PRESERVATION OF IDLE STATIC & ROTARY MECHANICAL EQUIPMENT

prepared by

FUNCTIONAL COMMITTEE ON PRESERVATION OF IDLE STATIC & ROTARY MECHANICAL EQUIPMENT

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Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director
Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is 100 years old. Because of various collaboration agreements, a variety of international codes, standards and practices have been in vogue. Standardisation in design philosophies and operating and maintenance practices at a national level was hardly in existence. This, coupled with feedback from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the industry to review the existing state of art in designing, operating and maintaining oil and gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self-regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safe operations. Accordingly, OISD constituted a number of functional committees of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present document on "Preservation of Idle Static & Rotary Mechanical Equipment" has been prepared by the Functional Committee on "Preservation of Idle Static & Rotary Mechanical Equipment". This document is based on the accumulated knowledge and experience of industry members and the various national and international codes and practices. This document is meant to be used as supplement and not as a replacement for existing codes and practices. It shall be borne in mind that no standard can be a substitute for the judgment of a responsible qualified Engineer. Suggestions are invited from the users after it is put into practice to improve the document further. Suggestions for amendments to this document should be addressed to

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These documents are intended only to supplement and not replace the prevailing statutory requirements.
FUNCTIONAL PANEL ON PRESERVATION OF IDLE STATIC & ROTARY MECHANICAL EQUIPMENT

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1.0 GENERAL

1.1. INTRODUCTION

Preservation of idle equipment installed in the plant involves safeguarding unattended and inactive equipment from deterioration during their down period, generally above one month arising out due to the reasons like feed problems, haulage problem, major repairs, revamps, modifications, retrofitting, etc. Deterioration of equipment during periods of idling is usually caused by conditions entirely different from those that exist during operation. Many deposits formed during operations turn usually corrosive under shutdown conditions. Moisture, oxygen, dirt, dust, ultraviolet rays, extreme pressure and temperature, corrosive environment of coastal areas and closeness to other chemical plants, are the some of the factors causing deterioration.

Preservation of static and rotary equipment and their spare parts, which are required to be kept in store for prolonged periods, needs to be carried out to prevent their deterioration, and as such preservation procedures for the equipment/spares kept in store should be adopted. New equipment received at plant/project site should be preserved considering manufacturer’s recommendations.

1.2 SCOPE:-

This standard lays down the preservation procedures to be followed in oil and gas installations for various static and rotary idle mechanical equipment installed at plant and for the equipment/spares kept in stores. The scope does not include the electrical equipment, instruments and chemicals.

1.3 DEFINITIONS

a) Preservation :
Preservation is safeguarding of unattended and inactive equipment from deterioration during their down period.

b) Coating :
Coating means an application of a coat of preservative media like paint, Oil or grease etc.,

c) Surface Preparation :
Surface Preparation includes cleaning of the parent metal surface for removing foreign particles like rust, scale, liquid etc., by mechanical or chemical cleaning techniques.

1.4 CONSIDERATION FOR SELECTION OF PROTECTIVE SYSTEM:

A careful study should be undertaken before finalising a protection system. This should consider the type of equipment, its cost and ease of repair/replacement, period of protection, rate of deterioration expected and allowable deterioration etc. Equipment, which can be shifted easily, should preferably be moved to warehouse.

Before going for protective measures, following should be considered:

a) Period of shutdown
b) Allowable deterioration and rate of deterioration
c) Probability of reuse
d) Expenditure for repair/replacement
e) Time for repair/replacement after the shutdown
f) Type of protection systems (various alternatives)
g) Condition of the equipment
h) Criticality of the service
i) Type of environment in which equipment/spares are to be stored.

Equipment/spares will need no preservation if

a) It has become obsolete and will not be put to service again.
b) It has deteriorated beyond economical repair and required to be condemned.
c) The estimated value of the equipment is not worth the expenditure to be made for preservation, if it is not in critical service.

2.0 PRESERVATION OF IDLE STATIC EQUIPMENT

This section covers the Preservation of following idle equipment.

a) Heat Exchangers

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b) Columns & Vessels

c) Fired Heaters, Ducts & Stacks

d) Cooling Towers

e) Storage Tanks

f) Boilers

g) Pipelines

2.1 PRESERVATION OF HEAT EXCHANGERS

Exchangers need to be carefully protected when idle. Exchangers may deteriorate due to conditions, which are different from those that exist during operation. The deterioration may be primarily due to water, sludge or other corrosive elements in the entrapped process fluids and environmental conditions. Some fluids may have a tendency to congeal after a long time of retention. Preservation technique should be based on the duration of idleness, type of equipment, its service and environment. Exchangers in non-corrosive service should be preserved in case idle period is more than six months. For exchangers in corrosive services, preservation should be done based on corrosiveness of the fluid. The following procedures for preservation should be adopted:

a) Open the exchangers, remove the bundle, disassemble all components.

b) Clean all the parts thoroughly by hydroblasting / hydrojetting or chemical cleaning. No deposits should be left on inside or outside surface of the equipment/bundle.

c) Thoroughly coat with preservative oil/grease on the required surfaces including bolting flange and gasket faces, etc.

d) Reassemble all components, blank off all nozzles and close all vents and drains.

e) All the exposed bolts and flanges to be coated with grease.

f) Austenitic stainless steel component should be suitably passivated before exposure to atmosphere in line with the procedure as laid down in NACE Standard RP-01-70.

g) Depending on the environmental conditions, coating to be applied on the external surfaces. If the weather is very humid, completely remove the insulation and apply the paint.

h) For finned air cooler, clean the tubes internally, circulate preservative oil through the tubes and seal off all the header boxes.

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i) When the tube bundle is to be stored separately, bolt wooden flanges to both
the tube sheets and cover with waterproof tarpaulin, if necessary.

