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Enriching Lives

REBOOTING YOUR COMPRESSOR

#PostLockDown

This publication is directed to operators, technicians, and supervisors to establish standards and guidelines for carrying out operations and maintenance functions on Refrigeration Compressors.

For maximum benefit it should be used in conjunction with the Kirloskar Refrigeration Compressor manual, parts list and drawings. We strongly recommend following the instructions as given in the manual supplied along with the equipment, on handling, installation, operations, maintenance care, adjustments, repair etc.,

Refrigeration compressors and systems require routine monitoring, evaluation, adjustments, cleaning and replacement of components, hence scheduled inspection and maintenance are often required to achieve equipment performance and system
efficiency.

Conducting regular scheduled inspection and maintenance prolongs efficiency, promotes safety, guards against the risk of unplanned downtime and lowers utility costs. A robust maintenance program will pay for itself in energy savings.

Due to system requirements on stoppage of machine possibility of liquid carry over to compressor is more, hence oil condition is to be checked. Oil is to be replaced along with filters.

Any compressor taken out of service for extended shutdown would deteriorate rapidly from rust and corrosion if not properly protected. Contact the manufacturer or the authorised service provider to obtain the proper preservation procedure for protecting the equipment.

Any compressor taken out of service for shutdown without carrying out preservation & proper storage instructions as prescribed by the manufacturer, requires check inspections to be carried out by a qualified engineer. Contact the manufacturer or the authorised service provider to know the detailed start-up procedure.

Carry out proper evacuation/drying of the refrigeration system in case of extended shutdown. Use a proper vacuum pump to evacuate the refrigerant from the compressor. Ensure no leakage of the refrigerant gas directly in the environment.

For any additional information on Kirloskar Refrigeration Compressors concerning procedures, check-inspections, parts recommendations, modifications and retrofits, and service package offerings for scheduled preventive maintenance or on-call visits,
Kindly contact *service1@3t-saudi.com*

General & Basic Rules of Good Installation & Operation

1. All personnel working on Compressed Refrigeration Systems should use PPEs – Safety Shoes, Hardhats, Gloves, Masks, Eye and Ear protection.

2. Perform tasks in a safe manner in accordance with the SOPs and report immediately to their supervisors of any equipment defects or operational deficiencies.

3. Do not work alone, one more person should be on hand to provide assistance, if needed.

4. Always use the correct tools for the job. Always use insulated tools.

5. Do not try attempt to repair or remove any compressor parts without first relieving pressure from the entire system.

6. Do not try to connect meters to circuits unless you are qualified. Wait for the electrician.

7. To prevent skin ruptures and sensory injuries when working with compressed gases.

8. Close isolation valves before working on lines or fittings.

9. Know Warnings & Cautions, they are indicated in the manual. Caution & Warnings are to be strictly followed w.r.t to operating or maintenance procedure, work practice, equipment condition etc., if these are not explicitly observed could result in damage to, or destruction of the equipment, downtime and production losses, long term health hazard, injury or even death of personnel.

10. Schedule Periodic calibration of instruments/gauges and display of error charts.

11. All operators should be thoroughly familiar with the type of equipment and systems they operate.

12. The operator should be familiar with the drawings, location of parts, functions of each part, ex. valves, switches, electrical controls, and other control devices and its operation.

13. Use only lubricants recommended by the manufacturer and establish a lubrication schedule. Frequency of oil change is dependent upon severity of service and atmospheric dust and dirt. Ensure Oil, Grease and Greasing equipment are not contaminated and are free from dust.

14. Supervisors to plan periodic refresher trainings to operators and maintenance personnel on normal and safe operation, inspection & maintenance procedures & practices, trouble shooting, safety, house-keeping, etc., covering various aspects on cleanliness, lubrication, temperature, vibration, maintaining inspection records, alignment, torque, leak in compressed gas system, etc.,

15. Keep the compressor clean at all the times. Wipe the machine daily with a cloth. Dirt on the machine will eventually find its way into the lubricating system. On air-cooled compressors, dirt accumulations form an insulating blanket causing increased temperatures within the machine and excessive wear on moving parts.

