

FEFPEB GUIDELINES for Industrial Packaging: PRESERVATION AND CONDITIONING (Version 1.0)

FIELD OF APPLICATION AND AIM OF THE GUIDELINE

The guideline “PRESERVATION AND CONDITIONING” is the result of the work of the Section “Industrial Packaging” of FEFPEB and it aims at including a (non – exhaustive) list and description of the main minimum requirements for the wooden industrial packaging about the issues of preservation and conditioning: therefore, the requirements included in this guidelines are lower than the requirements included in the national standards and national guidelines for wooden industrial packaging manufacturers. As “wooden industrial packaging” it is meant the packaging and shipment of machinery, plants, materials and manufactured goods in general, of small and large dimensions.

INTRODUCTION

The purpose of the packaging is to protect the goods from dirt and possible damage, to make it possible to transport and store them, to prevent any deterioration of the product and to ensure suitable conditions for establishing and maintaining a situation of **humidity control, so as to ensure the insulation of the products.**

Humidity generates condensation which in general occurs:

- on the walls of wooden crates and containers (effect of rain);
- on the coldest surfaces often on the ceiling of the container.

Equipment, machinery, mechanical apparatus, electric cabinet etc. contains no water, wood and paper used for manufacturing the industrial packaging are hygroscopic materials and therefore can release humidity that can damage the product. This relatively water content is problematic for most of goods due to its sensitivity to the corrosion.

Corrosion begins at the relative humidity of 40% and rapidly accelerates at relative humidity >60%. Depending upon the sensitivity of the goods to corrosion, even the slightest rust film can seriously damage the goods.

Protection must accordingly be provided against all forms of moisture: excessive humidity, condensation water, rain and seawater.

The degree of rusting of steel consignments should be recorded in the shipping documents, packaging specification recommendations, possibly using the following definitions:

- wet before shipment
- partly rust and / or stained rusty
- gear marked
- contaminated by foreign substance
- contaminated by saltwater
- chafed in places
- packing torn exposing contents

Humidity is one of the main causes of damage to goods, since it may generate mould, the budding of wheat, corrosion of metals and alteration of many products.

Hygroscopic merchandise, perishable goods and those generating gas are particularly sensitive to humidity.

In ferrous metals the primary oxide layer is attacked and destroyed by humidity; aluminium and zinc are stable in water at a pH (power of hydrogen) value of 5 to 8.5 while copper-based metals are subject to corrosion in water regardless of the pH value, given the presence of dissolved oxygen.

Further damage caused by humidity is possible during any type of transport:

- discoloured, crushed and flaky packaging;
- development of bad smells, toxins, incrustations to the detriment of the quality of the goods;
- development of moulds;
- loss of shine on steel and corrosion of metals;
- damage caused by ice, sticking.

PRACTICAL OPERATING PRECAUTIONS

As mentioned above, among the various factors to be considered by the manufacturer, the risk of corrosion of the content to be packed is very important: in this sense, if timber is used inside the “protective barrier”, the manufacturer should consider the “hygroscopic nature” of this material and should evaluate the option of using dry timber; on the other hand, the wooden parts of the packaging that are outside the “protective barrier” could be fresh, since their moisture content doesn’t have any effects on the risk of corrosion. As a reference to distinguish “fresh” and “dry” timber, the moisture content of 20%, indicated in the standards EN 12246 and EN 14081-1 can be used: timber is “dry” at a mean moisture content of 20% or less, timber is “fresh” at a mean moisture content higher than 20%. In addition, remember that goods are often packaged in cardboard which may absorb and release humidity. Metal containers are at risk of humidity (>60%). Smaller sized goods have an increased exchange surface and in the case of high humidity the damage may be consistent. Sea transport in containers may expose goods to extremely high levels of humidity.

Different systems or/and methods may be used to protect the goods from humidity during transport and storage. Too it will be crucial, for the manufacturer, to know and indicate the “duration of preservation”, since this factor changes according to different country specifications and customers requests.

