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DEFENSE LOGISTICS AGENCY INSTRUCTION **DLAI 4145.1**

GUIDE FOR BASIC MILITARY PRESERVATION AND PACKING

DECEMBER 1999

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DEPARTMENTS OF THE ARMY, THE NAVY, THE AIR FORCE,
AND THE DEFENSE LOGISTICS AGENCY

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GUIDE FOR BASIC MILITARY PRESERVATION AND PACKING

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Chapter 1
Introduction

GENERAL

PURPOSE

This circular provides a series of lessons for use in training personnel in preservation and packing operations. These lessons are published for use as an official document in the training of military and civilian personnel from all segments of the Department of Defense (DOD) and supporting agencies. It contains information based on specifications, standards, MIL-STD-2073-1C, Standard Practice for Military Packaging, and other pertinent documents. In keeping with the established preservation and packing policy, emphasis is placed on efficiency and economy in all preservation and packing operations. The use of this set of lessons will eliminate the need for the preparation of similar guides at separate installations

CONTENT, FORMAT, AND USE

GENERAL

These lessons have been prepared for use in training operating personnel working on preservation and packing lines at installations throughout DOD. In the preparation of these lessons, the dominant consideration has been to make them as flexible as possible so that they may meet the requirements of a variety of training situations. The technical data and specifications referenced in this pamphlet represent the current preservation and packing practices. The titles of the documents referenced in the various lessons herein are listed in appendix A located immediately after chapter 4.

FORMAT AND CONTENT

Lesson Content

This circular consists of lessons on the following:

- X Introduction to military preservation.
- X Corrosion control.
- X Cleaning and drying.
- X Electrostatic discharge control.
- X Preservatives.
- X Preservation materials and heat sealing equipment.
- X Cushioning, blocking, and bracing.
- X Methods of preservation.
- X Miscellaneous packaging requirements.
- X Introduction to military packing.
- X Fiberboard shipping boxes.
- X Triple-wall corrugated fiberboard boxes.
- X Wooden boxes.
- X Crates.
- X Miscellaneous containers.
- X Weatherproofing the pack.

- X Cargo unitization.
- X Marking and labeling.
- X Hazardous materials.
- X Small parcel shipment.

KEEPING THE TRAINING PRACTICAL

Time Allotments

In accordance with lesson objectives, methods of instruction, and time allotments established for each lesson, it is suggested that all training be made as practical as possible. This will assure an improvement in the quality of workmanship. The allotment of approximately 25 percent of the training time to conference instruction and 65 percent to demonstrations and practical exercises should be followed as closely as possible. Actual preservation and packing working areas should be used.

Objective

The what, how, when and why of each major preservation and packaging principle has been emphasized. These lessons will serve to keep instruction focused on the basic requirements of military preservation and packing.

LESSON ARRANGEMENT AND SUGGESTED TIME ALLOTMENTS

The following lesson arrangement may be used as a guide in presenting the information in this pamphlet:

- X Chapter 1 - Introduction
  - o Purpose
  - o Content, Format, and Use
- X Chapter 2 - Military Preservation
  - o Introduction to Military Preservation, Conference (1 hour)
  - o Corrosion Control, Conference (1 hour)
  - o Cleaning and Drying, Conference (1 hour), Practical Exercise (1 hour)
  - o Electrostatic Discharge Control, Conference (1 hour)
  - o Preservatives, Conference (2 hours), Practical Exercise (1 hour)
  - o Preservation Materials and Heat Sealing Equipment, Conference (1 hour), Practical Exercise (1 hour)
  - o Cushioning, Blocking, and Bracing, Conference (2 hours), Practical Exercise (1 hour)
  - o Methods of Preservation, Conference (3 hours), Practical Exercise (1 hour)
  - o Miscellaneous Packaging Requirements, Conference (2 hours)
- X Chapter 3 - Military Packing
  - o Introduction to Military Packing, Conference (1 hour)
  - o Fiberboard Shipping Boxes, Conference (1.5 hours), Practical Exercise (1.5 hours)
  - o Triple-wall Corrugated Fiberboard Boxes, Conference (1 hour), Practical Exercise (1 hour)
  - o Wooden Boxes, Conference (2 hours), Practical Exercise (2 hours)
  - o Crates, Conference (2 hours), Practical Exercise (2 hours)
  - o Miscellaneous Containers, Conference (1 hour)

X Chapter 4 - Packing Procedures and Operations
- o Weatherproofing the Pack, Conference (1 hour), Practical Exercise (1 hour)
- o Cargo Unitization, Conference (2 hours), Practical Exercise (1 hour)
- o Marking and Labeling, Conference 2 hours), Practical Exercise (1 hour)
- o Hazardous Materials, Conference (2 hours)
- o Small Parcel Shipment, Conference (1 hour)

Changes and Revisions

Revisions or changes to this publication, due to major changes in preservation packing policy, doctrine, revision of specifications, and other official preservation/packing instructions will be made on a continuing basis as the need arises.

Users of this training circular are encouraged to submit recommended changes or comments to improve the publication. Comments should be keyed to the specific page, and line of the text in which the change is recommended. Reasons should be provided for each comment to ensure understanding and complete evaluation. Comments should be forwarded to Dean, School of Military Packaging Technology, ATTN: ATSL-MPT, 360 Lanyard Road, Aberdeen Proving Ground, MD 21005-5003.

CHAPTER 2
Military Preservation

INTRODUCTION TO MILITARY PRESERVATION

NEED FOR TRAINING/PRESERVATION

Need for Preservation Training

An understanding of preservation is needed at all department levels, especially at the operational level. Personnel at the operational level have the most physical contact with preservation. They must know what they are doing and fully understand the need for doing it.

Deficiencies

Deficiencies in preservation are caused by many different factors. Failure to employ proper preservation instructions results in deficiencies. These packaging deficiencies are reported on SF 364, Supply Discrepancy Report (SDR).

Training

To correct deficiencies, personnel must be trained in the proper procedures for preservation of military supplies.

What is Preservation?

Preservation is the application or use of protective measures to include cleaning, drying, preservative application, protective wrapping and/or cushioning, placing the item into a container, and complete identification markings. The basic steps involved in preservation are illustrated in figure 2-1.

Cleaning

All substances (contaminants) which would cause or promote corrosion must be removed.

Drying

Must be accomplished immediately after cleaning to remove cleaning solutions or any other remaining moisture.

Preservative Application

A preservative is used to keep items in a useful condition by providing a barrier to keep out moisture, oxygen, and other causes of corrosion.

Wrap and/or Cushion

Appropriate wrapping is used to retain the preservative on the item. Cushioning is used to protect the item against physical and mechanical damage and to protect barrier materials and containers against puncture.

Placing in Container

Interior containers are used to increase the assurance that the cleaned, dried, and preserved item will be in a serviceable condition after shipment or storage.

Marking

Markings must be applied to identify the contents.

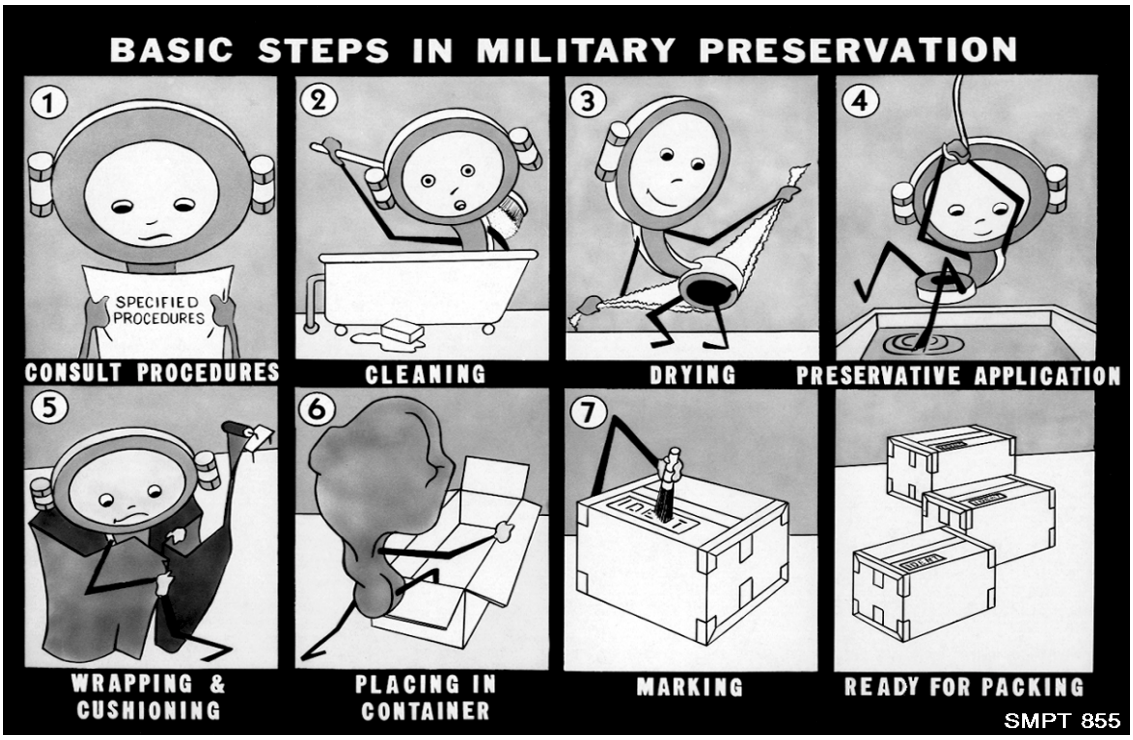


Figure 2-1. Basic steps in Military Preservation.

Hazards to Military Supplies and Equipment

General

We must protect our military supplies and equipment from both climatic and mechanical hazards from procurement to end use.

Climatic hazards

Thirty minutes does not seem like a long time, yet 30 minutes of improper storage could damage some items when they are exposed to a variety of climatic conditions such as those shown in figure 2-2.

Damage by water

Water damage is the largest source of damage to military items. Water may cause damage in two ways:

X Water combined with oxygen will cause rust on iron and steel. It will cause corrosion on other kinds of metals. Corrosion may be caused by water in one of three forms. It may be liquid, such as rain or snow. It may be in the form of mist or spray, such as fog or ocean spray. Ocean spray contains salt and is especially corrosive. It may be in the form of invisible vapors. This form of water is nearly everywhere and is hard to control since it cannot be seen. Water vapor can penetrate into the smallest crevice and cause damage to even the most intricate item.

X Water can cause damage by aiding in the growth of mold, mildew, fungi, and rot.

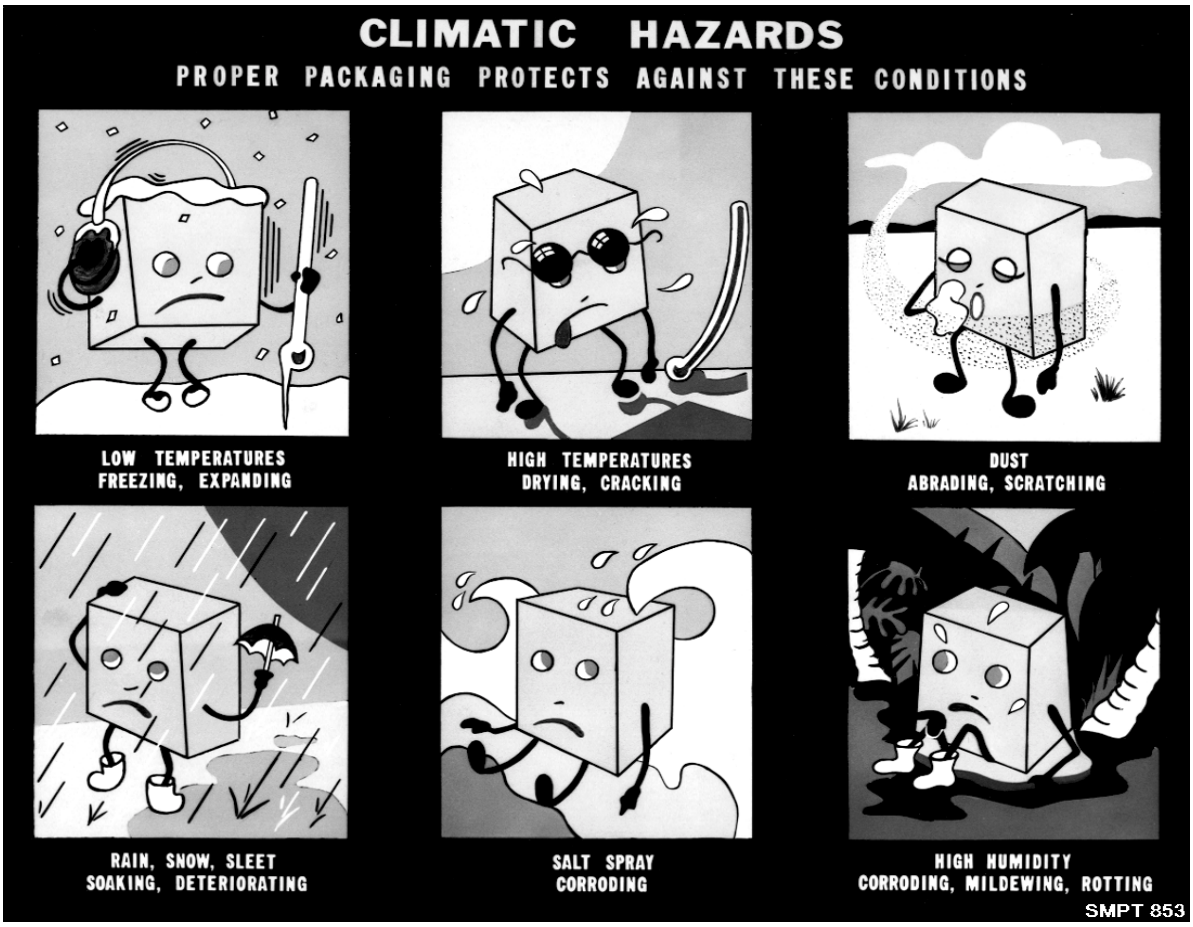


Figure 2-2. Climatic Hazards.

Damage by Dust and Dirt

Dust and dirt can damage small bearings, gears, and small moving parts. A wristwatch, for example, would be ruined if dust and dirt were allowed inside it. Dust and dirt may contain chemical ingredients which may pit or corrode polished or critical surfaces. Dust from factory wastes may be highly corrosive. Dust and dirt may scratch precision lenses on binoculars, cameras, and fire-control items. It may also scratch highly polished metal surfaces. Dust and dirt may also contaminate sterile medical supplies, such as medicines, bandages, and instruments.

Damage by Direct Sunlight

Direct sunlight will cause some fabrics to fade when exposed and may cause a breakdown and change in certain chemicals. Films, rubber, and sensitive paper will be ruined by exposure to sunlight or it may cause the rupture of containers if they are filled to capacity with volatile liquids. Direct sunlight or heat may cause expansion of metals, which could result in the decalibration of highly precise instruments.

Mechanical hazards

The kind of hazards pictured in figure 2-3 cause severe damage to our supplies and equipment and is the result of improper handling, stacking, or the improper use of equipment, e.g., ships, cranes, slings, nets, etc.

Damage by Insects, Vermin, Rodents, and Birds

Bird droppings and rodent excreta may soil items, particularly fabrics. Moths may eat fabrics, especially wool. Insects and rodents will eat perishables and food stuffs.

Special Consideration Necessary in Storage of Liquids

Liquids may leak or evaporate. This could cause a safety hazard if the liquid is flammable, corrosive, or toxic. Heat can cause the rupture of containers if sufficient room for expansion is not allowed. Many liquids must be protected from freezing or prevented from setting.

Static electricity

Some electronic components are sensitive to electrostatic discharge and must be protected during, handling, storage, and shipment from this hazard.

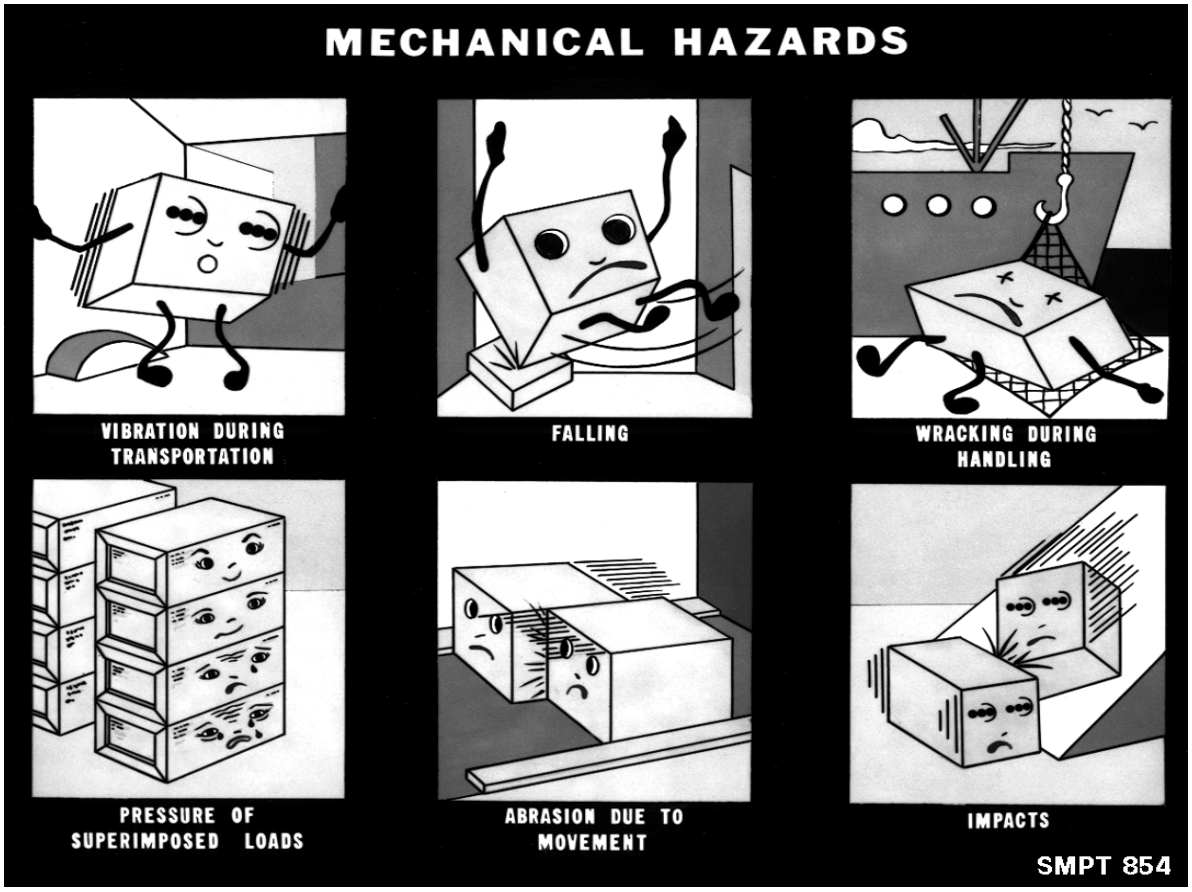


Figure 2-3. Mechanical Hazards.

Policy for the Packaging of Materiel

Every company or business in operation today operates under some kind of corporate instructions, bylaws, policies, etc. The Department of Defense also has policies which must be followed. These policies are in the form of instructions and are implemented by the military services and other components of the government. The implementing document is AR 700-15/ NAVSUPINST 4030.28D/AFJMAN 24-206/MCO 4030.33D/DLAd 4145.7, Packaging of Materiel.

Policy statement

All defense materiel shall be afforded the degree of protection required to prevent deterioration and damage during shipment, handling and storage.

Military Packaging Versus Commercial Packaging

There is a clear distinction between the guidelines set forth for the military packaging concept and those set forth for commercial packaging. The difference between the two is as follows:

- X Military packaging requires the use of specification materials; interpretation of preservation/packing instructions; MIL-STD-129, Military Marking; and the preservation methods of MIL-STD-2073-1C, Standard Practice for Military Packaging. Military packaging should be used for items expected to enter the military distribution system. The military distribution system is the process by which materiel, <u>not</u> intended for <u>immediate</u> use, is stored and/or moved within or between DOD facilities. It may also cover items intended for delivery-at-sea, items delivered during wartime, or items requiring reusable containers.
- X Commercial packaging permits use of nonspecification materials, and ASTM D 3951, Standard Practice for Commercial Packaging, provides standard commercial guidelines. Application of preservation/packing techniques is at the discretion of the contractor or the activity. Items not going into stock, items intended for immediate use (ex. AOG), items for not mission-capable supply (NMCS), items intended for depot operational consumption, small parcel shipments (CONUS, not-for-stock) and direct vendor deliveries (CONUS) shall be packaged in accordance with standard commercial practice as defined in ASTM D 3951.

Levels of Military Protection

A means of specifying the level of packing that a given item requires to assure that it is not degraded during shipment and storage. Figure 2-4 shows the levels of protection for military packing. These levels are identified as level A and level B. Level A provides maximum protection, and level B provides moderate protection.

- X Levels of Packing.
  - o Level A. Protection to meet the most severe worldwide shipment, handling, and storage conditions. A level A pack must, in tandem with the applied preservation, be capable of protecting materiel from the effects of direct exposure to extremes of climate, terrain, and operational and transportation environments. Examples of situations which indicate a need for use of a level A pack are: mobilization, strategic and theater deployment and employment, open storage, and deck loading. Examples of containers used for level A packing requirements include, but are not limited to,

overseas type wood boxes, and plastic and metal reusable containers.

- o Level B. Protection to meet moderate worldwide shipment, handling, and storage conditions. A level B pack must, in tandem with the applied preservation, be capable of protecting materiel not directly exposed to extremes of climate terrain and operational and transportation environments. Examples of situations which indicate a need for use of a level B pack are: security assistance (e.g., Foreign Military Sales (FMS)) and containerized overseas shipments. Examples of containers used for level B packing requirements include, but are not limited to, domestic wood crates, weather-resistant fiberboard containers, fastpack containers, weather-resistant fiber drums, and weather-resistant paper and multi-wall shipping sacks.

X Figure 2-5 depicts progressive item protection based on levels of protection.

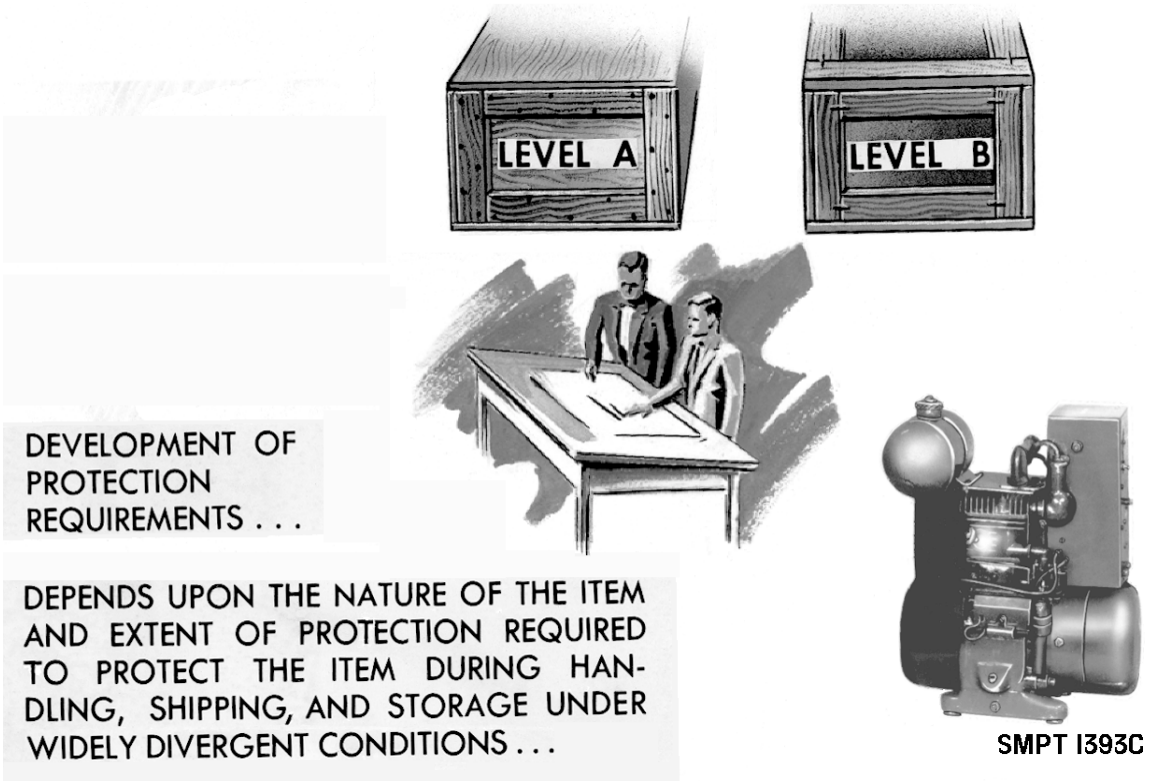


Figure 2-4. Levels of Protection.

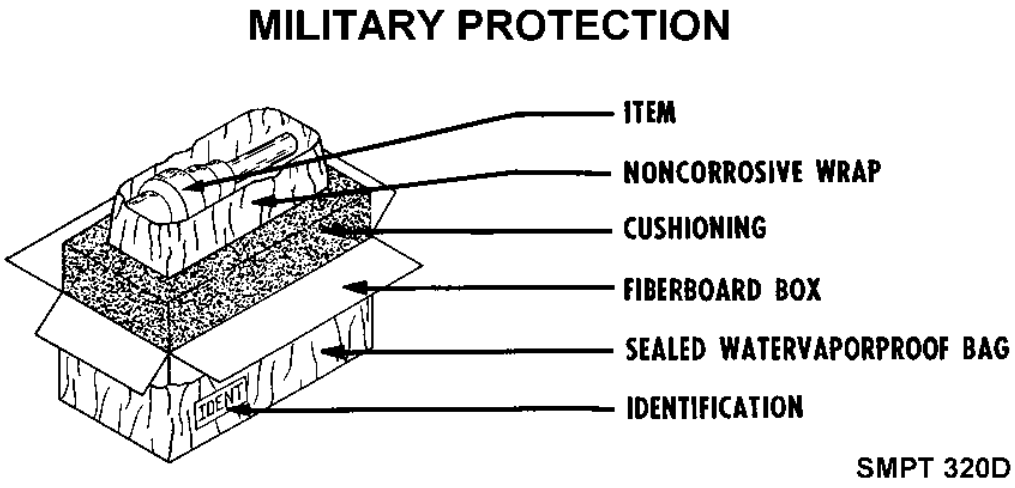


Figure 2-5. Levels A and B Protection.

Packaging

Commercial packaging will be acceptable when it meets the requirements of ASTM D 3951.

Economy in Preservation and Packing

As personnel in the preservation and packing field, each one of you should be concerned with saving money for the Government and yourselves.

Factors Influencing Economy

Many factors influence economy. The three most important are materials, equipment, and manpower. Such factors as the cost of different materials may effect overall economy. Packing materials, such as containers, cushioning, and blocking and bracing should be saved and reused wherever possible. Equipment cost, arrangement, and utilization also affect economy. Proper use, placement, supervision, and training of personnel will result in savings.

Material Cost Reduction

Material cost will vary according to the type, quantity, availability, etc. A few ways to get a reduction in material cost are as follows:

- X Compare different barrier and cushioning materials and use the least expensive material that provides the required protection.
- X Salvage cushioning materials, fiberboard boxes, and wood pallets in good condition and reuse for outgoing shipments.

Manpower Cost Reduction

Reduction of manpower cost may be accomplished in several ways with the most important being training of workers for their jobs.

- X Management. Every organization must have someone to establish the policies, rules, and regulations for efficient operations.

- X Proper supervision. The quality and quantity of work are directly related to the kind of supervision given.
- X Job requirements. It is important to show technical competence on the job and to understand our individual job assignment and its impact on the overall mission.
- X Planning. Each operation in preservation and packing should be well planned in efficient use of personnel and machines.

Checkup

- X What are the basic steps of military preservation and packing?
- X What are the two levels of military protection?
- X What level of protection is required for the protection of materiel against the most severe conditions known or anticipated to be encountered during shipment, handling, and storage?
- X List some important factors that can influence economy in packing.
- X Why is marking an important step of preservation?
- X Why is it important to dry an item immediately after cleaning?
- X What is the reason for using cushioning inside a package?
- X Why is it important to train personnel at the operational level?

CORROSION CONTROL

CORROSION

Corrosion is the breakdown of metals when they are in contact with water and air. Rust is often used to describe any type of corrosion. It is actually a term which describes corrosion on iron or related metals. Ferrous metals are any metals which contain or are made from iron.

CORROSION OF FERROUS AND NONFERROUS METALS

Corrosion on iron and steel (ferrous metals) is termed rust. It is usually red in color and forms a rusty film which holds moisture and oxygen like a blotter. It speeds up further corrosion by acting as a reservoir which feeds moisture and oxygen to unrusted areas, as shown in figure 2-6.

Figure 2-7 illustrates corrosion on nonferrous metals such as zinc and cadmium which is often white or gray in color. The terms "white rust and oxidation" are often applied to this type of corrosion.

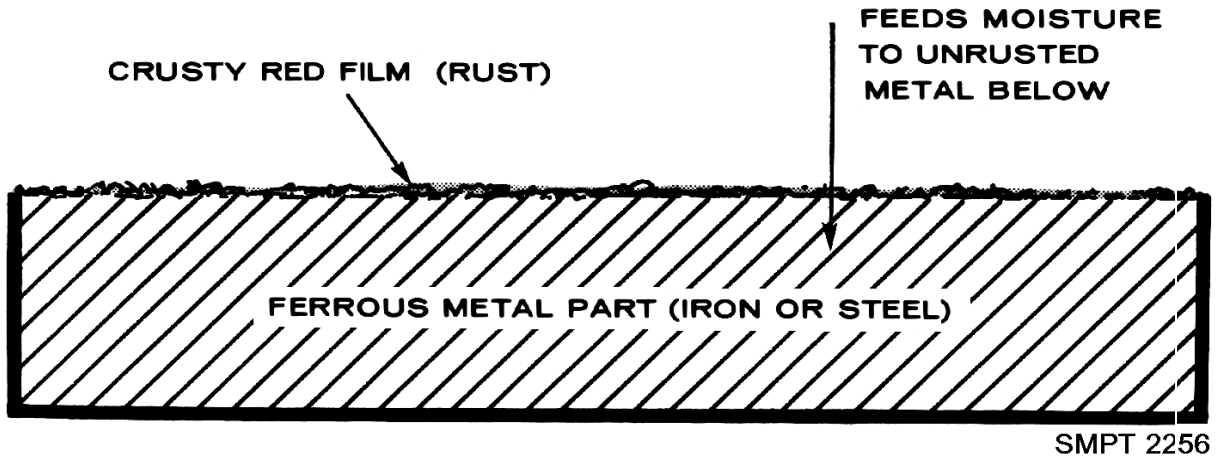


Figure 2-6. Corrosion of Ferrous Metals.

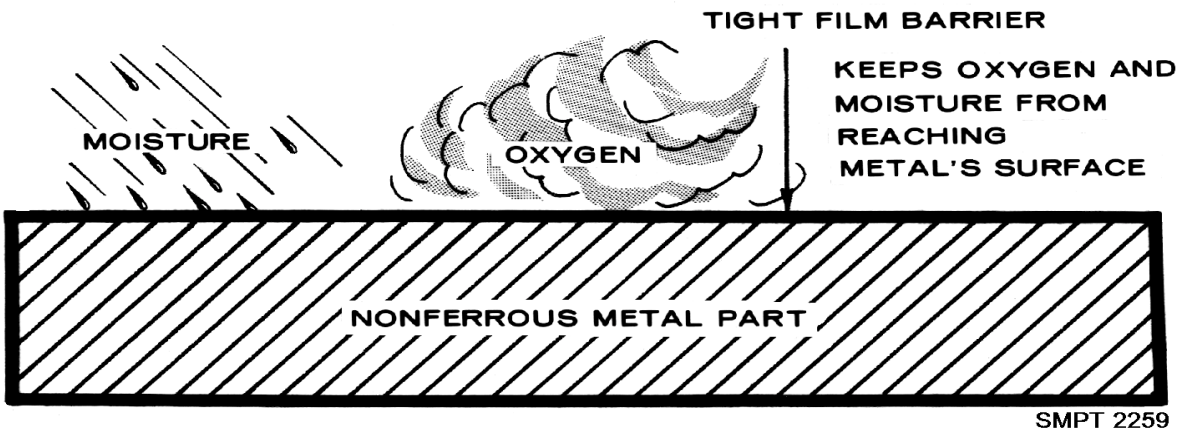


Figure 2-7. Corrosion of Nonferrous Metals.

WHAT IS KNOWN ABOUT CORROSION--BASIS FOR CONTROL

For the purpose of understanding corrosion control, corrosion will be explained by comparing it to the operation of a storage battery. In order for corrosion to take place, certain elements have to be present. They are a metallic part, water, and oxygen. In order for a battery to produce a charge, certain elements must also be present, as depicted in figure 2-8. They are positive and negative metallic electrodes, and an electrolyte. The positive electrode is constructed of one kind of metal, and the negative electrode of a different kind of metal. This potential difference (a positive and a negative) must be present for an electric current to be produced. The electrolyte in the storage battery would be similar to the water and oxygen in the corrosion process, and the battery's metal electrodes are similar to the metal which corrodes.

