Recommandation about storage and preservation of printed circuits.

1 – Recommended storage environment: air-conditioned room or temperature controlled cabinet, also referred to as a dry storage cabinet.

A dry storage cabinet provides a dry atmosphere suitable for storing electronic components, equipped and bare printed circuit boards as well as semi-finished products that are sensitive to humidity. This prevents dampness from penetrating into the components which later results in damages to them during soldering operations. It is possible to fill a dry storage cabinet with compressed air and/or nitrogen based on the level of humidity required to create an atmosphere with low humidity. If they are not stored under optimum conditions, T° = 22°c ± 3°c and Humidity = 50% ± 10%, we recommend placing them in an oven for a short cycle at 150°c for 2 hours or for a long cycle at 50°c for 8 hours.

2 – Storage requirement under dry atmosphere

Humidity is damaging: components, semi-finished products and printed circuit boards are sensitive to moisture. When they are stored under normal ambient conditions, humidity present in the air can penetrate them. Components are exposed to high temperatures during soldering operations and this is when moisture evaporates and creates steam. When it expands, it causes strong pressure on the components. The steam is suddenly expelled, then causing irreversible damages if the maximum pressure load is reached.

RoHS instructions: since 1st July 2006, in accordance with CE 2002/95/CE directives, certain substances previously used to manufacture electronic components are now prohibited. The RoHS (Restriction of the use of certain Hazardous Substances) directive concerns the limitation of dangerous substances contained in electrical or electronic equipment, and in particular recommends non-lead soldering of electronic components. The solder metals now used have a higher melting point, and when replacing alloys that contain lead, this requires using higher soldering temperatures. These higher temperatures increase the pressure applied to the components, semi-finished products and printed circuit boards during soldering and may cause damages.

Components size : The trend towards miniaturized components continues. Components are becoming smaller and smaller and require less and less space. At the same time, this reduced space must provide greater functionality. This renders the components more and more sensitive to the effects of ambient conditions.

Warranty entitlement: Manufacturers and traders of components and printed circuit boards indicate how electronic components should be stored. The warranty does not apply if they are stored under inappropriate ambient conditions.

3 – What must be stored.

Components: Components must be stored in a dry atmosphere as indicated by the manufacturers. These components are packed in vacuum-sealed bags. If all the components of a batch are not used to equip a printed circuit, the remaining items must be stored in a dry storage cabinet.

PCBs and semi-finished products: Printed circuits must be used whenever possible under dry atmospheric conditions. Otherwise, they absorb moisture, which can lead to damages during the soldering process. Bare PCBs before solder operations as well as partially or fully equipped boards should be stored in a dry storage cabinet.

Equipped boards: Equipped circuit boards are not always immediately used, and since they are sensitive to moisture, similarly to other components, they must be stored in a dry storage cupboard.

4 – Consequences of faulty storage.

The "Pop-Corn" effect: Humidity present in the air may, under normal ambient conditions, penetrate electrical components and printed circuits. Water vapour forms inside the components whenever they are exposed to the high temperatures resulting from soldering operations. This water vapour produces strong pressure that can burst electronic components and printed circuits. This bursting, referred to as "Pop-corn effect" causes irreparable damages such as inter-laminar separation or microcracks.

Delamination of layers: Electronic components and printed circuits are often composed of several layers of materials. Pressure resulting from soldering because of the steam causes the various layers to separate, thereby making them unstable. This is the result of the "pop-corn" effect and is qualified as "inter-laminar separation".

Microcracks: The "pop-corn" effect also results in microcracks. The water vapour escaping from the electronic components or printed circuit boards during the soldering process produces small microscopic cracks that render them unusable.

Damages due to oxidation: When printed circuits are stored under normal conditions, oxygen present in the ambient air results in oxidation of the layer of tin covering the basic material. Up to now, it had been possible to compensate minimal oxidation by the fluidity of alloys containing

lead. However, there can be problems with non-lead alloys that induce surface moisture and not are sufficiently aggressive. This results in soldering defects such as insufficiently moistened solder pads that allow components to loosen.

Bursting and shrink holes: Water vapour produced during soldering operations suddenly escapes from the electronic components. In addition to laminar separation, this also results in bursting and internal shrinkage cavities. Bursting occurs when steam escapes from the solder points and then makes holes. Internal shrink holes appear when steam remains inside the component material. This leads to steam-filled cavities that render electronic components unstable and therefore unusable.

5 – Long term storage.

Damages due to humidity and oxidation: In the case where components or boards are stored under normal ambient air, they absorb humidity present in the air and become unusable shortly thereafter. Metallic surfaces oxidize due to oxygen present in the ambient air. Since components or boards must be sold as new items even after several years of storage, only adequate storage conditions ensure these items retain their original state.

Storage in nitrogen: a nitrogen-filled atmosphere, such as found in dry storage cabinets, is suitable for long term storage of components, circuits and boards. This environment without oxygen prevents humidity from penetrating and prevents oxidation of metallic surfaces, thereby ensuring components and modules retain their original state. They can then be used without any problems even after several years of storage.

6 – Advantages of dry storage.

Different storage methods: Different storage methods have been developed to enable use of components, boards and printed circuits. It is therefore possible to “bake” electronic components, for example before their use, in an oven. Furthermore, it is possible to store unused components in vacuum-sealed bags. A third method consists of storing components, boards or printed circuits by packaging them with bags of silica beads that absorb humidity present in the air and in the components. The dry storage cabinet running with compressed air and nitrogen is the best method, compared to those presented above.

Drying by baking: Baking components, boards and printed circuits requires major logistics investments. Baking can last several hours and up to eighty days based on the temperature and the thickness of the components. Furthermore, high temperatures expose electronic components to major structural stress. The cooking process is synonymous with very high electrical consumption, whereas for a dry storage cabinet, it is comparatively low. With a dry storage cabinet you can also remove components just before using them without needing to prepare them for a long period of time. They are not subject to various forms of stress during storage.

Vacuum-sealed packaging: components, boards and printed circuits are wrapped and sealed in new vacuum-sealed bags, the “Dry-Packs”. The “Dry-Packs” require new labelling each time (which is not the case with a dry storage cabinet), which means this method also takes a lot of time. This method does not include any active re-drying, which means the moisture seeping into

the components, boards and printed circuits stays there and risks causing problems when the items are later used.

Packaging with silica packs: the components, boards and printed circuits are stored in appropriate containers containing packets of silica. The granules or gels absorb the moisture in the air and the components and expel this humidity in the outside air through a specific process.