Methods:

- **Ventilation is the first condition on the package**, easy to create with hole protected by grid on the case.
- **Coating method** with protective oil, applied immediately at the end of production, is the first method that can prevent corrosion. Where liquid corrosion protection agents are used, care must be taken to ensure for transport operations. For example, in the tropics, where dropping point is very high and >80%, there is a risk that the corrosion protection agent, which works well in temperate latitudes, will drip or run off the treated surfaces and will thus be unable to perform its protective task.

- **Fitted Barriers** The waterproof barrier is generally a material which can be used to wrap the goods so as to insulate them from the outside environment. In some cases such barriers may be used to cover the inside of the containers. The use of the barrier material (that is waterproof) may consist of an operation aimed at creating a technical "vacuum" which protects sensitive goods against the oxidation. In cases in which the goods need to be anchored to the packaging, spring lock washers should be applied at the anchoring points at the holes made for the passage of the bolts. Alternatively sheets of rubber foam material may be used. Today the material most commonly used is polyethylene foam.

In addition, if necessary, it should be possible to easily remove the oils used to protect processed surfaces from rust and corrosion with the use of everyday solvents;

the heat-soldered sack should contain a sufficient quantity of dehydrating salts to reduce and maintain the desired level of humidity (indicative value which should be assessed case by case depending on the manufacturer's instructions) for the entire period foreseen. The dehydrating systems must be firmly attached, placed so as not to leave unprotected areas and so as not to come into contact with delicate parts of the packaged material.

The continuous changes in temperature humidity during the transport and or storage of the product are mild risk factor: a non-secure environment favours the creation of condensation that may affect the integrity of the package contents, compromising product performance. The conditional waterproof packing is the effective and reliable solution, a protective Fitted Barrier is formed from multiple layers of films flexible of various types, depending on the result to be obtained: because you can create a barrier to moisture penetration, decreasing condensation on the inside of the packaging, a more or less high mechanical resistance to tearing.

How it works

The packaging is conditional pairing between the coupled multilayer high barrier, composed of polyester, aluminium and polyethylene, ect., and the desiccants.

While the coupled barrier, set up in the form of bag and place to "shield" outside protects the product tightly preventing the penetration of air, light and water in the package, the desiccants, placed internally and adequately dimensioned according to the size of product and the packaging, absorb any moisture present at the time of packaging or created during transport and/or storage.

In addition, the conditional waterproof packing may be supplemented by specific indicators that allow the detection of the actual percentage of moisture inside the barrier bag.

Typical areas of application packaging affected are: mechanical, electrical and electronic, packers, logistics, military, textile, chemical, pharmaceutical and food industries.

When wood is used for fixing and securing machinery on the case (*dunnage*), and is enclosed within the sealed package, the moisture content of such materials must be taken into account when calculating the necessary quantity of desiccants. Unless specially dried lumber has used, the water content of lumber is generally so high that a disproportionately large quantity of desiccants must be enclosed in the packaging.

It is thus advisable to carry out cargo securing measures outside the sealed package.

If many different metals and alloys have been used in a piece of equipment, the desiccant method is the most reliable corrosion protection method.

- **Desiccants bags.** Where necessary, depending on the type of goods and transport, systems for the control and maintenance of constant humidity conditions (DESICCANTS) may be employed, using them inside the waterproof barrier system used. In such case, depending on the different conditions, the right quantity and correct arrangement of the Desiccants system inside the barrier must be determined (FOLLOW THE INSTRUCTIONS AND TECHNICAL SPECIFICATIONS PROVIDED BY THE DEHUMIDIFYING SYSTEM MANUFACTURER!).

When a vacuum barred system is used, the manufacturer has to know that he will have to use the desiccant bags (their use will not be an option).

