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**Attachments:** &AZ W-SC 0820.001 - Preservation Record, &AZ W-SC 0820.002 - Preservation Tag

# Purpose and Scope

This document shall describe and specify the general activities and procedure to preserve material and equipment supplied by LINDE (EP contract) or in general at construction sites controlled by LINDE (EPC contract).

The Owner (EP contract) taking over LINDE supplied material shall be responsible towards LINDE to keep up and carry out below described preservation measures.

For specific preservation measures requiring extensive preparation, such as the preservation of large diameter pipelines, large modules or underground installations, special method statements shall be developed.

This procedure is used in addition to the valid requirements given in "&AZ W-SC 0804 – Storage and protection of equipment and material on site" and other specifications per discipline and relevant LINDE Standards.

Any manufacturer requirement higher than the herein described shall prevail and be used for respective preservation activities of such material.

Attention:

Special procedures and activities need to be considered for any material or equipment for OXYGEN SERVICE.

IN GENERAL NO SURFACES OF PROCESS RELATED PARTS SHALL BE CONTAMINATED WITH ANY PRESERVATION AGENT WITHIN ASU PROJECTS.

# Definition and reference

Definitions within this document:

|  |  |
| --- | --- |
| Preservation | The protection and preventive maintenance carried out on equipment or material from ex-works status up the takeover by commissioning / operation and maintenance. Preservation measures shall take place at the manufacturer, in the warehouse, in workshops and on site. |
| Preservation interval | The Preservation interval is the time duration until a preservation measure has to be repeated. |
| Preservation record | A template with check items used to guide and document a specific preservation activity. |
| Preservation tag | A coloured tag on an installed equipment or material recording which shows when and by whom preservation activities have been carried out on this specific equipment. |
| Conservation | Measures targeting the long term passive protection of material or equipment not being in use.  Conservation measures are typically used for stored spare parts or plants or parts thereof being decommissioned for longer time periods. |
| OWNER | Party who awarded the EP or EPC contract to LINDE |
| LINDE | Respective LINDE entity which went into contract with OWNER |
| CONTRACTOR | Any company or entity performing contracted by and performing work in behalf of LINDE |
| MANUFACTURER | Any company or entity fabricating or manufacturing material or equipment based on a LINDE purchase order and specification for the respective project. |
| PRESERVATION RESPONSIBLE | The LINDE site responsible for preservation as defined by project. (or assigned OWNER representative for EP contracts) |

Reference is taken to following documents:

|  |  |
| --- | --- |
| &AZ W-SC 0801 | Material Receiving, Inspection, Release and Site Procurement for Equipment and Materials |
| &AZ W-SC 0804 | Storage and protection of equipment and materials on site |
| &AZ W-SC 2401 | Metallic Piping Systems (Construction Specification) |
| LS 148-12 | Preservation Methods (for the application within the time frame from mechanical completion until commissioning and start-up) |

# Preservation procedure

## General Responsibilities

The listing of equipment and material being subject to preservation shall be compiled by each project.

**NOTE:**

**Any tools and consumables (borescope, desiccant, caps, covers, grease, chemical, nitrogen, tarpaulin, tags and signs etc.) required to apply or maintain preservation shall be borne by the party applying and maintaining such measures.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Party** | **Fabric.-Yards / Workshops** | **Warehouse / Laydown** | **On Site** |
| **Manufacturer** | Provide specific preservation procedure if required | Provide specific preservation procedure if required | Provide specific preservation procedure if required |
| **CONTRACTOR (or OWNER for EP contracts)** | Apply / Maintain / Document | Apply / Maintain / Document | Apply / Maintain / Document |
| **PRESERVATION RESPONSIBLE (or OWNER for EP contracts)** | Assure implementation & spot check | Assure implementation & spot check | Assure implementation & spot check |

## Safety

For site and all related areas CONTRACTOR shall train the personnel carrying out preservation activities. The training topics shall be in related procedures, planned activities and especially all related safety regulations. Preservation activities are to be handled as any other construction activity. All valid HSE regulations and procedures (such as job risk analysis etc.) as per construction site apply.

Special awareness shall be brought to activities as powering up heaters, moving shafts of rotating equipment, pressurising with nitrogen, preservation in live areas or application of any chemicals.

