SECTION 808-210-072
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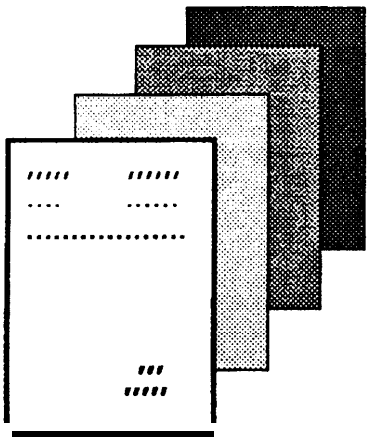
Environmental Control Guidelines for Storage of Electronic Equipment



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1. GENERAL

1.01 This section provides the recommended guidelines to be followed for storage of electronic systems and other equipment manufactured or furnished by GTE Communication Systems Corporation.

1.02 This section is reissued as a general update. Due to the extensive changes involved, change indicators are omitted. Remove the previous issue of this section from the binder or microfiche file and replace it with this issue.

2. OVERVIEW

2.01 Although the environmental factors of temperature, moisture, and air pollutants are taken into careful consideration when determining the operational atmosphere of the equipment, they are frequently ignored or overlooked during storage. Most corrosion problems experienced by telephone companies can be traced to improper storage of equipment because these environmental factors were overlooked.

2.02 With the advent of electronic systems and the use of static-sensitive components, the added factor of static charge generation cannot be avoided. Guidelines are offered that, if followed, will lessen the chances of component damage due to static discharge. Failure to follow these guidelines may result in severe electrical damage to static-sensitive components.

2.03 The guidelines presented in this section are based on the best available technical data and experience with existing systems. There is no substitute, however, for a good common sense approach to the application of the information presented or to cases not specifically covered in this section.

3. PRELIMINARY CONSIDERATIONS

3.01 Prior to receipt of the shipment of electronic equipment, a thorough inspection of the proposed storage area should be performed. The same care should be taken in choosing a storage area as in selecting an operating area. The inspection should include, but not necessarily be limited to, an evaluation of the following:

(a) Equipment storage time.

(b) Temperature range.

(c) Humidity range.

(d) Air contamination (dust, harmful vapors, etc).

(e) Floor load capacity.

(f) Accessibility (loading docks, doors, etc).

3.02 If, because of various economic, space, or time limitations, a storage area that meets operating area requirements, cannot be obtained, arrangements should be made for correction of the environmental characteristics. Adequate ventilation for the containers and cooling, heating, and/or filtering of the air may be required.

Equipment Storage Time

3.03 Except as noted in paragraphs 4.13 through 4.16, electronic equipment should be stored according to the following guidelines:

(a) Equipment may be stored for a maximum period of 6 months within the environmental ranges outlined in this section.

(b) The period of storage may be extended to 1 year if the maximum environmental limits are not reached or reached only occasionally.

(c) If the equipment is to be stored for more than 1 year, it should be

stored in an area that meets the environmental limits described in Section 808-2 1 O-070.

Temperature Range

3.04 If the temperature of the storage area is expected to rise above 71.1 ºC (160ºF), consideration should be given to adding air-conditioning (or cooling) equipment. if the temperature is expected to drop below 4.4ºC (40ºF), arrangements should be made for proper heating of the area. (This will also aid in preventing the formation of condensation on the equipment.)

Humidity Range

3.05 If the humidity is expected to rise above 85 percent, arrangements should be made to remove excess moisture, possibly in conjunction with air-conditioning equipment. The use of desiccants in conjunction with a stored electronic system is deemed impractical, because most of the containers for the equipment are not capable of being sealed airtight and the containers for the frames at-e quite large.

Air Contamination

3.06 The use of a filtering system to remove dust and other impurities from the air in a storage area should be given consideration. Since shipping containers are not sealed airtight at the factory, it is quite possible for dust to enter the containers.