Figure 2-9 shows that when an item is made of two or more dissimilar metals, accelerated corrosion will take place. When only one kind of metal exists, normal corrosion will take place. Without the three elements, shown in figure 2-9 there would be no electric current from a battery and no corrosive action on the metallic item. In many cases, batteries are packed in a "dry" state so that the battery will not generate an electric current. Similarly, in corrosion, basically no corrosive action will take place unless moisture is present. The most obvious thing to do to prevent corrosion would be to eliminate moisture. This could be done by applying a waterproof or water-vaporproof barrier to the item. Even if the part is not made of two different metals (as the electrodes in the battery), there is enough potential difference between areas within one metal to cause corrosion. In order for these two areas to react, they have to be connected some way. This is done by the electrolyte (water).

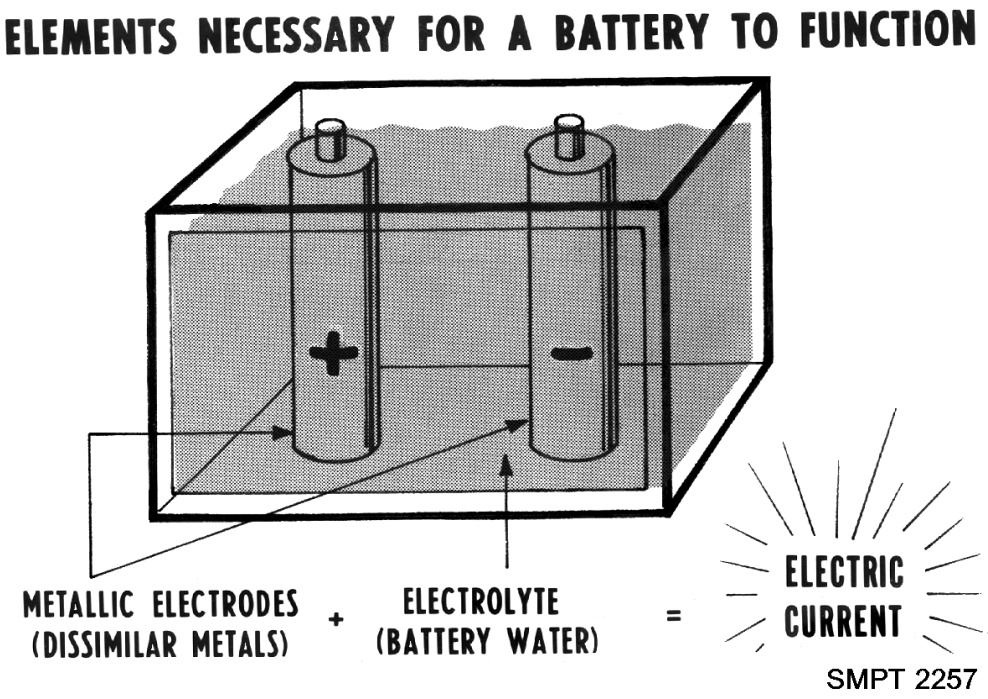


Figure 2-8. Comparing Corrosion with a Storage Battery.

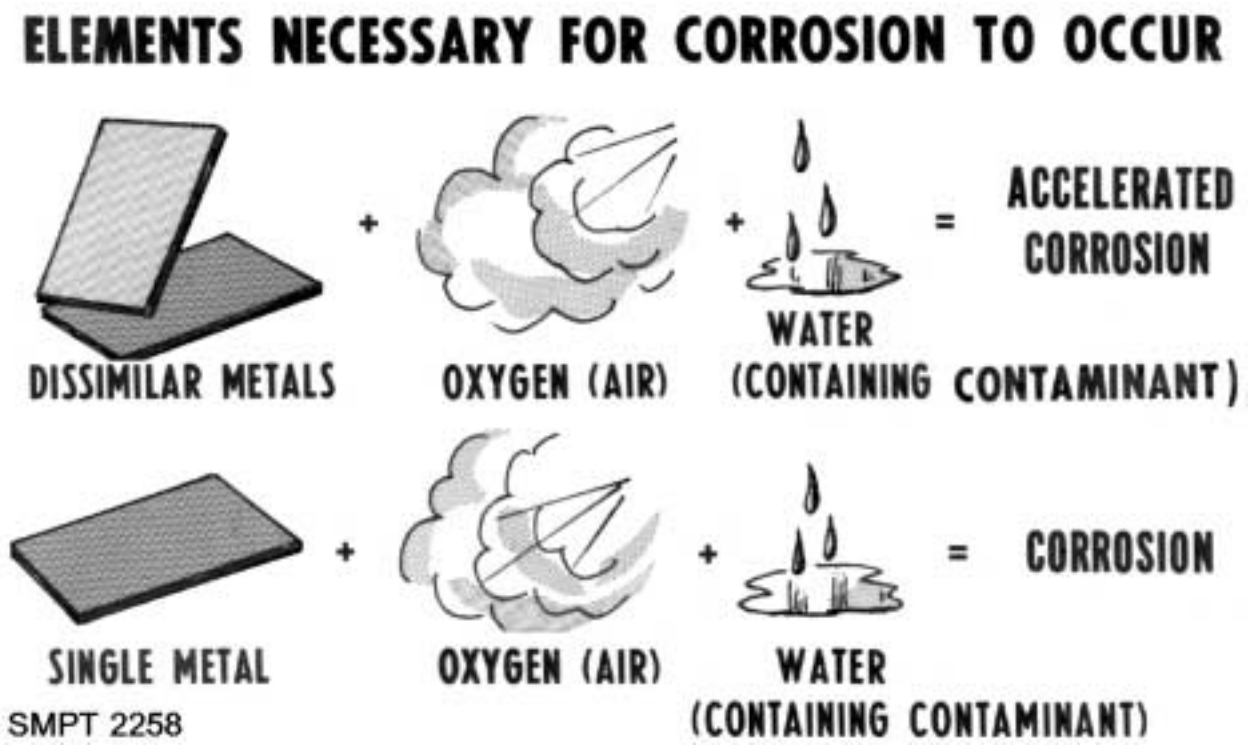


Figure 2-9. Corrosion Elements.

CORROSION CONTROLS IN PRESERVATION

Simply stated, preservation controls corrosion by controlling what would amount to the battery water in the "corrosion battery." Contaminants, which would make any moisture present a better electrolyte, must be removed. Moisture, which would take contaminants into solution to make an electrolyte, must be kept from the surface of the part by preservative application and/or sealed unit packages. Oxygen is sometimes controlled by adding a substance (antioxidant) to the preservative. This substance removes the oxygen.

Corrosion controls are included in the three basic operations which make up unit protection (cleaning, preservative application, and unit packaging).

Cleaning is the first operation in unit protection. Details of the cleaning processes will be covered in another lesson. The main reason for cleaning is to remove contaminants from the item to prevent a battery-type action from taking place. Immediately after cleaning, the item must be thoroughly rinsed to remove the residue of the cleaning agent. Heavy emphasis is placed on fingerprint removal when cleaning items which have a highly polished critical surface. The reason for this is because oils from fingers are salty-acid contaminants which act as an extremely effective electrolyte when combined with water. Drying, although accomplished by separately identified procedures, becomes part of the overall cleaning operation.

Preservative application is the second operation in unit protection. Details will be covered in another lesson. The main reason for a temporary preservative coating is to insulate the metal surface from moisture and contaminants. To fight corrosion, we must apply a good, uniform, continuous coating of preservative to the item. The heavier preservatives may not be used on more complex items because of their difficulty in removal. A lighter preservative may be used within a sealed barrier provided in the method of unit protection.

Completing the method of unit protection is the third operation in unit protection. Details will be covered in another lesson. The following general observations relate the preservation methods to corrosion control.

Cleaning, preservative application, and unit protection make up the techniques required to prevent corrosion. These three operations should be carried out in a continuous cycle without layover between operations. It is especially important that parts not be held over between cleaning and preservative application.

Checkup

X In general, it can be stated that most corrosion takes place in the presence of what three things?

X How would a zinc plated steel bolt appear as it becomes progressively corroded?

X Why can the operation of a storage battery and formation of corrosion be compared?

X What is the preservation approach to corrosion control?

X Preservation operations should be performed in one continuous cycle. From a corrosion control standpoint, where is the most damaging place to have a time break in operations?

CLEANING AND DRYING

CLEANING REQUIREMENTS

The cleaning requirements differ for military preservation from those for commercial packaging and are defined below.

Commercial Packaging

The cleaning requirements for commercial packaging are specified in ASTM D 3951. Items will be free from dirt and contaminants which would contribute to deterioration of the item or which would require special cleaning by the customer prior to use. Coatings and preservatives applied to the item for protection are not considered contaminants.

TYPES OF CONTAMINANTS

Before we discuss the cleaning and drying operations, we will learn about the different types of contaminants that must be removed as shown in figure 2-10.

A contaminant is any matter on the item, other than the material it was made from. Dirt is often called a contaminant. In general, we are concerned with four types of contaminants.

Oil Soluble

This group includes all oily or greasy substances. These should be the first contaminants removed in any cleaning operation.

Water Soluble

This group includes fingerprints, perspiration, soldering and welding fluxes, and marking inks. These contaminants are not removed with ordinary solvents or cleaners. They are removed with a fingerprint removing compound.

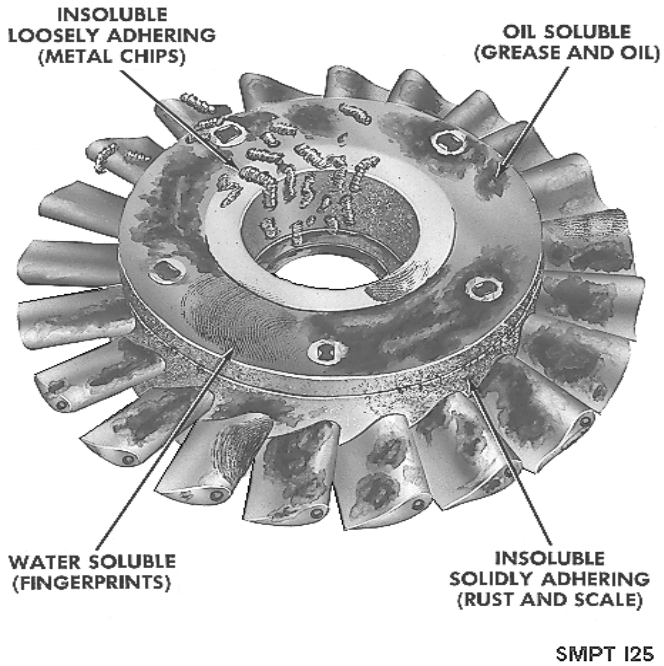


Figure 2-10. Types of Contaminants.

Insoluble Loosely Adhering Contaminants

Loosely adhering contaminants may be solid dirt particles, abrasive grains, metal chips and filings which can be removed with water or solvents.

Insoluble Tightly Adhering Contaminants

Tightly adhering contaminants may be mill and heat scale, carbon deposits, rust, and other corrosion products which must be removed by mechanical cleaning processes.

Each of these groups of contaminants must be removed by different means. If contaminants from more than one group are on the item, *the oils and greases must be removed first*, then the insoluble contaminants, followed by the water soluble contaminants.

BASIC CLEANING REQUIREMENTS

Good workmanship is necessary to do a good job in cleaning. The following requirements illustrated in figure 2-11, have been established for cleaning:

Cleaning Must be Thorough

All contaminants must be removed before the application of a preservative. Any contaminant left on an item will cause corrosion or deterioration.



Figure 2-11. Basic Requirements for Cleaning.

Process Must Not Injure the Item

Select a process that will not cause damage to an item. You wouldn't select a harsh solvent for leather goods because of its damaging effect.

Disassembly Shall be Limited

Limit the disassembly to a point where reassembly can be easily done without special tools or skills.

Fingerprints Must be Removed From Critical Surfaces

The acid in our fingerprints is corrosive, and, if not removed from critical (precision) surfaces, it will etch these surfaces in a short time.

To assure thorough cleaning of the item, it should pass a cleanliness test. If any contaminant is left on the item, the item must be recleaned.

CLEANING PROCESSES SELECTION

The selection of a cleaning process depends upon the following factors:

Composition of the Item

The composition of the item limits the choice of the cleaning processes. Items made from aluminum or zinc should not be cleaned in highly alkaline cleaners because of the detrimental effect of the cleaner. Nonmetallic items of rubber, fabric, cork, or other organic composition should not be cleaned haphazardly in organic or water-soluble alkaline cleaners. If solvent cleaning is applied to such items, the solvent exposure must be brief and scrubbing action limited when dimensions and use conditions of the item are critical. Solvents are detrimental to most rubber and synthetic rubber materials. If metallic and nonmetallic materials are combined in an assembly, the cleaning process must be carefully considered and the choice of the process governed by the nature of the materials combined in the assembly.

Surface Finish of the Item

Some cleaning processes are safe to use on highly finished and precision surfaces while other processes are likely to damage the finish. For instance, alkaline cleaning should not be used on polished aluminum. Acid cleaners are used in iron and steel with extreme care. Solvent cleaning processes are usually recommended for most critical surfaces of metal items. Surfaces of rough forgings or castings, rough ground or rough machined items, or surfaces having no finishing after stamping or drawings are cleaned by alkaline cleaning processes. Items with porous surfaces, small crevices, or holes are not cleaned with alkaline cleaning processes because the complete removal of all residues is not possible and corrosion will result. Solvent cleaning cannot be applied indiscriminately to painted surfaces; however, zinc-coated primers, exterior paints, lacquers, and enamels are usually handled safely in solvent cleaners.

Complexity of the Item

Items having irregular surfaces, crevices, undercuts, and pockets that could trap cleaning fluids may only be cleaned by brushing or wiping when solvent cleaning is used. Clean complex assemblies before they are assembled. Assemblies such as electric generators, motors, starters, gauges, meters, timing devices, and other complex units should be cleaned before assembly and kept clean thereafter.

Health and Safety Hazards

All cleaning processes have health and safety hazards that must be recognized. These cleaning processes must comply with the requirements of the Occupational Safety and Health Act (OSHA) of 1970, or Executive Order 11612, as applicable.

Approved Cleaning Processes

The selection of a cleaning process is very important; if not selected properly, more harm than good may result.

Cleaning Process

Items shall be cleaned and dried by any suitable process which is not injurious to the item. The methods and materials of cleaning may include the following; however, they are not limited to those listed below:

X Wire brushing may be used to remove loose scales and light rust from items. Oily or greasy contaminants must be removed before wire brushing. Wire brushes should be made of the same material as the metal being cleaned.

X Air vacuum cleaning should be used on items which cannot be cleaned by other mechanical or chemical processes. It can be used on radio and electronic items to remove dust, lint particles, etc.

X Barrel tumbling cleans by the use of both chemical and mechanical actions on the corroded surface.

X Chemical cleaners such as pickling baths.

Solvent Cleaning

Solvent cleaning uses several different kinds of solvents. Solvent cleaning is used when the only contaminant is a light grease or oil. It will not remove rust or fingerprints and other water-soluble contaminants. Fingerprint removal is used on all items with critical functioning surfaces or items with close tolerances to remove fingerprints, perspiration, and other water-soluble contaminants. Solvent cleaning followed by fingerprint removal is sometimes necessary.

Materials for Solvent Cleaning

The materials used in solvent cleaning are dry cleaning solvent Type III, paint thinner and fingerprint remover corrosion preventive compound.

X Dry cleaning solvent (P-D-680), Type III only. This is a water-clear liquid that is neutral to metals and is sometimes known as Stoddard solvent. It is slightly irritating to the skin and may be mildly nauseating when excessive vapors are breathed. It can be used on metal surfaces by brushing, wiping, spraying and immersion to remove oils and light greases. The solvent must be used only at room temperatures. P-D-680, Types I and II are being phased out as environmentally hazardous solvents which must be disposed of as a hazardous waste. There are environmentally compliant solvents that clean as well as P-D-680, Types I and II. Approved substitutes that are environmentally compliant solvents at this time include Breakthrough, Electron 296, Skysol 100, Skysol, and PF. Do not use water-based enzymes as a substitute for P-D-680 as they do not provide corrosion protection. For questions concerning the availability of solvent products, contact the Defense Supply Center Richmond, 8000 Jefferson Davis Highway, Richmond VA 23297-5100, or call 1-800-352-2852 and ask for the Environmental Products catalog.

Note: WARNING: Keep solvent away from any open flame or source of sparks.

X Paint Thinner (TT-T-291). This material is supplied in two grades and only grade I is used for solvent cleaning. It is similar to dry cleaning solvent (P-D-680) in that it removes oils and light greases, having a low flashpoint and degree of toxicity. Used paint thinner must be disposed of as a hazardous waste.

X Fingerprint Remover Corrosion Preventive Compound (MIL-C-15074). This material is a mixture of solvent, soap and water. It is used to remove fingerprints, suppress perspiration corrosion, and temporarily protect steel surfaces.

Equipment for Solvent Cleaning

Metal tanks are required for solvent cleaning, and they usually contain provisions for spraying operations. The tanks should be equipped with safety features consisting of a tight fitting lid, a fusible link, and a ground connection, as shown in figure 2-12. The reasons for the safety features are as follows: if the solvent should catch fire, the heat would melt the fusible link and allow the tight fitting lid to close and smother the fire, and the ground connection is used to carry off any static charges of electricity. It is important that the fusible link always be in an operable condition and that the lid should never be wired or fastened in the open position.

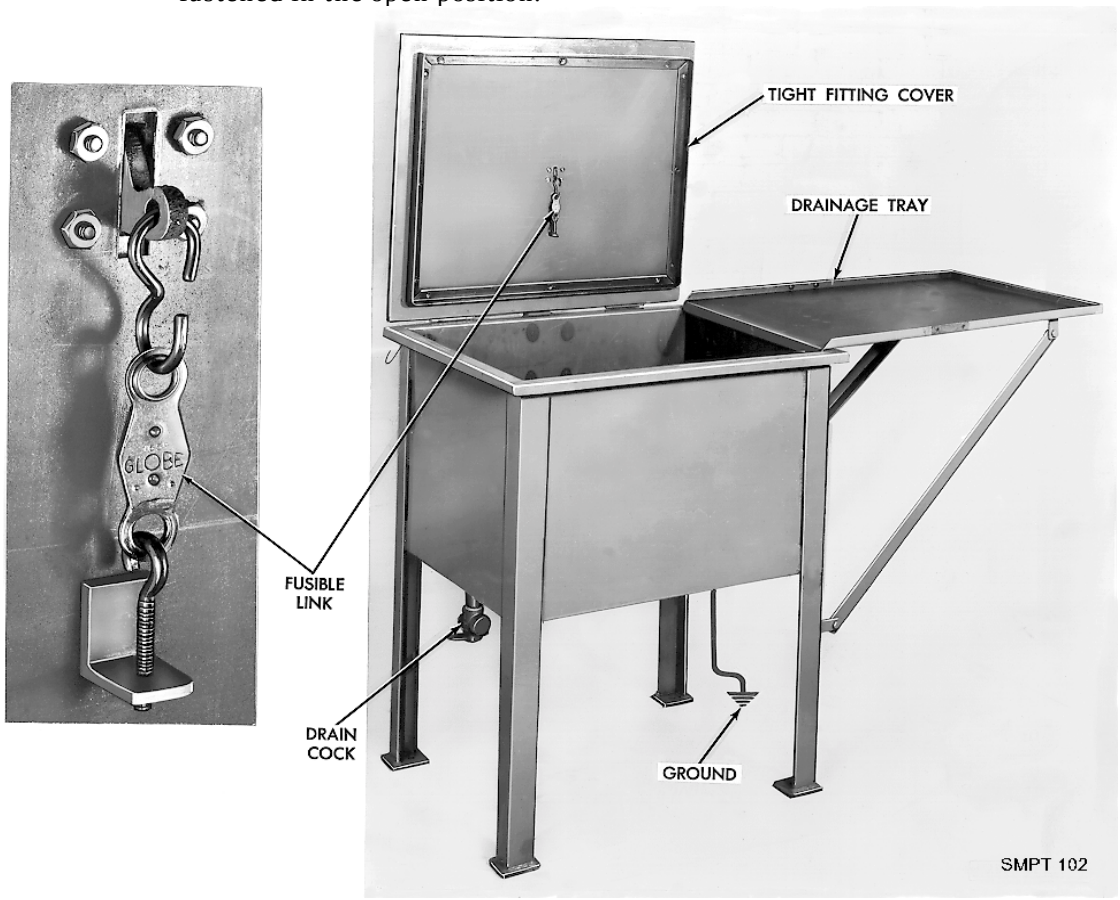


Figure 2-12. Solvent tank with safety features.

Safety Precautions for Solvent Cleaning

Observe the following:

- X When not in use, covers must be kept closed on all solvent tanks.
- X Provide adequate ventilation to prevent vapor fume build up. Inhaling solvent vapors may cause dizziness, fainting and nausea.
- X Fire extinguishers must be located in the area, and personnel must be trained in their use.
- X A fire blanket should be located nearby.
- X Since solvents may cause skin irritations, operators should wear oil resistant rubber or plastic gloves and work aprons during cleaning operations as illustrated in figure 2-13.

Solvent Cleaning

Figure 2-14 depicts two tanks required to clean by immersion. One tank is used for cleaning and the other for rinsing.

- X Cleaning by immersion. The solvent cleaning immersion steps are illustrated in figure 2-15. These steps include placing items in the solvent cleaning tank so they receive the most effective washing action; agitating the items thoroughly for complete cleaning; using a brush where necessary to remove heavy contaminants; removing clean items from the tank and allowing them to drain completely; immersing the items in a second tank (rinse tank) and agitating as necessary; and removing items from the rinse tank and placing them on a tray to thoroughly drain.
- X Cleaning by scrubbing and wiping. When contaminated items are too large for the cleaning tanks, or because it is impractical to clean by immersion or spraying, they should be cleaned by scrubbing and wiping. The solvent cleaning by scrubbing and wiping steps are as shown in figure 2-16. The steps include soaking clean cloth or brush in clean solvent; masking off areas of the item that can be damaged by solvent; applying the soaked cloth and/or brush to the dirty area and scrubbing and wiping as necessary; rinsing off the area with a clean cloth soaked in clean solvent; and draining and wiping the cleaned area dry.
- X Cleaning by spraying. When items are of a simple construction, free of cavities and indentations where cleaning solvents can be trapped, the cleaning can be done by spraying as described in figure 2-17. The steps involved in solvent cleaning by spraying include loading items in a work basket and lowering the basket into a spray tank; turning on the spray pump and directing the nozzle at items, assuring complete cleaning of the item; and removing the basket of items from the spray zone and allowing it to drain. A rinse is not required if the spray system is equipped with filters allowing the sprayed solvent to be cleaned.
- X Perspiration and fingerprint removal.
- X Solvent cleaning followed by fingerprint removal.

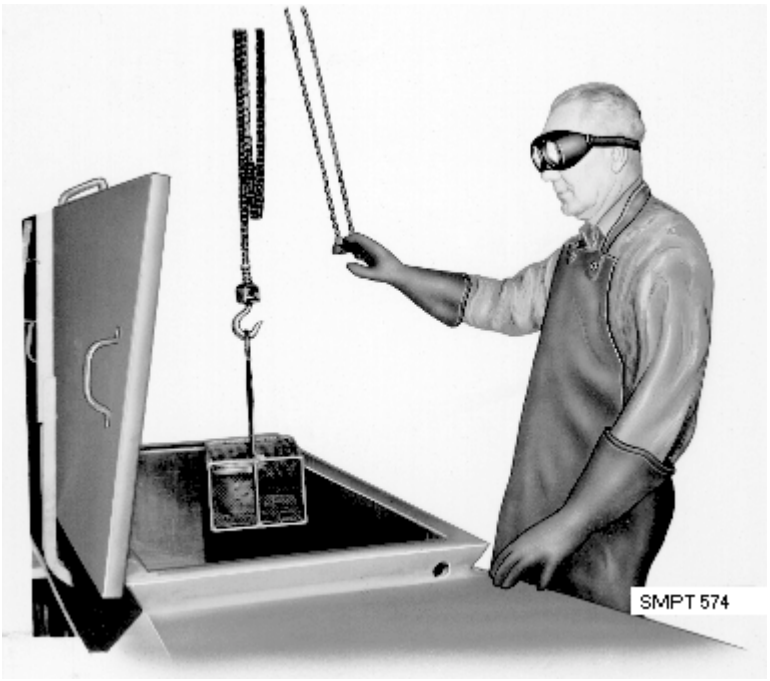


Figure 2-13. Solvent safety clothing.

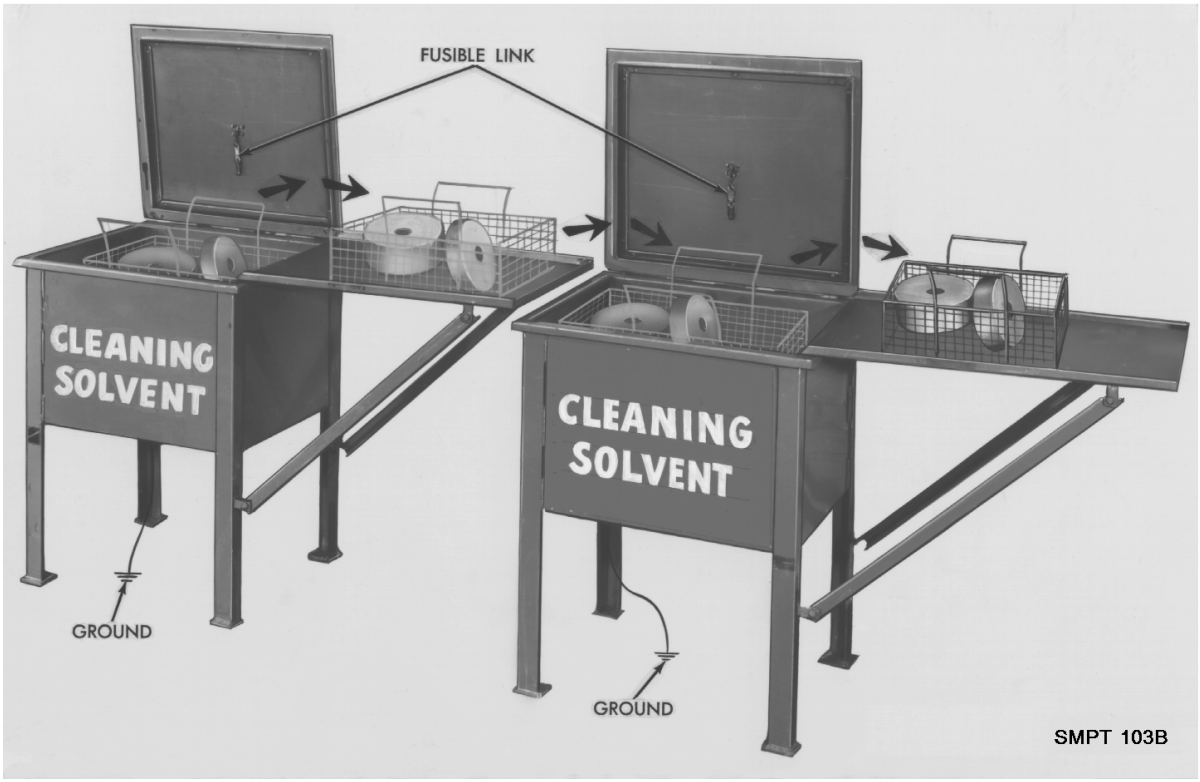


Figure 2-14. Solvent cleaning by immersion.

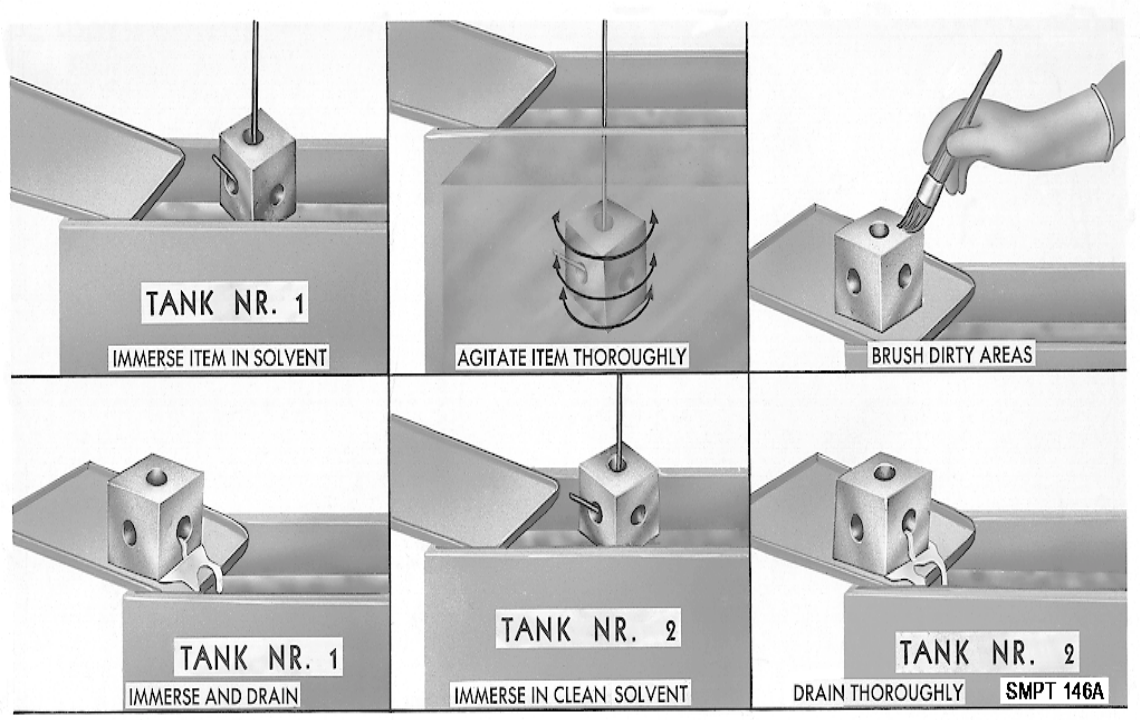


Figure 2-15. Solvent immersion steps.

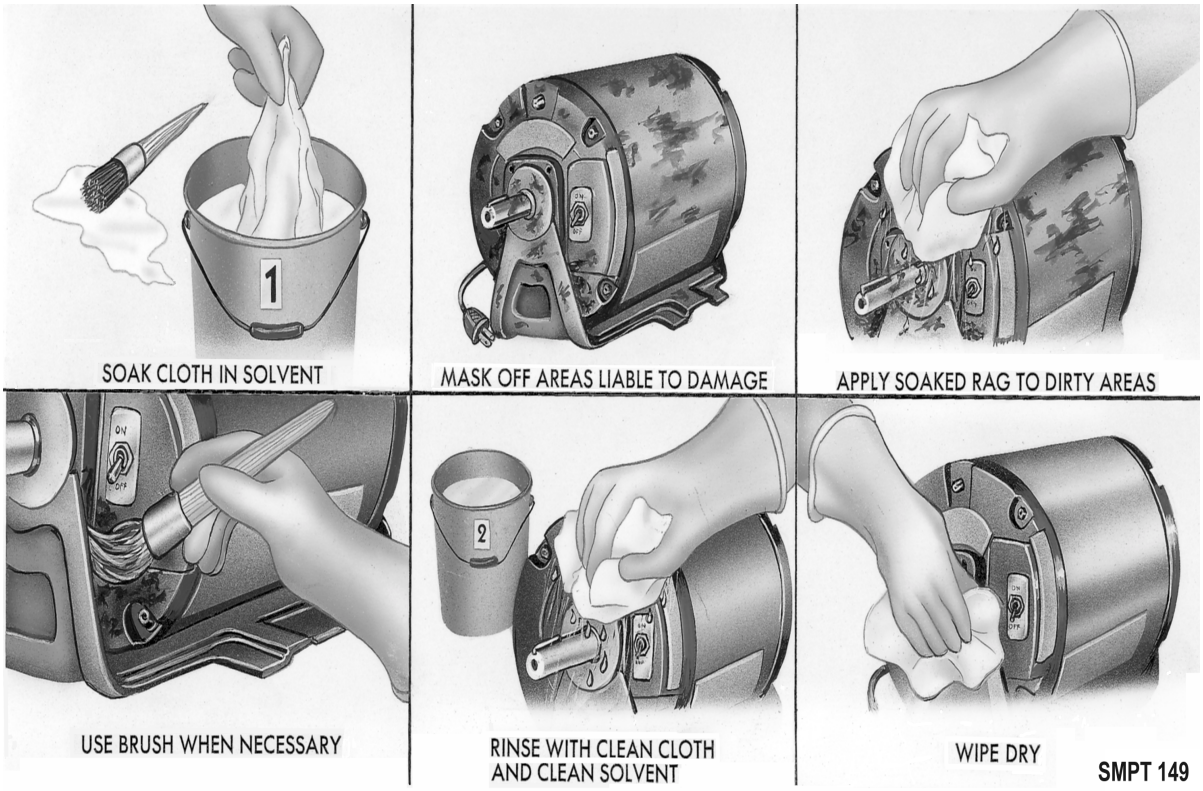


Figure 2-16. Solvent scrubbing and wiping.