2.2 PRESERVATION OF COLUMNS & VESSELS

In columns/vessels when idle, corrosion can take place either due to condensation
of retained vapours or from the moisture in the atmosphere. Corrosive products
may also form due to the chemical reaction of water with scales/deposits.
Following procedures for preservation should be adopted:

a) Flush/clean the equipment, carry out neutralisation wherever applicable and
drain.

b) Purge with nitrogen after ensuring that all the openings are sealed and leak
free. Maintain a positive pressure of 100 mm of water column. Alternatively
spraying oil on the inner surfaces or filling and draining oil or placing desiccants
like bags of lime or silica gel may be considered.

c) Remove the safety valves (bolted only) and close all the openings. Safety
valves shall be stored indoors.

d) Coat all the exposed bolts anchor bolts, gaskets, flange faces with
grease/preservative oil.

e) Austenitic stainless steel components shall be suitably passivated before
exposure to atmosphere in line with the procedure as laid down in NACE
Standard RP-01-70.

2.3 PRESERVATION OF FIRED HEATERS, DUCTS AND STACKS

In heaters when idle, corrosion may take place either due to condensation or
chemical reaction of atmospheric moisture with scale/deposits on the tubes.
Following procedures for preservation should be adopted.

a) Tubes should be completely cleaned from outside and inside surface. After
cleaning the header, boxes should be sealed. For vertical heater drying with
nitrogen/ air should be considered. If the complete cleaning is not possible,
suitable neutralizing agent should be flushed through the tubes to avoid any
damage that may occur during idle period.

b) All the hinges on access doors, peep holes, drains and dampers, etc. should be
coated with grease to ensure smooth operation after shutdown.

c) When the external surface of the furnace/ducts/stack reveals paint failure, it is
advisable to touch up and maintain the paint on a regular schedule. Sulphur
deposits if found, should be removed.

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d) Refractory should be kept dry at all the times to prevent any cracking due to water ingress. The ingress of atmospheric moisture should be avoided by proper capping of stack and duct opening and by sealing all those locations from where water or moist air can seep in. Supplementary heat or a desiccant can also be considered.

2.4 PRESERVATION OF EQUIPMENT IN COOLING TOWERS

The cooling tower consists of concrete basin, main structure of red wood, fan and fan motor. The conditions are more severe when the cooling tower is in operation than it is idle. Following preservation procedures should be adopted while cooling tower is idle.

a) Drain and flush all the pipelines.

b) Drain all water from the basin, remove all debris, muck, etc. and clean the basin thoroughly.

c) Replace all unsatisfactory structural members. Replace warped and missing slats.

d) Carryout repairs to the concrete walls and floors of the basin for cracks, loose concrete, slope of the floor, etc.

e) Remove fan motor and protect it as per OISD-146 (Preservation of idle electrical equipment).

f) Drain the oil from gear box and refill it with a high grade mineral oil. Clean the exterior surfaces of the gear reducer housing and paint them. Wrap all exposed shaft with Plastic tape. Store the reducer in a warm and dry area.

g) Clean the fan with appropriate cleaner and apply suitable paint, if required.

h) Cover the fan drive gear with a light grease and water proof paper.

i) Secure the fan blades to prevent rotation and to provide supports.

In areas where it is undesirable or unnecessary to remove the fan drive components, the fan should be operated every 3-4 weeks and routine preventive maintenance be carried out.

The dry wood of an idle cooling tower is a serious fire hazard. Therefore, for idle periods of about two months, a perforated hose should be laid around the tower and spray water periodically to keep wood in wet condition all the time. For extended shutdowns, the plenum and fill should be sprayed with a fire retarding chemical and a biocide.
2.5 PRESERVATION OF ATMOSPHERIC STORAGE TANKS

Tank interiors can be corroded by the water present in the product or by condensation of the vapours in fixed type of roofs. Floating roof is subjected to exterior corrosion due to stagnant water on the roof. Following procedures for preservation should be adopted.

a) The tank shall be made free of gas and any residue. Extra precautions shall be taken when pyrophoric iron sulphide or residue of leaded gasoline are present.

b) All the loose scales on the internal surface of the tank should be removed.

c) The internal surface should be coated with preservative oil by spraying. Brushing can be used in the case of structural members.

d) All the manholes should be closed.

e) The external surface should be cleaned and protected by suitable repainting as necessary.

f) Tanks located in areas subjected to windstorms of high velocity shall be filled with an inhibited water.

g) If the tank is with steam coils, the condensate should be drained off and the steam coil should be positively blinded.

h) The tanks isolated from service shall be externally inspected annually.

i) In case of floating roof tanks, the floating roofs should preferably be kept afloat by filling with inhibited water and roof drains be kept open. Water accumulated on the roof tops due to rain etc, if any, shall be cleaned periodically.

2.6 PRESERVATION OF IDLE BOILERS

Unless proper storage procedures are followed, severe corrosion may occur in idle boilers. The method to protect idle boilers depend primarily on length of downtime. Cold storage of boilers include dry or wet storage. Dry storage is preferred when the boilers will be out of service for a period of 45 days or more while wet storage may be suitable for a shorter duration.

2.6.1 Cold storage

a) Dry Storage

The boiler should be drained, thoroughly cleaned and dried completely by means of hot air. Close attention should be given to complete elimination of moisture from nondrainable superheater tubes. A suitable absorbing material in a water tight container should be placed in the boiler drums or on top of the flues in a fire tube.
boiler. The most commonly used moisture absorbents are quick lime and silica gel. Silica gel is more efficient in absorbing moisture and can be regenerated by heating so that it can be used over again and again. Since it is not a caustic substance, can be used more easily and safely, it is generally preferred.

After placing the quick lime or silica gel in the boiler as per manufacturer’s recommendation, all openings should be tightly closed. The unit should be checked at an interval of every two or three months, as experience dictates, for renewal of the lime or regeneration of silica gel.

b) Wet Storage

The boiler should be cleaned and inspected and then filled to the normal water level. If deaerated water is not available, dissolved gases should be expelled by boiling water for a short time with boiler vented to atmosphere. The boiler water alkalinity should be adjusted with caustic soda to a minimum of 400 PPM. Sufficient Sodium sulfite should also be added to produce a minimum sulfite residual of 100 PPM. After the boiler is cooled and before a vacuum is created, the unit should be filled completely with water and all connections closed.