3.07 Some equipment may be shipped covered with an antistatic polyethylene dust shield. This dust shield serves two purposes: it prevents dust from settling on the equipment and also acts as a protective barrier against static discharges that could damage sensitive components. However, the dust shield does not provide adequate protection from circulating dust.

3.08 While the dust, by itself, is not a major problem, the impurities or chemicals that may be carried by the dust could be a potential cause of problems. In the process of removing dust particles, a filtering system can remove the chemicals and impurities. if the dust shield is disturbed for any reason, the guidelines on static discharge damage prevention described in part 5 must be followed.

3.09 Examples of substances that may be present in the air and that are detrimental to electronic equipment are as follows:

(a) Turpentine fumes from paints or varnishes.

(b) Fumes from cleaning compounds such as carbon tetrachloride.

(c) Organic compounds emitted from floor waxes or similar compounds.

(d) Sulfur compounds from nearby industries, such as paper processing.

For this same reason, equipment should not be stored in a newly constructed concrete enclosure. Concrete, while fresh, is a very corrosive substance. Its properties may be carried by the water vapor and dust in the air, and subsequently bring it into contact with the electronic equipment, causing serious or irreparable damage.

Floor Load Capacity

3.10 The floor load capacity of the proposed storage area should be considered, particularly when storage is proposed in an older, existing structure. Storage floor load requirements are 100 pounds per square foot (approximately 488 kilograms per square meter).

Accessibility

3.11 The storage area should have good accessibility, i.e., adequate-sized loading docks, doors, etc, for proper movement of the equipment. Consideration should also be given to forklifts, hoists, or other

machinery to be used to move the various equipment containers during the storage process and later when the equipment is relocated to its final site. Ample working room must be given to prevent damage to any equipment being store.

3.12 Detailed information regarding control of the atmospheric environment as applied to operating areas may be found in the 808 division of GTE Practices. For long-term storage, the storage area should be prepared in accordance with the applicable portions of these sections.

4. STORAGE GUIDELINES

4.01 All equipment manufactured by GTE Communication Systems Corporation is adequately protected by special finishes, plating, and materials to safeguard it against rust and corrosion during its normal lifetime, provided it is properly stored and installed in a suitable location. A notice to this effect is secured to each major container within a shipment. Table 1 contains a list of do's and don'ts for proper storage. The guidelines in the following paragraphs will also aid in protecting the telephone company's investment and in securing maximum use of the equipment.

Stacking

4.02 Network frames, as received in their shipping containers, may be stacked for storage. Stacking of the units, however, must be limited on the basis of size and weight of the individual containers. Figure 1 shows proper stacking methods.

4.03 Containers housing single-width electronic or electromechanical frames should be stacked as follows:

(a) Containers of 200 pounds (approximately 90 kilograms) or less may be stacked three units high.

(b) Containers in excess of 200 pounds may be stacked two units high.

4.04 Containers that hous double-width frames should be stacked only one unit high. However, a single contarner of iess than 200 pounds may be stacked on top.

4.05 A number of small containers, each less than 20 pounds (approximately 9 kilograms) and the aggregate less than 200 pounds, may be stacked on a container housing either a single- or double-width frame.

4.06 Containers in excess of these weights and odd-sized containers should be stacked on pallets or skids. This allows ease in relocating the containers as well as proper ventilation.

4.07 Containers should not be placed in direct contact with the ground or on concrete floors. Both the concrete and the soil may conduct moisture and pollutants to the container, even though they appear to be dry. The containers should be supported by adequate bearing surfaces at each end and at the stacking points of the container (Figure 1). Supporting the containers in this manner provides a twofold purpose: adequate ventilation around the container and a means of moving the container with a forklift or similar equipment.

4.08 When stacking frame containers, the preferred method is to stack them without supports between the containers. This allows the weight of the second (or third) container to be distributed evenly over the surface of the supporting container.

NOTE: If proper equipment is not available for removal of the containers stacked in this manner, and the spacing supports must be used, ensure that supports are placed at the stacking areas indicated on the container.