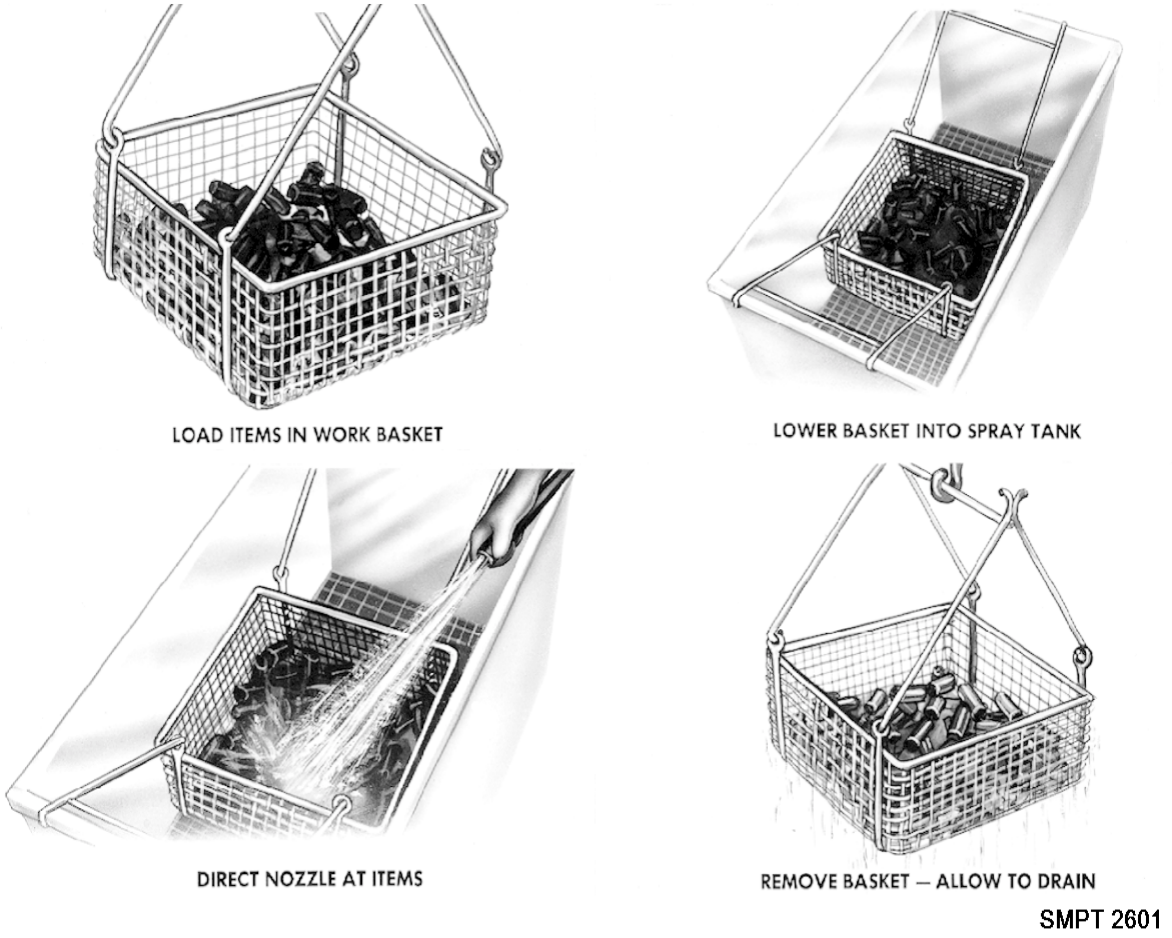


Figure 2-17. Solvent spray cleaning.

Perspiration and Fingerprint Removal

Two tanks are required for cleaning perspiration and fingerprints. One tank should contain fingerprint remover compound (MIL-C-15074) and the other a cleaning solvent. This process is used on all items having critical functioning surfaces or close tolerances. Before this process is used, the item must first be cleaned of all other contaminants. Steps involved in the perspiration and fingerprint removal process are illustrated in figure 2-18 and include immersing item(s) in perspiration and fingerprint remover compound and agitating while in the compound for *2 to 3 minutes*; removing item(s) from fingerprint remover compound and allowing them to drain; immersing item(s) in a second tank containing clean dry cleaning solvent and thoroughly rinsing; and after rinsing, draining and drying the item(s).

Solvent Cleaning Followed by Fingerprint Removal

This process is accomplished by completing the cleaning steps described for solvent cleaning, followed by perspiration and fingerprint removal. Figure 2-19 details the steps involved.

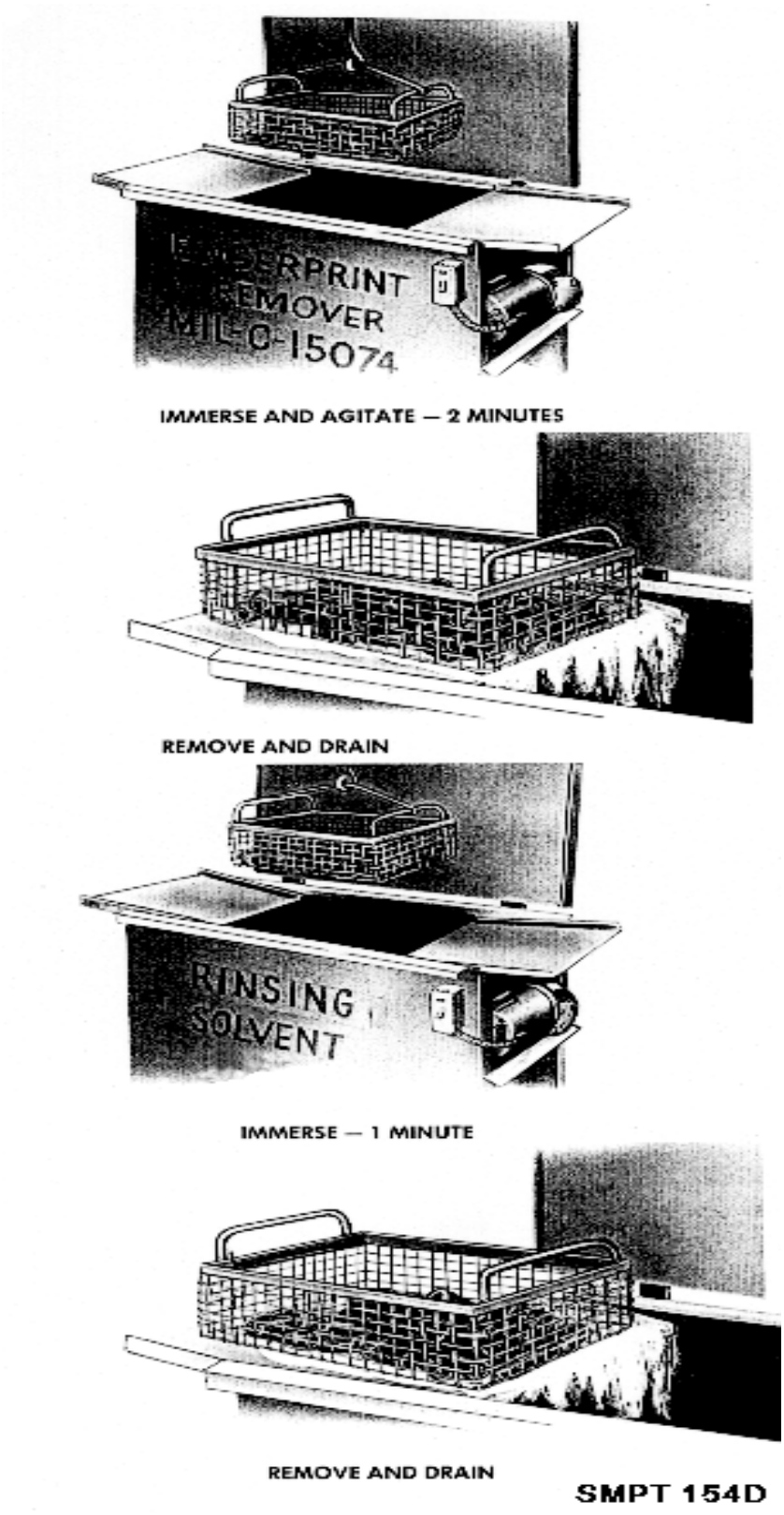


Figure 2-18. Fingerprint removal operations.

Vapor Degreasing

Cleaning by vapor degreasing. This process differs from the previous processes in removing contaminants from the items. As you recall, cleaning materials were not heated. In this cleaning process, we are going to heat nonflammable solvents and use the vapors to throughly remove heavy oils, greases, and wax. This process should not be used on items that can be damaged by heat. The degreasing process is quite simple but must be done only in special equipment because of the hazards involved.

X Material used in vapor degreasing. The materials used in vapor degreasing are known as chlorinated solvents such as trichloroethane-1,1,1. Trichloroethane-1,1,1 is a clear, non-flammable solvent and can be used either in liquid form or in vapor form after heating. It has a boiling point of 165EF. These materials will not remove fingerprints, rust, or scale. Its primary purpose is to remove heavy oils, greases, and wax. Environmentally friendly degreasers are also available and are highly recommended for this process.

X Equipment for vapor degreasing. This cleaning process should only be done in properly designed equipment that may vary in size and shape. The manufacturer's guide must be carefully followed. Figure 2-20 shows the parts of a typical vapor degreaser.

X Safety precautions for cleaning by vapor degreasing are: (WARNING) VAPOR HARMFUL!

1. Use only with adequate ventilation.
2. Avoid prolonged or repeated breathing of vapor.
3. Avoid prolonged or repeated contact with skin.
4. Do not take internally.
5. Contact with flames or hot glowing surfaces may form corrosive acid fumes.
6. The manufacturer's manual must be used as a guide, with particular attention focused on cleaning the tanks.
7. Wear protective clothing, gloves, aprons, and goggles.

X How the vapor degreaser cleans. This method of cleaning removes heavy oils and greases. The cleaning action is due to vapors condensing on the cool item, which then dissolves the greases and oils and rinses them from the item as illustrated in figure 2-21. Cleaning steps involved in vapor degreasing are as follows:

1. Place items on racks or in baskets. Place in such a way that when the greases and oils drain, they won't be trapped in pockets or crevices.
2. Lower the items slowly into the vapor area at a rate of 10 to 12 feet per minute to prevent the escape of vapors from the tank.
3. When vapors stop condensing on the items, slowly remove from tank.
4. If some contaminant still remains on the item, cool to room temperature, then repeat the above steps.
5. Remove slowly from vapor area and allow items to cool.
6. No drying process is required.

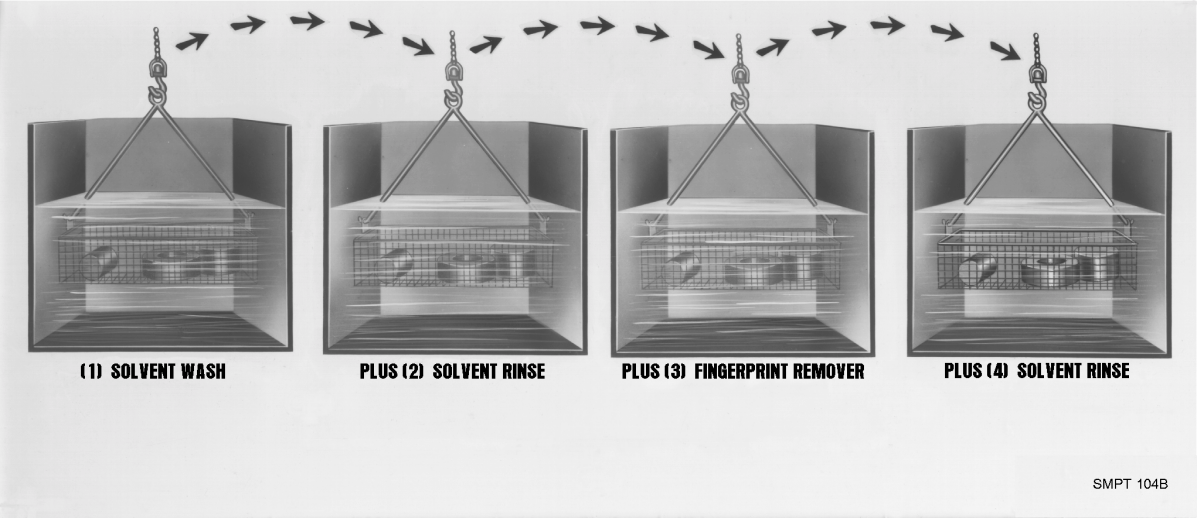
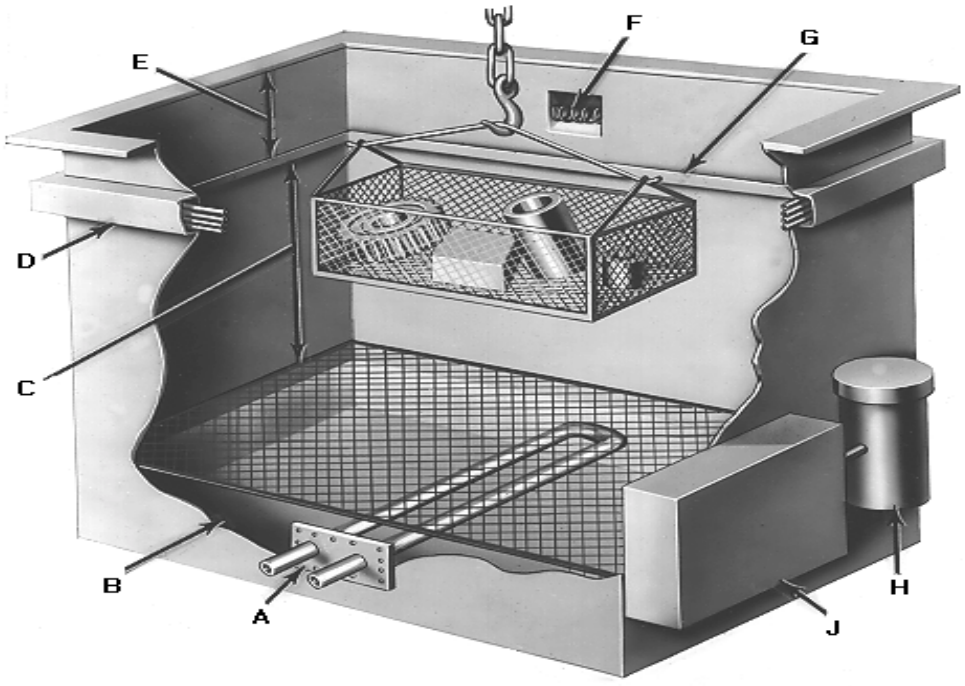


Figure 2-19. Solvent cleaning followed by fingerprint removal.



A. HEATING ELEMENTS
B. BOILING CHAMBER
C. VAPOR AREA
D. CONDENSER
E. WORK CLEARANCE SPACE
F. SAFETY THERMOSTATS
G. DRAINAGE TROUGH
H. WATER SEPARATOR
J. CLEAN SOLVENT STORAGE TANK

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Figure 2-20. Vapor degreasing.

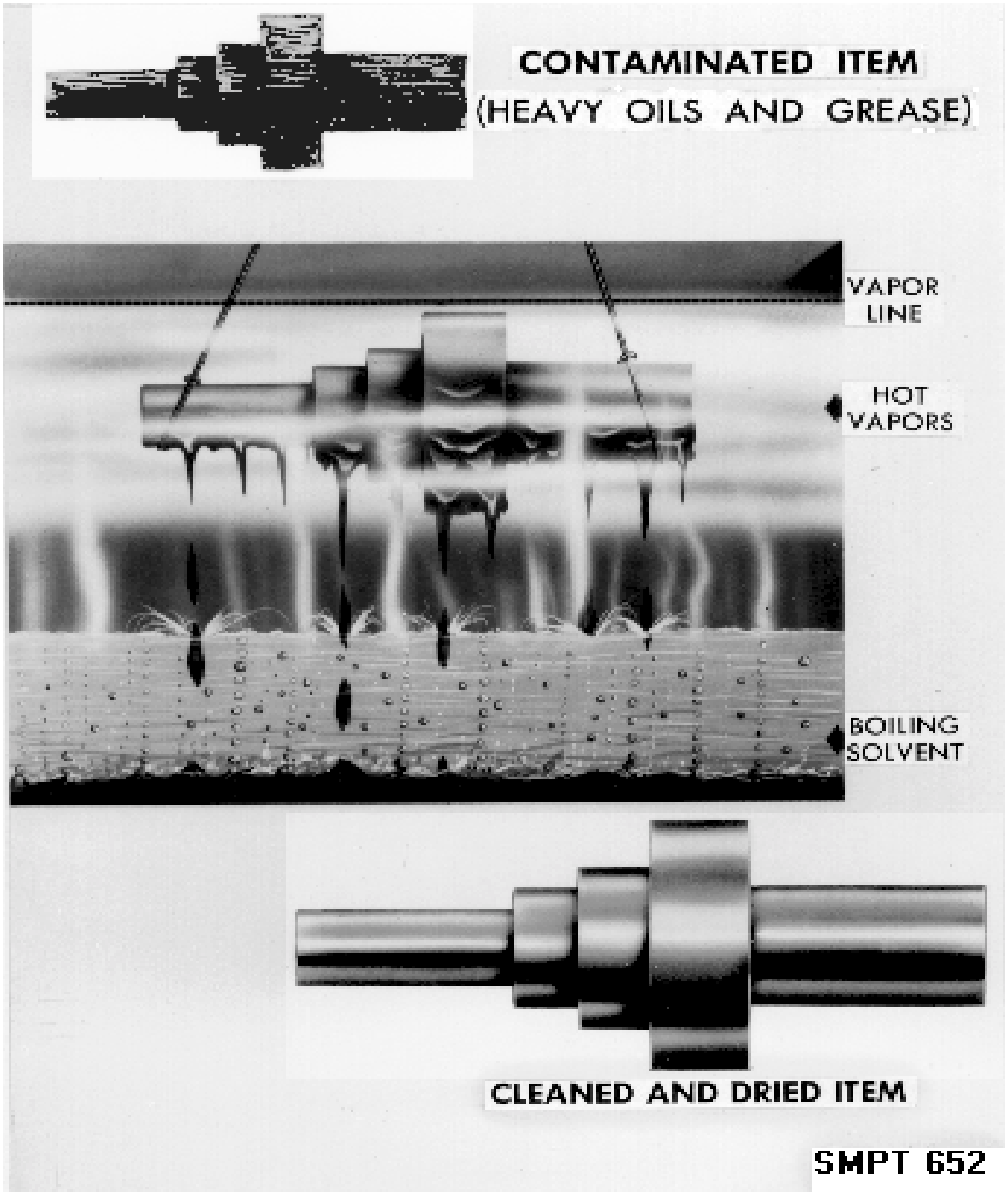


Figure 2-21. Vapor Degreasing an item.

Vapor Degreasing Followed by Fingerprint Removal

This cleaning process is a combination of two other cleaning processes. If the item has a critical surface and is coated with heavy oil or grease, the heavy oil or grease must be removed before the fingerprint removal compound is used on the critical surface. Clean the item by vapor degreasing first to remove the heavy oil or grease. Allow the item to cool until it reaches room temperature. Then clean the item in the fingerprint removal compound to remove any water soluble contaminants on the critical surfaces of the item.

For environmentally safe substitutes for Trichloroethane 1,1,1, refer to the Environmental Products Catalog, Defense Supply Center, Richmond, VA, http://www.dscr.dla.mil. Manufacturer's recommendations and Material Safety Data Sheets (MSDS) should be consulted.

Jet Spray Washing

Procedures such as solvent cleaning that use solvents, which have chloroflourocarbons in them or are ozone depleting chemicals or water pollutants, are being replaced by environmentally safer cleaning processes. Jet spray washing is a cleaning method designed to operate with the lowest buildup or generation of contaminants which pollute the environment.

Items with heavy or light greases or oils are placed into units which are preheated to temperatures over 200 EF. A cleaning compound is placed in the units and mixes with the very hot water which is "jet sprayed" with considerable force onto the items until they are clean.

As the items are being jet sprayed, the contaminant is scraped or skimmed from the surface of the solvent and compressed into a small unit for easy disposal. The liquid portion of the cleaning compound provides for safer disposal into normal water drainage systems. The items receive thorough cleaning and are very hot at the end of the cleaning cycle. No special drying technique is necessary.

Regardless of the high temperature, jet spray washing will not remove fingerprints, perspiration, etc. from metal items with critical surfaces. The fingerprint removal compound process will still be necessary. However, this process does not provide the corrosion protection of the chlorinated solvents.

Abrasive Blast

The abrasive blast process consists of directing a high velocity stream of an abrasive material against the surface of the item. It should be used on surfaces where the abrasive action will not affect the function of the item such as rough castings. The choice of abrasive materials is so large that almost any type of surface finish may be obtained. These materials include hardened cast steel shot, sand, garnet abrasives, and glass beads. The equipment used in this process ranges from small blast cleaning cabinets to large blasting rooms and open air blasting operations.

In general, the following steps are performed:

- X Protect yourself with approved protective equipment.
- X Mask off any portions of work that must not be blasted.

- X Adjust pressures of compressed air to the type of surface being cleaned, 60 to 100 psi for hard materials or 30 to 50 psi for the softer materials.
- X Direct the stream of abrasive at a 90E angle to the work surface and move nozzle only as fast as the surface is cleaned.
- X If surfaces are dusty and have metal chips clinging to them after blasting, blow off with compressed air or rinse in an inhibited cleaning solution.
- X If iron dust and metallic particles continue to adhere to metal surfaces after rinsing, demagnetize items prior to further cleaning.

Alkaline Cleaning

The alkaline cleaning process, as pictured in figure 2-22, consists of soaking the items in alkaline cleaner solution and rinsing in clean hot water above 180EF. Items cleaned by this process are of a simple construction having noncritical surfaces. Alkaline cleaning will remove shop dirt, soil, oily and water-soluble contaminants, and heavy waxes.

Electrocleaning

This process consists of immersing the item in a solution and making the item an element of an electrochemical cell. It must be rinsed in clean hot water above 180EF. Figure 2-23 illustrates the removal of rust by electrocleaning.

Emulsion Cleaning

Figure 2-24 shows the emulsion cleaning process. This process consists of subjecting the item to a pressure spray or soaking in a tank of grease emulsifying, solvent-soluble cleaning compound to remove solvent-soluble grease, oil, dirt, etc. from various surfaces.

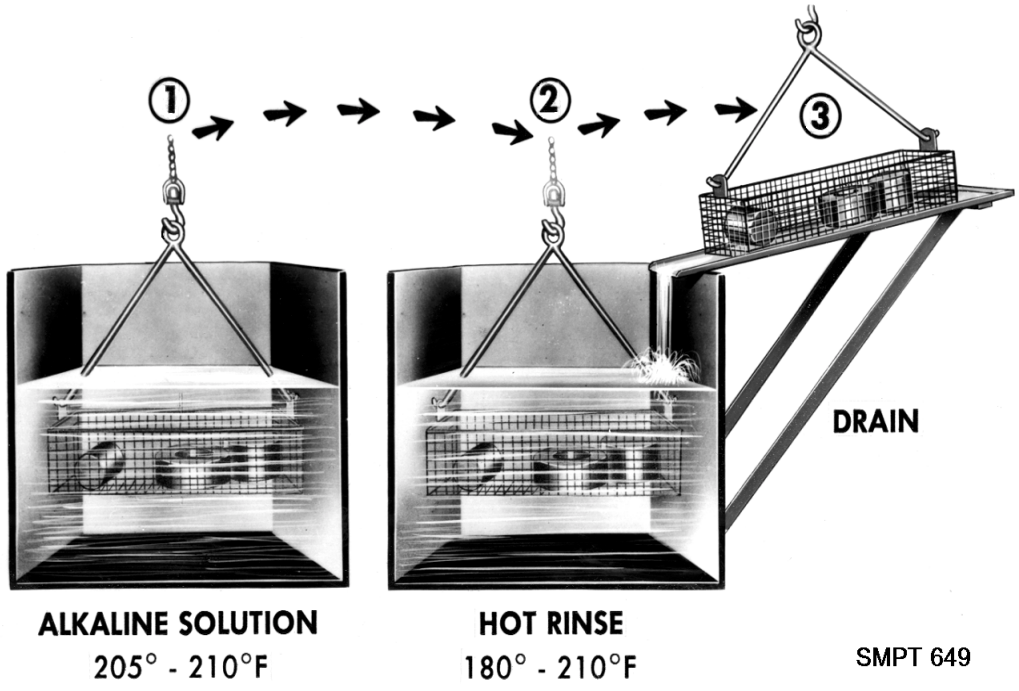


Figure 2-22. Alkaline cleaning.

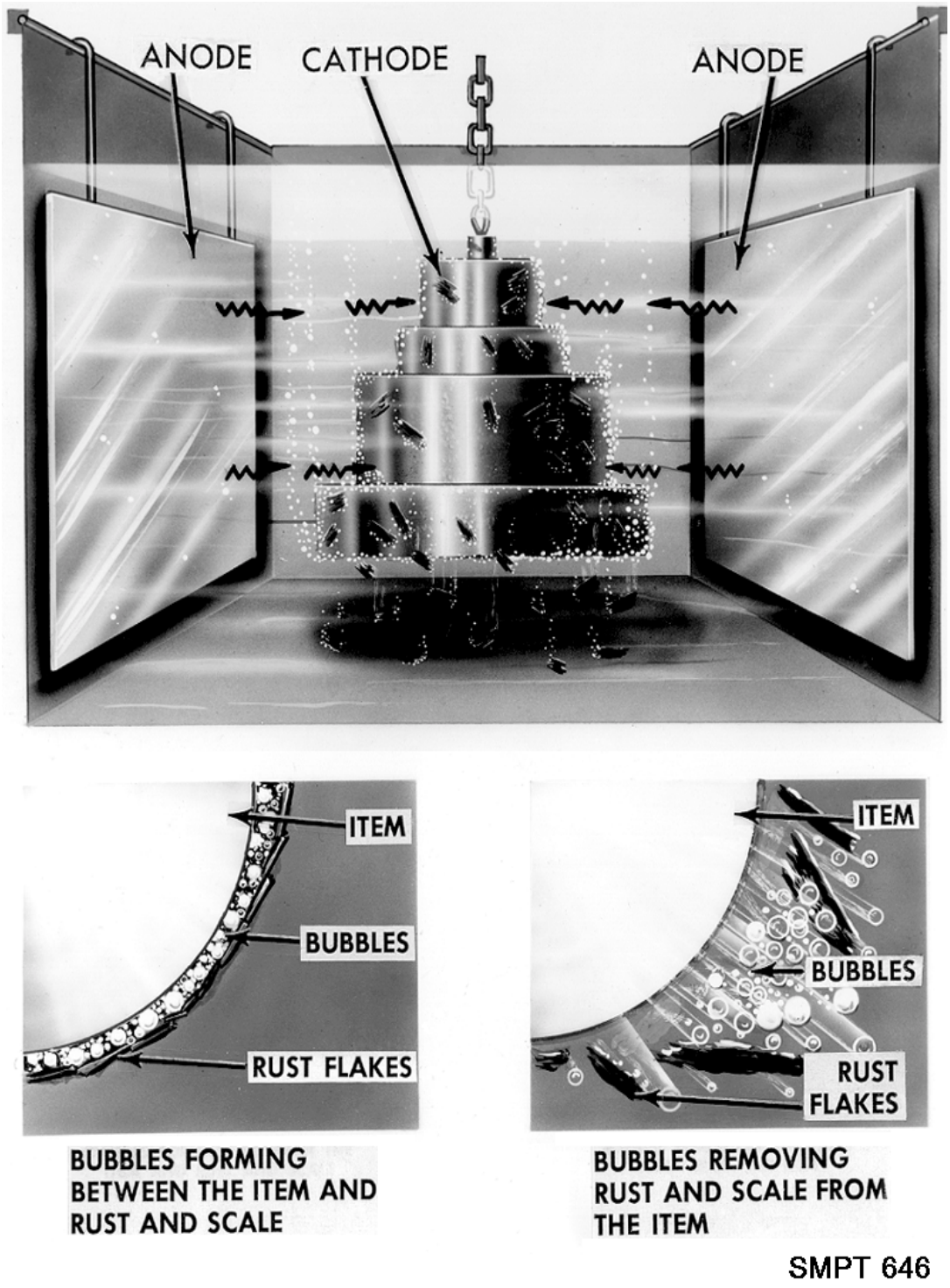


Figure 2-23. Electrocleaning.

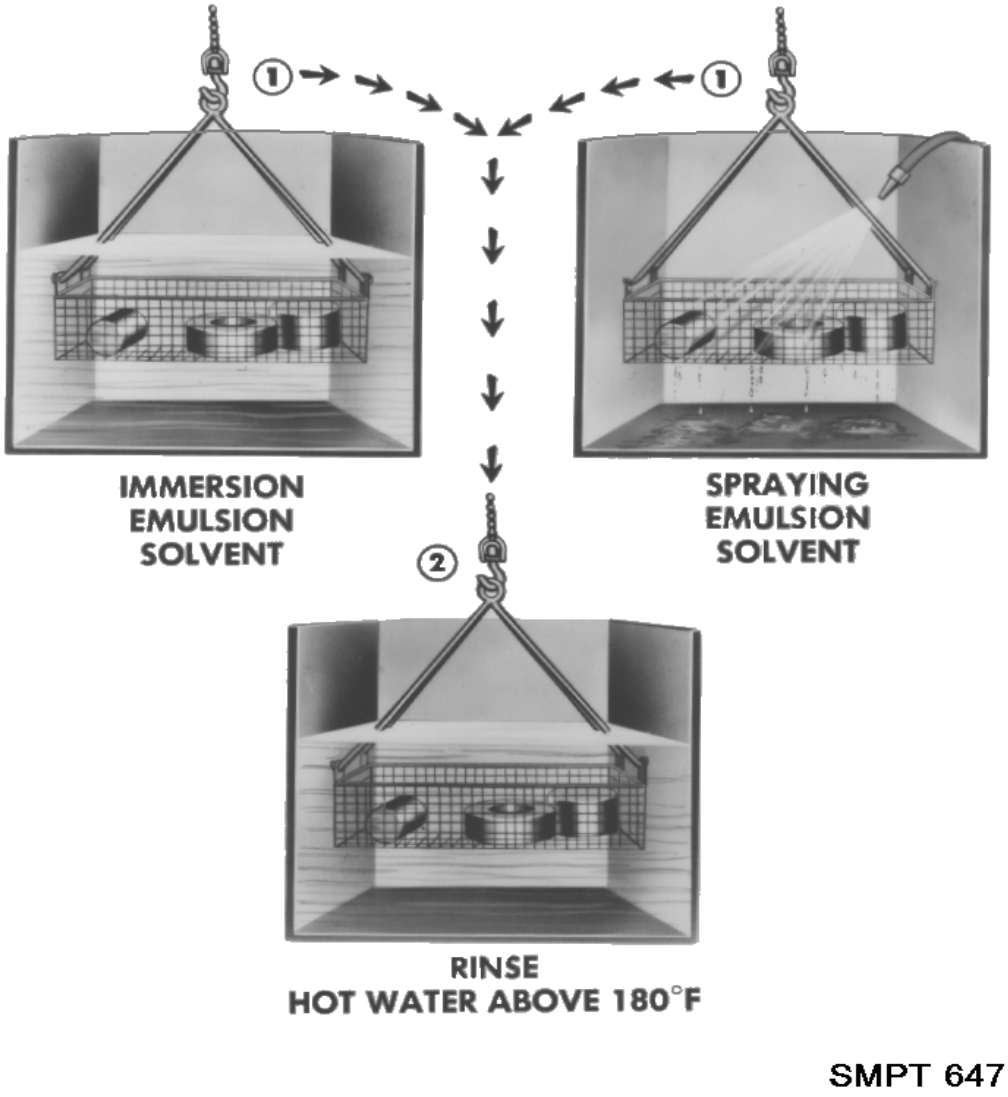


Figure 2-24. Emulsion cleaning.

Steam Cleaning

The steam cleaning process consists of subjecting the item to a stream of steam with an added cleaning compound followed by steam alone. Figure 2-25 depicts a typical use of steam cleaning to remove heavy greases from automotive equipment, such as trucks.