Any applicable permit to work system needs to be applied to.

## Standard Procedure

The party applying/carrying out preservation activities shall prepare itself with the following (as per tag number to be preserved):

1. **Manufacturer Maintenance or Preservation Instruction/Manual**
2. Applicable project specifications for packing, preservation, storage
3. Drawings/Data Sheet (if applicable)
4. Preservation Record (1 per equipment/material for each time of preservation activities)
5. Preservation Tag (1 per equipment/material)
6. Applicable tools and preservation consumables (borescope for inspection, desiccant, grease, caps, covers, nitrogen etc.)

If documents are not transmitted as yet the, party applying preservation shall actively request those documents.

**NOTE:**

**Preservation activities shall be carried out according to following steps:**

1. **Review Manufacturers' and LINDE Preservation instructions**
2. **Review Drawings (if applicable)**
3. **Positive Identification of Equipment / Material as per location and tag number**
4. **Attach Preservation Tag (first time only)**
5. **Carry out applicable preservation measures**
6. **Fill and sign Preservation Tag and Record**
7. **Return Preservation Record to LINDE**
8. **Spot Check and countersign Preservation Record by PRESERVATION RESPONSIBLE**

To each stand-alone tagged equipment or material a coloured plastic preservation tag will be attached in order to record the latest preservation activity on the spot. Within skids or other packaged units each equipment requiring preservation shall get its own preservation tag.

The party carrying out Preservation activities shall provide and install such plastic tags.

If a preservation requirement cannot be applied as specified, it needs to be noted on the Preservation Record and has to be brought to the PRESERVATION RESPONSIBLE attention.

LINDE shall then initiate appropriate measures to remedy the situation.

Filled and signed Preservation Records shall be returned to PRESERVATION RESPONSIBLE for review and filed in respective site documentation.

## Specific preservation procedures and method statements

As previously mentioned this procedure describes general and minimum preservation activities.

For complex equipment, such as large skids or pre-assembled packaged units, a specific preservation procedure shall be inquired by the LINDE Equipment Responsible and be provided by the manufacturer.

For complex modules or pre-assemblies performed by construction a specific preservation method statement reflecting all related disciplines shall be developed.

This shall consider all related manufacturer requirements and below mentioned general standards. A detailed description of works, including drawings, work steps and check items shall be part of such method statement.

The specific method statement shall be developed by CONTRACTOR with support of PRESERVATION RESPONSIBLE and reviewed and approved by the LINDE Equipment Responsible (EQR).

## (Pre-)Fabrication or Module yards

At any yard where delivered material is assembled or (pre-)fabricated preservation shall be carried out on all equipment and material as per this procedure.

Protective corrosion appliances shall be inspected and if required repaired after any handling or construction activity within the yard.

For transportation of modules or packages the applicable logistics packing and shipping specification shall also be observed.

The more stringent requirements shall apply.

The LINDE fabrication yard supervisor shall be invited to assure the proper preservation before final packing is carried out.

## Warehouse and storage

With material reception on site the integrity of the transport preservation and packing is inspected and controlled.

If required the packing opened by customs or damaged during transport shall be properly reinstated and repaired. This may include replacement of desiccant, restore vacuum-packing and proper (heat-)sealing of packing.

This especially applies to all equipment and material which is planned to be stored in open spaces.

Please refer also to the project's valid material reception procedure.

**NOTE:**

**The CONTRACTOR shall be responsible to update the PRESERVATION RESPONSIBLE on weekly bases on all arrived material and equipment.**

**CONTRACTOR shall identify together with the PRESERVATION RESPONSIBLE such material and equipment being subject to preservation. CONTRACTOR shall establish and update a list of such identified material and equipment.**

**This list of equipment and material being subject to preservation shall be used by CONTRACTOR to organise the start-up of relevant preservation activities.**

## On Site

**NOTE:**

**With material hand over any CONTRACTOR will proceed with the preservation for the specific equipment or material in accordance to manufacturers or LINDE requirements. This is to be continued even after material installation up to Mechanical Completion.**

The planning and documentation of such preservation activities shall proceed under the above described procedure and tracking system.

For sensitive or critical equipment a specific transport, weather protection and preservation method statement for site shall be developed by CONTRACTOR in accordance to manufacturer's requirements and relevant procedures. This shall be part of the installation method statement for such equipment.