Test should be conducted on weekly basis and additions to the treatment chemicals should be made necessary to maintain the minimum recommended concentrations. When treatment additions are required, the boiler water should be circulated by means of an external pump or by lowering the water to operating levels and steaming the boiler for a short time. The boiler should then be completely flooded as outlined previously. The temperature of boiler should be maintained as low as possible since the corrosion rate increases at higher temperatures.

When the boiler is returned to service, a high rate of blowdown should be maintained initially so that alkalinity and sulfite be reduced to normal operating levels rapidly.

In some small installations or where weekly testing is not practicable, Chromate salts can be employed to protect idle boilers against corrosion. The concentration maintained should be 2000-2500 PPM as sodium chromate. The boiler should be completely filled and closed tightly. To assure good mixing, circulation of the water with a pump is recommended. Boilers stored in this manner should be blown down heavily to dissipate the chromate colour, before being returned to service.

Nitrogen or other inert gas may also be used for storage purpose. A slight positive pressure of the gas is maintained after the boiler has been filled to operating level with deaerated feed water.

c) Superheater Storage

In some boilers it is not possible to separate the super heater section from rest of the boiler. Accordingly, it is necessary to follow the same storage procedure for the
superheater section as for the other portions of the boiler. Wet storage of drainable superheaters is relatively simple while wet storage of nondrainable superheaters is more complicated. In dry storage, care must be taken to remove all the moisture from the nondrainable superheaters by reheating the superheaters sufficiently to evaporate all the water. This may be accomplished by means of a small fire in the boiler furnace. In some cases it may be possible to dry the no drainable superheaters with hot air diverted from the air heaters of one of the operating boiler. Depending on the actual design, there may be a choice as to whether the dry air is directed over the external surfaces or internally.

Since a residue will be left in no drainable superheated tubes after boiling out, if the superheater has been flooded with water containing boiler water salts, it is desirable to employ a method of wet storage which does not involve the use of solid chemicals.

Volatile chemicals or inert gases can be used in superheater section. The volatile chemicals recommended are hydrazine and ammonia or neutralizing amine. If high purity is not available to fill the entire boiler, the superheater tubes can be filled with condensate or demineralised water from the outlet end. The recommended treatment concentrations are approximately 100 PPM of hydrazine and sufficient ammonia or neutralizing amine to elevate the PH to approximately 9.0-10.0.

2.6.2 Hot storage

Instead of keeping standby boilers in banked condition or operating all the boilers in lower capacity, standby boilers can be kept under pressure as “Accumulator” with a simple modification. The modification required is a 2” steam line from main steam header to be connected to the blowdown line upstream of blowdown valves with 2 nos. of 2” NRV. Through this accumulator steam line, steam from the main steam header enter into MUD DRUM and get condensed and hence the boiler will be under pressure without keeping the burners in service. About 3 to 5 Tonnes per hour of steam may be consumed in this way to keep the boiler as Accumulator- depending upon the insulation of the boiler.

To keep the boiler as accumulator

a) Stop the burner/s
b) Stop the FD fan
c) Close the main stop valve
d) Open both accumulator steam line block valves slowly avoiding water hammering

To put back the boiler in service

a) Open the start up vent line

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b) Open the SH drain

c) Start FD fan

d) Take the burner/s into service

e) After about 5 minutes of venting of steam, open the main stop valve and close the start up vent and SH drain valve

To operate blowdown valves during accumulator condition (drum level may rise during accumulator condition due to the condensation of the accumulator steam in the MUD DRUM) to lower the drum level.

a) Close the accumulator steam 2” gate valve near the MUD DRUM

b) Operate the blowdown valves

c) After blowdown - close the blowdown valves and open the Accumulator Steam 2” gate valve

2.7 PRESERVATION OF PIPELINES

The following procedures should be adopted

a) Flush the lines clean

b) Open the flange joints and valves at low points to ensure complete draining.

c) Dry the lines or circulate an inhibited or uninhibited oil through them

d) Inspect insulated and wrapped lines, uncovering the piping where leaks are suspected.

e) Repair all damaged insulation and wrapping. Bare pipe should be wire brushed and painted.

f) Lubricate all valves.

g) Spray all external surfaces of the valves with oil and cover valve stem with grease. Relief valve should be rotated or separated from their discharge piping. Their discharge side should be sprayed with oil and covered with water proof paper or plastic.

h) Tighten all flanges. Spray mating flanges joints with oil, and wrap them with suitable wrapper to prevent crevice corrosion between mating flanges.
On idle units, process and utility lines (except fire water lines) should be blinded off near the battery limit.

3.0 PRESERVATION OF IDLE ROTARY EQUIPMENT

This section covers preservation of the following Rotary Equipment while they are idle.

a) Pumps
b) Compressors
c) Steam Turbines
d) Gas Turbine
e) Diesel Engine
f) Fans & Blowers

3.1 PRESERVATION OF IDLE PUMPS

The following procedure should be adopted for preserving an idle pump

3.1.1 Preservation of idle centrifugal Pumps

a) Close the suction and discharge valves and blind the same. Isolate the pump from all other connected auxiliary lines. In case the pump is to be removed and kept in storage, disconnect all pipe connections and blind the suction and discharge flanges.

b) Open all vents and drains in the pump casing and bearing housing. Flush the casing and housing with a suitable solvent or cleaning agent.

c) For pumps with gland packing, remove the packing, coat the interior of the stuffing box with light grease, repack with a few rings of ordinary non-metallic packing to avoid ingress of water into the stuffing box and then retighten the gland.

d) For pumps with single mechanical seal, loosen the seal gland, pack the seal with a light grease and tighten the seal gland lightly.

e) For pumps with double mechanical seal, drain the stuffing box and flush it with a cleaning agent, plug the lower stuffing box drain and fill it with a light weight grease or lubricating oil.

f) Plug the bearing housing drains and fill the bearing housing completely with lubricating oil.