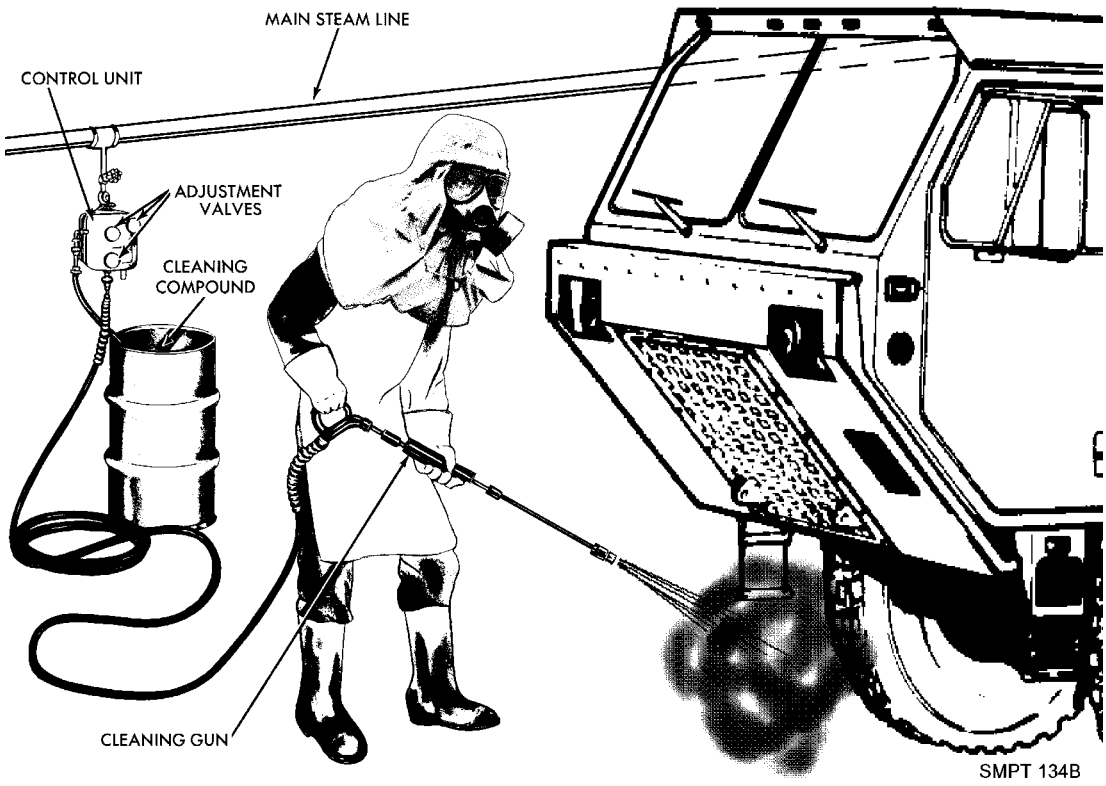


Figure 2-25. Steam cleaning.

Abrasive Blast (Honing Process)

The honing abrasive blast process consists of subjecting the items to a stream of atomized water containing a fine particle size abrasive and a *corrosion inhibitor*. It will remove light coats of rust or scale. Equipment similar to that shown in figure 2-26 is used for abrasive blasting. Steps involved in cleaning by this process are as follows:

- X Place item into the cleaning chamber and close door.
- X Thrust arms through rubber sleeve openings. Make sure that sleeves fit tightly around the wrist.
- X Hold item in one hand, while directing the blasting stream with the other.
- X Continue the abrasive blasting until all contamination is removed.
- X Remove cleaned item from cabinet and dip it in a tank of corrosion inhibited rinse water.
- X Dry the item as soon as possible after rinsing.

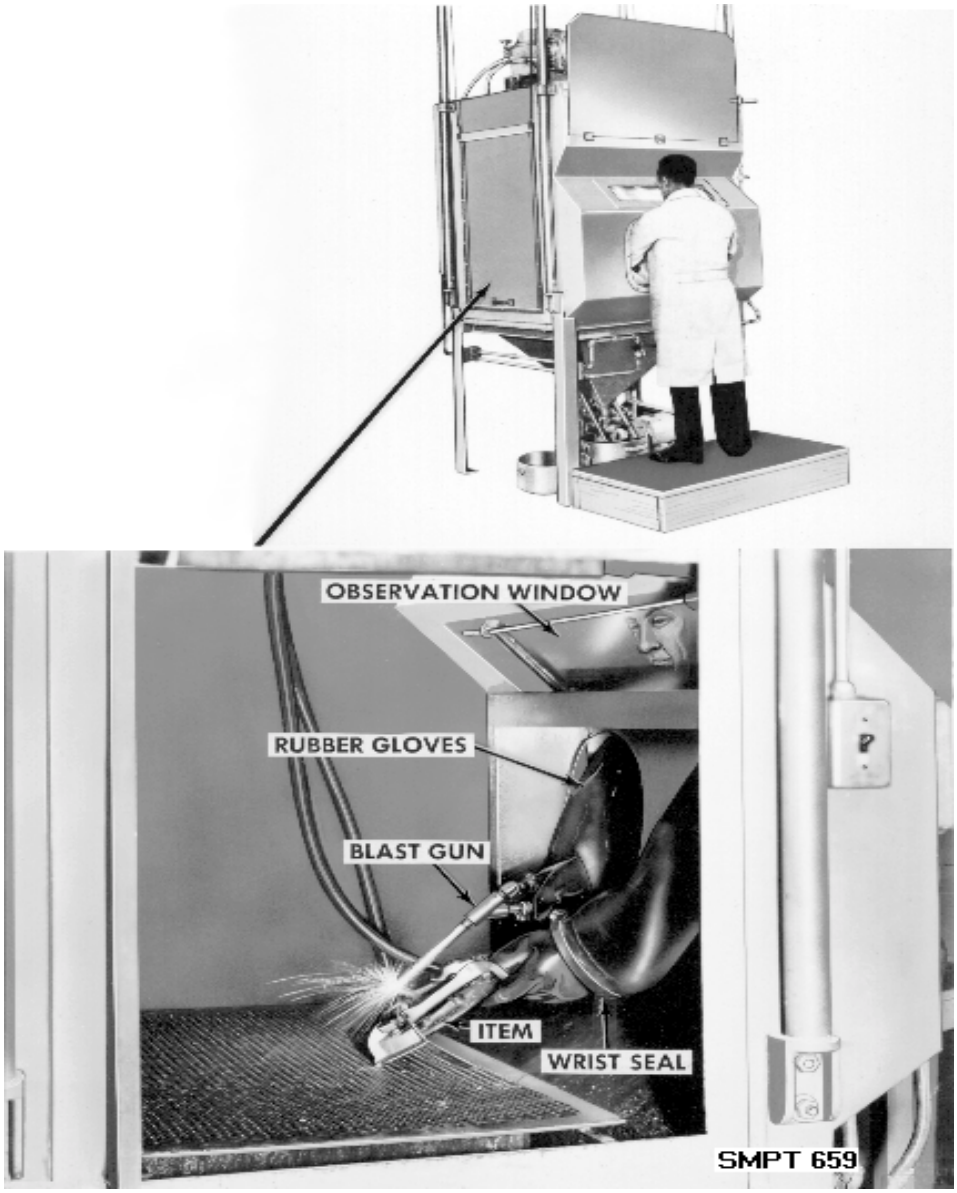


Figure 2-26. Abrasive blast cleaning honing process.

Soft Grit Blast

The soft grit blast process consists of subjecting the item to a high velocity stream of water containing a soft abrasive material.

Ultrasonic Cleaning

Ultrasonic cleaning should be used on nonabsorbent materials such as those found in electronic devices. This process consists of suspending the item to be cleaned in a cleaning agent, then directing the force of high frequency sound waves through the agent against the surfaces to be cleaned. The sound waves set up an agitation action along the surface, so in reality the bubbles scrub the contaminant off the surface by means of an implosion as shown in figure 2-27.

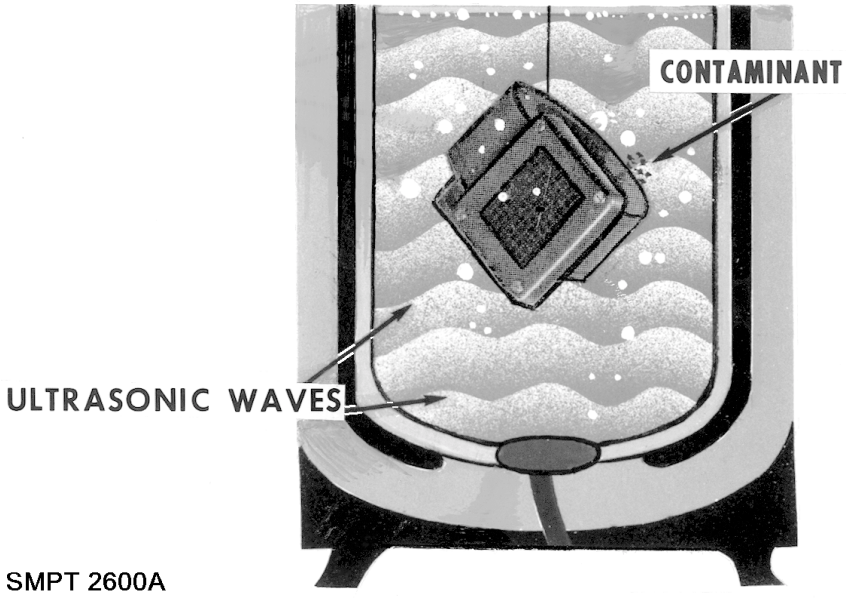


Figure 2-27. Ultrasonic cleaning.

DRYING PROCEDURES

Immediately after cleaning the item, it must be thoroughly dried *to remove any cleaning solutions or remaining moisture.* Figure 2-28 illustrates the approved drying procedures.

Drying With Compressed Air

The air for drying must be free from oil, dirt, and moisture. Dry all surfaces of the item by applying the clean air until all solvents disappear.

Drying With Ovens

This is done by placing the item into a heated air oven. The oven should be well ventilated and temperature controlled.

Drying With Infrared Lamps

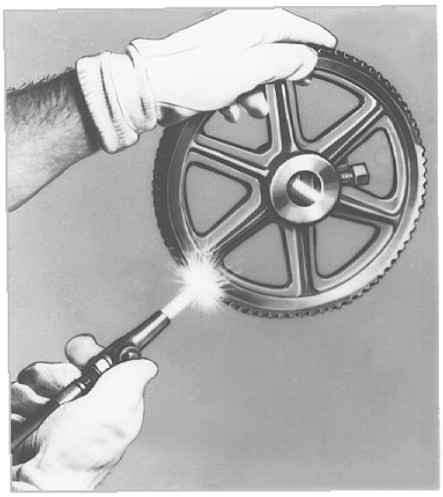
This is done by placing the item between rows of infrared lamps. This is a commonly used procedure for drying.

Drying by Wiping

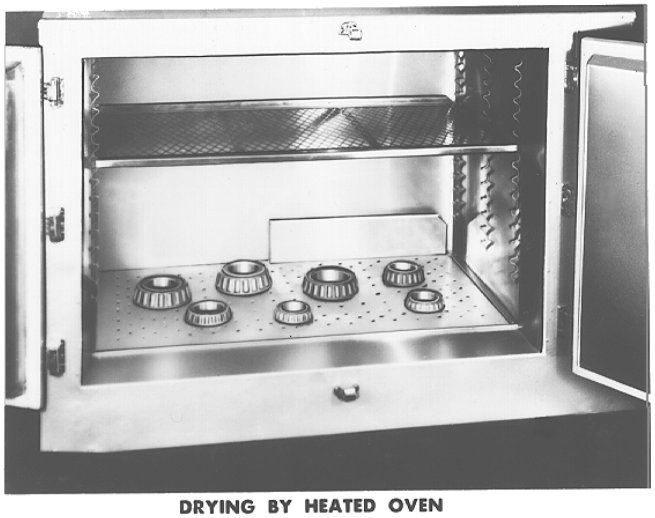
This is done by wiping the item with clean, lint-free cloths. It is difficult to wipe areas that have blind holes and undercuts.

Drying by Draining

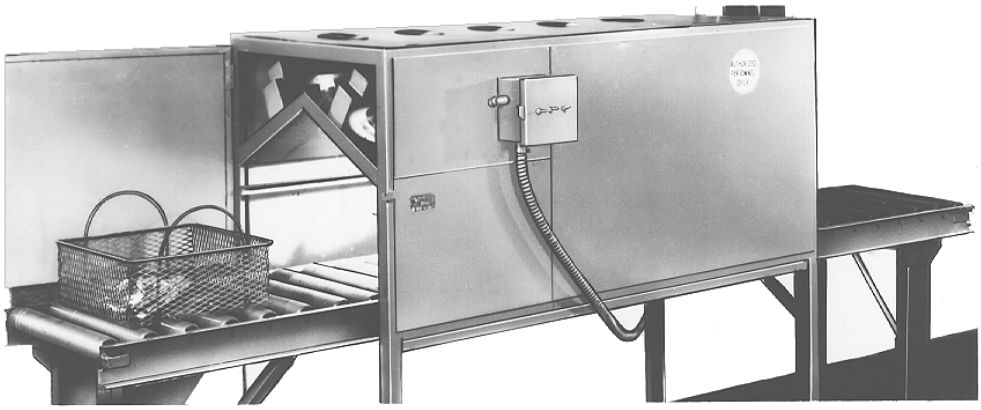
This drying process is used only when the final step in cleaning involves a petroleum solvent, and the item is to be preserved with a material using a petroleum solvent as a thinning agent.



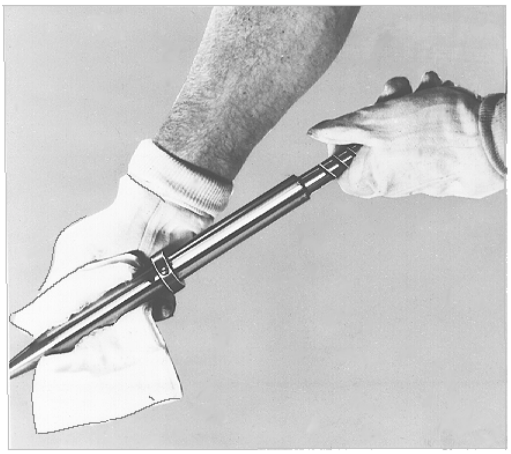
DRYING WITH COMPRESSED AIR



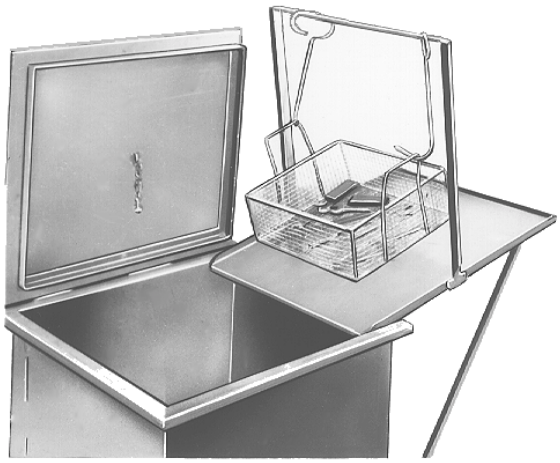
DRYING BY HEATED OVEN



DRYING WITH INFRA RED LAMPS



DRYING BY WIPING



DRYING BY DRAINING

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Figure 2-28. Drying procedures.

Checkup

- X What is the first operation in the preservation of metal items?
- X What type of contaminant is removed by solvent cleaning?
- X Name the three safety feature requirements of a solvent cleaning tank.
- X When can drying by draining be used to dry an item?
- X What are the requirements when drying with compressed air?
- X What cleaning process must be used on items having a critical surface?
- X How long must an item be in a fingerprint removal compound?
- X What must be done to an item after removing it from fingerprint remover compound (MIL-C-15074)?

CLEANING AND DRYING PRACTICAL EXERCISE

Objective

The student will answer questions on the proper selection and application of the various cleaning processes and drying procedures.

General Directions

- X The exercise will require approximately one class period, including the critique for completion.
- X The instructor will hold the critique when the students have completed the practical exercise.

Conduct of Exercise

Situation

You have received classroom instruction on the selection of cleaning processes and drying procedures. Your job is to produce properly cleaned and dried items.

Requirement No. 1. Answer the following questions on cleaning:

1. What cleaning materials may be used for solvent cleaning?

2. Why is it necessary to wear protective clothing during cleaning operations?

3. What contaminants are removed using solvent cleaning?

4. Are fingerprints removed by solvent cleaning?

5. What is the cleaning requirement for an item with a critical surface?

6. What cleaning process uses sound waves to create a cleaning action?

7. After an item is cleaned in the chemical process alkaline cleaning, what must be done before we dry or preserve the item?

8. What processes may be used to remove insoluble tightly adhering contaminants?

9. What process is used to remove heavy greases from automotive equipment such as trucks?

10. If a cleaning compound is used in the steam cleaning process, what must be done immediately after the cleaning compound is turned off?

11. What are the four general types of contaminants?

12. What must be considered in the selection of a cleaning process?

13. What are the basic cleaning requirements?

14. What are the recommended safety features required on a solvent cleaning tank?

Requirement Number 2. Answer the following questions on drying:

1. Why must an item be dried following cleaning?

2. Which process will be used if an item is cleaned by a solvent cleaning process and is to be preserved with a material using a petroleum solvent as a thinning agent?

3. Which drying procedures use heat?

4. What is meant by "Prepared" compressed air?

Critique

Instructor will call on class members to give the answers to the questions.

Care of Area, Training Aids and Equipment

Not applicable.

ELECTROSTATIC DISCHARGE CONTROL

ELECTROSTATIC DISCHARGE

We have been aware for quite some time that static electricity can impose damage on metal oxide semiconductors (MOS). More recently, we have become aware of the sensitivity of other parts to electrostatic discharge (ESD) through use, testing, and failure analysis. Sources of ESD policy include MIL-W-87893 and MIL-HDBK-773.

Trends in technology are toward greater complexity and construction. Design features of current microtechnology have resulted in parts which can be destroyed or damaged by ESD voltages as low as 20 volts.

Various electrical and electronic parts which have been determined to be sensitive to electrostatic voltage levels commonly generated by production, test, operation and maintenance personnel include:

- X Microelectronic and semiconductor devices.
- X Thick and thin film resistors.
- X Chips and hybrid devices.
- X Piezoelectric crystals.
- X All subassemblies, assemblies, and equipment containing these parts not having adequate protection circuitry are also ESD sensitive (ESDS).

Materials which are prime generators of electrostatic voltage are common plastics such as polyethylene, vinyls, foam, polyurethane, synthetic textiles, fiberglass, glass, and rubber.

Actions which cause these and other materials to generate electrostatic voltages are the sliding, rubbing, or separation of materials. These movements can frequently result in electrostatic voltages of 15,000 volts.

Materials can be ranked in accordance with their ability to become positively charged with respect to other materials. This ranking is known as a triboelectric series. Material uppermost in the series becomes positively charged when rubbed with a material lower in the series. The materials lower in the series become negatively charged. Conditions such as cleanliness, variation in chemical composition and processes, humidity, and the mechanics of rubbing or separation affect the series to a great extent. Thus the ranking of elements or compounds in the series will not always be reproducible. One of the many versions of the series follows.

- X Positive (+)
  - o Air
  - o Human hands.
  - o Asbestos
  - o Rabbit fur
  - o Glass
  - o MICA
  - o Human hair
  - o Nylon

- o Wool
- o Fur
- o Lead
- o Silk
- o Aluminum
- o Paper
- o Cotton
- o Steel
- o Wood
- o Amber
- o Sealing wax
- o Hard rubber
- o Nickel, copper
- o Brass, copper
- o Gold, platinum
- o Sulfur
- o Acetate rayon
- o Polyester
- o Celluloid
- o Orlon
- o Polyurethane
- o Polypropylene
- o PVC (vinyl)
- o KEL F

X Negative (-)

- X Silicon
- X Teflon

Protection of electrical and electronic ESDS parts assemblies and equipment can be provided through the implementation of low cost ESD controls. Lack of control has resulted in high repair cost, excessive equipment downtime, and reduced mission effectiveness because susceptible parts are being damaged during processing, assembly, inspection, handling, packaging, shipping, storage, stowage, testing, installation, and maintenance throughout the equipment's life cycle, both at the manufacturer's and the user's facility.

The effects of ESD on electrical and electronic items are not generally recognized because they are often masked by reasons such as:

- X Failures due to ESD are often analyzed as being caused by electrical overstress due to transients other than static.
- X Failure caused by ESD is often incorrectly categorized as random, unknown, manufacturing defect, or other, due to improper depth of failure analysis.
- X Few failure analysis laboratories are equipped with scanning electron microscopes or other equipment and technology required to trace failures to ESD.
- X Some programs and projects are accepting high operational failure rules as normal and simply procure more spares instead of recognizing and solving the basic ESD problem.
- X Belief of personnel that static controls are necessary, for only MOS at the part manufacturer's site and for handling of ordnance, is widespread.
- X Also common is the belief that an ESDS part "protected" by a diode, resistive network or other protective part is non-ESDS.
- X Static discharge failures do not always occur immediately following exposure but may result in latent defects.

In order to protect ESDS devices while handling and packaging, it is important to provide a conductive path to ground in the environment. Such a path should provide for rapid dissipation of the static electrical charge. Figure 2-29 illustrates a typical static protective work station which uses a conductive table and floor mats as well as a wrist strap to ground the operator.

Because the human body is a conductor, it may be effectively grounded. Clothing, however, will generate and retain electrostatic charges, sometimes as high as 30 thousand volts. These static charges will not bleed off when grounded.

People handling ESDS items should wear long sleeved ESD protective smocks or close-fitting, short sleeved shirts or blouses.

If long sleeve clothes are worn, the sleeves must be rolled up or else covered with an antistatic sleeve protector, called a gauntlet, from the bare wrist as far up as the elbow. When gauntlets are worn, the clothing does not have to be made of ESD protective material.

Antistatic garments can be made by treating cotton or synthetic clothes with an antistatic chemical agent in final rinse during laundering. Each time the clothes are washed, the antistatic agent must be reapplied.

The proper control of static electricity is often overlooked in the field. During in-field replacement of sensitive components or printed circuit boards, the new component or board may be destroyed or degraded by an ungrounded service technician. An ESD protective field service kit is designed to help solve these problems for the field service technician and for field packaging operations as well.

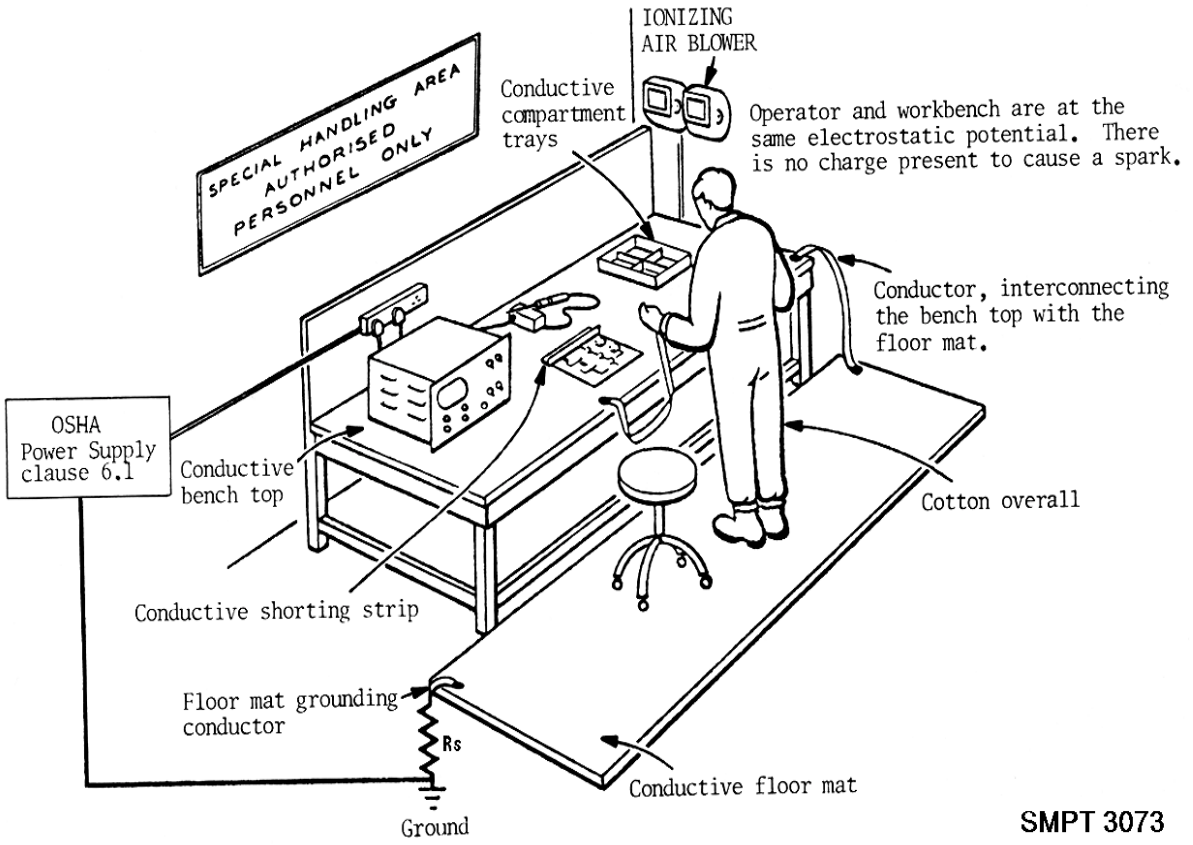


Figure 2-29. Protective Work Station.

The ESD protective field service kit includes a grounded work surface mat (typically 2' x 2') and a conductive wrist strap.

Some field work surface protective mats contain pockets which are sewn into the mat and can be used to store ESDS components or boards while transporting to and from the field. For larger boards, the mat is folded around the board to provide protection (the ESDS item may require additional protection).

The ground lead contains a current limiting series resistor to protect the worker from being shocked in case of accidental contact with line voltage.

For proper operation, the wrist strap cable is connected to the mat at the same terminal where the ground lead is also connected. Then the ground lead is connected to a bare metal part of the main frame of the system containing the part being worked on.

Packaging for protection for ESDS items requires the use of appropriate materials. Protection shall be provided to prevent physical damage and to maintain leads and terminals in an as-when-manufactured condition during handling and transportation.

An acceptable means of packaging ESDS items would be to first place them in an antistatic or static dissipative environment by wrapping and/or cushioning them in one or more of the following materials:

- X MIL-PRF-81705, type II barrier material, transparent, waterproof, electrostatic protective.
- X PPP-C-795, class 2 antistatic (pink tinted) cushioning material, flexible, cellular, plastic film.
- X PPP-C-1842, type III, type A or B cushioning material, plastic open cell.
- X PPP-C-1797, type II cushioning material, resilient, low density, unicellular, polyproplene foam.
- X After being protected by antistatic or static dissipative materials, they may then be shielded in a bag or pouch conforming to MIL-PRF-81705, type I barrier material watervaporproof, greaseproof electrostatic and electromagnetic protective (opaque).

Marking of ESDS items will be per MIL-STD-129, which requires that unit packs, intermediate and exterior containers be marked with the ESDS device caution label, which is a triangle and reaching hand. All unit packs shall be marked with the ESD label prescribed by ASTM D 5445, Standard Practice for Pictorial Markings for Handling of Goods. The symbol and lettering shall be marked in black on a yellow background. The label shall include the ESD sensitive device symbol and the words “ATTENTION STATIC SENSITIVE DEVICES” and the statement “HANDLE ONLY AT STATIC SAFE WORK STATIONS”. Unit packs that are not overpacked and are used as exterior containers shall be marked with the unit pack label.

Intermediate and exterior containers shall also be marked with the ESD sensitive devices symbol and the words “ATTENTION OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC DISCHARGE SENSITIVE DEVICES.” One 2 by 2-inch label shall be placed on the identification-marked side of the intermediate container. Two 4 by 4-inch labels shall be placed on each exterior container that exceeds one-half cubic foot. One label shall be placed on the identification-marked side, and one label shall be placed on the opposite side. Smaller exterior containers shall be marked in the same manner except that the 2 by 2-inch label may be used in lieu of the larger label. The minimum size of the symbol shall be five-eights of an inch measured vertically at the base of the triangle.

Checkup

- X What actions cause materials to generate electrostatic voltages?
- X Are certain materials when placed together more apt to generate static electricity than others?
- X How can electronic items be protected from static electricity?
- X What document covers the basic markings required for ESD sensitive items?

PRESERVATIVES

GENERAL

Contact preservatives are materials that are applied to, or come in contact with, items to protect them from deterioration resulting from exposure to environmental conditions during shipment and storage.

Some preservatives protect items by providing a physical barrier against moisture, air, and other agents of corrosion. These are contact preservatives.

Preservatives should be applied whenever items require protection against deterioration. Some metals such as gold, platinum or beryllium are immune to corrosion under ordinary conditions and seldom require the application of a preservative.

Many items susceptible to corrosion can be made less subject to deterioration by the application, at the time of manufacture and subsequent operations, of a protective coating or plating which remains an integral part of the item during its useful life. Such coatings and platings are called permanent preservatives.

Many items, however, because of close tolerances, operating characteristics such as rolling, sliding, or bearing surfaces, or other limiting factors cannot be protected with a permanent coating, but must be protected during shipment and storage by temporary preservatives. These preservative materials are applied after the item has been manufactured and must be removed before the item can be used.

APPLICATION REQUIREMENTS

Most contact preservatives are oily or greasy in nature, and vary greatly in chemical composition and consistency; therefore, they cannot be used indiscriminately on all kinds of materials. They may even destroy the usefulness of an item due to the difficulty of removal.

A preservative may penetrate into unwanted areas and cause swelling or decomposition of the material, or reduce its electrical conductivity.

Petroleum preservatives are applied to those metal surfaces on which corrosion in any form would impair the usefulness of the item or assembly.

EXCEPTIONS TO APPLICATION REQUIREMENTS

Petroleum preservatives are not applied to surfaces which are protected by solid film lubricants, plastic or paint coatings. They are not normally used on noncritical metal surfaces that are inherently resistant to corrosion such as items made from copper, nickel, chromium, brass, bronze, or other corrosion resistant metals.

Oily type preservatives are not applied to items that are vulnerable to damage by the petroleum ingredients such as textiles, cordage, plastics, mica, rubber, paper, felt, leather or prelubricated bushings.

Preservatives are not applied to certain types of electrical and electronic components or equipment such as condensers, electrical connectors, distributor rotors, circuit breakers, fuses, switches, resistors and rectifiers.

Preservatives are not applied to any items which would suffer damage to the mechanism or structure, or where malfunction or unsafe operational conditions would result from the application or removal of the preservative.

Need for Temporary Preservatives

A great number of military supplies are made of such materials or are so complex that it is either impossible or impractical to apply a permanent preservative to them. Working parts of machinery, for example, are often precision fit and must be free from any type of coating when in use.

Some bare metal items must be given a coating which will protect them from the time they are made until they are used. This coating must be readily applied and easily removed. Petroleum type preservatives are used for this purpose. Other metal items must be protected by volatile corrosion inhibitors (VCI) or desiccated packs.

Formerly, lubricating oils and greases were used. This was better than no preservative, but these oils and greases proved inadequate for the full protection desired.

To achieve full protection, there are two kinds of additives used in preservatives to help prevent corrosion. They are known as inhibitors and polar compounds. An inhibitor is a substance that slows down or prevents rusting by chemical action. A polar compound is a substance that gives water displacing properties.

Various types of preservative oils and greases containing inhibitors and polar compounds are referred to in military preservation specifications.

SELECTING THE PRESERVATIVE

It should be realized that there is no one preservative suitable for all purposes. Selecting the right preservative must be as carefully considered as selecting a proper cleaning process. In most instances, selection of the preservative has been prescribed in procurement documents, process data sheets, special packaging instructions, or similar forms.

Care must be taken that the preservative selected will not damage the mechanism, structure, or function of the item, either when applied, in use, or during removal. In making a selection, the following considerations should be used.

Item Composition

As shown in figure 2-30, the composition of an item determines whether it needs to be preserved and, if so, what kind of preservative will be used. Generally, metal items are preserved with any of the petroleum type compounds.

Surface Finish

If the item is forged, stamped, rough cast, rough ground, or rough machined, and has nonprecision surface, it may be protected by almost any of the petroleum type preservatives. On the other hand, items with precision surfaces should be protected with an oil or light grease type preservative. Figure 2-31 illustrates various surface finishes.



Figure 2-30. Composition of the item.

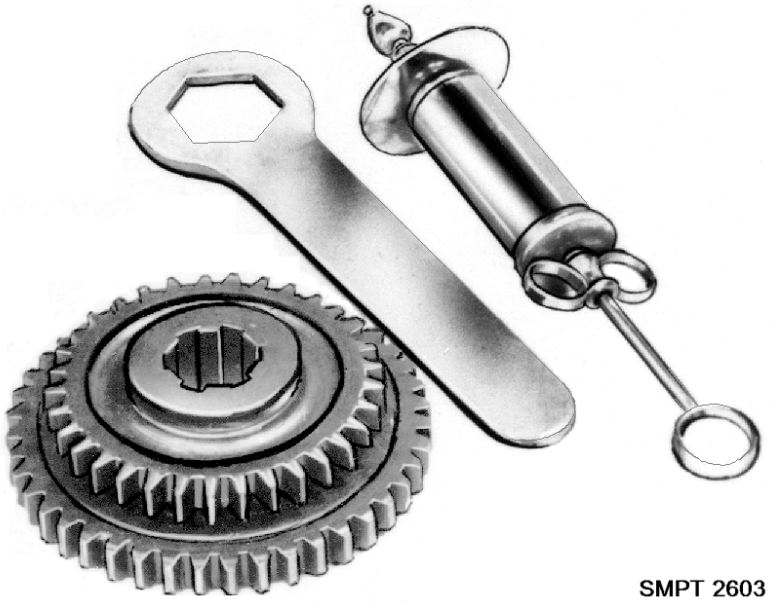


Figure 2-31. Surface finish of the item.

Complexity of Construction

Items should be cleaned, dried, and preserved in as simple a unit state as possible. Disassembled items with close tolerances should not be coated with heavy greases or hard drying types of preservatives which may interfere with or prevent reassembly. If disassembly is not practical or the item is highly irregular with blind holes and crevices, heavy preservatives may be difficult to apply and impossible to remove. Complexity of constructions is depicted in figure 2-32.