16. Do not use gasoline, kerosene or other low flashpoint solvents as a cleaning agent.

17. Clean intake suction strainers regularly to prevent atmospheric dust from entering the compression chamber.

18. Maintain daily operating logs that record pressures, temperature of air, lubricating oil, water in compressor, inter-cooler and aftercooler.

19. Dispose used oil, oil-soaked cotton, gloves, old O Rings as per hazardous material rule.

20. Follow lock-out tagout procedures.

First Aid for Ammonia Exposure

1. Remove victim to fresh air

2. Flood immediately with water for at least 15 minutes. Eyelid must be held open during washing.

3. Summon an ambulance.

4. Determine if patient is wearing contact lenses and advice medical personnel.

5. Decontaminate the victim with water before transporting in the close confines of ambulance.

6. Flood clothing with large quantities of water.

Caution: Skin may be frozen to clothing. Decision to remove clothing should be made by medical personnel only.

Compressors on Storage

A compressor unit should not be stored for more than six weeks without proper preservation. This time frame may vary according to geographical location of the unit. In very damp, humid climate, a compressor may need to be processed for long term storage in as little as one or two weeks. In very dry climate, a compressor could be stored without processing for 10 days to two weeks.

An electric motor that does not experience regular usage while being exposed to normal humid atmospheric conditions is likely to develop rust in the bearing or rust particles from surrounding surfaces may contaminate the bearings. The electrical insulation may absorb an excessive amount of moisture leading to the motor winding failure.

Installation Checks

These checks are required to be carried out to verify installation completeness before the compressor is started.

1. All foundation bolts and nuts are tight to the required torque.

2. Ensure all assembly / system completeness

3. Pressure gauges are installed

4. Ensure oil return line from oil separator is connected to compressor crankcase.

5. Check for free rotation of flywheel and motor pulley.

6. Check coupling alignment on units that are direct coupled.

7. Check alignment of pully and flywheel for belt driven units, misalignments may damage shaft seal and bearings.

8. Check the condition of the belts and set the belt to the correct tension.

9. Safety cage is installed

10. Electrical Systems: Fitment, specifications, wiring is as per drawing, tightness, earthing, voltage on energising the compressor is as per the specification etc.,

11. Motor Protection: Motor protection & Insulation Resistance

12. All accessories have been installed: Filters, SOVs, NRV, Pressure & Safety Valves and switches

13. Ensure suitable float switch controller and expansion valve is installed to avoid liquid entry.

14. All interconnecting pipelines are connected and secured.

15. Ensure proper insulation is provided for suction lines of single stage compressor and HP suction line of two stage compressor.

16. Ensure correctness of the installation in accordance with the P&ID supplied along with the equipment

17. Ensure proper protection at cable entry points for rodent control.

18. Ensure all drain plugs are installed.

19. Drain Pan

20. Ensure whole refrigeration system should be pressure tested, nitrogen flushed and vacuumed before commissioning or after long shutdown

Inspection

Compressors on Extended Shutdown without proper preservation requires thorough inspection in the following areas.

Clean the compressor to ensure cleanliness (use dry air with pressure < 2.5 bar)

Visual inspection during maintenance are of importance. The result of inspection determines whether one or more parts must be replaced.

Lubrication Oil

The quality of oil affects the oil consumption of the lifetime of the moving parts. Determine the physical condition of the oil. Check for decolourisation, emulsification, solidification, and contamination (dust, water, etc.,). If oil analysis is not available, replace as advised by the manufacturer. When changing oil, clean the inside of the crankcase by wiping with clean, lint-free rag.

Use Kirloskar Advantage Refrigeration duty lubrication oil for highest performance.

Inspect shaft seal. Pour lubrication oil in enough quantity and rotate the crankshaft, continue to pour refrigeration oil until oil level stop reducing. Ensure crankshaft rotates freely.

Suction filter housing to be cleaned, inspect suction filter continue to pour in fresh oil and rotate crankshaft until oil level stops reducing.

Check and clean suction oil wire gauze filter.