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g) Close all drains and fill the entire pump casing with a lubricating oil. Rotate the pump shaft slowly to ensure complete coating of the inner surfaces.

h) Rotate the pump shaft every three to four weeks, leaving it in a different position each time.

i) Clean the exposed pump shaft and protect with grease.

j) Protect the shaft couplings by filling them with grease or coating them with a rust preventive.

3.1.2 Preservation of Reciprocating Pumps.

I) Preservation of idle steam/air driven Reciprocating Pumps

a) Open all vents and drains on both the liquid end and steam/air end of the pump.

b) Disconnect all pipe connections, blind the suction, discharge and steam flanges/air connections.

c) Remove the packing from the stuffing box and coat the stuffing box and rods inside the box with light grease. Repack the stuffing box with a non-metallic packing and re-tighten the gland.

d) Remove the valve cover plate from liquid end of the pump and slide valve cover from steam/air end. Remove a valve from each end of each cylinder on the liquid end. Flush the cylinders with a cleaning agent. Fill all cylinders with a suitable preservative oil. Fill the steam/air cylinders with a suitable preservative oil through slide valve opening at the steam/air end. Slowly bar each piston back and forth.

e) Apply a suitable rust preventive to all valves and valve covers and install them back.

f) Drain the excess preservative oil from the cylinders and close all vents and drains.

g) Clean and cover exposed rods with grease.

h) Fill all lubricators with oil.

II) Preservation of idle motor driven Injection/Metering Pumps

a) Open all vents and drains.
b) Remove the pump, clean, fill the liquid chamber with a lubricating oil and fix back the pump.

c) Blind the suction and discharge valves

d) In case of diaphragm type pump drain the hydraulic oil from the hydraulic chamber, flush and fill the hydraulic chamber with a lubricating oil.

e) Drain the gear box oil; flush and fill the gear box with a lubricating oil.

f) Close all vents and drains in the pump and gear box.

g) For pumps with gland packing, remove the packing, coat the interior of the stuffing box with light grease, repack with a few rings of ordinary non-metallic packing to avoid ingress of water into the stuffing box and then retighten the gland.

3.2 PRESERVATION OF IDLE COMPRESSORS.
The following procedure should be adopted for preserving idle compressors.

3.2.1 Preservation of idle centrifugal Compressors

Whenever the centrifugal compressor is required to be at stand still for a prolonged shutdown of more than 3 months the following method may be used for preserving the compressor components.

a) The compressor casing may be charged with a low positive pressure of dry nitrogen 50 to 70 mm WG during the whole time of shutdown at stand still condition for all the compressors which are not provided with oil seals. For the type of compressors, which are provided with oil seals nitrogen supply, may be given after putting into operation the seal oil system. However, if the nitrogen pressure can be maintained around 70 mm WG even without seal oil system in service, nitrogen supply can be given without operating seal oil system.

b) The lube oil and seal systems should be operated for half an hour once a week to protect the system against corrosion.

c) The compressor rotor shall be rotated by turning gear or by hand by the following procedures:

- It should be rotated by 180 degree from the standstill condition after three months
- It should be rotated by 90 degree after 3 months.
- It should be again rotated by 180 degree after 3 months.
• It should be rotated by 90 degree position after 3 months.

• This procedure shall be continued subsequently.

For compressors which are idle for a period over 6 months, the following preservation methods may be used.

a) Blind off all process, oil supply and oil drain openings

b) Remove the rotor and associated parts, such as bearing and seals and diaphragms.

c) Preserve the removed parts with a protective material as detailed in Para 4.9

d) Fill the compressor system with oil through a drain opening and displace all air from the case by venting and close all drain and vent connections.

e) Fill the oil seal system with oil.

f) The water cooling system shall be drained, flushed and filled with clean fresh water dozed with anticorrosive chemical.

g) Change water every six months.

3.2.2. Preservation of idle Reciprocating Compressor.

The following procedures should be adopted for preserving an idle reciprocating compressor.

a) Close and seal all frame openings to prevent contamination of frame interior.

b) When the compressor (lubricated as well as dry lubricated) compressor is kept idle for a period less than six months, run the motor driven/hand driven crank mechanism lube oil pump for 10-15 minutes once in every week.

While the crank mechanism lube oil pump in operation, rotate the shaft by a few revolutions at least once in every two weeks. The shaft need not to be stopped at previous locations.

c) When the compressor (lubricated as well as dry lubricated) is kept idle for more than six months fill up the crank case with enough suitable preservative oil to bring the oil level to the mark on the oil level gauge window. Close all holes/ opening of the crank case and purge the air inside the crank case with dry nitrogen and keep a nitrogen pressure of about 100 mm WG. Run the lube oil pump for 10-15 minutes and at the same time rotate the shaft, by a few revolutions, manually or by a barring jack. Avoid that the shaft stops in previous position. Repeat the operation once in two weeks. In case dry nitrogen is not available, introduce in the crank case a

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suitable quantity of dehydrating agent at such a location that it does not get soaked with oil during the running of lube oil pump. Check the effectiveness of the dehydrating agent periodically.

d) Apply suitable grease on the shaft end outside the crank case and all other exposed surfaces.

e) For lubricated compressors keep the compressor valves immersed in suitable rust preventive oil. As an alternative apply rust preventive oil on the compressor valves and keep them in plastic bags with dehydrator. For dry lubricated compressors remove the valves from cylinder, put sufficient quantity of dehydrating agent in the valve chambers and assemble the valve covers. Clean the valves and keep them in plastic bags with dehydrator.