4.09 When possible, containers should be opened to allow the air around the

Table 1. Quick Reference Chart for Storage of Electronic Systems.

DO:
• Allow for proper air circulation around equipment. • Provide appropriate temperature and humidity control. • Make frequent inspections of the equipment to determine condition. • Keep storage time to a minimum.
DO NOT:
• Allow containers to become wet. • Store equipment outdoors. • Place containers directly on concrete or soil. • Store in newly constructed concrete enclosure. • Store in shipping vehicle or unheated enclosure, including garages, barns, trailers, or railroad cars.

equipment to escape or circulate, thereby decreasing the chances of condensation. If the equipment is covered with a protective dust cover, care should be taken to prevent direct contact with the equipment unless the proper static discharge damage prevention precautions in part 5 are followed. Under normal storage conditions, it is usually not necessary to remove the dust cover because it is not sealed and air is free to circulate within the opened container. If the equipment is to be stored in closed containers, additional precautions regarding air circulation must be observed.

System Elements

4.10 Certain elements of the various systems require a different storage temperature and humidity range than others. Some elements of the systems may be stored at temperatures as low as -17.7ºC (0º F), but this is not recommended. The overall range, as specified in paragraph 3.04, should be used as the guideline. Equipment not covered by the overall range includes the following:

(a) Tape transptor unit.

(b) Magnetic tape cartridge drive.

(c) Magnetic tape cartridge.

(d) Matrix printer.

(e) Ferrite core memory.

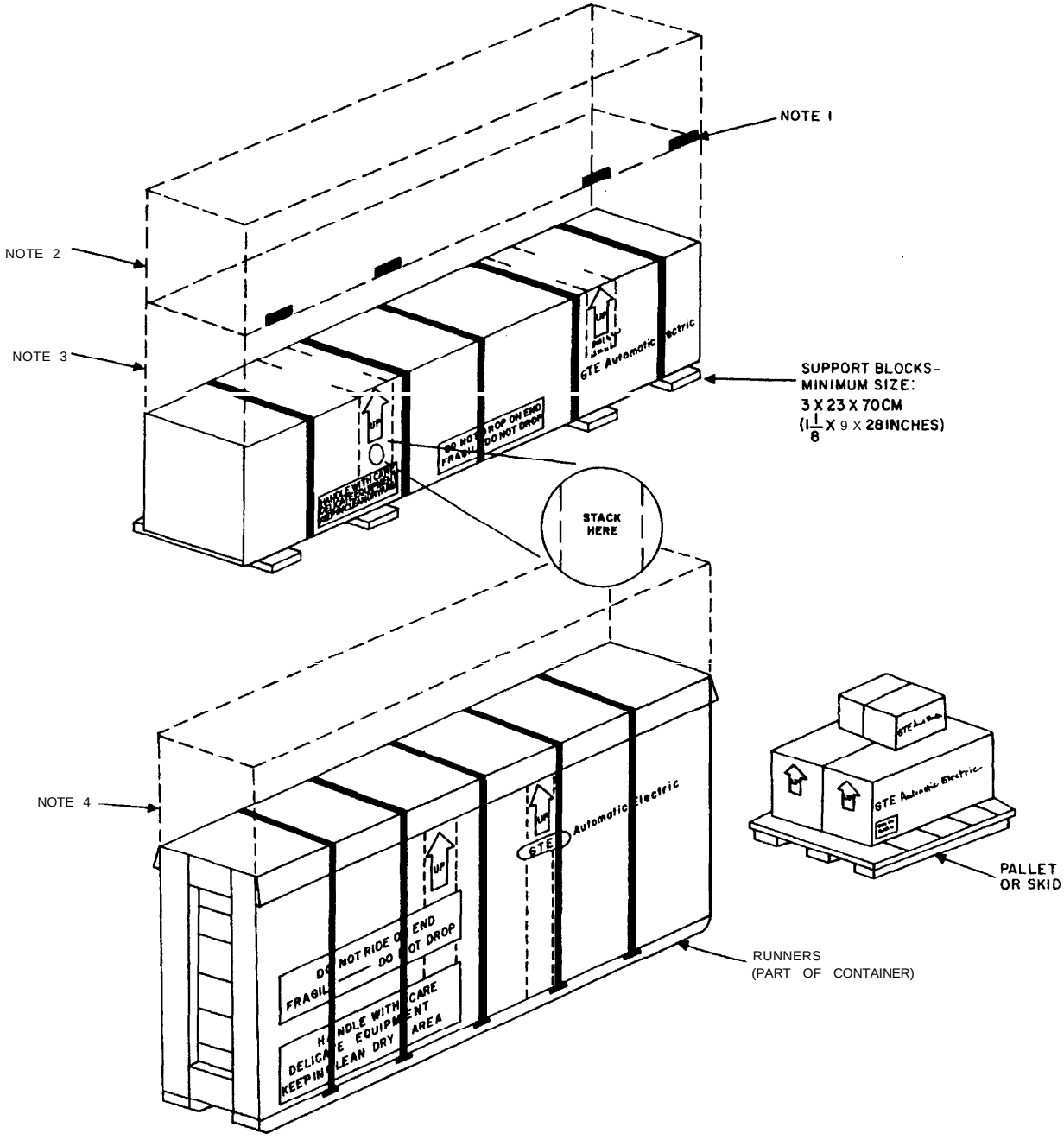
(f) Printed wiring card assemblies and con nectors.