# Preservation requirements

## Project environmental conditions

All preservation requirements and activities have to be tailored to specific local environmental conditions.

Any environmental or climate condition shall be considered for preservation activities, this includes but is not limited to heat, sun radiation, dust/sand, snow/frost, rain, salty air/sea water, humidity, wind and suitable pest control (insects, rodents and other animals).

In wet environments or with condensing atmosphere (e.g. by day/night temperature) rain water and condensation moisture needs to be controlled or prevented from.

In corrosive or dusty atmospheres surface protection and enclosing is important. Any sort of openings shall be properly closed. Purging should be done with clean gases only.

Protection from frost, snow and ice can be provided by covers, shelters and heating fans.

## General requirements

Special procedures and activities need to be considered for any material or equipment for OXYGEN SERVICE. No grease, oil, fluid, corrosion agent is allowed, cleanliness is of the essence.

**NOTE:**

**The equipment or material manufacturer's transportation, preservation, storage or installation instructions need to be reviewed and complied to at all times for all disciplines!**

Where exposed to atmosphere machined function surfaces shall be coated with a preservation agent and protected. This applies especially to any flange faces, valve spindles and rotor shafts where exposed to atmosphere.

All hinges (doors or manholes), rollers, bearing parts and fasteners shall be properly lubed or coated with a preservation agent in order to prevent corrosion of surfaces in contact.

Flexible gaskets in doors, windows, manholes and other openings shall be protected from perishing with a suitable agent.

For any containerised equipment (e.g. diesel gen set, compressor stations, analyser container, substation) if available, the respective HVAC system shall be powered up. During storage in the laydown area this shall be granted by temporary power supply.

## List of critical equipment and material

| Equipment Name/Typ | Preservation during INSTALLATION | Remark |
| --- | --- | --- |
| Civil |  |  |
| Anchor bolts | Surface corrosion protection. Dry storage preferred. |  |
| Rotating Equipment |  |  |
| Pump Skids | Preserve electrical motor/components; turning of shaft; lube; rain/weather protection; cap nozzles |  |
| Pump (Large) | Open drain (if applicable); turning of shaft; lube; rain/weather protection; cap nozzles |  |
| Pump (Small) | Turning of shaft; lube; rain/weather protection; cap nozzles |  |
| Gear Box | Rain/weather protection; lube; preservation agent; use inspection holes for corrosion inspection; regular turn if possible |  |
| Compressors (incl. Lube Oil Units) | Rain/weather protection; cap/blank off nozzles close to casing; open drains; close vents; purge with dry air/nitrogen via oil unit; |  |
| Turbines (incl. Lube Oil Units) | Rain/weather protection; cap/blank off nozzles close to casing; open drains; close vents; purge with dry air/nitrogen via oil unit; |  |
| Static Equipment |  |  |
| Mol-Sieve | Please refer to &AZ B-PP 2626.LMS |  |
| Mol-Sieve (regeneration gas heater) | Inspect and power up space heater or purging of junction box | Heating elements have hygroscopic insulation filling. Entering humidity can reduce the insulation. |
| Insulated Tanks (perlite) | Purge perlite with dry air/nitrogen |  |
| Cold-Box (Perlite) | Purge perlite with dry air/nitrogen |  |
| Chemicals / Catalysts / Filling or Packing Material | Control environment after installation, strictly follow Manufacturer requirement; e.g. purge vessel with dry air |  |
| Other and Bulk Material |  | &AZ W-SC 2401 – Metallic Piping Systems |
| Piping (stainless) | Cover from other construction activities (prevent corrosion) |  |
| Piping (special material / alloys) | To be reviewed and specified |  |
| Cold Box Piping | Avoid any water ingress |  |
| Valves (small bore, bulk) | Lube spindle; regular movement of hand wheel; cap off is open ending |  |
| Valves (large, manual) | Rain/weather protection; cap off if open ending; lube/preserve spindle; regular movement of hand wheel |  |
| Valves (large, control/motorized) | Rain/weather protection; blank off positioners/sensors; lube/preserve spindle; |  |
| Safety Valves | Rain/weather protection |  |
| Packaged Units | Avoid any ingress of water |  |
| Electrical/Instrumentation Equipment |  |  |
| Electrical Motors | Inspect and power up space heater (if available); plug holes and cable entries, rain/weather protection, measures for rotating equipment apply (shaft/bearings) |  |
| Switchboards / Cabinets | Only install if HVAC is running  Inspect and power up space heater (if available); keep room clean from dust otherwise cover up; use clean dry air overpressure to keep cabinets clean (if specified) |  |
| Junction Boxes (equipped) | Rain/weather protection, cap/blank off openings until cable glanding is installed, avoid ingress of dust and moisture |  |
| Junction Boxes (empty) | Keep cable entries closed/plugged |  |
| Transformer (dry) | Inspect and power up space heater (if available); keep dry/weather protected |  |
| Transformer (oil filled) | Maintain nitrogen filling up to oil filling; Inspect and power up space heater (if available); maintain dehydrating breathers (if available); rain/weather protection |  |
| Batteries / UPS | Only install if HVAC is running  Conduct risk assessment (e.g. hydrogen); Regular charge of battery; |  |
| Instruments /switches | Rain/weather protection; Cable and process entries closed/plugged until glanding/tubing connection; |  |
| Analyser | Rain/weather protection; |  |
| Tubing | Keep ending/openings closed/capped |  |
| Cable | Pulled cabling to be sealed at the ends with heat shrinkable tube/cap until connection |  |