f) When lubricated compressors are kept idle for less than 6 months, wet the cylinder and packing with sufficient quantity of lube oil and also have 10-15 piston strokes at the same time. Repeat the operation once in every two weeks.

g) When dry lubricated compressors are kept idle for less than 6 months, Seal all holes of the cylinder, purge with dry nitrogen and maintain a pressure of about 100 mm WG. If nitrogen is not available, keep sufficient quantity of dehydrating agent such as silica gel and close tightly. Check periodically effectiveness of the dehydrating agent.

h) When lubricated compressors and dry-lubricated compressors (for process that allow traces of grease), are kept idle for more than 6 months, take out the pistons out of the cylinders. Remove the piston rings and rider rings. For metallic piston rings, apply grease on the entire surface and keep them in sealed polythene bags with dehydrator. Non-metallic piston rings do not require any special protection. Clean thoroughly and apply suitable grease inside the cylinder and the housing for valves and packing. Seal all holes of the cylinder, purge with dry nitrogen and maintain a pressure of about 100 mm WG. If dry nitrogen is not available, keep sufficient quantity of dehydrating agent such as silica gel inside the cylinder and check the effectiveness of the dehydrating agent periodically. Fill lubricators with lubricating oil. For dry-lubricated compressor all traces of rust preventive grease shall be removed before putting into service.

i) When dry-lubricated compressors for process that do not allow traces of grease, are kept idle for more than 6 months, the pistons, piston rings, valves and packing shall be degreased with thinners and kept in sealed polythene bags with dehydrator. Seal all holes of the cylinder, purge with dry nitrogen and maintain a pressure of about 100 mm WG. If dry nitrogen is not available, keep sufficient quantity of dehydrating agent such as silica gel inside the cylinder and check the effectiveness of the dehydrating agent periodically.

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j) Drain cooling water from cylinder jackets, inter coolers and after coolers wherever applicable.

k) Purge the piping with dry nitrogen. Close all openings and maintain a nitrogen pressure of 100 mm of WG. As an alternative, close all openings tightly and keep inside the piping sufficient quantity of dehydrating agent such as silica gel, in accordance with their dimensions and shape. Check the dehydrating agent periodically.

3.2.3 Preservation of idle oil free screw type Air Compressor.

The following procedure should be adopted when the compressor kept idle for a period up to two months the compressor should be run on no load once a week for approx. 10-15 minutes.

When the compressor kept idle for more than two months, the following steps should be adopted.

a) With the compressor running on LOADED condition open the manual condensate drains of inter cooler and after cooler and ensure all drain pipes are free. Close the drains and reopen them only after the unit has stopped.

b) Remove the moisture trap flange of the inter cooler and place sufficient quantity of moisture absorbing agent inside the moisture trap.

c) Close the flange hole of moisture trap airtight. Keep the flange separate in dry condition.

d) Close the manual drains.

e) Rotate the compressor drive shaft a few turns by hand once a week.

f) Drain off the lubricating oil and refill the oil sump with a suitable preservative oil.

g) Run the compressor on no load after first two months for at least half an hour to ensure that the normal working temperatures have been reached. Before running the compressor, remove and discard the moisture absorbing agent and refit the moisture trap flange.

h) Proceed further as described under steps (a) to (e) above using a new moisture absorbing agent.

i) When the unit is standing idle for an extended period the above mentioned procedure should be repeated every six months.

j) Drain the cooling water, close the inlet and outlet valves and fill the line with fresh water.

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3.2.4 Preservation of idle oil flooded screw Compressor

When the compressor is going to be idle for more than six months

a) Blind off suction and discharge valves
b) Drain the oil in the casing of the screw elements.
c) Flush and fill the casing of the screw elements with suitable preservative oil.
d) Close all drains and vents
e) Drain the cooling water, close the inlet and outlet valves and fill the line with fresh water dozed with anticorrosive chemical.
f) Rotate the compressor drive shaft a few turns by hand once a week.
g) Change the preservative oil every six months/one year as per schedule.
h) Change water every six months.

3.3 PRESERVATION OF STEAM TURBINES

a) The lube oil system and governing oil system shall be either kept in service on a weekly basis or filled with a low positive pressure of dry nitrogen.

b) Dry nitrogen may be admitted into the turbine including all steam spaces and gland sealing through one of the pressure tapping points in the turbine exhaust hood of turbine case. This shall be done during a period of minimum humidity and air inside the turbine is to be purged out completely.

c) Maintain a positive pressure of about 50 to 75 mm WG during the idle time and monitor the same.

The turbine rotor shall be rotated by turning gear or by hand by the following procedures:

- It should be rotated by 180 degree from the standstill condition after three months
- It should be rotated by 90 degree after 3 months.
- It should be again rotated by 180 degree after 3 months.
- It should be rotated by 90 degree position after 3 months.
- This procedure shall be continued subsequently.

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3.4 PRESERVATION OF GAS TURBINE

The following procedure should be adopted for preserving idle gas turbine

Machine already erected at site and the final commissioning of the machine is expected to be longer than one month.

a) For a single shaft turbine, cranking has to be done for half an hour once in a week keeping the lube oil system under operation. Apart from cranking of HP shaft, Low pressure (LP) shaft of two-shaft turbine has to be rotated manually for a few complete revolutions every week with help of suitable fixtures fitted with coupling hub in the direction of rotation keeping the lube oil under operation.

b) The lube oil has to be internally circulated through a centrifuge every day for 8 hours or whatever time required to drive out the moisture/ dirt/ dust from the lubricating oil when the Gas Turbine is lying in idle condition.

c) If the cranking is not possible by motor not being provided with electrical connections, in such case rotation of the machine to be done manually using suitable fixtures keeping the lube oil under operation.

d) The rotor in no case shall be rotated without lube oil circulation.