(g) Power supplies.

(h) Batteries, including the sealed lead-acid battery.

The storage conditions for this equipment are covered in paragraphs 4.11 through 4.23.

4.11 The ranges of temperature and humidity indicated in paragraphs 3.04 and 3.05, if taken individually, represent reasonable conditions under which equipment is stored. However, the combination of the



NOTES:

1. PREFERRED STACKING METHOD IS WITHOUT SPACING BLOCKS, FOR LOAD DISTRIBUTION OVER GREATER AREA. IF BLOCKS MUST BE USED, THEY ARE TO BE SAME SIZE AS SUPPORT BLOCKS AND PLACED AT ENDS AND STACKING POINTS.
2. SINGLE-WIDTH FRAME CONTAINERS OF 90 KG (200 LBS.) OR LESS EACH MAY BE STACKED THREE UNITS HIGH.
3. SINGLE-WIDTH FRAME CONTAINERS IN EXCESS OF 90 KG (200 LBS.) MAY BE STACKED TWO UNITS HIGH.
4. A SINGLE CONTAINER (OR SEVERAL SMALLER CONTAINERS) OF LESS THAN 90 KG (200 LBS.) MAY BE STACKED ON A DOUBLE-WIDTH CONTAINER.

Figure 1. Proper Stacking Methods.

maximum values of these conditions could cause serious or even permanent damage to the equipment. Figure 2 shows the combined temperature and humidity ranges of the electronic systems' network elements.

4.12 The network elements may be safely stored at any combination of temperature and humidity indicated. As a reference, the recommended and maximum operating ranges of the system are superimposed on the chart, as well as the suitable range for transport, but not storage, of the equipment.

CAUTION

Under no circumstances should a combination of temperature and humidity that would permit condensation to form on any of the following units be allowed to occur:

(a) Tape transport unit.

(b) Magnetic tape cartridge drive.

(c) Magnetic tape cartridge.

(d) Ferrite core memory.

(e) Printed wiring card assemblies and connectors.

Tape Transport Unit

4.13 Storage of the tape transport unit (used in several of the various systems) should be under the following maximum allowable conditions:

(a) 20 to 80 percent relative humidity.

(b) A maximum of 1 year at -20°C to +60°C.

(c) 1 to 2 years at 0°C to + 50°C.

If "dead" storage at elevated temperature and high humidity occurs, care should be taken to slowly condition thepackages to room ambient conditions. A minimum period of 48 hours should be allowed for drying prior to application of power to the unit.