## Methodology, Consumables and Tools

Following table shall provide an overview on different methods, consumables and tools typically used for below mentioned standard preservation activities:

| Name | Type | Targeted effect | Applied to | Remark |
| --- | --- | --- | --- | --- |
| Lube, oil, grease | Consumable | Surface / corrosion protection | Bearings, hinges, spindles, fasteners, moving parts, metal surfaces | Never used for piping system & piping components of Air Separation Units |
| Preservation / corrosion agent | Consumable | Surface / corrosion protection | Machined function surfaces, shafts, metal surfaces |  |
| Glycol | Consumable | Anti freeze, water dosing | (cooling) water cycles |  |
| Caps / Plugs (plastic) | Consumable | Water / dust protection | Pipe ends, any flanges |  |
| Caps (heat shrink) | Consumable | Water / dust protection | Cable ends |  |
| Plywood | Consumable | Waste / dust protection | Any large flanges, openings, manholes, doors |  |
| Rubber Liner | Consumable | Water / dust protection |  | Usually used to improve function of plywood |
| Tarpaulin (fireproof) | Consumable | Water / sun / dust protection | Any equipment | During storage (normal) or installation/on site (fireproof) |
| Sealed vacuum packing | Consumable | Corrosion protection | Any equipment |  |
| Desiccant / Silica gel | Consumable | Corrosion protection | Any equipment | Usually used to improve function of vacuum packing |
| Wooden boxes | Consumable | Mechanical protection | Any equipment or bulk material | Protects either the equipment itself or the preservation measures (e.g. sealed vacuum packing) |
| Shelter | Method | Water / sun protection | Any equipment or bulk material | Only to prevent direct weather impact, supports other detailed preservation measures |
| Container storage | Method | Water / sun / dust protection | Any equipment or bulk material | Only to prevent direct weather impact, supports other detailed preservation measures |
| Warehouse | Method | Water / sun / dust protection | Any equipment or bulk material | Only to prevent direct weather impact, supports other detailed preservation measures |
| Warehouse (HVAC) | Method | Corrosion / insulation protection | Sensitive equipment, often electrical/instrumentation |  |
| Megger Testing | Method | Check insulation resistance | Electrical equipment with windings (such as motors and generators) | Only used upon manufacturers requirement |
| Nitrogen | Consumable | Corrosion / insulation protection | Any enclosed space (mechanical / electrical) | Either as overpressure (e.g. vessel) or as purging gas  !CONDUCT RISK ASSESSMENT!  The use shall be duly planned and reviewed with HSE Manager |
| Dry air | Consumable | Corrosion / insulation protection | Any enclosed space (mechanical / electrical) | For purging (e.g. instrument air from permanent) |
| Dehumidifier | Device | Corrosion / insulation protection | Any enclosed space (mechanical / electrical) | Either to purge dry air to a system or directly dry air inside an enclosed space (water collected or drained) |
| Heating fan | Device | Corrosion / insulation protection | Any enclosed space (mechanical / electrical) | For purging |
| HVAC | Device | Corrosion / insulation / dust protection | Usually for buildings / housings | Either powered up permanent equipment or mobile temporary device |
| Air Filter (particle) | Device | Dust protection | Any enclosed space | Usually used to improve function |
| Dehydrating breathers | Device | Corrosion / insulation protection | Any enclosed space (mechanical / electrical) | Installation at suitable flange (usually drain) of a vessel or equipment, the rest to be sealed |
| Space heaters | Device | Corrosion / insulation protection | Usually electrical equipment or casings | Use temporary power for early utilisation during storage/installation |
| Breathing glands / vent plugs | Consumable | Corrosion / water protection | Casings / junction boxes / cabinets (open air) | Installation at suitable opening (e.g. cable entry) to minimize condensation |