Machine already commissioned and the idle period is longer than one month

a) The unit should be operated on NO LOAD for at least 30 minutes in every month to dry out any moisture inside the ducting and other components and to recirculate the lubricating oil to recoat the moving parts to prevent rust and corrosion.

b) The lube oil has to be internally circulated through a centrifuge every day for 8 hours or whatever time required to drive out the moisture/ dirt/ dust from the lubricating oil when the Gas Turbine is lying in idle condition.

c) If the cranking is not possible by motor not being provided with electrical connections, in such case rotation of the machine to be done manually using suitable fixtures keeping the lube oil under operation.

d) The rotor in no case shall be rotated without lube oil circulation.

3.5 PRESERVATION OF DIESEL ENGINES

The following procedure should be adopted for preserving an idle diesel engine when the diesel engine is kept idle for a period less than 6 months, run the engine on load for 10-15 minutes once in a week. If the engine cannot be

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run on load, idle run the engine till the temperatures of cooling water and lubricating oil reach the normal operating range.

When the engine is kept idle for a period more than six months the following steps should be adopted.

a) Start the engine, increase the speed gradually up to 1200 rpm or a fast idle, operate the engine with no load until the engine is thoroughly warm and then stop the engine.

b) Drain all lubricating oil from the oil sump and refill the oil sump with suitable preservative oil.

c) Drain coolant from cooling system and thoroughly flush with clean water and suitable radiator cleaner. Refill the cooling system with mixture of water and suitable radiator protector in the ratio recommended by the manufacturer.

d) Fill two portable containers one with diesel and other with the preservative oil mentioned in (b) above.

e) Start the engine with engine pulling fuel from the container with diesel through the filter and the injector drain line flowing into the container with diesel. Once the engine is running smooth at idle, switch the fuel line to the container with preservative oil. Run the engine 5-10 minutes on NO LOAD till it is observed that the preservative oil is coming out from injector return line. Stop the engine.

f) Drain the oil sump, fuel filter and fix back the drain plugs.

g) Turn fuel pump manual shut off valve to ‘OFF’ position so that the engine will not start.

h) When the engine has become cool, disconnect the inlet and exhaust manifolds, spray suitable preservative oil into air intake and exhaust outlets, engine being turned by hand during spray operation. Cover all intake manifold opening with tape to prevent entry of dirt and moisture. Cover all engine openings of cylinder block, oil breather and crank case including coolant inlets and outlets. All vents, dynamo, starter motor, magneto if any and air cleaners to be carefully sealed with water proof paper and water proof adhesive tape.

i) Loosen V belt tension. Remove rock lever covers and spray preservative oil over rocker levers, valve springs & stems, guides, cross head and push tubes. Replace cover.

j) Do not rotate the crank shaft after the above operations.

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k) Tag the Engine with date of treatment to indicate it has been treated with preservatives and should not be turned over.

l) Periodically inspect engines for rust or corrosion and take corrective action if necessary.

m) Repeat the engine preservative treatment as mentioned above once in every six months.

n) Before taking into service, the engine shall be represerved as per the procedure given below

   i) Clean off all accumulated dirt and rust preventive using suitable solvent from exterior of engine.

   ii) Remove all paper cover, tape and wrappings and reinstall the dismantled components. Carry out precommissioning checks.

   iii) Flush cooling system.

   iv) Refill the oil sump with clean lubricating oil

   v) Adjust the injectors, valve and belts and check cylinder head cap screws, filters, air filter and screens.

   vi) Pressurise the lubricating system about 1 Kg/cm² including turbo charger or supercharger prior to starting the engine.

   vii) Run the engine with diesel on NO LOAD LOW IDLE for 5 minutes to flush the entire fuel system out of any preservative oil

   viii) Remove any foreign matter, which may collect on screens and strainers, before regular operation of the engine.

When the diesel engine is kept in store as a spare complete set and likely to be unused for more than six months

a) Keep the engine on a suitable pedestal

b) Just after six months from the date of despatch, the preservative oil should be drained off from the engine. After flushing the internal parts with a suitable solvent, wipe and clean the parts with the solvents. Clean the parts with dry felt cloth.

c) After drying suitable rust preventive should be again sprayed and dried on the parts

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d) The crank case should be filled with suitable rust preventive and should be filled up to the high oil level mark of crank ease

e) Connect a electrical motor driven lube oil priming pump with suction of the pump connected to the crack case drain point and discharge connected to the inlet of the lube oil filters

f) All the openings to be covered or blinded to make the engine air tight

g) Run the lube oil pump once in week to achieve the operating pressure inside the engine and then stop the pump. By this method all bearings, pistons connecting rod, rocker arms, valves, etc. will be lubricated

h) After six months repeat the above procedure as per steps (b) to (g) mentioned above

i) Replace the preservative oil as per schedule.

3.5 PRESERVATION OF FANS & BLOWERS

The following procedure should be adopted for preserving idle fans and blowers

a) Coat the interior of the casing and the impeller of the fan/blower with a suitable rust preventive.

b) Blind the suction and discharge end of the fans/blowers.

c) Close all openings in the casings.

d) Clean and coat the exposed shaft with grease.

e) In case of grease lubricated bearings remove the grease, clean the bearing and bearing housing and fill the bearing housing fully with fresh grease. Close all openings of the bearing housing.

f) In case of oil lubricated bearings drain the oil. Flush and fill the housing fully with suitable grade of fresh lubricating oil. Close all openings of the bearing housing.

g) Coat all the exterior surface of the casing/bearing housing with suitable rust preventive.

h) Drain the oil from gear box and refill it with a high grade mineral oil. Clean the exterior surfaces of the gear box and paint them. Wrap all exposed shaft with Plastic tape. Store the reducer in a warm and dry. The gear box rotor shall be rotated by the following procedures:

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• It should be rotated by 180 degree from the standstill condition after three months.

• It should be rotated by 90 degree after 3 months.

• It should be again rotated by 180 degree after 3 months.

• It should be rotated by 90 degree position after 3 months.