During transport always remember:

The container will continue to transpire, but more slowly. Wet loads may be transported either with the ventilation holes open or closed. The manufacturer could choose to add desiccants to the container.

As explained above, if timber is used inside the “protective barrier”, the manufacturer should consider the “hygroscopic nature” of this material and should evaluate the option of using dry timber. Make sure that the dehumidifying systems are not covered. Make sure that all the units are suspended, firmly attached and not in contact with the load.

The DESICCANTS units must have:

- sufficient absorption capacity to protect from condensation and to reduce humidity in extreme conditions;
- sufficient absorption capacity for the entire duration of transport;
- The number of units to be used depends on (the length of the journey or transport); temperature variations during transport; environmental conditions during transport; humidity of the goods and of the packaging.

The use of a humidity indicator is requested case by case or according to specifications. If requested, one indicator should be placed for every 5 cubic metres of volume of the barrier sack, with a maximum of three per crate and not more than one per wall. The indicators should be placed in the positions deemed most suitable by the packager, but at a height of approximately 1500 mm from the ground so as to facilitate their reading through the view guard.

The effective desiccants contain granules that can absorb moisture and condensation inside the packaging (e.g. CALCIUM CHLORIDE, SILICA GEL, ACTIVATED CLAY). All salts are chemical neutral and comply with DIN 55473, MIL 3464 E and NFH 00320.

Unit of measure

The unit of measure for the desiccants is regulated by French and American standards.

- **VCI (Vapour Corrosion Inhibitors)**

VCI method is another way for the protection against corrosion that can be used.

The various environments or conditions which the metal finds itself in may be more or less corrosive. For example:

- damp air is more corrosive than dry air
- hot air is more corrosive than cold air

- hot water is more corrosive than cold water
- polluted air is more corrosive than clean air
- acidity is more corrosive than alkalinity
- salt water is more corrosive than fresh water
- no corrosion occurs in a vacuum at very high temperatures.

Various types of protection from corrosion exist, among which the originally solid VCI (Vapour Corrosion Inhibitors) which sublime, conditioning a closed atmosphere with protective vapours which, by condensing on all the metal surfaces of the product, protects them.

There are different types of VCI on the market which generally function or are characterised as follows:

- generally they are mixtures of organic compounds. Among the most effective and non-toxic are the carboxyl salts.
- the corrosion inhibitor molecules (VCI) are adsorbed by the metal surface, forming a protective layer which prevents the electrochemical reaction between metal, air and water.
- The VCI molecules spread within the environment they are placed in, migrating from the areas of higher concentration to those of lower concentration until a condition of equilibrium is achieved.
- It is essential to maintain an adequate concentration of VCI molecules inside the packaging and follow the instructions of the VCI manufacturer.
- “Anti-corrosion” means such as inhibitors in a vaporous state or VCI molecules require a closed-sealed environment, otherwise they leak outside and lose their efficacy.
- As with all contact protection methods, the metal surfaces must be clean and free of any traces of oxide.
- When VCI films or other emitters are used, it’s important to follow the manufacturer’s instructions about the useful protection distance between the VCI source and the surface of the goods to be protected.
- Another important factor which should be verified with the manufacturer, is the conditioning time: it is important, for the VCI goods protection system, to be conditioned for a minimum time before starting the shipment or handling the goods, especially in winter, to prevent condensation phenomena. It is essential for the VCI molecules to reach the surfaces to be protected before any water which might be formed by condensation, to avoid transporting the goods from a heated to a cold environment without allowing the VCI to act for the time needed.
- The VCI films do not work on metals treated with traditional oils (lubricants), these should therefore be removed and the surfaces “cleaned” before using the VCIs. “Clean” surface means that there must be no interference between VCI and the metal (i.e. oil, plastic and so on).
- FOLLOW THE INSTRUCTIONS AND TECHNICAL SPECIFICATIONS PROVIDED BY THE VCI MANUFACTURER OR DISTRIBUTOR!