Magnetic Tape Cartridge Drive

4.14 The magnetic tape cartridge drive may be stored under the following maximum allowable conditions:

(a) -30°C to + 60°C temperature.

(b) 20 to 80 percent relative humidity.

(c) Up to 10,000 feet altitude.

Magnetic Tape Cartridge

4.15 The magnetic tape cartridge may be stored under the following maximum allowable conditions:

(a) -40°C to + 45°C temperature.

(b) 20 to 80 percent relative humidity.

Under no circumstances should a cartridge be exposed to temperatures greater than 75°C, because permanent damage will result from storage at these temperatures. If at any time a cartridge is stored at temperatures outside of the cartridge operating limits (5°C to 45°C), the cartridge should be conditioned at room temperature for 8 hours. If the cartridge's storage temperature differed by more than 10°C from the operating temperature at any time during storage, the cartridge must be rewound before use. Wind the tape from beginning to end and rewind back to the beginning at 90 inches per second.

Matrix Printer

4.16 A matrix printer may be stored under the following conditions:

(a) -30°C to + 70°C temperature.

(b) 5 to 95 percent relative humidity.

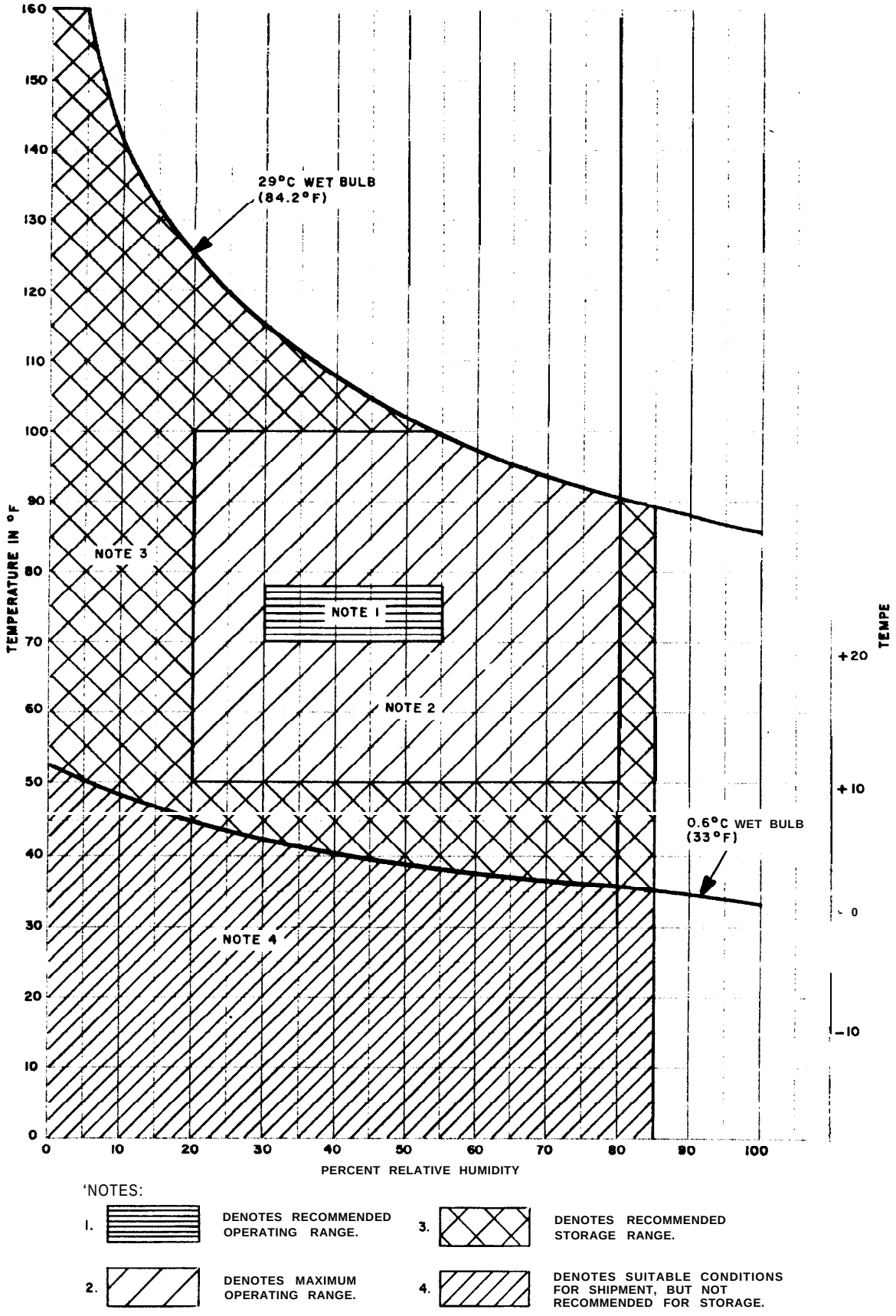


Figure 2. Temperature Versus Humidity for Storage of Electronic Systems.

Ferrite Core Memory

4.17 An occasion may arise when it is necessary to store the ferrite core memory, used in several of the systems, apart from the remainder of the system. The ferrite core memory has a wider storage temperature range than the system as a whole and may be stored under the following maximum allowable conditions:

(a) -55°C to + 75°C temperature.

(b) 0 to 90 percent relative humidity.

Printed Wiring Card Assemblies and Connectors

4.18 Moisture condensation on printed wiring card assemblies and connectors provides a medium for corrosion to occur. This corrosion can eventually lead to circuit or connector failure. Therefore, storage should be neither in a damp area nor in an area where temperature and humidity fluctuate, such as one where fresh concrete is curing. An area where adequate air circulation exists is desirable.

Power Supplies

4.19 Power supplies may be stored under the following maximum allowable conditions:

(a) -40°C to + 85°C temperature.

(b) 10 to 95 percent relative humidity.

Certain combinations of allowable storage temperature and relative humidity may result in moisture condensation. Before attempting to energize a power supply with moisture condensation, the power supply unit must be conditioned for 24 hours at an ambient temperature of 23°C ± 2°C and at 50 percent relative humidity.

Batteries

4.20 It is not recommended that batteries be placed in storage, because they require frequent attention, such as charging and measuring the specific gravity of the electrolyte. When storage becomes necessary, the supplier of the batteries should be contacted for storage instructions for the particular type of batteries involved. In general, batteries should not be stored at temperatures above 32.2°C.

4.21 For low temperatures, the determining factor is the specific gravity of the cells at which the freezing point of the electrolyte occurs. (The electrolyte will rarely freeze solid; the freezing point is that temperature at which the solution becomes slush.) Table 2 indicates that the discharged cells will freeze at a considerably warmer temperature than fully charged cells.

NOTE: Since batteries vary, it is recommended that storage temperatures be kept above those shown in Table 2. The table is presented for reference only and may not apply to all batteries.

Seaied Lead-Acid Batteries

4.22 The non-maintenance lead-acid batteries can be stored in temperatures over the range of -60°C to + 60° C, subject to self-discharge limitations. Recommended storage is at less than + 30°C. The lead-acid batteries lose their stored energy when allowed to stand on open circuit. The self-discharge rate is greater at higher ambient temperatures. Consequently, it is desirable to store the batteries in a cool, dry environment.

4.23 If the sealed lead-acid batteries must be stored, it is recommended that a First In, First Out (FIFO) stocking procedure be used, using the oldest batteries first. To maintain the FIFO stocking procedure, a record of the storage must be kept. Table 3 contains limits of storage time versus temperature; although the maximum storage time is 126 weeks, it is

Table 2. Typical Freezing (Slush) Point of Battery Electrolyte Based on Specfic Gravity.