• This procedures shall be continued

4.0 PRESERVATION OF MATERIALS IN STORES

Moisture, oxygen and atmospheric conditions are the main contributing factors causing deterioration. These may cause rusting, pitting of surfaces and other forms of deterioration. Proper identification system should be used for material stored in the warehouse to avoid mixing. Procedure for preservation of stored material should be adopted as follows.

4.1 PRESERVATION OF HEATER COMPONENT:

4.1.1 HEATER TUBES:

Both CS and low alloy steel heater tubes can be stored outdoor on a sloped concrete surface. These tubes shall be kept either on steel racks or wooden rafter. Tubes shall not be allowed to get submerged in the ground or in contact with water. Both the ends of tubes shall be suitably capped or plugged. CS heater tubes shall be given a coat of oil preservative externally before stacking the tubes. 300 mm length at each end of tube shall be coated with grease and water proof wrapping paper where rolling operation is performed. To avoid chloride attack, it is preferable to store Stainless steel heater tubes indoors on wooden rafter with both the ends plugged.

4.1.2 Return Bends:

CS/ Low alloy steel cast plug type return bends should be stored in a covered shed. Grease preservative shall be applied on all the machined and threaded surfaces. However other type of return bend can be stored outdoors after applying necessary protective coatings as given to heater tubes in downward position to avoid any accumulation of water inside the bend.

4.1.3 Heater Tube Support or Hangers, etc. :

These shall be stored indoor. No preservative is needed for these components.
4.2  PRESERVATION OF PIPES, PIPE FITTINGS AND VALVES

4.2.1  Preservation of Pipes:

Both CS and low alloy steel pipes can be stored outdoor in a self draining position on a concrete surface either on steel racks or woody rafter placed in such a position that rain water does not accumulate and affect pipes. Pipes shall not be allowed to get submerged in ground or pool of water.

Pipes/pipe fittings shall be protected with an external coat of black bituminous paint. Pipes shall also be painted internally at the ends, upto a length of 12" or as practicable.

Stainless steel pipes shall be stored indoor on wooden rafters/concrete, separate from CS, with ends opened or plugged. The ink used for marking, if any shall be free from chloride, sulphur and lead.

For pipes with threaded connection, extra care shall be taken in protecting the threads by putting plastic caps or wrapping with jute cloth.

4.2.2  Preservation of Flanges:

Flanges with anticorrosive painting shall be stacked on stands/concrete or wooden sleepsers with their gasket seating surfaces at the bottom and covered with tarpaulin. All the flange gasket seating surface must have a protective coating & extreme care must be taken during handling to avoid damage.

All SS flanges should be stored indoors.

4.2.3  Preservation of Pipe Fittings:

Forged fittings can be stored outdoor on sloped concrete surface or wooden platform. All fittings shall be preferably given a coat of anticorrosive paint and shall be stored in such a location that rain water does not accumulate in it.

Stainless steel fittings should be stored indoors.

4.2.4  Preservation of Fasteners:

Fasteners shall be kept indoors. Carbon steel and alloy steel fasteners shall be stored in separate bays after oil preservation spray. Stainless steel fasteners do not require any protection.

4.2.4  Preservation of Valves:

End cover of all the valves shall be plugged by wooden/rubber/PVC blanks.
Valves shall be stacked on a concrete surface on wooden rafters, with wooden planks on flanges.

Grease shall be applied on valve steel spindle and flange faces of CS & AS valves. Valves shall be kept in upright with spindle upward and gate in closed position.

All SS valves shall be stored indoor without any preservative.

4.3 PRESERVATION OF HEAT EXCHANGERS/ CONDENSERS/ COOLERS:

4.3.1 Bundles:

CS & AS tube bundles shall be stored suitably covered on wooden rafters. Oil preservation spray on tube extended surface shall be done once in a year. Tube sheets shall be greased properly and covered with wooden boards.

CS & AS tube bundles can also be stored in wooden boxes with tarpaulin cover on top.

Tube bundles of brass/ stainless steel and high alloy steel shall be stored on wooden rafters with proper covers. Special care needs to be taken for SS bundle to avoid chloride attack. No preservative is needed for these bundles.

4.3.2 Tubes:

All the exchanger/ condenser tubes shall be stored indoor on steel racks. CS and alloy steel tubes shall be coated with oil preservative or black bituminous paint whereas brass/ stainless steel tubes do not require any preservative. Tubes may be provided with tightly fitted HDPE/ PVC end caps.

4.3.3 Tube Sheets:

CS and alloy steel tube sheets shall be stored indoor on wooden rafters with grease applied on it. Brass/ SS tube sheets shall be stored indoor without any preservative.

4.4 PRESERVATION OF PLATES:

CS plates can be stored in a sloping fashion on wooden rafters in bunches keeping sufficient clearance from the ground. Top, bottom and side surface of the bunch (of same size) coming in contact with atmosphere should be coated with preservative oil/grease/ paint.

Alloy Steel/ Stainless steel plates may be stored indoor. No preservative is required for these plates.

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4.5 PRESERVATION OF STRUCTURAL STEEL:

Structural steel shall be positioned in a way to allow self draining. Structural steel should not be in contact with soil during preservation.

4.6 PRESERVATION OF COLUMN TRAYS & FITTINGS:

These shall be stored indoor. CS/AS fittings shall be kept after a spray of oil preservatives. Stainless steel parts shall be kept as it is.

4.7 PRESERVATION OF VESSEL & EXCHANGER SHELL:

Closed vessel shall be kept on their steel supports. In absence of steel support, wooden saddles shall be used. Vessel shall be painted externally with Zinc Oxide primer. Preservative oil spray shall be done on internal surface. Flanged faces shall be greased and covered with wooden boards. All the nozzles shall be suitably covered so that rain water will not ingress.

4.8 PRESERVATION OF REFRACTORY

4.8.1 Refractory Bricks:

Refractory bricks shall be stored indoors in a dry shed. The storage shed shall be at a well-drained location. In stacking, the bricks, shall be stacked on edge with laths in horizontal joints.