Extent of Protection Required

When an item is made from two different materials, for example, metal and plastic, only the metal part of the item would be coated with a preservative. In the case of the mallet, as shown in figure 2-33, no petroleum preservative would be required.

Ease of, or Need for, Removal

The user of the item must be kept in mind when choosing the preservative. The time required for removal, the equipment available, and the necessity for removal are of importance to the user. Figure 2-34 illustrates this consideration.

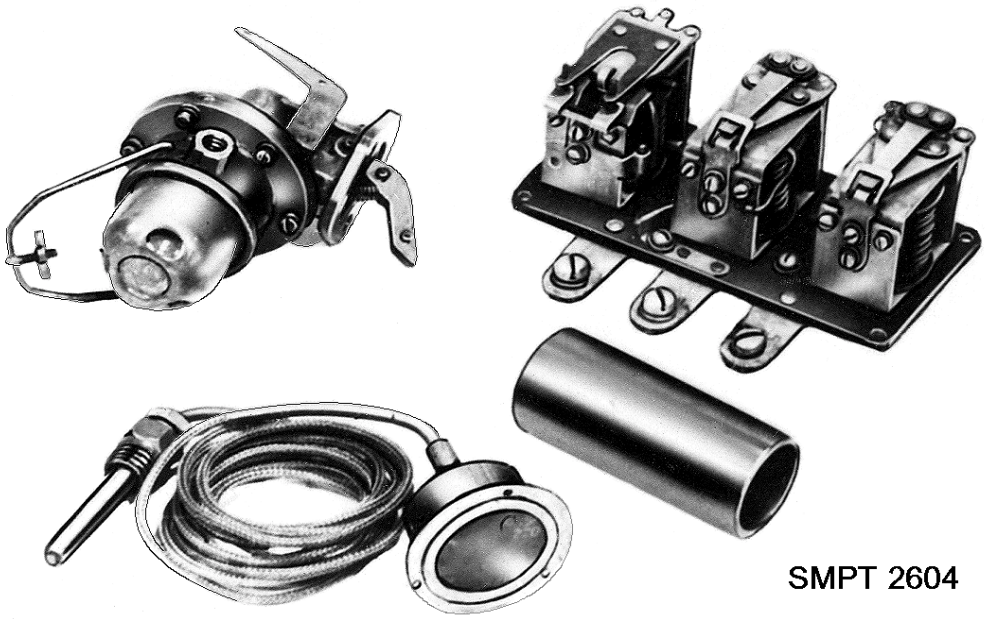


Figure 2-32. Complexity of construction.

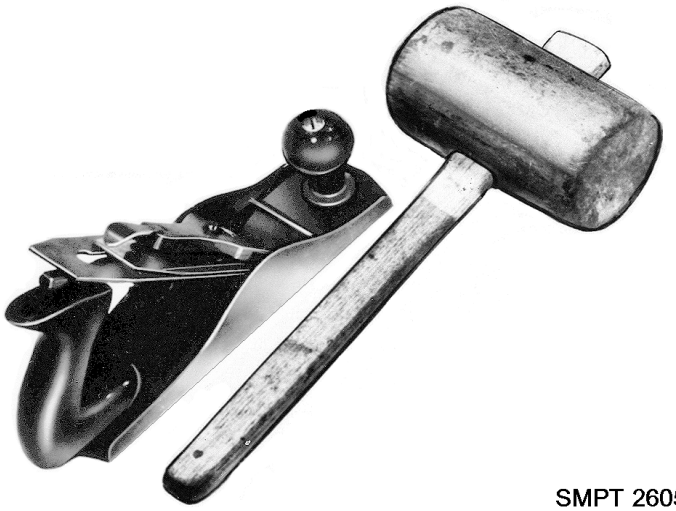


Figure 2-33. Extent of protection required.

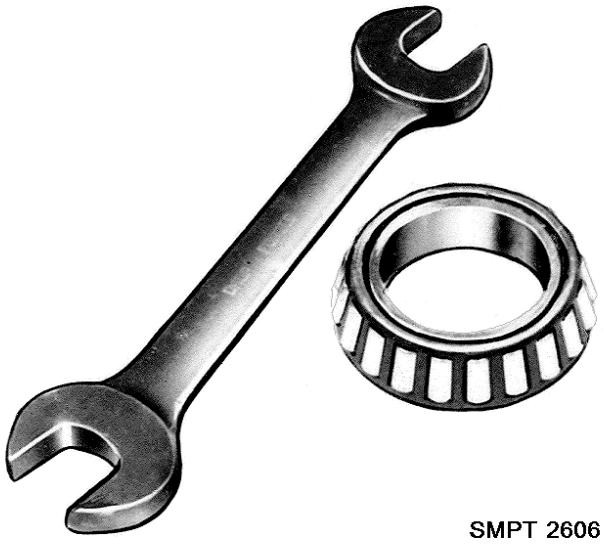


Figure 2-34. Ease of, or need for, removal.

Other Functions of the Preservative

In some instances, the nature of the item or assembly requires that the preservative also act as a lubricating oil or hydraulic fluid. Figure 2-35 shows items that have this requirement. In such cases, the lubricating requirements must be met first and the preservative properties secondarily.

CONTACT PRESERVATIVES

There are several different temporary contact preservatives. We will describe only the more frequently used.

MIL-PRF-16173, Grade 1, Hard Film, Corrosion Preventive Compound, Solvent Cutback, Cold Application (formerly P-1)

Description and Characteristics

This is an asphalt compound dissolved in petroleum solvent. It dries to a hard, thin, opaque film on the item when the solvent evaporates. Flashpoint of the solvent is 100EF. It is suitable for protection of noncritical metal items that are stored outdoors or where a "dry-to-touch" film is desired. In most cases, overwrapping of an item coated with this compound is not necessary, due to the hardness of the film.

Intended Uses

For preservation of items and equipment when removal prior to using the item is not required. Examples of items preserved are simple hand tools, nuts, washers, chains, etc.

Methods of Application

This preservative can be applied by brush, dip, or spray. For effective spray application, the preservative material requires dilution with dry cleaning solvent to a greater degree than for dipping or brushing.

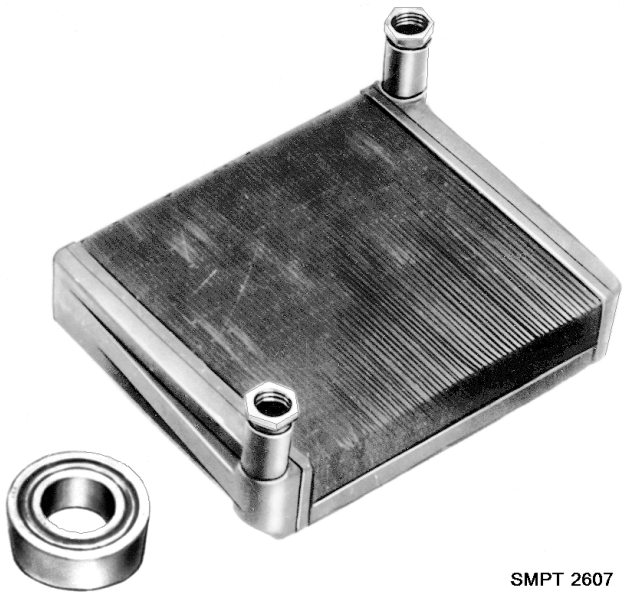


Figure 2-35. Other functions of the preservative.

MIL-PRF-16173, Grade 2, Soft Film, Corrosion Preventive Compound, Solvent Cutback, Cold Application (formerly P-2)

Description and characteristics

This is a solvent-dispersed, corrosion-preventive compound, which deposits a thin, soft film on the item. Flashpoint of solvent is 100EF. Items preserved with this require a preliminary greaseproof wrap or are enclosed in a greaseproof bag when a submethod requires a bag as the preliminary container, because it is a soft preservative and will be absorbed by the packing materials.

Intended Uses

It is used to protect interior and exterior metal surfaces destined for extended undercover storage. Examples of items preserved are pipe and tube fittings, pistons, piston rings, bearings and instruments, and exterior surfaces of machinery. It is used outdoors for limited periods only.

Methods of Application

It is usually applied by brush, dip, or spray.

MIL-PRF-16173, Grade 3, Water Displacing, Corrosion Preventive Compound, Solvent Cutback, Cold Application (formerly P-3)

Description and Characteristics

This is a solvent-dispersed, water-displacing corrosion-preventive compound, which deposits a thin, nondrying film on the item upon evaporation of the solvent. Flashpoint 100EF. Due to its chemical composition, this material has a greater attraction to metal surfaces than water and actually displaces water from metal surfaces.

Intended Uses

This water-displacing preservative is intended for use where fresh or salt water must be displaced from corrodible surfaces and for the protection of interior surfaces of machinery and equipment under cover. Examples of items on which it is used are radiators, boilers, and cooling systems.

Methods of Application

This preservative is generally applied by brushing, dipping, or spraying when used to preserve exterior surfaces. When used on interior or enclosed surfaces, it may be applied by filling or flushing.

MIL-PRF-16173, Grade 4, Transparent Film, Corrosion Preventive Compound, Solvent Cutback, Cold Application (formerly P-19)

Description and Characteristics

This is a nontacky, transparent, thin film with a flashpoint of 100EF. This preservative dries to a hard, transparent, nontacky film.

Intended Uses

This preservative is intended for general purpose indoor and limited outdoor preservation of corrodible metals with or without an overwrap. This preservative is also used where a transparent coating is required.

Methods of Application

The preservative may be applied by dipping or brushing at room temperature.

VV-L-800, Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature) (formerly P-9)

Description and characteristics

This is a highly refined, light oil, containing rust-inhibiting additives. It also has water-displacement characteristics. Its flashpoint is 275EF.

Intended Uses

VV-L-800 is intended for use in the lubrication and protection against corrosion of small arms and in the lubrication of fuze mechanisms and lubricating and preserving internal surface of machine assemblies (except combustion engines). This oil is used frequently for preserving items submerged in oil in sealed containers. Items, which are to be preserved with another petroleum preservative, will sometimes be dipped in this one first to assure the removal of any traces of water moisture.

Methods of Application

VV-L-800 is applied by brushing, dipping, spraying, flow coating, slushing, filling, and fogging at room temperature.

MIL-L-21260, Type I, Lubricating Oil, Internal Combustion Engine Preservative and Break-in (grades 10, 30, and 50) (formerly P-10)

Description and Characteristics

The viscosities (weight of oil) of this engine lubricating oil range from very light to very heavy according to its grade. There are three grades of engine lubricating oil. The grade of oil you use depends upon the kind of engine it will be used in-

X Grade 10 (very thin or light weight oil). Flashpoint 360EF.
X Grade 30 (medium weight oil). Flashpoint 290EF.
X Grade 50 (heavy weight oil). Flashpoint 400EF.

Intended Uses

The engine oils being discussed here are intended for use in all types of ground equipment at ambient temperatures above -10EF. As preservative media for reciprocating internal combustion engines of both spark-ignition and compression-ignition types, the oils are intended to protect engine parts from deterioration during shipment and storage. The oils should be used as factory-fill for all new and rebuilt engines intended for shipment and storage.

MIL-H-83282, Hydraulic Preservative Oil

The hydraulic preservative oils are covered by various specifications because of differences in system requirements. The use of hydraulic preservative oil has two purposes. First, it serves as a lubricant and second, it serves as a preservative. The use of hydraulic preservative oil should be governed by the kind of system to which it will be applied.

MIL-G-10924, Grease, Automobile and Artillery (formerly P-11)

Description and Characteristics

A smooth, homogeneous mixture of mineral or synthetic oil or combination of both with a gelling agent to give low and high temperature performance between -65E and 225EF. Preservative grease is normally applied to items where removal is not generally required.

Intended Uses

For lubrication of automotive or artillery equipment. For use in the preservation of antifriction bearings, gear boxes, and plain bearings. For use in ball, roller, and needle bearings.

Methods of Application

Preservative grease is applied by the use of special pressure grease guns, smearing with the hands, or brushing.

MIL-L-22110, MIL-PRF-3420, Volitile Corrosion Inhibitor, Treated Material and MIL-PRF-22019, Transport VCI-Treated Barrier Material (formerly P-18)

Description and Characteristics

Volatile corrosion inhibitors (VCI) are chemical compounds which prevent the corrosion of ferrous metals by releasing vapors. The vapors surround the item and prevent moisture vapor from coming in contact with the surfaces. The vapor will surround the item as long as the item is in a sealed barrier or container. VCI is available in many different forms: powder, bore tubes, impregnated in papers, in oils, etc.

Intended Uses

For protection of unpreserved ferrous (iron) metal items. For use on nonferrous metals for which compatability has been proven. VCI should not be used on optical systems, most nonferrous metals, or in packs containing desiccants.

MIL-C-10382, Corrosion Preventive (Food Handling Machinery & Equipment, Nontoxic)

Description and Characteristics

A smooth uniform mixture of petrolatum wax, lanolin and additives in petroleum solvent. Flashpoint 100EF minimum melt, or flow point minimum 150EF. Preservative is normally applied by spraying at room temperature to produce a thin easily removable film on drying.

Intended Uses

For use on food handling machinery and equipment.

Method of Application

It is applied by spraying at room temperature.

METHODS AND TECHNIQUES OF APPLYING PRESERVATIVES

As soon as practicable after an item has been cleaned and dried, it should be preserved in order to prevent or slow any rusting action. Regardless of the method of application of the preservative, it is important to obtain an even continuous coating on the metal item.

Application by Dipping

Figure 2-36 illustrates the dipping process. Due to ease of application, and total coverage afforded by this procedure, it is the preferred method of application. When items are dipped in a tank by hand or by conveyor, care must be taken so that air bubbles are not trapped on the preserved item. Frequent stirring of the preservative will prevent air bubbles from forming. After the preservative has dried or set, the item should be placed on a precut piece of greaseproof barrier material. This is the initial wrap for the preservation operation.

Application by Flow Coating

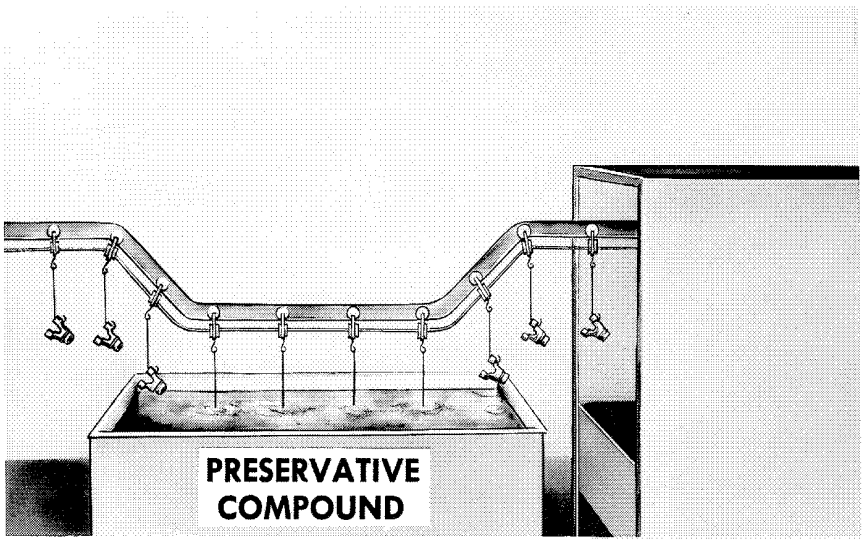
The procedure shown in figure 2-37 is accomplished by coating the inner surface of the item by pouring preservative into the interior (sections) of the item. Before applying the preservative, position the item in such a manner that the excess preservative will drain off.

Application by Slushing

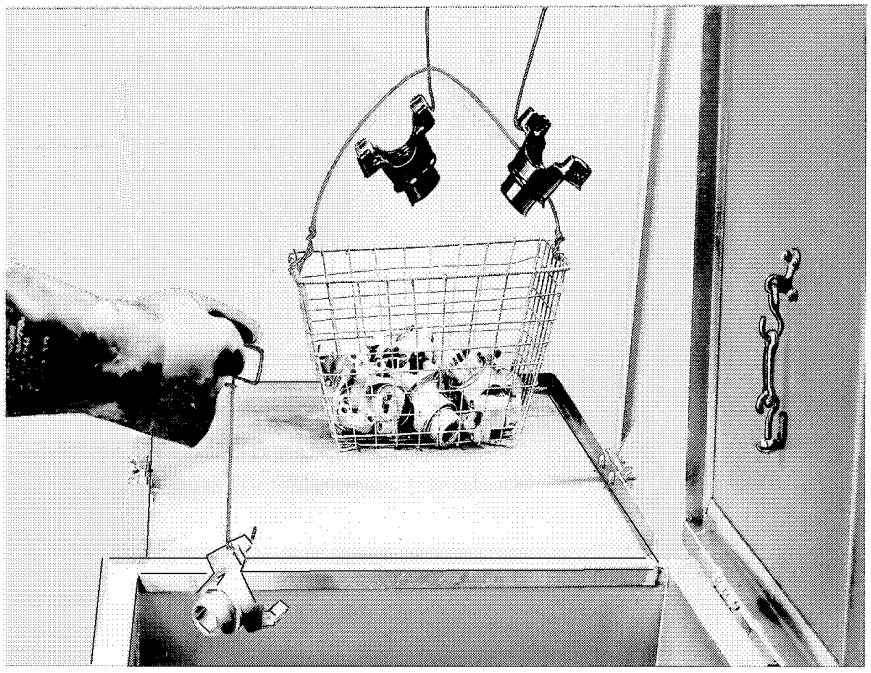
This procedure is accomplished by pouring the preservative into the part to be preserved and rotating, agitating, or slanting it to ensure that all interior surfaces are coated. The excess preservative is then drained, as depicted in figure 2-38. After slushing, all openings in parts must be closed to exclude dust, dirt, and other foreign matter. Plastic plugs may be used for this purpose.

Application by Brushing

This procedure should be used when no other procedure is available or acceptable. Brushing is used frequently when only one portion or portions of an item or assembly, like that in figure 2-39, require preservative application.



CONVEYORIZED DIPPING



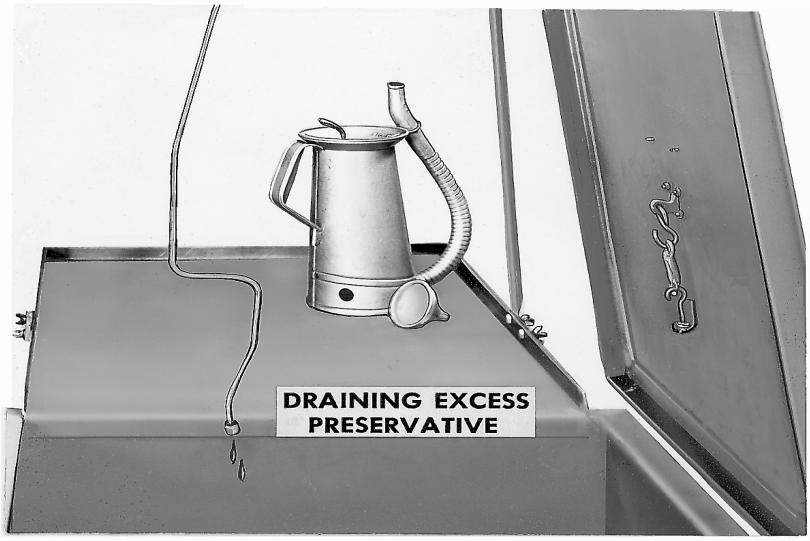
HAND DIPPING

SMPT 718A

Figure 2-36. Application by dipping.



NOTE. POUR PRESERVATIVE INTO TUBE ALLOWING IT TO FLOW THROUGH TUBE AND COVER INTERIOR SURFACES.



NOTE. DRAIN EXCESS PRESERVATIVE FROM TUBE BY HOLDING TUBE OVER PRESERVATIVE TANK ALLOWING PRESERVATIVE TO DRAIN INTO TANK.

SMPT 719A

Figure 2-37. Application by flow coating.



Figure 2-38. Application by slushing.

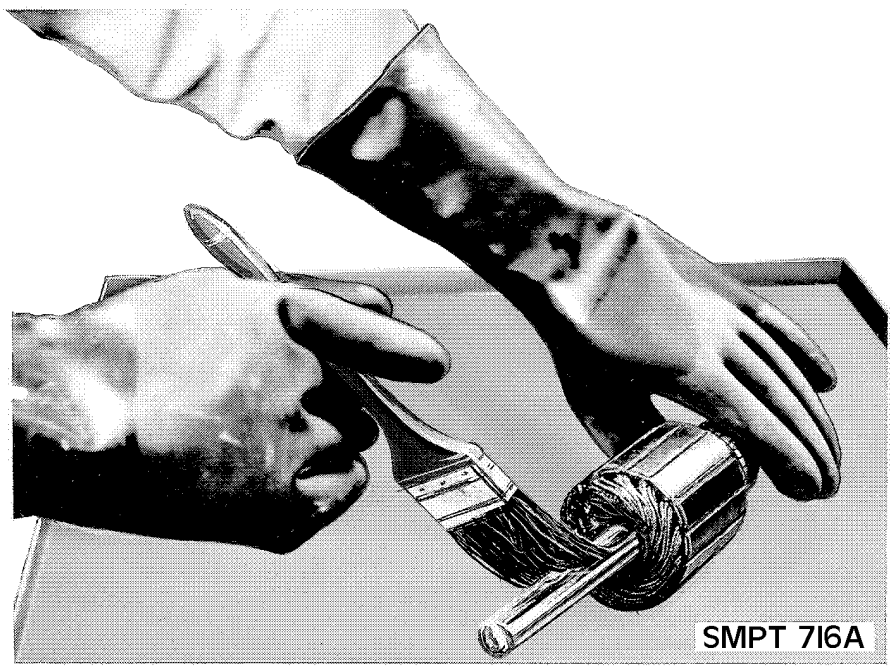


Figure 2-39. Application by brushing.

Application by Filling or Flushing

This procedure is accomplished by completely filling the item with preservative until all interior surfaces are satisfactorily coated and then drained. If the preservative is not drained, space must be allowed for thermal (temperature) expansion. All openings should be sealed to prevent leakage. This procedure is best suited for items similar to the one shown in figure 2-40 that, because of their size or weight, cannot be easily handled.

Application by Fogging

Fogging is illustrated in figure 2-41. This procedure has application in the preservation of such items as gasoline tanks, interior surfaces of engine cylinder walls, and other closed chambers. This procedure consists of coating the interior surfaces with a preservative injected as a cloud or mist from an air atomizing gun until the interior surfaces are completely coated.

Application by Spraying

Spraying is accomplished by coating the interior or exterior surfaces of the item with preservative applied as a spray. As shown in figure 2-42, normal spray painting techniques should be followed in the application of preservatives by this method.

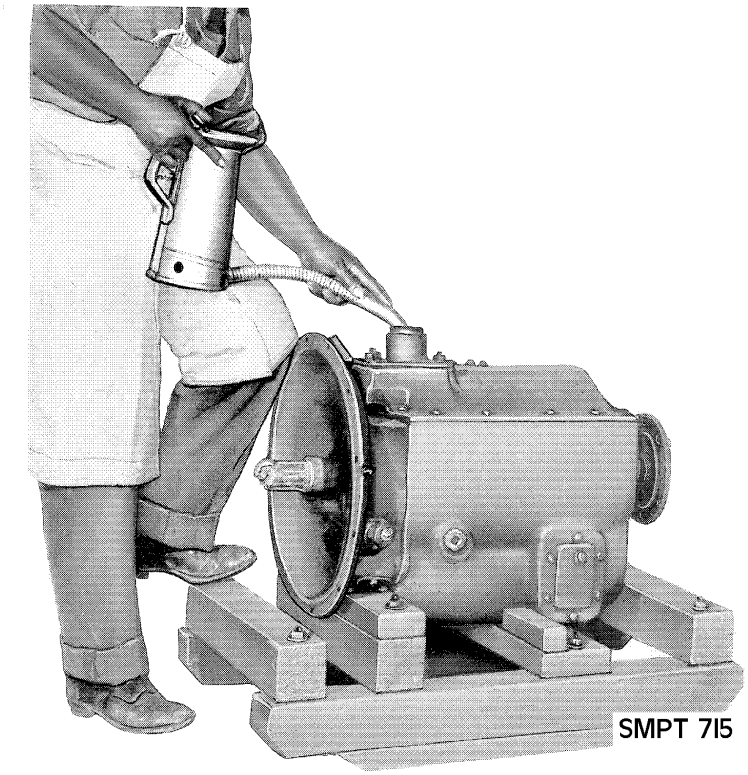


Figure 2-40. Application by filling or flushing.

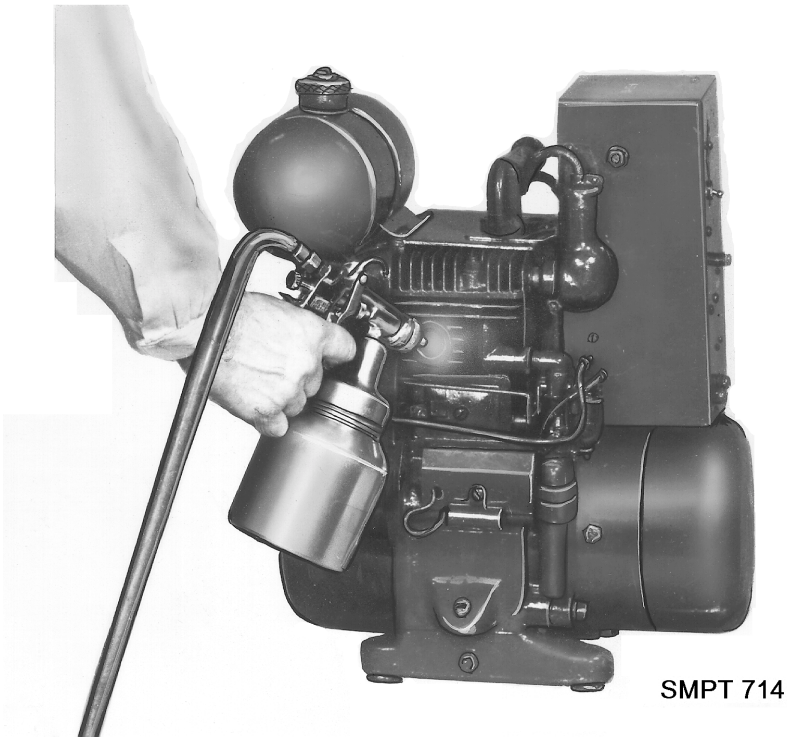


Figure 2-41. Application by fogging.

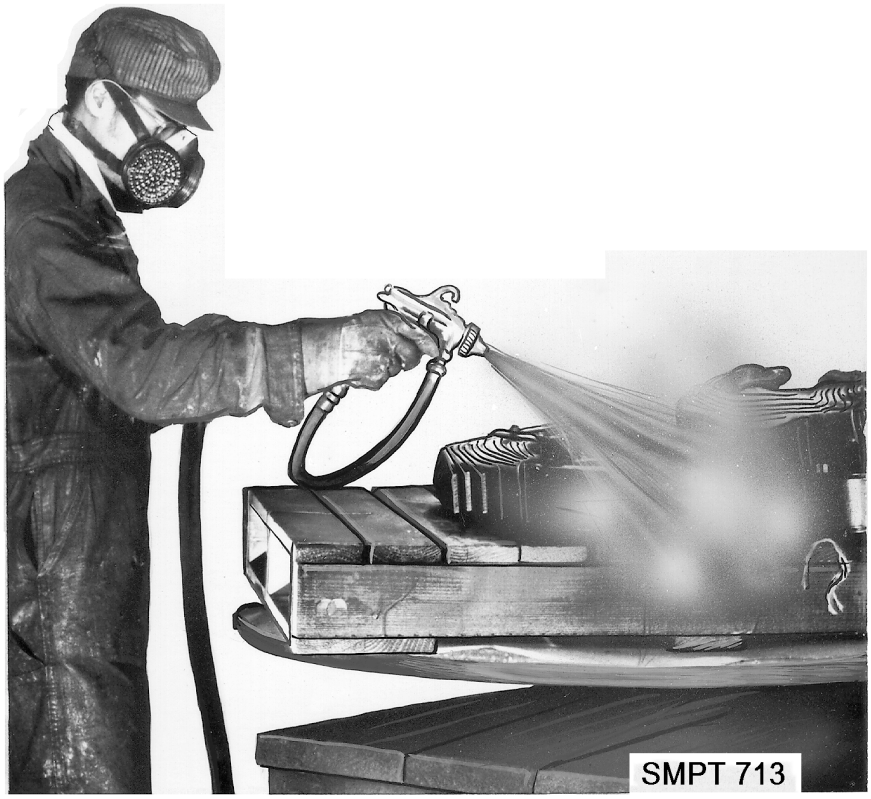


Figure 2-42. Application by spraying.

Checkup

X What is a preservative?

X What is a distinguishing characteristic of MIL-PRF-16173, Grade 1?

X Which method of preservative application should we use when no other is available or acceptable?

PRESERVATIVE APPLICATION PRACTICAL EXERCISE

Objective

The student will answer questions on the selection and application of the proper preservative.

General Instructions

This exercise will require approximately 1-1/2 class periods.

The instructor will hold the critique when the students have completed the practical exercise.

Conduct of Exercise

Situation

As a packaging technician, you are to select the correct preservative for metallic items after they are cleaned.

Requirement No. 1. Answer the following questions.

1. What are the two basic types of preservatives?

2. When official information cannot be found, what factors will help to determine the preservative to be used?

3. Which preservatives are often used for small arms?

4. What are the seven methods of preservative application?

5. What is the preferred method of applying preservatives?

6. What method of applying preservatives should we use only when no other procedure is available or acceptable?

7. Which preservatives do not usually require overwrapping?

8. Which preservatives can displace water on a metal surface?

9. Which preservative does not itself contact the item but uses a vapor shield instead?

10. What is a preservative?

11. Which preservative is used as a preservative and a break-in lubricating oil for internal combustion engines?

12. What are contact preservatives?

13. Why is there a need for temporary Petroleum type preservatives?

17. To what types of items are oily preservatives normally not applied?

Critique

Instructor will orally critique the practical exercise questions.

Care of Area, Training Aids & Equipment

Not applicable.

PRESERVATION MATERIALS AND HEAT SEALING EQUIPMENT

PRESERVATION

Preservation Goal

In military preservation, the primary goal is to afford the required protection at the least possible cost. A considerable amount of money has been wasted on excessive preservation. Many times it has been observed that the preservation costs have exceeded the cost of the item when the item was not critical and did not require the degree of protection it received. In order to accomplish this goal, the military must have preservation personnel who know the characteristics of products to be preserved and how to select the proper preservation method and details to provide the kind and amount of protection required.

Preservation Cost Savings

The greatest savings in preservation costs are possible through the application of basic preservation knowledge by trained personnel.

DISCUSSION OF PRESERVATION MATERIALS AND EQUIPMENT

These are a variety of materials available for use as barriers, wraps, cushions, and interior containers. Each one has characteristics which make it suitable for use in preservation. Those described below are most commonly used.

Barrier Materials and Wraps

Barrier Material, Greaseproofed, Waterproofed, Flexible (MIL-B-121)

This material is used for protection of military supplies and equipment during transportation and storage under all climatic conditions. It is available in a variety of types, grades, and classes.

Grade A is used as a unit container (wrap or bag) in Method 20 and Method 33. Also as the first greaseproof wrap to maintain and protect coating of oily or soft preservatives. Class 1 Heat sealable, nonstretchable is used for making greaseproof, waterproof bags (Method 33) or waterproof bags (Method 32 and Method 31) as shown in figure 2-43. Class 2 Non-heat sealable, stretchable is used as an intimate wrap (first wrap) to maintain and protect items coated with oily or soft preservatives as depicted in figure 2-44.

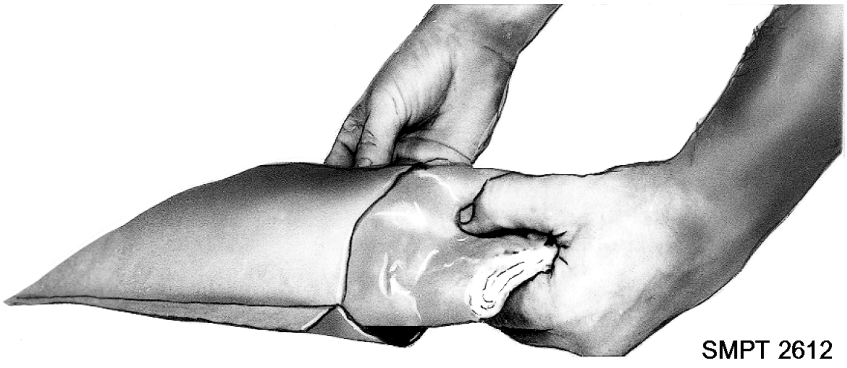


Figure 2-43. MIL-B-121 barrier used for making greaseproof, waterproof bags.