## Mechanical Equipment

All flanges of any equipment require special attention. Usually they are capped or blanked off by manufacturer to prevent them from physical damage or scratching. Missing caps or covers are to be replaced.

It has to be considered that corrosion can take place under such caps and covers and this may also damage the gasket faces of the flanges. Therefore an appropriate preservation agent or surface protection needs to be applied, controlled and maintained under such covers.

### Vessels

For vessels usually the corrosion protection and cleanliness is the main focus for preservation.

Therefore some vessels are already at the manufacturer filled with nitrogen over atmospheric pressure, to prevent any moisture or air to enter the vessel. Due to pressure loss, this inert filling has to be checked and if required topped up with a nitrogen source.

Such equipment shall be clearly marked with signs "Attention: Pressurised with nitrogen" at all valves and flanges.

On vessels which are not inerted with nitrogen, openings shall be capped or kept close at all times to prevent from entrance of debris. Condensation within the vessel shall be avoided and regularly checked.

In order to prevent the collection of condensing water the drains can be opened or a dehydrating breather can be installed at such a drain nozzle.

### Cold Box

Besides the above mentioned preservation of the internal vessels special focus shall be drawn to the perlite insulation of the cold box.

Usually perlite is filled into the cold box on the construction site, but also pre-filled packaged cold boxes exist in some projects.

In any case the perlite needs to be purged with dry/warm air or nitrogen to protect the perlite from any humidity.

### Rotating equipment

**NOTE:**

**The equipment manufacturer's transportation, preservation, storage or installation instructions need to be reviewed and complied to at all times for all disciplines!**

Preassembled rotating equipment, such as pumps, shall be given special attention as per the general requirements for bearings and machined surfaces of the shaft.

A regular turning or movement of the shaft shall be performed as specified by the manufacturer.

In case no manufacturer recommendation is available greasing and turning of the bearings shall be carried out at least every 4 weeks. Possible transport blocks or locking devices need to be considered and if applicable removed.

Within housings or casings condensation of humidity must be avoided by storage or other measures.

Special attention shall be brought to gear boxes. Keep the casing dry inside, by proper storage, purging or heating. If the casing is tight the connection of dehydrating breathers to plug-hole or drain nozzle is also an option help to prevent moisture to enter the casing.

A regular inspection via inspection hole for traces of condensation shall be carried out.

**For larger turbo machinery the following typical steps shall be considered in consultation with the LINDE Equipment Responsible (EQR):**

* During construction period in open space use flame resistant tarpaulin or other sheltering to protect equipment from weather
* Close and seal process media suction and discharge side as close as possible to the casing (e.g. by full gasket / thin metall sheet)
* Open drain nozzles (valves or plugs) at the casing, at chillers/heat exchangers, at shaft seal
* Keep all vents (valves or plugs) closed
* Purge the machine (via lube oil demister nozzle, exiting at drains) at night with
  + Nitrogen, if permanent plant supply available AND RISK ASSESSMENT is done
  + Dry air (from permanent plant instrument air supply, otherwise by eletric powered dehumidifier with particle filter) or
  + Filtered warm air (using a heating fan with particle filter)

### Skids and packaged units

For any skid and packaged unit also the non-mechanical parts, such as valves, motors, cabinets and instruments shall be reviewed in relation to preservation requirements. Also the manufacturer documentation shall be consulted to create a proper preservation planning and identify all parts requiring preservation.