4.8.2 Refractory Castables:

Castables shall be kept in dry storage and protected from rains and moisture. The stacking of castables shall start approximately 15 cms above the concrete floor which itself shall be sufficiently above ground level. If the floor is not dry ensure storage of bags above the damp floor by providing timber boards on bricks, planks or any other suitable device.

Bags of castables shall be stacked at least 30 cm away from the walls to ensure that they shall not come in contact with walls which may be damp. In very large sheds, bags shall be covered with plastic sheets.

4.9 PRESERVATION OF SPARE PARTS OF PUMPS AND RECIPROCATING COMPRESSORS:

Preservation should be carried out in accordance to Para 4.4 of OISD-STD-126

4.10 PRESERVATION OF ANTI-FRICTION BEARINGS:

Preservation should be carried out in accordance to Para 4.5 of OISD-STD-126

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4.11 PRESERVATION/ REPRESERVATION OF COMPONENTS OF CENTRIFUGAL COMPRESSOR / STEAM TURBINE / GAS TURBINE / DIESEL ENGINE

4.11.1 Rotor:-

Preservation/Represervation of rotor should be carried out in accordance to Para 4.3 of OISD-STD-126.

4.11.2 Casing:-

Casing surface to be sprayed with suitable rust preventive oil. To the extent possible the parting planes of the casing shall be kept on top. If this is not possible and if the casing is required to be kept in the inverted position, the parting planes shall be kept on dry wooden beams. To avoid rusting of the contact area between the casing parting plane and the wooden beams, rubber pads or grease/ oil immersed felt shall be kept.

4.11.3 Journal Bearings, Thrust Bearings, Oil Seals And Couplings:

These small spare parts which are to under go forced lubrication, should be protected by coating with suitable grease and wrapped in water proof plastic paper/ VCI paper.

4.11.4 Crank case/Connecting rods/ pistons/liners and other components to be stored in a covered shed preferably with a coating of anticorrosive paint. All shaft connecting rods shall be provided with proper wooden supports.

4.12 PRESERVATION PROCEDURE FOR EQUIPMENT NOT INSTALLED/ KEPT AT STORE.

When the Reciprocating Compressor is not installed at site and likely to be kept idle more than six months.

a) Inspect the Crank case cover to check the condition of crank shaft, connecting rod and other components. After cleaning them thoroughly flush and drain the Crankcase by filling suitable preservative oil and then fill the same oil upto the Crank Case oil level.

b) Open the inspection cover to check the condition of piston rod, rod nut, cross head, etc and after cleaning these are to be coated with rust protective layers. Close the crank case cover to prevent the entry of dirt/ dust and moisture.

c) Suction and Discharge valves, piston rod pressure packing rings should be taken out and cleaned thoroughly by some solvent and then coat them with some rust preventive oil and wrap then in polythene pack and should be kept separately.

d) All piping connections and openings should be carefully plugged, blinded.

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e) Lubricated cylinders should be lubricated by manually turning the force feed lubricator, which should be kept filled up with suitable preservative oil. Wherever the force feed lubricators are not available apply suitable preservative oil inside the cylinder surfaces.

f) For non-lubricated cylinders, keep sufficient dehydrating agents such as silica gel inside the cylinder and close all the openings tightly. Check the effectiveness of the dehydrating agent periodically.

g) The barring of the compressor to be done at least once in three months.

When the oil free screw air compressor is not commissioned and kept idle for more than five months.

a) Renew the drying agent such as silica gel placed in the inter cooler moisture trap immediately upon receipt of the compressor at site

b) Renew the drying agent such as silica gel kept in the inter cooler moisture trap once in every 3 months

c) Store the compressor units indoors in a dry space

d) Ensure that there is absolutely no water in the crate, on any plastic cover, or any where along the canopy or the base frame of the unit

e) Install a motor driven special lube oil pump of small capacity capable of developing the maximum operating pressure of the main oil pump of the compressor with suction of the pump connected to the oil sump drain point and the discharge of the pump connected to the upstream of the lube oil filter.

f) Fill the lubricating circuit with a rust inhibiting oil.

g) Run the special oil pump for 15 minutes. While the oil circulates, turn the compressor coupling by hand. The silica gel kept in the inter cooler moisture trap is to be removed before starting the lube oil pump. After lubrication insert new silica gel.

h) Repeat the procedure mentioned in (g) above once in six months

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5.0 REFERENCES

(i) API Guide for Inspection of Refinery Equipment - Chapter XVIII – Protection of Idle Equipment.

(ii) NACE Standard – RP - 01 – 70 - Protection of Austenitic Stainless Steel in Refineries against Stress Corrosion Cracking by Use of Neutralizing Solutions During Shut Down.

(iii) ASME Boiler & Pressure Vessel Code, Sec VII – Recommended Rules for care of Power Boilers.

(iv) The Preservation of Equipment and Piping Standing Idle – DEP – 70.10.70.11 – GEN of Shell Group.


(vi) OISD-STD-146 – Preservation of Idle Electrical Equipment.
ANNEXURE I

COMMONLY USED PRESERVATIVES

I. OIL PRESERVATIVES: Generally, it is a lubricating oil of viscosity SAE 30, compounded with inhibitor and wetting agent. It may be applied by brushing, splashing or spraying. In absence of any oil preservatives, spent lubricating oil can also be used in exigency.

II. GREASE PRESERVATIVE: It is an asphaltic/petroleum type base cutback with solvent. It leaves a greasy film that can be easily removed by a petroleum solvent. It may be applied by brushing or dipping.

III. PAINTS: Bituminous anti corrosive paints manufactured by various reputed manufacturers can be used. It is applied by brushing or spraying.

IV. WRAPPING: Water proof wrapping papers may also be used. Papers coated with volatile corrosion inhibitor (VCI paper) are available and have got longer life.