Ensure there are no leakages from oil piping connections & blind plugs during pressure testing.

Check the condition of the anti-friction bearings.

If the oil is due for replacement as per the preventive maintenance schedule, replace oil and oil filter before start-up of compressor.

The oil filter is always to be replaced along with the lubrication oil to coincide with the replacement periodicity.

Carry out purging of the lubrication system.

Dirt Accumulation

Cylinder jackets of water-cooled compressors should be checked for dirt accumulation and cleaned at least once annually. Dirt accumulation can interfere with water flow/circulation.

Flushing/Cleaning can be accomplished by a hose with nozzle to inject nitrogen through the cylinder jackets.

Valves

Remove, dismantle & Inspect the valves for wear, valve seat surfaces, carbon deposits etc., Replace all defective valve parts. Failure to do this will result in more rapid valve and spring wear. Valve parts including suction valve ring, buffer spring, stroke limiter are to be washed in non-flammable cleaning liquid. Before replacing valve, inspect valve seat and cover plate for its condition. Make sure the valve is returned to the same port from which it was removed. Follow manufacturer's instructions for dismantling, replacement of parts, assembling and testing.

Cylinder

Check the condition of the cylinder liner walls for their honing profile.

Piston Assembly

Check the condition of piston head, ring area, connecting rod, pin and bush assembly and piston internals. Check for tightness of securing bolts.

Rings

Check the condition of the O Rings and Sealing Rings at valve cover and un-loader piston, in case found worn out replace.

Suction Strainers

Check and Clean suction gas strainer. Dust and foreign particles may reduce compressor efficiency.

Electrical Control Panel

Ensure electrical panel & accessories are free of dust and foreign particles, and insects from the inside.

Wiring connections to be checked for completeness, correctness in accordance with the wiring drawing supplied with the equipment.

Check for frayed wiring, insulation damages on cables and wires, and corroded terminals.

Ensure tightness of power cable at bus bars, control wiring, connectors, transmitters (PT/RTD), Switches, VFD cables etc.,

Also, ensure the instrumentation for controls is in accordance with the P&ID

Cylinder

For motors with “Do Not Lubricate” on the name plate, the motor shaft should be rotated a minimum of 20 times to redistribute the grease within the bearing every three months or more often.

The motor with re-greaseable bearing must be greased as per the instructions provided in the manual. The motor shaft must be rotated a minimum of at least 20 times manually after greasing to distribute the grease within the bearing.

Winding Insulation check is to be performed. Record the IR (Insulation Resistance). Windings should be discharged immediately after measurement to avoid risk of electric shock.

Connect and Ensure tightness of power cable at motor terminal and VFD cables.

Drive System

Check and adjust belt tension.
Check tightness of Flywheel Retaining plate.

Safety Valves & Relief Valve

Check function of relief and safety valves as per pre-set values.

Pressure Switches

Ensure proper functioning of Safety Switches.

Pre-Start Inspection

Carefully inspect the compressor installation to ensure the following prestart requirements are fulfilled. These checks are required to be carried out before the compressor is energised.

1. Ensure all repair work are completed.

2. Ensure system has been cleaned free of dust for testing any oil or gas leaks.

3. Confirm the initial oil charge has been completed.

4. Ensure no oil spillage on floor, place an oil drip tray under the crank-case housing.

5. Ensure pressure testing of the plant has been completed at 21 Kg/cm2 on HP side and 15 Kg/cm2 on the LP side. Hold up to 24 hrs

6. Ensure that all system lines are flushed with nitrogen to remove moisture and foreign particles.

7. Ensure all piping support are installed properly in order to avoid vibration and induced stress.

8. Open all shutoff valves between compressor and receiver and its outlet.

9. Ensure compressor suction stop valve is closed.

10. Turn on cooling water. Check water flow through drain vents.

11. Ensure water flow & pressure as specified by the manufacturer is available for water cooled units.

12. Ensure relief and safety valves are installed and operating properly.

13. Ensure compressor is lubricated in accordance with the instructions as given in the manual supplied along with the compressor, both Grade and oil level. Crank by hand to see the oil is getting to all moving parts.