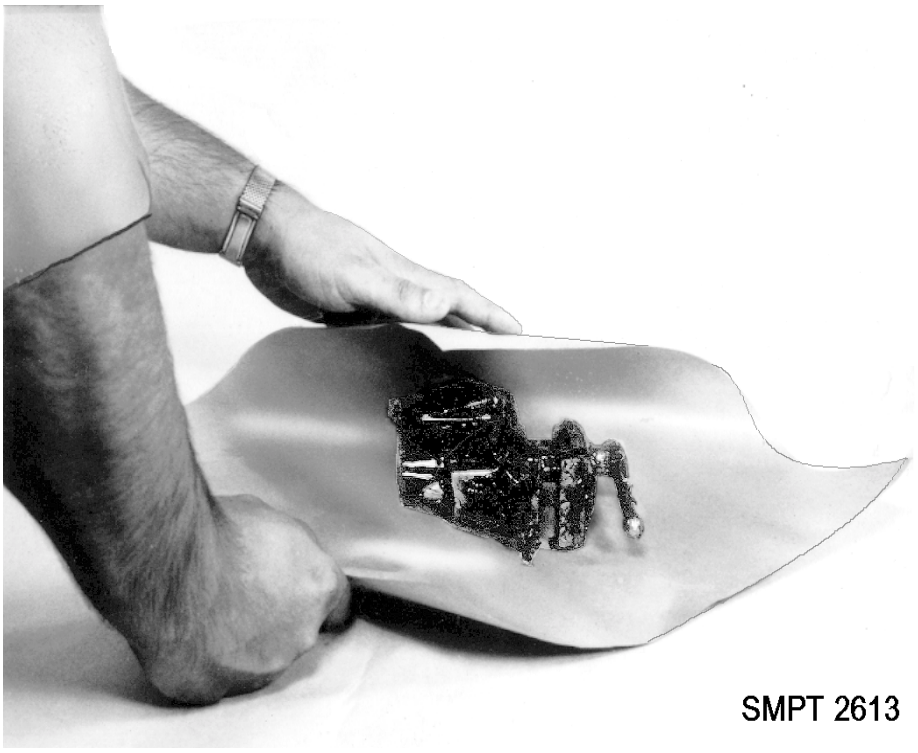


Figure 2-44. MIL-B-121 barrier used as a greaseproof wrap.

Barrier Material, Watervaporproof, Flexible, Heat Sealable (MIL-PRF-131)

There are two types of material. Type I is non-flame resistant and type II is flame resistant. Type I barrier material is available in three classes:

- X *Class 1-Plastic and non-woven backing.* There are no size or weight limitations for items placed in bags made from Class 1 material used for general preservation applications.
- X *Class 2-Kraft (limited use).* Items to be placed in bags made from Class 2 (Kraft) material must not exceed a weight limitation of 10 pounds and a size limitation of 42 inches (sum of length and width of barrier material). This material can only be used for items that meet these limitations. Class 2 material shall not be used in the fabrication of Methods 44 and 54 (floating bag).
- X *Class 3-Scrim (woven fabric) backing.* There is no size or weight limitations for items to be placed in bags made from Class 3 (scrim) material.

This material is used to make unit containers in submethods where watervaporproof bags are required. Class 1 is used for making watervaporproof bags and watervaporproof floating bags, as shown in figures 2-45 and 2-46. Since Class 2 material has limited use, it can only be used for items weighing 10 pounds or less and a size limitation of 42 inches (total of length and width), as depicted in figure 2-47.



Figure 2-45. Watervaporproof bag (MIL-PRF-131, Class 1).

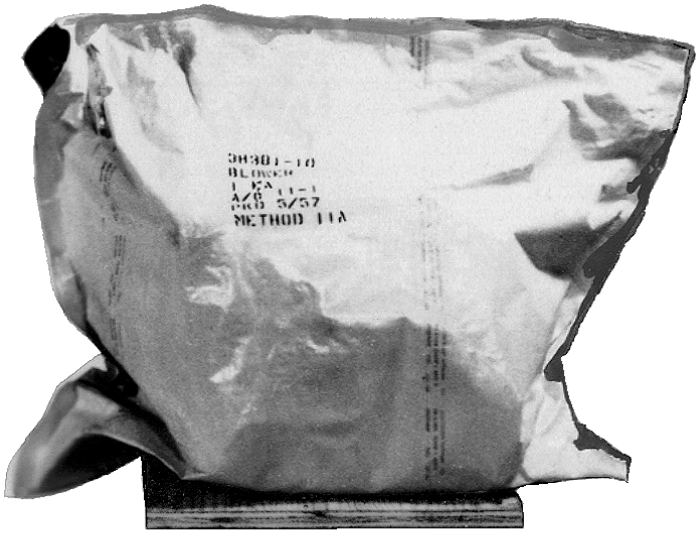


Figure 2-46. Watervaporproof floating bag (MIL-PRF-131, Class 1).

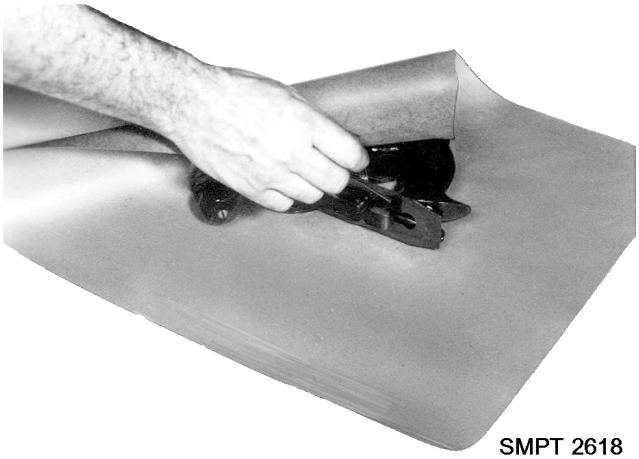


Figure 2-47. Watervaporproof bag, sealed (MIL-PRF-131, Class 2).

Aluminum Foil (A-A-1676)

This material is noncorrosive, flexible, and greaseproof. It cannot be heat sealed. Direct contact of aluminum foil with metals other than cadmium, magnesium, aluminum, or zinc should be avoided if the item may be exposed to water to prevent a galvanic (rust) action. This material can be used as the first wrap around an item coated with an oily or soft preservative as shown in figure 2-48.

Barrier Material, Waterproofed, Flexible (PPP-B-1055)

This material is available in fifteen classes. It is fabricated with kraft paper laminated with asphalt. Figure 2-49 illustrates the use of this material as case liners, interior wraps and shrouds, and temporary tarpaulins.

Plastic Sheet and Strip, Thin Gauge, (Polyolefin) (L-P-378)

This material is a clear transparent plastic that is available in flat cut sheets or rolls and is available in four types, four classes, three grades, and two finishes. This plastic film material is intended for use in general preservation operations where transparency, water resistance, and dust protection are desired. It may be used in the construction of Methods 31 and 32.

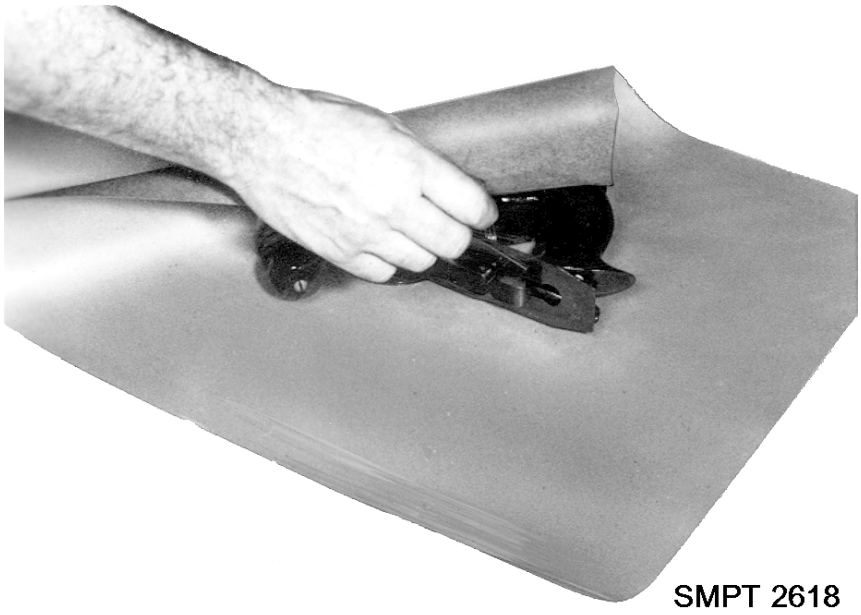


Figure 2-48. Aluminum foil used as a greaseproof wrap (A-A-1676).

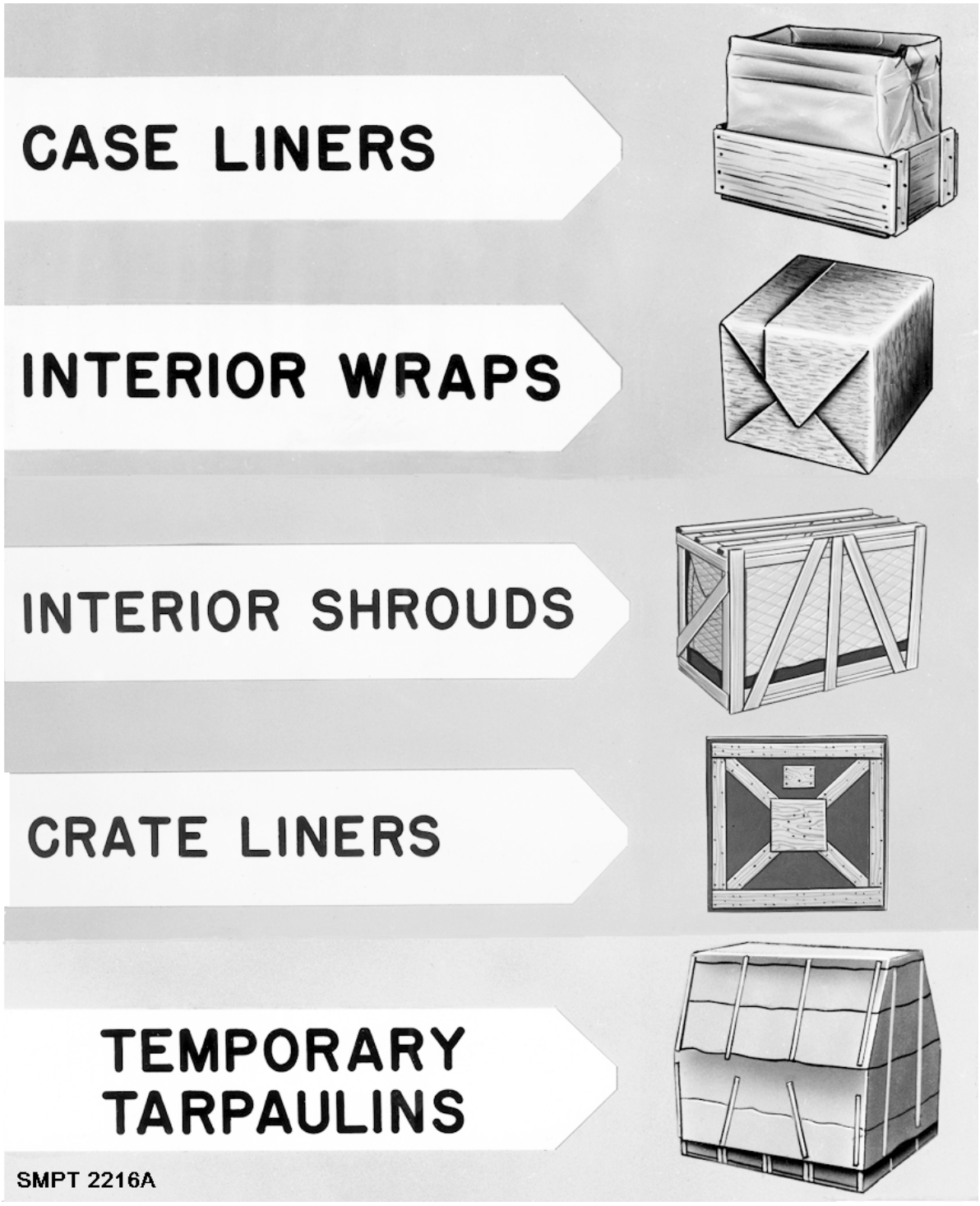


Figure 2-49. Use of waterproofed flexible barrier material (PPP-B-1055).

Barrier Material, Transparent, Flexible Heat Sealable (MIL-PRF-22191)

This material is available in three types. Type I is watervaporproof, waterproof, and greaseproof. Type II is waterproof, and greaseproof. Type III is waterproof.

Since this material is relatively costly, it shall be used when transparent unit protection is required to aid in the inspection of packs and shall be as specified in the contract or order. The kind of protection given to an item is achieved through the use of the correct type of material, as illustrated in figure 2-50. This material is authorized for use in Methods 31, 33, 41, 51, 52, 53, and Method 54.

Laminated and Creped Wrapping Paper (MIL-P-130)

This material is a heavy neutral wrapping paper used on heavier items and items with sharp corners. It is available in three types. It is used as a protective cover or wrapper over items that are wrapped in greaseproof barrier for an additional cushioning effect. It is not to be used as a greaseproof or waterproof barrier material. It is also used as an initial neutral wrap where a noncorrosive, dust protective wrap is required as part of a unit pack.

Chemically Neutral (Noncorrosive Wrapping Paper) (MIL-P-17667)

This material is a thin neutral wrapping paper used on lightweight items and is available in two types and two classes. It may be used as an initial or intimate wrap where a noncorrosive and nongreaseproof wrap is required. Caution should be exercised in using this material where highly polished or critical surfaces of silver and magnesium are involved since dulling of these metals' surfaces has been noted after prolonged periods of storage.

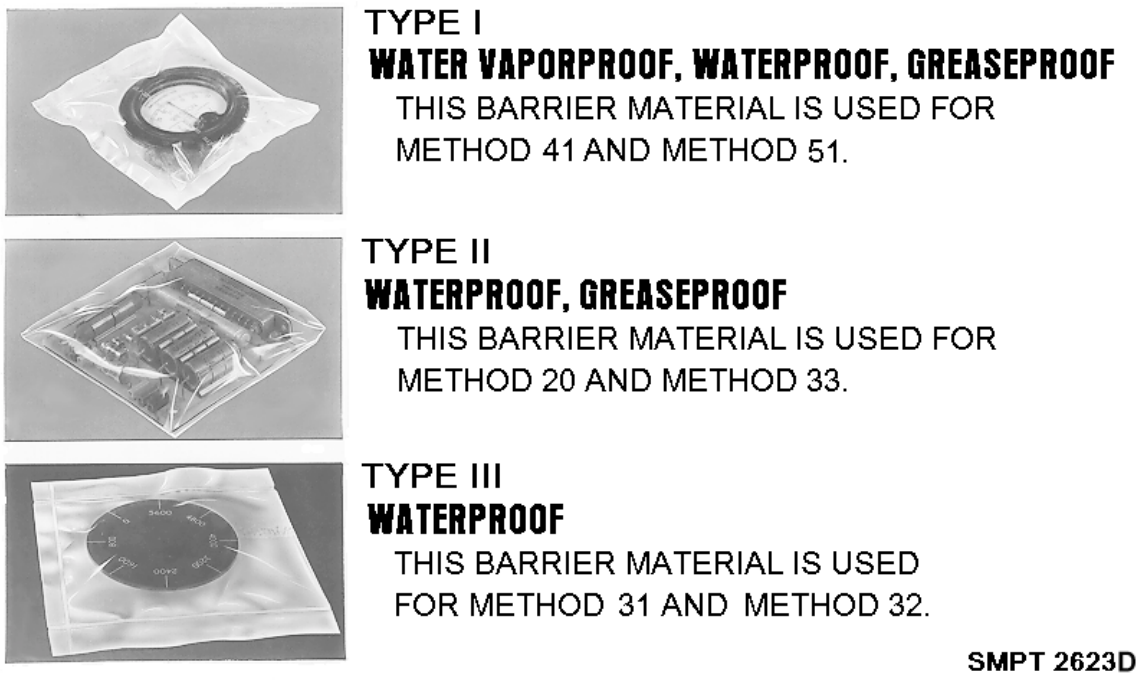


Figure 2-50. Use of MIL-PRF-22191.

Treated and Untreated Kraft Wrapping Paper (A-A-1894, A-A-203)

These materials have no special identification marking on either side. They are generally referred to as brown wrapping paper. A-A-203 is untreated and unbleached, while A-A-1894 is treated and is unbleached. They are used as an overwrap where a neutral, greaseproof, waterproof or watervaporproof barrier is not required such as in Method 42.

Cushioning Materials

Cellulosic Cushioning Material (A-A-1898)

This material is made of layers of paper and is available in two types and two classes. Type I is water absorbent and Type II is water resistant. Class A is low tensile strength, filler material, while Class B is high tensile strength, wrapping material.

This material is used for surface protection, cushioning sharp projections, and as a filler or dunnage material. The water absorbent type is used to cushion liquids in transit. It is dusty and will absorb moisture; therefore, it should not be placed next to an unprotected item. The water-resistant type can be used where a cushioning material is required to resist water in preservation operations.

Uncompressed Bound Fiber Cushioning Material for Packaging (PPP-C-1120)

This material is made of uncompressed, fiberous cushioning materials in rolls, flat sheets, and molded forms for preservation and packing operations. It is intended to protect against vibration and impact shocks. It is used for general cushioning applications and is cut to size or molded as needed. Bound fiber is abrasive and should not be used next to unprotected items. This material is available in five types and four classes.

Cushioning Material, Cellular, Plastic Film (For Packaging Applications) (PPP-C-795)

This material is furnished in two classes. Class 1 is transparent and Class 2 is opaque. The material has uniform distributed closed cells (bubbles) on one face and a flat surface on the other face.

It is intended for use within unit packs to protect items from damage due to shock, vibration, corrosion, and abrasion during handling and shipment. The material is especially suitable for use as cushioning within transparent bags and envelopes. CAUTION: Air bubbles may burst at high altitudes.

Cushioning Material, Polystyrene, Expanded, Resilient (For Packaging Uses) (PPP-C-850)

This material is essentially solid bubbles of polystyrene fused together to form sheets. It comes in two types--Type I, sheet form, and Type II, roll form. The material is nonabrasive and fungus and mold resistant. It is used as a cushioning material within packs to protect items from damage due to shock, vibration, and abrasion.

Cushioning Material, Packaging, Closed Cell Foam Plank (A-A-59136) or Packaging Material Sheet (A-A-59135)

This material is preformed polyethylene foam. It comes as planks, sheets, or die cuts in several densities. This cushioning is noncorrosive and nonabrasive. One form of the material is designated as an antistatic sheet and produces no static electricity during use.

Cushioning Material, Resilient, Low-Density, Unicellular, Polypropylene Foam (PPP-C-1797)

This material consists of thin sheets of a low density, closed cell foam in 1/16, 3/32, 1/8, and 1/4-inch thickness. It is noncorrosive, nonabrasive, nondusting and provides good thermal insulation. It is used to cushion light items and equipment with critical surfaces.

Cushioning Material, Plastic, Open Cell (For Packaging Application) (PPP-C-1842)

This material is formed from plastic sheets laminated together into a network of uniformly distributed open cells. It is heat-sealable and transparent and comes in three types. Type I is hexagonal; Type II is fluted; and Type III is hexagonal and electrostatic free.

Insulation, Thermal (Vermiculite) (ASTM C 516)

This material is a loose-fill, absorbent cushioning. It is used for cushioning breakable containers of liquid.

Rigid or Flexible Polyurethane Foam (MIL-PRF-26514)

This material consists of prefoamed rigid and flexible foam. Type I is called standard foam. Type II is called anti-static foam. Both are available as class 1, rigid, or class 2, flexible. The foam is relatively non-dusting.

Packaging Tapes

Tape, Gummed, Paper, Reinforced and Plain, for Sealing and Securing (A-A-1492, A-A-1671)

These tapes are gummed paper and require water to activate the adhesive. They are available in various types, classes, and grades. Types I and II of these tapes are used for closure of fiberboard boxes for domestic shipment and storage; securing wraps on packs; banding of tubes, wire pipe, hose, etc. Type III is used for general sealing of cartons and fiberboard boxes, wrappers of packs, and banding of paper and paper products.

Pressure-Sensative Tape for Packaging, Box Closure, and Sealing (ASTM D 5486)

This tape is water-resistant and pressure-sensitive. It is available in five types and two classes. The types designate the backing material and for which application the tape should be used. Class 1 indicates the tape is colored, while class 2 is transparent.

Type I is a polyester film-backed pressure-sensitive tape intended for box closure and sealing applications where strength and resistance to sunlight, rain, and other deteriorating elements are required. It is usually used on weather-resistant fiberboard. The tape is intended for H-type closure or sealing of regular slotted boxes and other applications where the tape will be overlapped onto itself. Type I, class 2 transparent tape can also be used for label attachment and covering applications where weather resistance is needed.

Type II is a polyester film-backed pressure-sensitive tape intended for box closure applications where strength and water-resistance are required. It is usually used on domestic grade fiberboard. The tape is most suited for center seam closure of regular or regular slatted boxes and other applications where the tape will not be overlapped onto itself. Type II, class 2 tape is also used for label attachment and covering applications where water resistance is desired.

Type III is a polypropylene film-backed pressure-sensitive tape intended for box closure applications where a general purpose water-resistant tape is desired. It is used on domestic grade fiberboard. The tape is suited for center seam closure of regular slotted boxes.

Type IV is a woven cloth-backed pressure-sensitive tape for less critical packaging applications where a cloth-backed tape is desired.

Type V is a paper-backed weather-resistant, water-resistant pressure-sensitive tape for box closure and sealing applications where weather resistance and water resistance are required. It may be used on weather-resistant or domestic fiberboard. The tape is suited for center seam and H-type closures or sealing of regular slotted boxes and other applications where it may be overlapped onto itself.

Pressure-Sensitive Tape for Packaging, Filament Reinforced (ASTM D 5330)

This tape is intended for use in closing and reinforcing fiberboard boxes and for bundling items for shipment. It is available in 4 types as follows:

- X Type I is an impact and cut-resistant low-tensile strength tape, usually with polyester fiber reinforcement. It is intended for bundling and similar applications and use where a greater amount of stretch before break provides an improvement in impact resistance over glass filament reinforcement.
- X Type II and III are intended for reinforcement of RSC's and similar fiberboard boxes and for bundling, where a snug bundle must be maintained, and other similar applications
- X Type IV is intended for applications in which weather-resistance high-tensile strength tape is required.

Tape, Pressure-Sensitive Adhesive, Plastic Film, Filament (MIL-T-43036)

This tape is available in two types, Type I reinforced polyester film and Type II non-reinforced polyester film. It is used primarily for sealing fiber containers and cans.

Interior Containers

Figure 2-51 illustrates commonly used interior containers.

Fiberboard Shipping Boxes (ASTM D 5118 and ASTM D 1974)

A fiberboard box is a container made of one or more pieces of corrugated or solid fiberboard. The pieces are creased, slotted, joined, and folded according to standard styles. Fiberboard boxes are available in two types: corrugated fiberboard (CF) and solid fiberboard (SF). Type CF is available in single wall (SW) and double wall (DW). There are four classes of fiberboard boxes: Class Domestic, Class Weather-Resistant, Class Waterproof and Water Vapor Resistant (WWVR), and Class Domestic/Fire Retardant.

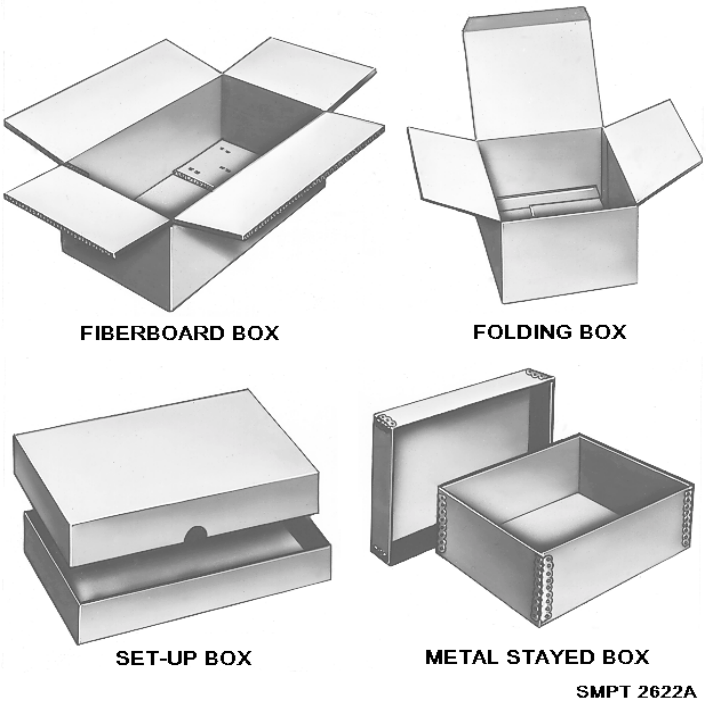


Figure 2-51. Examples of interior containers.

Paperboard Folding Boxes (PPP-B-566)

These boxes are suitable for use in unit packing of small parts. They are not waterproof and require a barrier material overwrap for waterproof protection. They are available in 14 styles and many classes and subclasses. Weight limitation of contents for this box is 20 pounds.

Setup Boxes (ASTM D 5118)

Setup boxes are used for interior packing of small items and for stackability in storage areas. These boxes are available in four types, five classes, and four styles. The weight limitation of contents for this box is 10 pounds.

Metal Stayed Paperboard Boxes (A-A-866, A-A-1623)

Metal stayed paperboard boxes are used for interior packing of small items and for stackability of supplies in storage areas. These boxes are available in nine styles and two classes. The weight limitation of contents for the class 1 metal stayed box is forty pounds. The class 2 metal stayed box is for items which weigh 10 pounds or less.

Metal Reusable Shipping and Storage Drums (MIL-D-6055)

The metal reusable drums are made of aluminum or steel and furnished in various sizes. The drums are made with a fully removable cover secured by an exterior locking ring. This locking ring is held in place by a removable nut and bolt. The container is supplied with a rubber gasket to provide a barrier against watervapor. The reusable container is mainly used for the packing of delicate instruments, electrical/electronic components, relays, and small electric motors.

Preservation Equipment

Heat Sealing

The reason for heat sealing is to accomplish closure of certain bags and provide a seal having the same waterproof or watervaporproof properties as the barrier material itself. Heat sealable barrier materials are generally constructed of layers of different materials, laminated together, to form a sheet, as shown in figure 2-52.

- X Heat sealable face. The heat sealable face (thermoplastic ply) has the characteristic of becoming semifluid when exposed to heat. When two faces are placed together in the presence of heat, the faces combine with each other. After cooling the two faces are fused together into a leakproof seal.
- X The impervious ply. The impervious ply is made of metal foil (aluminum) or a plastic film. This ply provides the greaseproof, waterproof, or watervaporproof characteristics to the barrier material.
- X The backing ply. This ply is laminated to the heat sealable face and the impervious ply to provide the strength and abrasion resistance to the material. It also allows for printing of required information for identification.
- X Temperature. Temperature is an important and critical factor affecting the heat-sealing process. Enough heat must be applied to the thermoplastic material on the sheets to be bonded to allow it to soften and reach its flow temperature. The thermoplastic plies will flow into each other and form one continuous mass. When the source of heat is withdrawn, the molten thermoplastic will cool and become a single, solid film producing a seal. Too low a temperature may result in either no seal being made or a weak seal because the thermoplastic has not reached its flow temperature. Too high a temperature may cause delamination or separation of the backing ply from the other plies. Manufacturers of heat sealable barrier materials are required to supply recommended temperatures for effective sealing of their materials on different types of equipment.
- X Dwell time. Dwell time is the length of time the material remains in the heating zone. Enough time must be permitted to raise the temperature of the heat-sealable face to reach its flow temperature and allow the molten thermoplastic surfaces to form one continuous mass. Dwell time and temperature are interdependent. The lower the temperature, the greater must be the dwell time, and vice-versa, provided that the limits for each factor are not exceeded.
- X Pressure. The purpose of using pressure is to bring the surfaces to be sealed into intimate and continuous contact. Excessive pressure will force out the molten thermoplastic material which will result in defective seals.

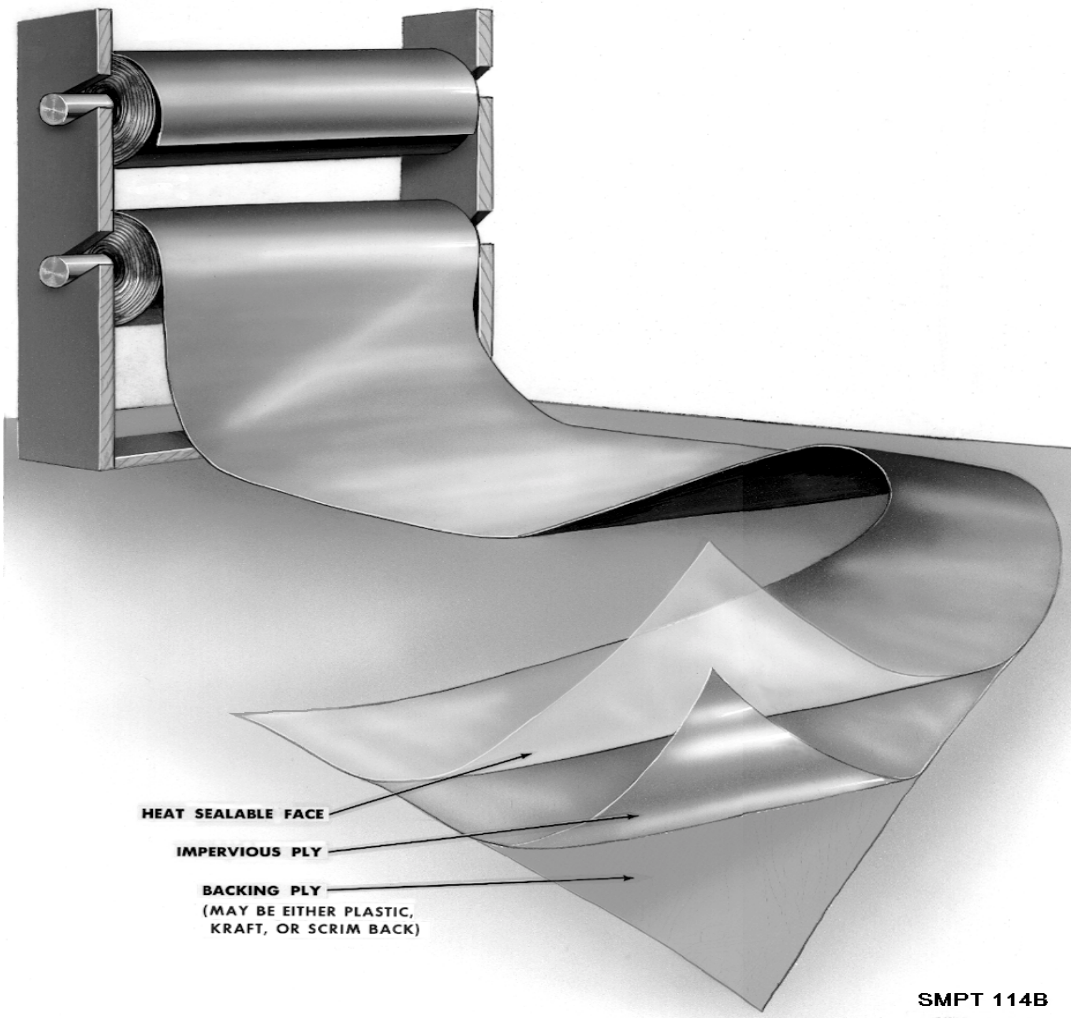


Figure 2-52. Construction of heat sealable barrier material.

Heat Sealing Equipment

Heat sealing equipment can be divided into two general classifications - unit type and continuous type. Each type may have many variations or attachments, depending upon the manufacturer; however, the basic operation is essentially the same within each classification since the machines must be equipped with adjustable, directly calibrated controls for pressure, temperature, and dwell time, as shown in figure 2-53.

X Unit or jaw-type heat sealer. This type of heat sealer has two opposed, parallel jaws which can be brought together either manually or mechanically. One or both of the jaws are provided with heating elements. The jaws of a unit-type sealer are sometimes covered or coated with an antistick facing material to prevent adhesion of plastic films to the hot surfaces. Examples of antistick materials are silicone or teflon. Some sealers are made with one or more resilient jaws which help to smooth out irregular thicknesses of material, such as wrinkles, splices, gussets, etc. The resilient material used on the jaws is silicone rubber.