### Piping and bulk material

The main focus for piping and bulk material is to minimise the corrosion impact and keep dust and debris out. The initial preservation with an agreed agent as well as the suitable storage contributes to maintain the material in good condition.

**NOTE:**

**Piping/spools shall be capped off at open endings at all times (in storage, workshops and during installation on site).**

**Installed piping systems not currently used can be slowly purged by dry air/nitrogen. This especially applies in any oxygen or ASU environment, where no preservation agents are used to prevent further corrosion of surfaces.**

**The use of nitrogen shall always be duly reviewed with applicable HSE rules and tools, such as Job Safety Analysis / Risk Assessment.**

Valves and especially automated valves with drives and/or positioners should be kept in their originated packing or be packed up to installation. After installation they shall be protected against rain and moisture.

Bulk materials, such as small bore valves also must be applied with the typical preservation measures as described above.

Specific requirements for piping and valves for OXYGEN SERVICE shall be considered.

## Electrical and instrumentation

**NOTE:**

**The equipment or material manufacturer's transportation, preservation, storage or installation instructions need to be reviewed and complied to at all times!**

Any electronic or electrical equipment shall be stored dry and dust free and the humidity shall be controlled.

Electrical or electronic devices shall be protected from high heat and direct sun radiation (not only in storage but also during construction activities).

**NOTE:**

**Available space heaters should be temporarily powered up by a qualified electrician after unpacking at any time for storage until after installation. If not other measures for humidity control need to be implemented.**

### Cable and other bulk material

The end of cables should be sealed with a tape or heat shrinkable tube/cap to prevent unreasonable water ingress inside the insulation layers. This practise shall be used also every time a cable drum is brought back into storage position after cutting the required cable length.

Empty junction boxes shall be properly stacked with spacers and all openings shall be plugged at all times.

The junction box of regeneration gas heaters (Mol-Sieve) shall be either slightly purged with nitrogen or dry/heated air to prevent ingress of dust and moisture. The drying process of regeneration gas heaters with to low insulation resistance inside the heating elements is very time consuming.

Other preassembled junction boxes shall be handled alike electric cabinets, as described below.

### Cabinets

Any cabinet, electronic devise and computer shall be kept in a humidity-, temperature- and dust-controlled environment at all times.

Before any cabinet installation the respective building needs to have a running air conditioning system (HVAC). This can be permanent or temporary.

### Instruments, breaker and electrical equipment

All electrical equipment with windings, such as motors, transformers or magnetic actuators shall be weather protected at all times. This is independent of its International Protection Code (IP-Code).

In addition the manufacturer requirements apply.

Some electrical devices also allow to connect dehydrating breathers, in order to dry the air entering due to temperature changes.

A regular megger testing of electrical equipment shall only be envisaged upon manufacturer's recommendation or requirement.

Electrical motors rotating components (shaft and bearing) shall be preserved as described in the mechanical section of this document.

All openings of panels shall be properly plugged or closed.

All openings of instruments and related equipment shall be properly plugged or bLINDEd.

## Batteries / UPS

Any batteries or UPS systems shall be connected to the regular charging system in accordance to supplier specification. This also can be powered up temporarily.

The storage shall be temperature controlled.

## Winterisation

During wintertime special attention has to be drawn to winterisation measures.

This includes proper storage of any frost sensitive material, proper dry out of any water left by construction/pre-commissioning, use of antifreeze agents in cooling water cycle and if required protection from snow and ice.

If applicable a special winterisation procedure shall be developed by CONTRACTOR.

## Chemicals / Catalysts / Filling Material

Any chemicals, catalyst or filling material shall be stored in accordance to manufacturer's requirements and available material datasheets (e.g. MSDS).

This should include if required separation from other material, ventilation, sun protection, controlled temperature and safety trough/collection pan at all times.

Calibration gas bottles (analyser calibration) need to be stored above -20 °C.

# Removal of preservation application

Upon request by Commissioning any preservation application, such as temporary surface protection, liquids, desiccants, covers, packing or transport blocks, shall be reversed or removed in accordance to the applicable procedure.

With handover to Commissioning Preservation Tags will be removed from equipment.