tighten up to the required torque. 4. Check and tight, if required. 5. Check the pressure. 6. Dismantle and replace the bearing.

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S. No.	Fault	Probable Causes	Remedial Actions.
1	Transmission problem in towing due to which transmission gear box variable pump and motor may get damage	Transmission gear box is not put in neutral position before towing the machine	<ol style="list-style-type: none"> 1. Putting the knob (out of transmission disconnect control valve located in operating cabin) and rotate it 90° anti clock wise to lock position to disconnect the transmission gear box. 2. Disconnect the drive shaft on the axle before towing the machine.
2.	No transmission hydraulic pressure.	Transmission pump boost pressure insufficient. Boost pressure should be 400PSI.	<ol style="list-style-type: none"> 1. Clean the dirty suction strainer 17664. 2. Check flow of filter, if required change it. 3. Adjust boost pressure of the relief valve. 4. Damaged /wear boost pump should be repaired/replaced. 5. Replace the shaft if shaft of boost pump found broken.
3	Boost pressure is alright but no transmission pressure.	<ol style="list-style-type: none"> 1. The pull cable linkage to the transmission pump may be disconnected. 2. Faulty adjustment of relief valve. 3. Pump shaft broken. 4. Excessive internal wear of axial piston pump. 5. Transmission motor shaft broken. Motor rotating freely. 6. Motor coupler with transmission gear-box broken. 	<ol style="list-style-type: none"> 1. Restore the connection 2. Adjust the relief valve. 3. Replace the pump. 4. Replace the pump. 5. Replace motor. 6. Replace coupler.

S. No.	Fault	Probable Causes	Remedial Actions.
4	Boost pressure is alright but transmission pressure is low	<ol style="list-style-type: none"> 1. Excessive external leakage in piston pump section 2. Wrong adjustment or leakage through relief valve pressure override valve 3. Internal leakage through transmission motor. 	<ol style="list-style-type: none"> 1. Replace the pump. 2. Repair as necessary. 3. Replace motor.
5.	Transmission hydraulic pressure is OK but still no drive.	<ol style="list-style-type: none"> 1. Drive motor damaged. 2. Transmission gear box damaged. 	<ol style="list-style-type: none"> 1. Replace the motor. 2. Repair/Replace

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XI. BEARING

The following cause which are responsible for the failure should be considered while maintaining a bearing

- Improper use of bearings.
- Faulty installation or improper processing
- Improper lubricant, Lubrication methods or sealing device.
- Improper rpm and operating temperature.
- Contamination by foreign matters during installation.
- Abnormally heavy load.

When bearing failure is found, even if it is insignificant, it is important to investigate the phenomenon to determine the causes. At this time, not only bearing but also the shaft housing, and lubricant used with the bearings should be comprehensively investigated, together with the bearings. To judge the causes of failure, sufficient knowledge and experience in bearings and lubricant and a good understanding of the characteristic of the equipment are necessary. In addition, consideration of the installation and operation process of the bearings is required.

1. Bearing Fracture -

1.1 Time of Fracture occurrence and Causes

For failure analysis, it is important to accurately determine the time a fracture occurs, because the possible causes of failure can be limited in according to the time of fracture occurrence. For reference, time of fracture occurrence and related causes are categorized and listed Table-1-1.

Table 1-1 Time of Breakage Occurrence and Causes

Time of fracture Causes Occurrence	In appropriate use of bearings	Faulty design of shaft housing or other installation aspects or improper processing	Improper lubricant, lubrication method or sealing device	Defects in bearings	Mis-mounting of bearings	Defect in sealing device contamination of water, dust or other foreign matters, shortage of lubricant
1. Fracture occurring immediately after bearings were mounted or within a short time after mounting	√	√	√	√	√	
2. Fracture occurring immediately after overhaul			√		√	
3. Fracture occurring after lubricant was supplied			√			
4. Fracture occurring immediately after repair or removal of shaft housing or other parts		√	√		√	
5. Fracture occurring during normal operation			√		√	√