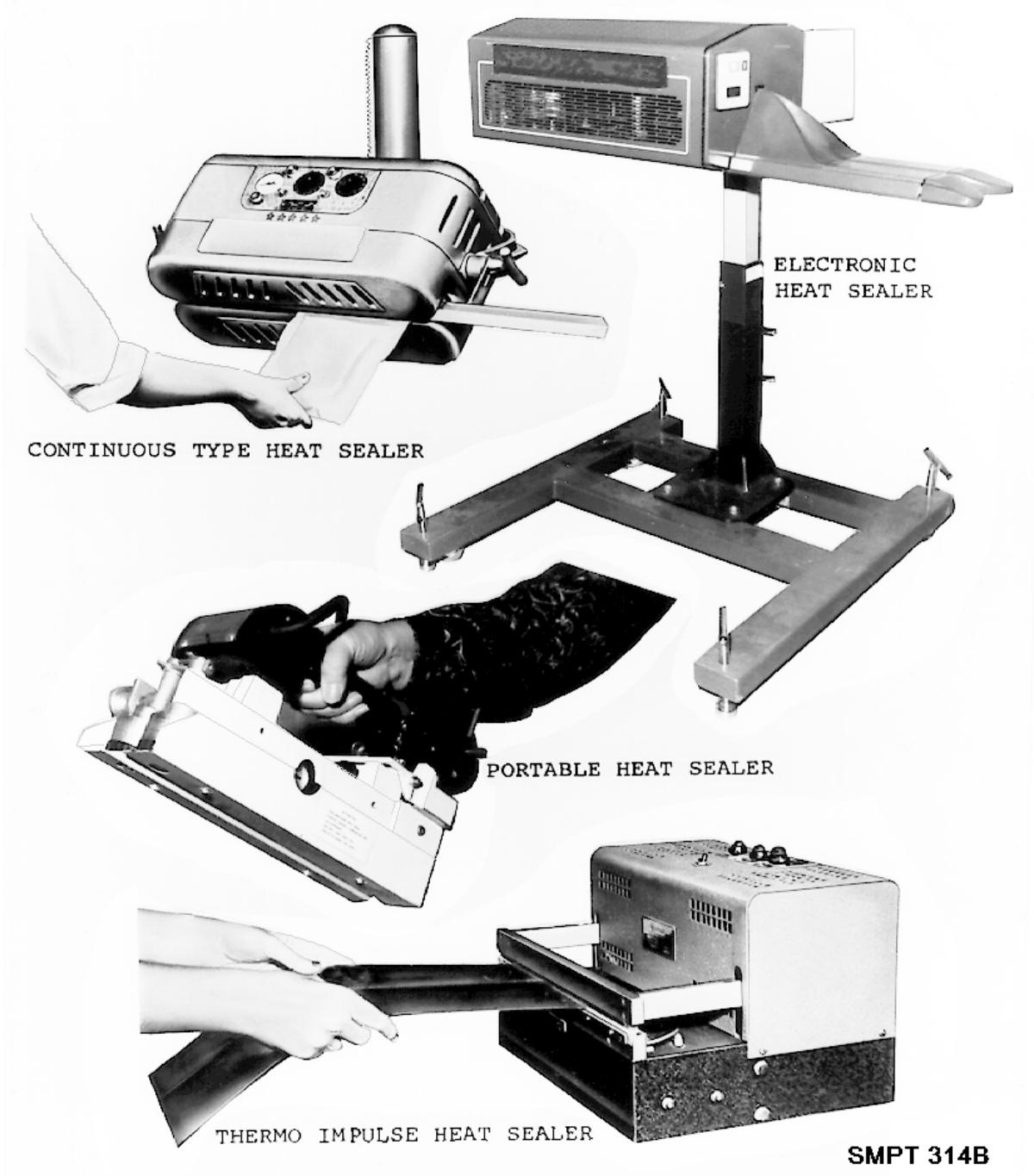


Figure 2-53. Heat sealing equipment.

X Continuous-type heat sealers. There are two basic variations of the continuous-type sealer known as rotary and band-type sealers, which are used for high volume heat-sealing operations. Rotary sealers in their simplest form consist of a pair of driven and heated rollers between which the material to be sealed is passed. The rotating wheels are used to apply heat and pressure to the barrier material to effect a seal. Dwell time is controlled by varying the rate of speed at which the material passes through the rollers. Rotary sealers are usually equipped with a chain or belt-type intake and/or discharge unit to feed the material into the sealer and guide it out after it has been sealed. Some sealers employ "preheaters" to raise the temperature of the thermoplastic prior to sealing. Band-type continuous sealers make use of two thin endless metal belts to carry the material through the heating zone (and sometimes a cooling zone) while applying pressure and heat continuously to the barrier material. The addition of water blocks for cooling enable this type of sealer to be used for sealing unsupported (plastic) films. Water cooling is used to set the seal before ejecting material from the sealer and to offset sticking of polyethylene and polyolefin. Hose or tubing is run from the source to the sealer and out to the sump. A fairly good flow of water is recommended for sealing polyolefin, polyethylene, and similar films. The band-type sealer may look like a rotary sealer but operates on a different principle. Heat is transferred from the heating jaws through the metal bands to the barrier material. Temperature is thermostatically controlled. Dwell time is controlled by varying the speed of the bands through the heating zone. Pressure is usually applied by pressure rollers although a small amount of pressure is applied to the bands by the heating jaws. The roller pressure is controlled by mechanical and/or hydraulic power. Continuous type sealers for unsupported plastic films are also available. They employ a water cooled belt in addition to the heated belt to eliminate the possibility of the unsupported film melting and fusing onto the steel belt.

X Other types of heat sealers. There are two other types of heat-sealing machines which are used primarily for the sealing of unsupported (plastic) films. The electronic type uses a high frequency current to generate heat in the surface to be sealed as the material passes between two electrodes. The electrodes remain at room temperature. The thermo-impulse type sealer looks like a conventional jaw-type sealer and operates mechanically the same way except that an electrical-resistance wire is mounted on one sealing jaw. The electrical-resistance wire placed in contact with the material is heated in a fraction of a second by a heavy current flow to melt and fuse the thermoplastic. The jaws remain closed after the flow of current, thus cooling the seal under pressure. Polyethylene, vinyl, polystyrene, and polyester are commonly sealed using this type of sealer. The thermal-impulse principle allows effective sealing through liquids, powder, wrinkles, and gussets and makes them adaptable to any process which requires two or more thermo-plastic films to be joined together.

Checkup

X What is dwell time?
X Name the plies of a typical heat sealable barrier.
X What does the impervious ply provide the heat sealable barrier?
X What are the essential factors in making a proper heat seal?
X What would be the result if too high a temperature is used?

PRESERVATION MATERIALS AND HEAT SEALING EQUIPMENT PRACTICAL EXERCISE

Objective

As a result of this practice, the student will be able to identify materials used in military preservation.

General Instructions

Each student will identify barrier materials and tapes used in preservation and fabricate a sample booklet.

The time to accomplish this practical exercise is one hour.

The practical exercise will be conducted in the classroom.

Conduct of Exercise

Situation

As a processor you are required to be familiar with the physical characteristics and intended uses of the various barrier materials and tapes used in preservation.

Requirement

Each student will be issued a barrier booklet and 2 metal fasteners. Each student will receive barrier materials, wraps and tape samples. Identify each sample of material and insert, after the printed sheet which identifies the material. After all samples have been inserted, fabricate material samples booklet by attaching booklet cover sheet and pages together and install fasteners.

Critique

Instructor will orally critique the packaging materials sample booklet.

Care of Area

Not applicable.

CUSHIONING, BLOCKING, AND BRACING

CUSHIONING, BLOCKING AND BRACING

Purpose of Cushioning, Blocking, and Bracing Materials

When working with cushioning, blocking, and bracing materials, we should know the purpose of each one and when and how they are used.

Cushioning

Figure 2-54 shows a typical use of cushioning as the means of providing physical and mechanical protection to an item by *controlling* the movement of the item within the container. It involves the use of resilient materials to support an item and reduce the intensity of shocks. In a previous session we discussed various materials which we can use to cushion our items.

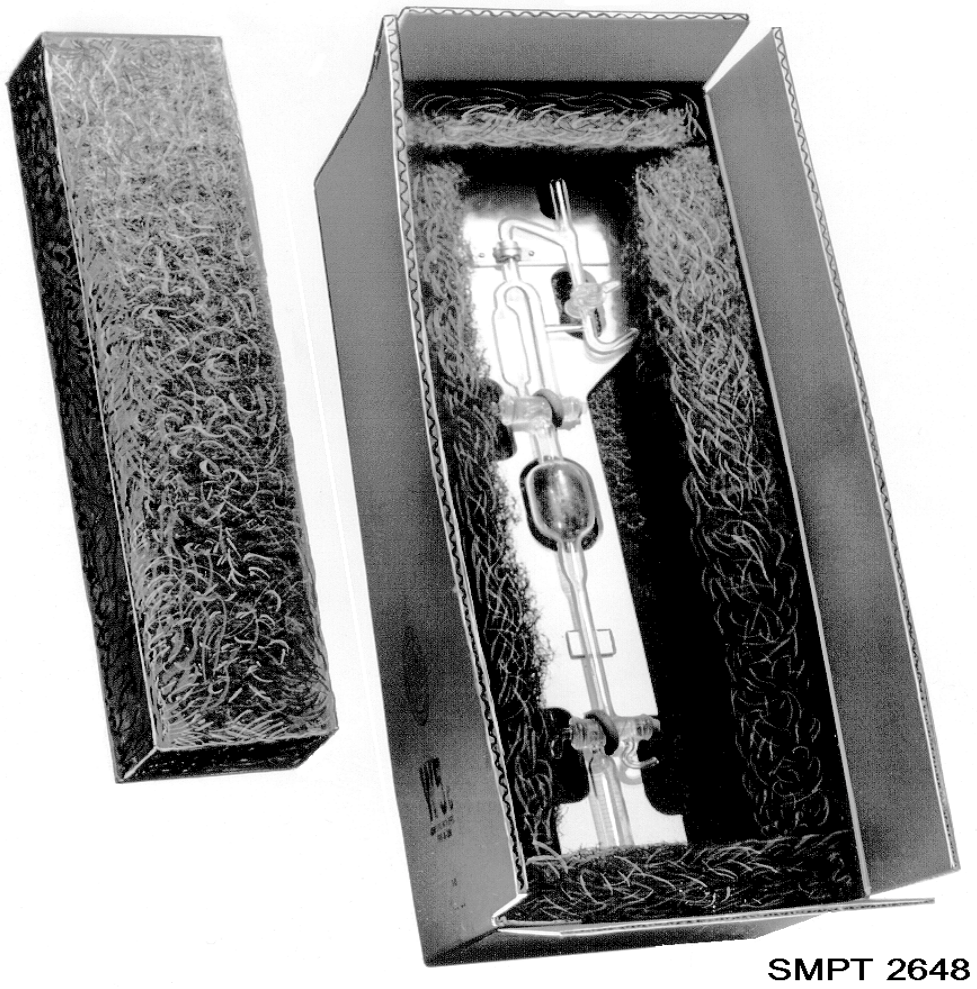


Figure 2-54. Cushioning used to control movement.

Blocking and Bracing

Blocking and bracing is the means of providing physical and mechanical protection to an item by *preventing* movement of the item within the container. It involves the use of rigid materials to position and hold the item in the container. Lumber, plywood, and particle board, as in figure 2-55, are the materials most commonly used. Solid fiberboard pads or similar materials are sometimes used.

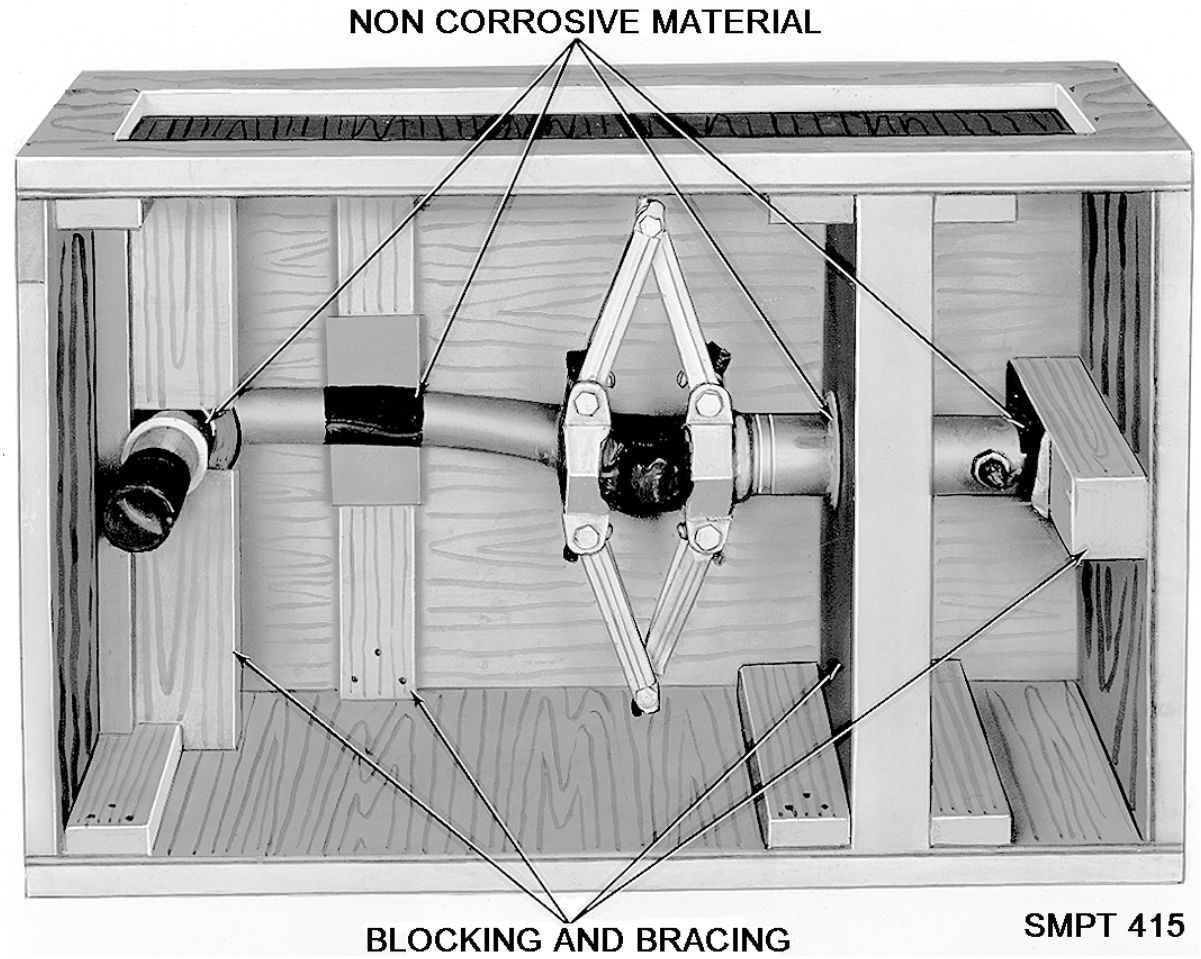


Figure 2-55. Blocking and Bracing used to prevent movement.

Functions of Cushioning

When cushioning is properly applied to a pack, it can serve any or all of the six functions shown in figure 2-56.

Absorbs Shocks Due to Impact

One of the primary functions of cushioning is to absorb energy transmitted as the result of an impact shock striking the container. The shock is absorbed as the cushioning material is compressed by the item. The extent of absorbing shocks will depend upon the degree of compressibility of the cushioning material and the thickness in which it is applied.

Distribute Forces

Cushioning materials reduce the effects of shock to the item by distributing the damaging forces over a larger area, thus reducing the shock concentration at any one point on the surface of the item. The most effective distribution of forces will result when the cushioning surrounds the entire surface of the item.

Control Movement and Vibration

Cushioning, when properly applied, controls movement of the item within the barrier or container and tends to reduce vibrations due to external forces.

Prevent Surface Abrasion

Cushioning is used to prevent surface abrasion to items that could be damaged from abrasive preservation and packing materials. This is accomplished by utilizing a thinner application of cushioning material than that required for shock protection since the purpose is to have the cushioning act as a buffer.

Prevent Rupture of Barriers and Container

In some instances, cushioning is accomplished mainly to protect the container or barrier material enclosing the item and not the item itself. This function of cushioning has special application in cases in which waterproof or watervaporproof barriers are used as unit containers, and the absence of water or moisture is essential to the effectiveness of the package.

Protect Fragile Items

Sometimes fragile or delicate components form a part of otherwise sturdy items and can be disassembled and packed separately. When disassembly is not allowed and the parts must be left on the item, adequate cushioning should be provided in relation to their fragility, their place in the container, and anticipated hazards they would come in contact with.

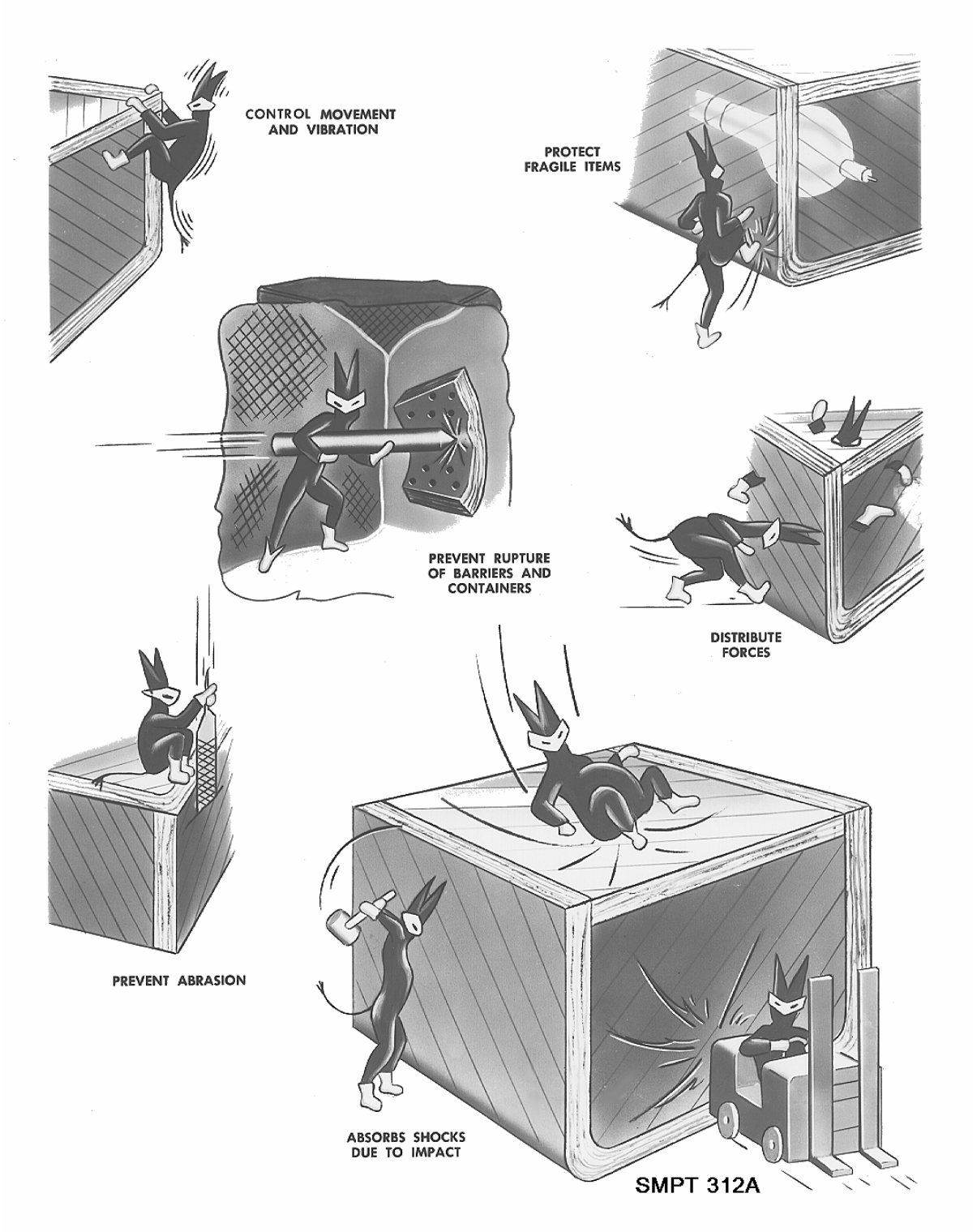


Figure 2-56. Functions of cushioning.

Factors to be Considered with Cushioning, Blocking, and Bracing

In planning to cushion, block or brace an item in a shipping container, the nature and physical limitations of the item must be thoroughly considered.

Shock Resistance

The resistance of an item to shock is determined by its ability to withstand impact without damage, and is the primary factor in determining whether an item is to be regarded as rugged, semifragile, or fragile:

- X Items are considered rugged if they can withstand severe impact without damage. Rugged items can be blocked and braced rigidly. Generally, cushioning is used with rugged items only to prevent surface abrasion.
- X Items are classed as semifragile if they can withstand a limited amount of impact with damage. Many semifragile items are fastened to one face of the container to prevent pressure on the item due to distortion of the container under impact. At least 2 inches clearance should be allowed in these cases between the item and all other faces of the container. Cushioning will be used in the packing of semifragile articles to prevent surface abrasion and to absorb part of the impact.
- X Items are classed as fragile if they can withstand very little impact without damage. If an item is fragile, the interior pack must be made to provide sufficient cushioning to absorb any shocks the pack may receive. Fragile items should not be fastened to, or come in contact with, any face of the shipping container. They may be blocked and braced to one or more faces of an interior container which in turn is floated by cushioning in an exterior container.

Size

A large item does not necessarily require more extensive or stronger blocking or large amounts of cushioning than a smaller item by virtue of its size alone. The large container needed by the large item may require more extensive and stronger blocking to bridge the wider spans between the container faces or frame members. By the same token, a large item may require that the cushioning be distributed over larger areas than on a smaller one.

Shape

A regular-shaped item requires minimal or no blocking in the container, whereas an irregular-shaped item requires an elaborate system of blocks and braces to secure it in place. Curved surfaces call for carefully fitted blocking and bracing to prevent damage of the item. However, foam-in-place polyurethane is a valuable tool for accomplishing a naturally conforming blocking and bracing with a minimum of labor. Long, slender items, especially if heavy, develop considerable end thrust when subjected to impact and must be blocked to prevent endwise movement.

Weight

Where weights are concentrated upon small areas, it is often necessary to distribute the weight over larger areas or to transmit part of the weight from one container face to the edges or corners of the container. For purposes of blocking and bracing, containers are stronger at or near the corners and are weaker at the unsupported center areas. The heavier and more concentrated the weight of the item is, the stronger must be the blocking and bracing to safeguard the life of the pack.

Degree of Disassembly Permissible

It is advisable to examine the possibilities of disassembling an item prior to planning the pack, especially if the item has one or more projecting parts. Disassembly may simplify blocking and bracing requirements, reduce the size of the container, or simplify preservation of the various parts. Before disassembling any piece of equipment, proper authorization must be obtained.

Types of Loads

The term type of load refers to the contents of a container (see MIL-STD-2073-1C) and its ability to add strength or cause damage to the faces of the container. Blocking and bracing is sometimes used in connection with Type 2 loads. In the case of type 3 loads, however, it is an unavoidable operation due to the irregular shape, fragility, heaviness, or high density of items which make up such loads. Cushioning is applied to the three types of loads. In the case of Type 1, it is used primarily to prevent surface abrasion; in the case of Type 2, to prevent surface abrasion and to absorb part of impact shocks; and in the case of Type 3 loads, to prevent contact of the items with each other and/or with the faces of the container, and to absorb shocks, jolts, and vibration.

Mounting Provisions

Frequently, it is possible to secure an item within the container using available mounting provisions. When the item has no adequate mounting facilities, one of the following methods may be used to secure it in place:

- X It may be strapped to a mounting board and the mounting board bolted to the base of the container.
- X If it is heavy, it may be suspended in a metal, wood, or combination wood and plywood frame, which is bolted to the base.
- X For heavy items with irregular lower surfaces, the blocking may be built as part of the base of the container. This permits the item to be lowered onto the blocking and fastened in place.

Cushioning Methods

There are three common methods of cushioning. They are known as the floated item, floated package, and suspension mounting.

Floated Item

In this method the item is floated in cushioning and placed directly into a shipping container as depicted in figure 2-57. This is the method most commonly used for cushioning small, lightweight, fragile items against shock, vibration, and abrasion. Direct contact of cushioning materials on metal surfaces should be avoided. An accepted and highly recommended practice is to wrap the item first in noncorrosive paper and then apply the cushioning. Greaseproof paper is required if the item is preserved. Cushioning materials must be secured about the item. Loose cushioning may result in either the displacement of the material when the item is subjected to shock, its disintegration under repeated vibration, or the production of dust or loose particles which will be trapped within the item. Since a container may be dropped on any one of its six faces, the cushioning material must withstand the full impact of the entire weight of the article in any direction.



Figure 2-57. Floated item.

Floated Package

Figure 2-58 shows the floated package method. The item is packaged in an interior container which in turn is floated in cushioning material. This method is generally used in connection with semifragile items of medium size and weight. The item is initially packed (which may include cushioning or blocking) in an interior container, then floated in cushioning and placed into an exterior container. A typical example of this method is the cushioning of an electrical part. Even though it may appear sturdy, it is moderately fragile due to its internal construction.

Suspension Mounting

This method is used to cushion fragile items and sensitive instruments or mechanisms that can be damaged by shock and vibration. The weight and size of the item may vary from light and small to heavy and large. The shock mounts may consist of a variety of materials and devices as shown in figure 2-59. This method of cushioning may be accomplished in many ways; among which the item may be suspended directly. The item may be blocked in a cradle and the cradle suspended. The item may be blocked in an intermediate container, and the intermediate container suspended. Due to a higher degree of fragility, delicacy and/or sensitiveness of the articles that are cushioned by this method, its use is always governed by detailed packaging

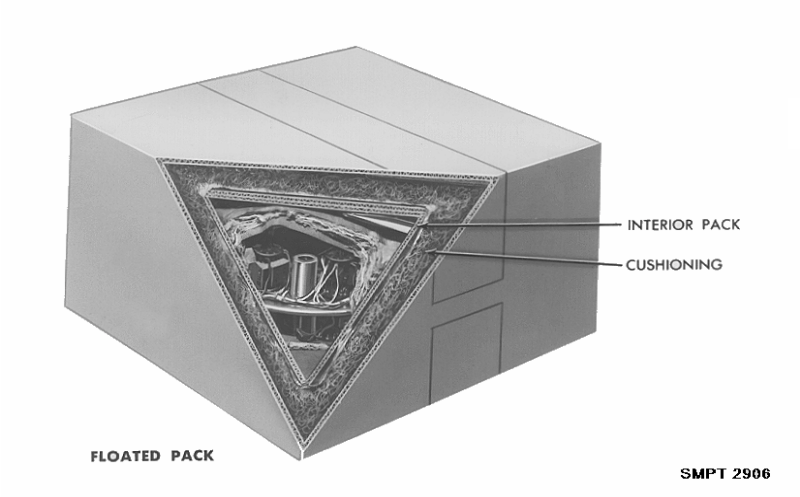


Figure 2-58. Floated package instructions.

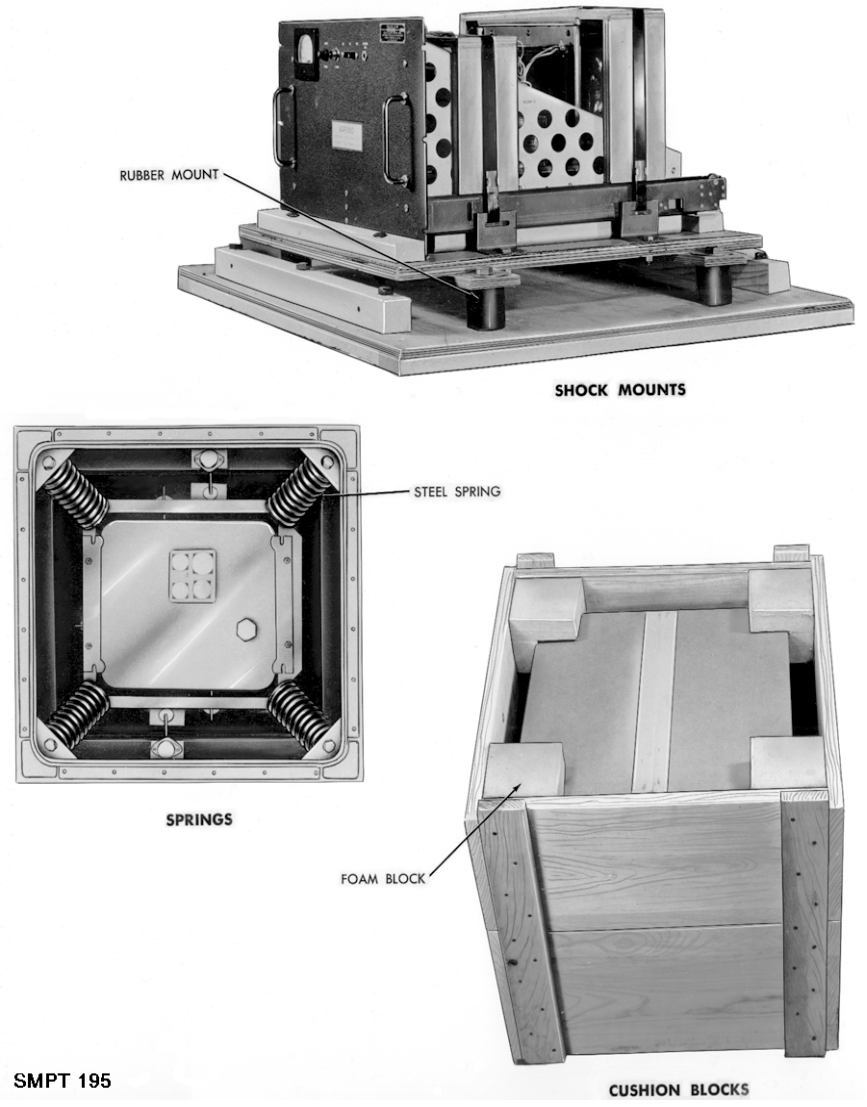


Figure 2-59. Methods of cushioning - Shock Mounts.

Cushioning characteristics

The chemical and physical properties of cushioning materials are many and may show both desirable and undesirable characteristics. Figures 2-60, 2-61, and 2-62 illustrate these characteristics. All cushioning used should be clean and dry as practicable.

Resilience

When a cushioning material springs back to its original shape and thickness after having been compressed under a load or pressure, such material is said to be resilient. Most cushioning materials, with the exception of rubber and rubberized products, do not approach 100 percent resilience in their performance. Resilient materials have special application when used in the cushioning of delicate instruments.

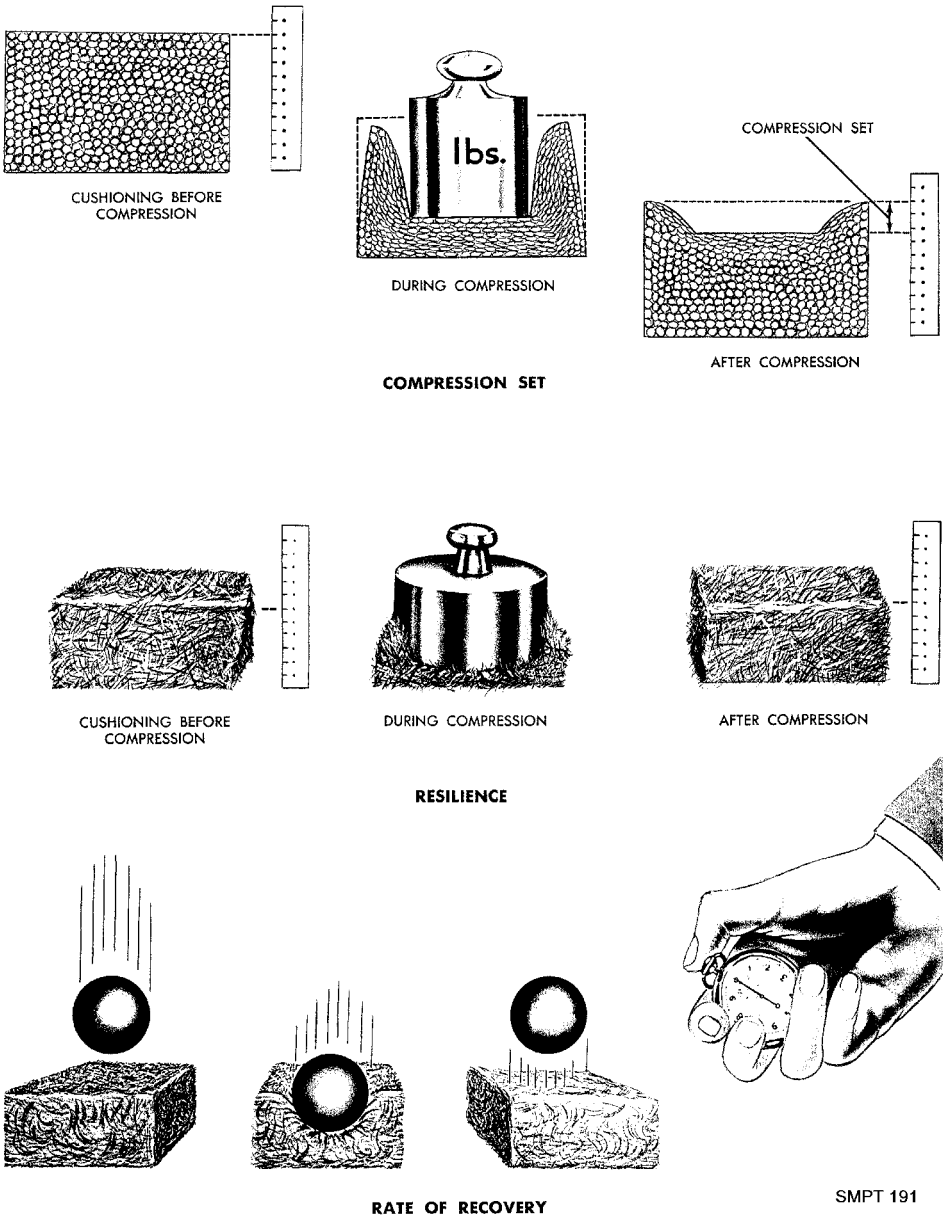


Figure 2-60. Cushioning characteristics.