14. Carry out bleeding of the lubrication system.

15. Carry out purging of the system.

16. Recommend using cloth bag in suction strainer till the system is dust and dirt free.

17. Bump start (i.e., control power de-energised immediately after start-up) compressor to check the direction of rotation of the motor. If the rotation of the compressor is backwards, the phasing should be corrected (reversing any two leads will change rotation) before attempting to re-start the compressor.

18. Remove head cover, buffer spring, delivery valve, stroke limiter, suction valve ring etc., run the compressor in this condition for 10-15 min. (open test) to carry out flushing and to ensure proper loading/ unloading. When fixing the valves, stage wise flushing is to be carried out.

19. All Electrical Panel functionality check to be carried out.

20. Cut out panel Safety Trips, Cut-out Switches functionality check to be carried out.

21. All accessories related to the compressor including cooling tower, drier and downline filters are installed, and their healthiness have been checked.

22. Check the condition of refrigerant line insulation.

Start-up Procedure for New/Overhauled/Extended Shutdown

For a compressor that is *New or that has been Overhauled or has been on extended shutdown*, allow the compressor to run in unloaded condition for 10 to 15 min to complete flushing, functional check of time delay complete time delay function, loading/ unloading, safety check and periodically check for overheating. Build up load gradually over a period of several hours. After a few days of operation, shut down compressor and recheck all cylinder head, head cover, cylinder flange, crank shaft and bearings, and foundation bolts for correct tightness.

Inspection During Start up

Perform the following checks after open run test.

1. Make sure the compressor is unloaded

2. The compressor does not make any unusually high-pitched noise at initial start-up

3. Lubricating Oil pressure builds up and maintains proper oil level and Oil pressure stabilises. Check the oil pressure time delay for KC Compressor.

4. Gradually open suction stop valve and monitor for oil or liquid carryover (observe excessive mechanical noise)

5. Intermediate pressure for two stage compressor is as per OEM recommendation.

6. Solenoid Valves turns ON: Oil, gas and for Water (in case of water-cooled models)

7. Check suction & discharge pressure builds up slowly and maintains as per the pre-set parameters.

8. Check for refrigerant gas leakages

9. Ensure there are no water leakages (applicable for water cooled compressor models)

10. Check if temperature is stabilizing

11. Check temperature and pressure of lube oil, refrigerant gas and water regularly

12. Intermediate pressure (as required)

13. Regularly monitor current and voltage

14. Check all the parameters on the gauges for their healthiness

15. Check for modulation: Loading/unloading at pre-set value

16. Functional check of Relief and Safety Valve

17. If automatic water drain traps are provided, check their operation.

18. Record operating parameters in the daily logbook before releasing the compressor for operation.

19. Open oil separator drain valve.

Compressor Operational Guidelines

1. Oil differential pressure should be 1.5 Kg/cm2

2. Do not operate compressor on part load (max 30 minutes allowed)

3. Time delay SOV to be operated after 30 seconds. (For KCX model only).

4. Suction superheat should not be beyond 10 Deg. Celsius.

5. Ensure no liquid refrigerant entry into the compressor

6. Check oil level in crankcase regularly. While the machine is in running condition, ensure oil level is maintained around the middle marking.

7. Follow the loading and unloading pattern as given in the manual.

8. Check for proper working and direction of the suction & discharge valves.

9. Follow Field Application Diagram (FAD) for loading pattern of Two Stage Compressor.

10. Do not use oil from Oil Separator till initial 500 Hrs.

11. Ensure that system is leakage free.

12. Check that the system NRV is working and the NRV shall be installed after oil separator.

13. Always maintain a required level of Refrigerant in Receiver in order to avoid low suction.

14. Always maintain an operation and maintenance logbook to assess the performance and condition of the compressor.

15. Do not run the compressor on Bypass mode. (Bypass of pressure switch0.

16. Check the functioning of accumulators' float switch / switch controller in order to avoid liquid entry.

17. Maintain a time interval of minimum 2 minutes between stopping and restarting

18. Maintain a time interval of minimum 10 minutes between starting and restarting.

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