SPECIFIC GRAVITY AT 25" C (77°F)	FREEZING POINT (SLUSH)
1.200	-29°C (-20.2ºF)
1.175	-22°C (-7.6ºF)
1.150	-16°C (+ 3.2ºF)
1.125	-12°C (+ 10.4ºF)
1.100	-9°C (+ **15.8ºF)**

recommended that no battery be stored longer than 87 weeks, with temperatures not exceeding 32°C.

Corrective Measures

4.24 If, during shipment or storage, a container becomes wet, the equipment should be removed and the container dried by either placing the container in a warm, dry room or by applying controlled heat. During the drying process, the air should be circulated by a fan or blower to ensure proper drying of all parts of the container.

CAUTION

Do not allow the equipment to remain in the container during the drying process, because the moisture absorbed by the container causes the enclosed air to become highly corrosive. If it becomes necessary to remove the protective dust cover from the equipment during the drying period, the proper antistatic guidelines must be observed during handling and storage of the equipment until such time as the dust cover can be replaced (refer to part 5).

Removal From Storage

4.25 When the operational site is ready to accept the equipment from storage, the same precautions used at the factory should be used to ensure transfer of the equipment to its final location without damage.

4.26 If containers were opened during storage, verify the following:

(a) Internal container braces (where applicable) are in place and undamaged_

(b) Packing or other cushioning material is located between the equipment and container on all sides.

(c) The polyethylene antistatic dust cover (where applicable) is in place over the equipment. If the dust cover was completely or partially removed during the storage period, follow the static discharge damage prevention guidelines (part 5) when replacing the dust cover.

(d) The container should be closed and taped or banded as required.

4.27 Containers should be positioned as indicated by the arrows printed or stenciled on their sides.

4.28 When loading containers in a vehicle for transport, the following rules apply:

Table 3. **Storage Time Versus Storage Temperature for Sealed Lead-Acid Batteries.**

TEMPERATURE						
(FAHRENHEIT)	68	86	89	95	104	122
(CENTIGRADE)	20	30	32	35	40	50
TIME (IN WEEKS)	**126**	**93**	**87**	**64.**	**44**	**21**

(a) Containers housing single-width equipment frames are stacked only two units high.

(b) Containers housing double-width equipment frames are stacked only one unit high.

(c) Containers of less than 22 pounds (approximately 10 kilograms) are placed on top of the stacked frame containers.

(d) Containers weighing more than 22 pounds are grouped and loaded into the vehicle on pallets or skids.

(e) Dunnage and lighter cartons may be placed on other containers to complete the load.

CAUTION

Do not stand frame containers on end. Do not lay frame containers on their side. Do not drop containers or subject them to shock or vibration.

5. STATIC DISCHARGE DAMAGE PREVENTION GUIDELINES

5.01 Static charges are produced whenever two nonconductive surfaces are brought into contact and then separated. In general, there are only two things that can carry enough charge to cause damage to sensitive components when exposed: common plastics or the ungrounded skin of the human body that has been statically charged. The human body obtains its charge from plastics (e.g., a man-made shoe sole parting from a nylon rug or plastic tile floor). Static charge potentials developed in the human body are in the thousands of volts range, whereas the potential required to destroy a sensitive component can be as little a 40 volts.

5.02 Because the effects of static discharge are contained within the components, there is no external physical indication of damage when it occurs. Therefore, the major objective is to isolate generated charges from the sensitive components.

5.03 To isolate the sensitive components from accidental contact with either charged plastics or direct body contact, some equipment is wrapped in an antistatic dust cover. This protective dust cover should remain in place at all times If it is removed, extreme caution must be observed to avoid component contact with common plastics, such as vinyl envelopes or shop carriers, or the human body and its clothing.

5.04 Backplane wiring and printed wiring card metallization should not come into contact with common plastics or the human body and clothing. Prior to replacing the dust cover or handling the equipment; direct physical contact should be made with the exposed metal portion of the equipment frame to drain off any

accumulated static charge; this should be done without making contact with any backplane wiring, printed wiring card metallization, or components.

5.05 **For additional information on the storage, handling, and transportation of static-sensitrve components and cards, refer to Section 007-005-015.**