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Bearing Failure

Defects in the appearance of bearing are referred to as bearing failure. Table-2 describes bearing failures first assigning general term to each type of failure then adding more detailed classification

Table-2

Failures	Failure details	Main Cause(reference)
Rolling Fatigue	Flake Pitting	Unavoidable
Wear Fracture	Wear, fretting	
Flaw Rust	Cracks, chips	
Seizure	Brineling, nicks scratches scuffing	Improper handling
	Rust Corrosion Seizure, Discoloration, Smearing	Improper lubrication

Table-3

Faults	Probable Causes	Remedial Actions
Increase in temperature	1 Excessively tight bearing internal clearance.	1. Replace with a new bearing (Correct bearing internal clearance and interference).
	2 Creep of bearing ring.	2. Replace with a new bearing (Correct interference).
	3. Excessively heavy load.	3. Remounting (Correct load by adjusting housing).
	4. Improper centering in mounting.	4. Remounting (Correct centering or widen mounting clearance).
	5. Defect in bearing.	5. Replace with a new bearing (Take proper countermeasures after inspecting the causes).
	6. Improper volume of lubricant.	6. Correct lubricant volume.
	7 Improper lubricant	7. Change to proper lubricant if required.
	8. Improper lubrication method.	8. Correct lubricant method by remounting or replacement with new parts.
	9. Excessive interference at oil seal.	9. Correct interference by installing new seal or changing seal.
	10 Shortage of lubricant.	10 Supply lubricant in sufficient quantity
	11. Improper oil seal.	11. Correct oil seal type or sealing method.
	12 Abnormal contact with labyrinth seal or other parts.	12. Remounting or modify parts.

TYPES OF FAILURE AND PARTS ON WHICH THEY OCCUR

Table 4

Bearing failure	Bearing ring, Rolling element		Bearing ring		Cage	
	Raceway surface Rolling surface	Roller guide surface Cage guide surface Roller end face	Others	Fitting surface	Pocket surface Guide surface	Rivet
Flaking pitting			√	√	√	
Wear		√				
Chips			√			
Brinelling		√	√	√		
Nicks		√	√	√	√	√
Scratches			√	√	√	
Scuffing			√	√		√
Rust	√		√	√	√	√
Corrosion			√	√	√	√

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Important Items For BRM

1. Longer blocks should be stressed for effective working.
2. Track should be surveyed thoroughly for broken sleepers & rail pieces etc., which may obstruct the working.
3. Signal cables and rods passing under the track must be attended by S&T official at site.
4. Frequent shifting of BRM from one location to another should be avoided to achieve good work and adequate progress.

General Safety Notes

- The machine has to be operated as per existing Indian Railways rules and regulations.
- The safety of yourself and other people is a most important consideration in the operation and maintenance of the machine.
- Remember, the machine is a working unit, carrying delicate instruments. Therefore the machine should not be driven at excessive speed over bad track or turnouts.
- Always keep your eyes open for other men working close to the machine.
- Do not forget to look out for signals, switches and track obstructions.
- Remember to make sure that all protection equipment and safety devices are in place on the machine and in working order especially when it is being driven from site to site.
- Always, keep the machine clean. Excessive oil or grease on the machine can cause you to slip and fall and is also a potential fire hazard.
- Always lock the machine before you leave. Make sure that the machine is protected in accordance with railways regulations.
- Whenever you have the opportunity while waiting to get out on a job, do some of the smaller maintenance jobs such as tightening loose nuts and bolts and cleaning the machine.
- Do not permit unauthorized persons to operate the machine.
- It is prohibited to use exposed light or fire on or near the machine.
- Whenever there is work in WING area, the wings have to be locked and whenever maintenance work involves going beneath the machine, such as tightening of cardan shaft bolts the hand brake should be applied.
- Do not tow the machine if the final drive is engaged.

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