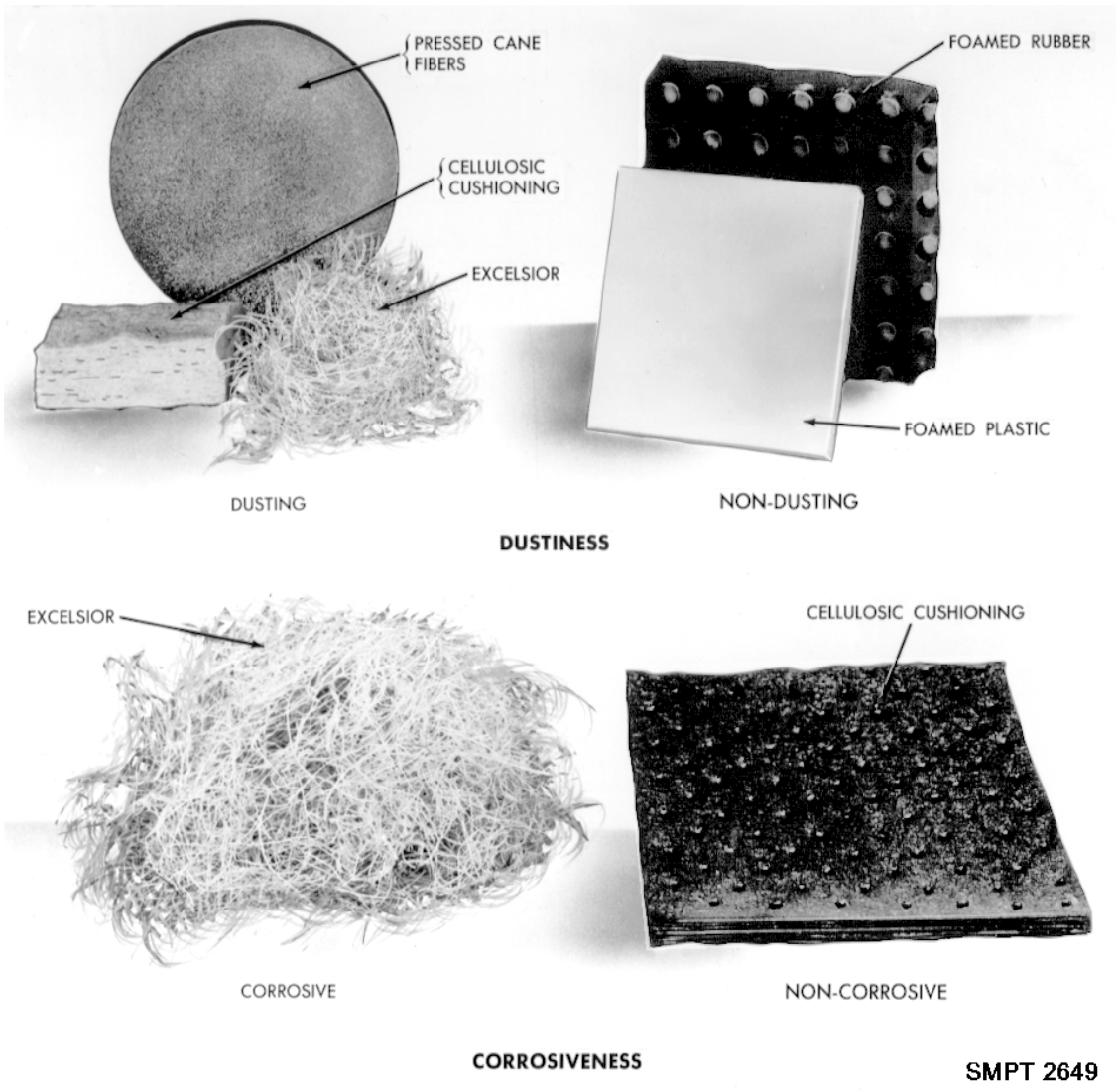


Figure 2-61. Cushioning characteristics.

Compression Set

When a load is applied to a cushioning material, it loses some of its original thickness. Upon removal of the load, the difference between the thickness of the compressed material and its original thickness is known as compression set. Compression set has a direct relation to resilience. Resilient materials show very little or no compression set. The presence of moisture or liquid water in cushioning materials increases compression set. This is another important reason that the materials used be as dry as practicable.

Rate of recovery

This is the time it takes for a cushioning material to return to its original shape after compression. Some materials have too rapid a recovery and "spring back" so quickly that damage to the item may result.

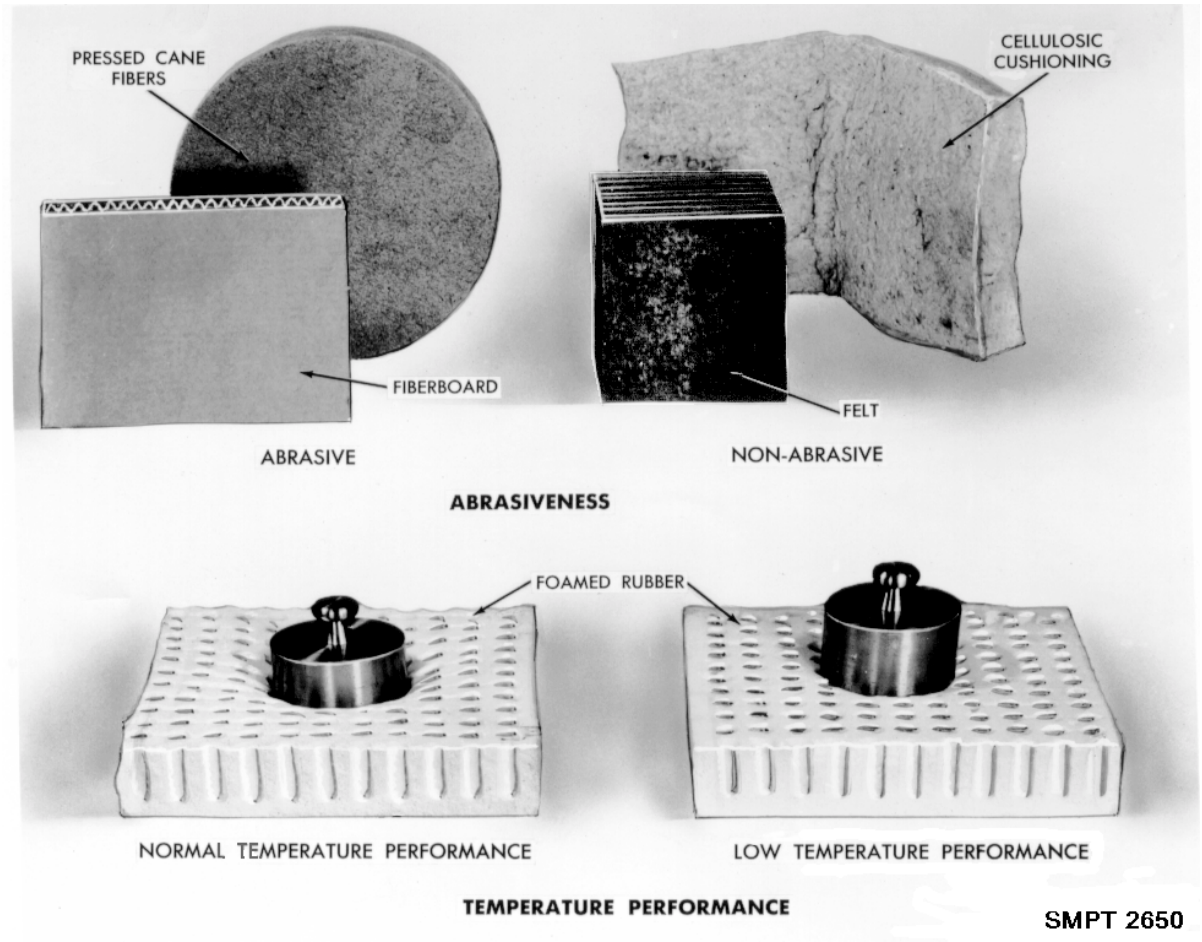


Figure 2-62. Cushioning characteristics.

Liquid-Absorption Capacity

The liquid-absorption capacity of cushioning materials varies form highly absorbent to very low absorbent materials. In some instances the use of a cushioning material that will absorb liquids due to leakage or breakage of the container during transit will be advantageous. When cushioning metal items or items made of organic materials which will be damaged by the presence of moisture or water, the low absorbent cushioning material will be used.

Dusting

The presence of small particles of fibrous materials in preservation and packing is undesirable since these particles can cause damage to mechanical assemblies. All cushioning materials dust to some degree.

Corrosiveness

Cushioning materials contain chemicals that form corrosive solutions in conjunction with moisture. When an item may be damaged by corrosion, a noncorrosive material should be used or the cushioning should be separated from the item by use of barrier material.

Abrasiveness

Many cushioning materials will cause abrasion on item surfaces. Avoid placing these materials
in direct contact with critical surfaces. Where critical surfaces are involved, barrier material must be used between the item surface and the cushioning.

Temperature Limitations

Cushioning applications for military use are subject to temperatures from -65F to 160F. The higher temperature requirement may cause increased compression set. Lower temperature requirement causes stiffness, resistance to compression and brittleness.

Electrostatic Field Shielding

This requires enclosing the item in a relatively conductive material. Normally, the greater the conducting of the enclosure, the greater the dissipation of the electrostatic field. Thus, electrostatic discharge sensitive (ESDS) items should have an overwrap of conductive packaging to protect against electrostatic induced fields.

Blocking and Bracing Methods

Boxes available for packing are seldom exactly the right size for the item to be packed. They are usually either too long or too wide or too deep or sometimes a little bit of all three. When you are choosing a box to pack an item which must be blocked in place, try to find a box as nearly the correct width as possible. It is fairly easy to block off excess length or depth, but much more difficult to block off excess width. The type of blocking and bracing you use must be suited to the item you are packing. No one pattern of blocking and bracing will be suitable for all occasions. There are four common methods of blocking and bracing.

Fiberboard, Prefabricated Wood, Particle Board or Plywood Blocking and Bracing

Fiberboard is used primarily in connection with irregularly shaped items. The wood or plywood is cut to fit or support certain portions of the item and nailed to the faces of the container. For items with irregular lower surfaces, the blocking may be built as part of the base of the container and the item lowered onto it. Figure 2-63 shows a number of possible designs.

Bolting

This method consists of fastening an item to the container by means of bolts. When the item has bolt holes, it is fastened to the base of the container in the same manner as it is fastened when in use. When the item does not have bolt holes, but has strong frame members close to the faces of the container, U or J-bolts are used. When no bolt or strong frame members are present, tie-rods (which are actually extended bolts) are used with wooden braces.

Framing

Framing consists of specially constructed sleeves, brackets, or frames made of metal, wood, or a combination of these to which the item is bolted. The sleeves, brackets, or frames are, in turn, fastened to the faces of the container.

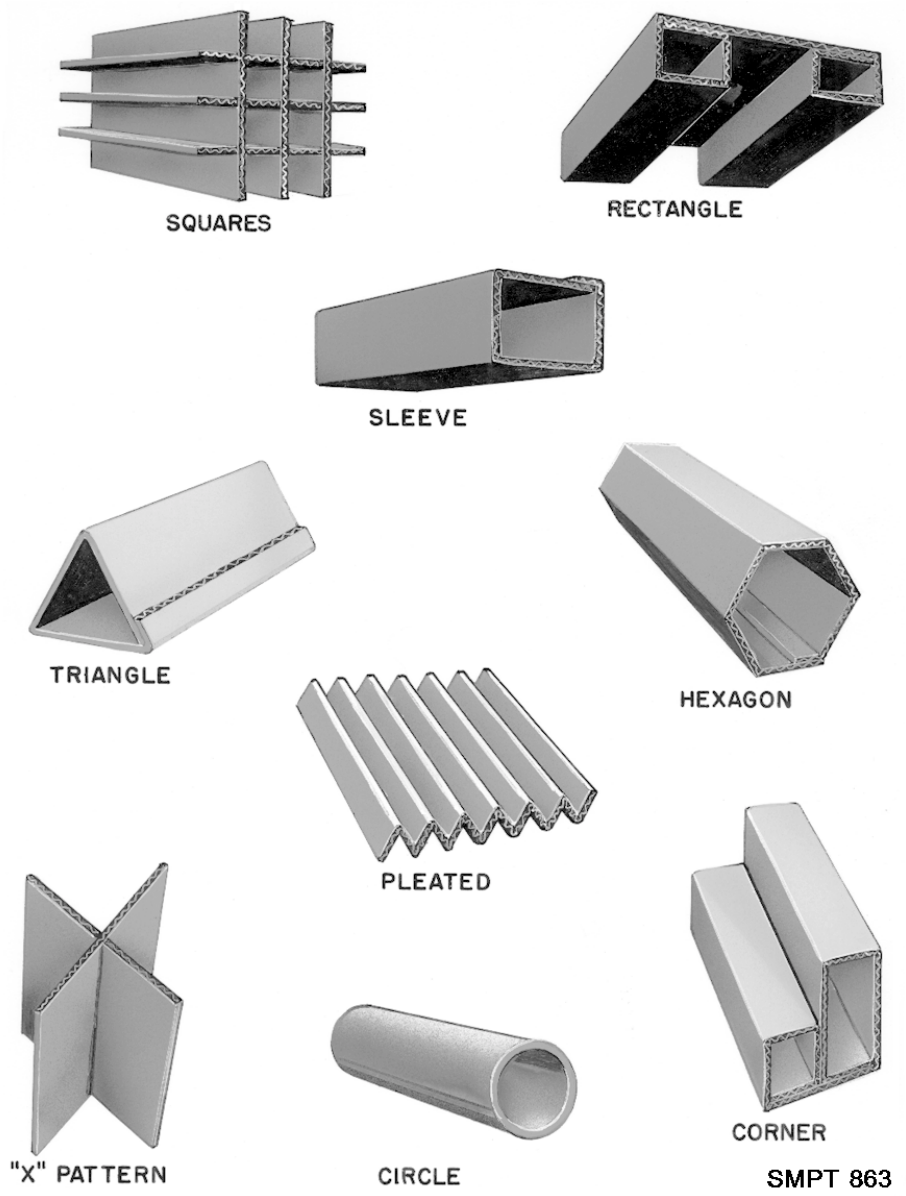


Figure 2-63. Fiberboard, pads and cells used for blocking and bracing.

Strapping

This method consists of securing an item to the base or other face of the container by means of flat metal strapping or round wire in tension.

Blocking and Bracing Materials and Their Application

Materials used for blocking and bracing must be strong and rigid. The greater the need for support, the stronger and more rigid the material must be.

Use of Lumber

Lumber used in blocking and bracing must meet the following requirements:

- X Be dry (its moisture content should be between 12 and 19 percent to avoid shrinkage and to eliminate the possibility of introducing moisture into the pack).
- X Be free from cross grain and knots, if located near the center of a piece that is being used as a beam or column. If knots, in particular, cannot be avoided, the following should be carefully considered. Edge knots shall be placed so that the knot will always be in compression. Center knots shall not have a diameter greater than one-fourth the width of the piece of lumber.
- X Thin pieces of wood split more easily than thick ones. Thin pieces of wood should not be used in blocking unless precautions are taken against splitting. Several precautions should be taken if thin boards are used. Do not nail too close to the edge of the board. Use the proper size nail. Prebore holes for nails. Reinforce the board with a facing of plywood.
- X All braces should, if possible, have the edges against the article in order to utilize their maximum strength. If it becomes necessary to have the flat face of the brace against the article, the size of the brace must be increased.
- X When bases of ordinary lumber are used, they should be constructed with sufficient cleats at right angles to the grain of the base boards and securely fastened with clinched nails to prevent the boards from splitting at the bolt holes.
- X Wood braces that are positioned between two faces of a container should be held in place by cleats fastened to the face of the container with a sufficient number of clinched nails, or, when the pressure is from more than one direction, by the use of a pocket cleat arrangement. Such braces should never be held in place by the use of end grain nailing, or the use of notches cut into the container's face boards. Application of wood blocking and bracing is shown in figure 2-64.

Use of Plywood

Plywood can be used to an advantage when thin blocking is required, due to its resistance to splitting; or where the blocking must be flexible to fit to a curved surface as shown in figure 2-65. Plywood has an added advantage for use as a base as it is available in wide panels. Plywood used as a base should be 1/2 inch or 3/4 inch thick for light articles. For medium and heavy articles, two or more pieces of plywood can be fastened together, or a series of strengthening plywood cleats can be added to the panel.

Use of Metal Brackets or Frames

Many articles have attachment points used for bolting but the points are not located on a regular base which can be fastened directly to the container. In such instances, specially constructed brackets or frames made of metal, structural iron, wood, or a combination of these, can be used.

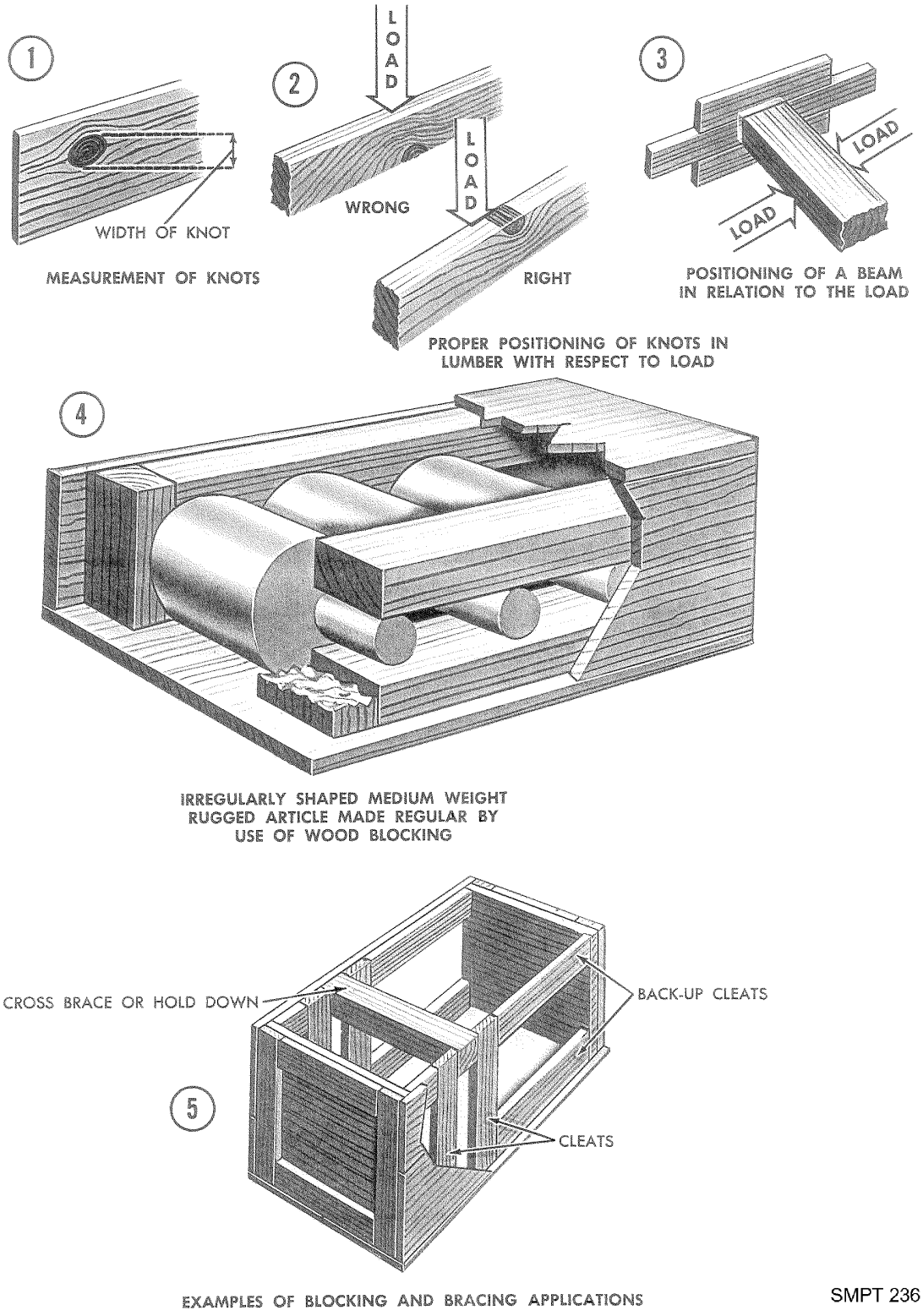


Figure 2-64. Application of wood blocking and bracing.

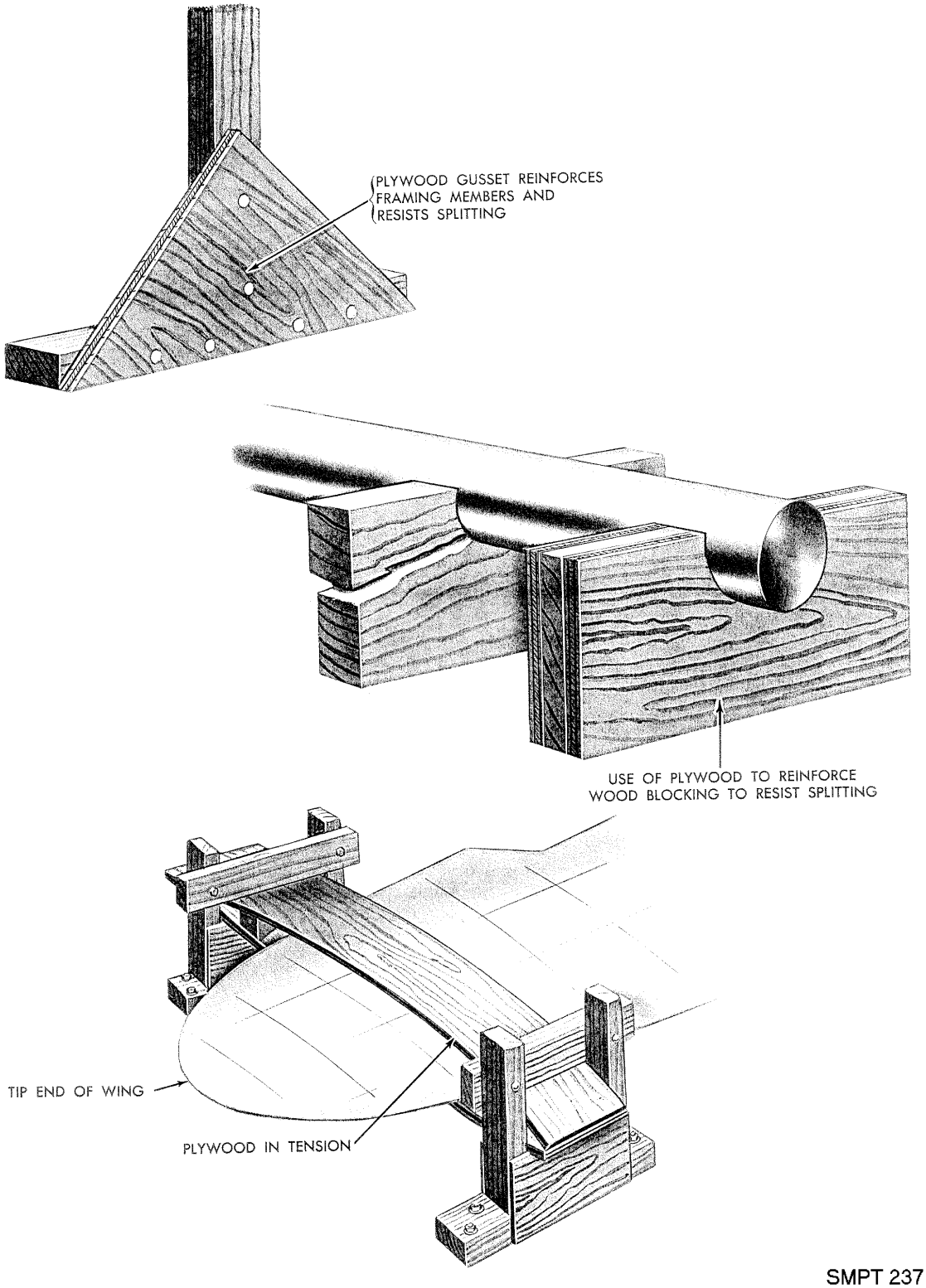


Figure 2-65. Use of plywood - blocking and bracing.

Use of Metal Strapping

The use of metal strapping to tie down an article to the base or other face of the container is often the only procedure that can be used. Metal strapping may be flat strapping or round wire. General precautions on the use of both flat strapping and round wire are as follows:

- X Use annealed wire or strap only for lighter articles since it stretches readily.
- X Straps should be placed only on those strong portions of the article which can withstand the impact load and weight of the article.
- X Place material such as felt or solid fiberboard between the straps and the article to prevent damaging finished surfaces.
- X Use one piece strapping whenever possible.
- X When strapping over a sharp edge of the item, use corner protectors to prevent strapping from fracturing.
- X When it is impossible to encircle the item and its support, anchor the two ends of the metal. For flat strapping, anchor the two ends of the strap to the container with anchor plates, or, if the strap is annealed, by direct nailing. For round wire, anchor the two ends of the wire to the container with drive screws and staples. Loop the wire around the shank of the drive screw and further fasten it with staples.

Use of Nails

Nails are the most common fastenings for blocking and bracing, especially standard sinkers and cooler nails. Clout nails, which are similar to roofing nails, are recommended where plywood of 1/2 inch thickness or less is used, because of their larger heads. Nails used in blocking and bracing should be cement-coated or chemically etched, particularly when they cannot be clinched. Etched nails should be used in preference to cement-coated nails whenever possible.

Use of Bolts

Bolts commonly used for blocking and bracing are step bolts, carriage bolts, and machine bolts, as shown in figure 2-66. U-bolts and J-bolts are used for special purposes where regular bolts cannot be applied. The following precautions should be observed in the use of bolts:

- X In bolting an article to a base, the bolt head should be on the outside of the container base and should bear against a wide flat washer. The bolt threads should be either coated with thick white paint, or slightly upset near the nut.
- X The base should never be counter-bored for the washer and bolt head.
- X When a container has skids, the bolts should be placed through the skids, if possible, with the bolt heads on the underside.
- X Where the article has strong frame members fairly close to the faces of the container, U-bolts or J-bolts may be used to advantage.
- X Tie-rods serve as extended bolts and should be used in the same general manner as other types of bolts. They should be placed vertically or diagonally in pairs.

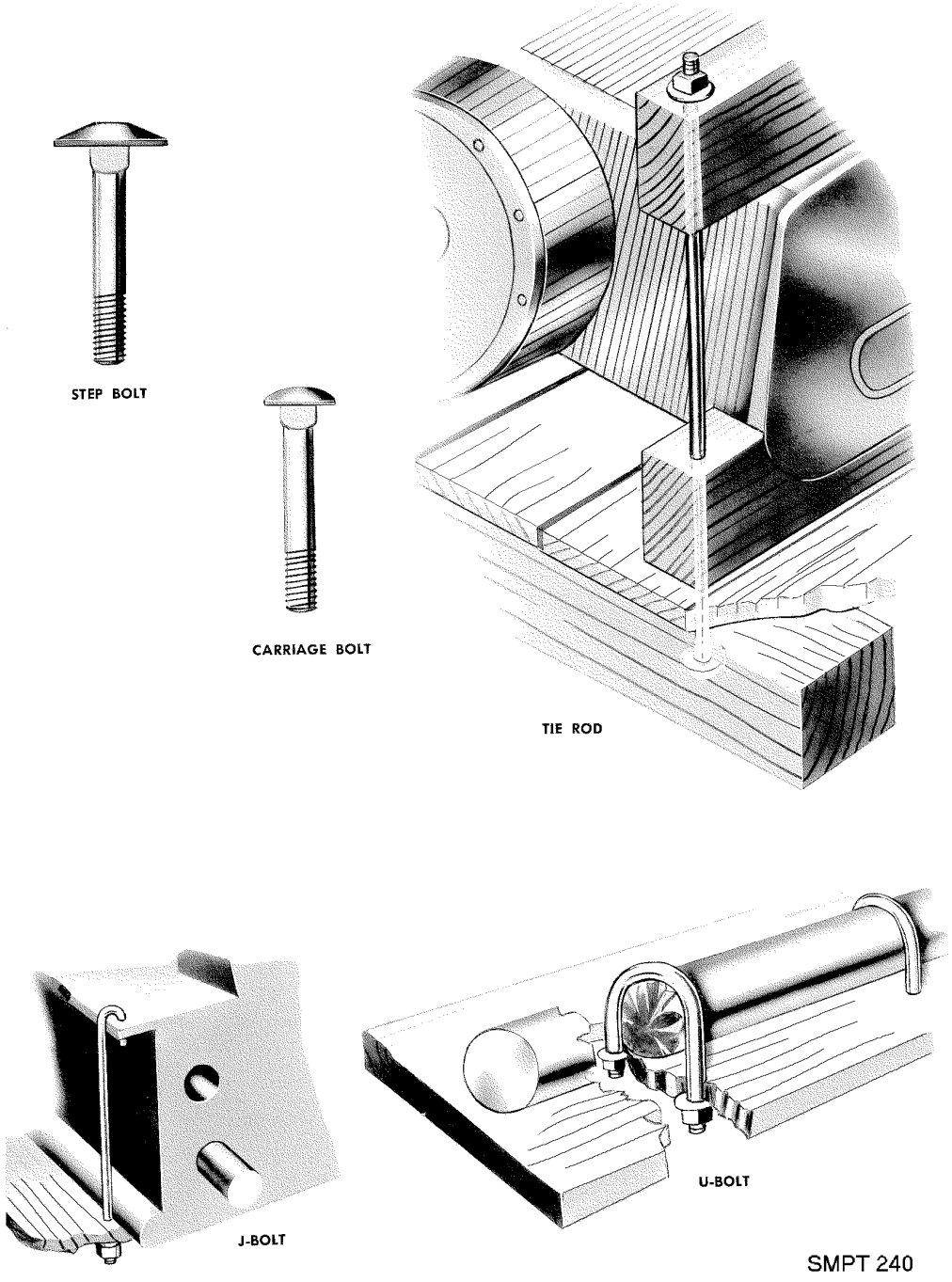


Figure 2-66. Use of bolts for blocking and bracing.

Foam-In-Place (FIP) Packaging

Foam-In-Place is another means of accomplishing cushioning or blocking and bracing.

This process consists of mechanically mixing two chemicals, called components A & B, together to form a urethane foam. The type of foam produced depends on the chemical elements in component B.

FIP materials used for cushioning are open celled foams normally of 1/2 pound per cubic foot density called semirigid foam or 1-1/2 pound per cubic foot density foam called flexible foam.

FIP materials used for blocking and bracing are closed cell foams of two pounds per cubic foot density. These are called rigid foams and absorb little or no shock.

Checkup

- X What does blocking and bracing accomplish?
- X What does cushioning accomplish?
- X What item, as a general rule, will require more blocking, bracing or cushioning, a regular shaped or an irregular-shaped one? Why?
- X In regard to shock resistance, how are items grouped?
- X Which type of load is blocking and bracing generally associated?
- X What is an important requirement for all materials used in blocking and bracing?
- X What are some of the requirements for cushioning materials?
- X What is the most common method of cushioning small, lightweight, fragile items?

CUSHIONING, BLOCKING AND BRACING APPLICATION PRACTICAL EXERCISE

Objective

As a result of this practice, the student will be able to identify various material and their application to accomplish preservation and packing operations.

General Instructions

The time allotted for this practical exercise is approximately 2 class periods. In the first class period, the student will write the answers on the work sheets.

The second class period will be devoted to a critique of the practical exercise.

This practical exercise will be conducted in the practical exercise work area.

The instructor will place the items from the kit on desks around the room.

Conduct of Exercise

Situation

As a packer you are to identify the items displayed and list their usage in preservation and packing on the work sheets contained in this practical exercise.

Requirement

- X Students will study the numbered items, identify each and give a brief description and the purpose of each.
- X During the critique of the practical exercise, the students will verify their answers on the work sheets with the answer given during the critique.

Critique

During the critique, each student will give a brief description of an item and how it is used in preservation and packing operations.

Care of Area, Training Aids and Equipment

Not applicable.

METHODS OF PRESERVATION

METHODS OF PRESERVATION

Proper Preservation

Preservation is the application or use of adequate protective measures to prevent deterioration including as applicable, the use of appropriate cleaning procedures, preservative protective wrappings, cushioning, interior containers, and complete identification marking up to, but not including, the exterior shipping containers.

Unit Preservation or Unit Protection

This is the protection given to one or more items through the application or use of the necessary cleaning, drying, preserving, wrapping, cushioning, interior containers, and marking for identification.

Unit Pack

The first tie, wrap or container applied to a single item or multiple thereof, or to a group of items of a single stock number, preserved or unpreserved, which involves a complete or identifiable package, as shown in figure 2-67.

Intermediate Protection

This is protection given to two or more unit packs of identical items by placing them inside an interior container. Figure 2-68 shows that this method provides additional protection and eases handling operations.



Figure 2-67. Examples of unit packs.

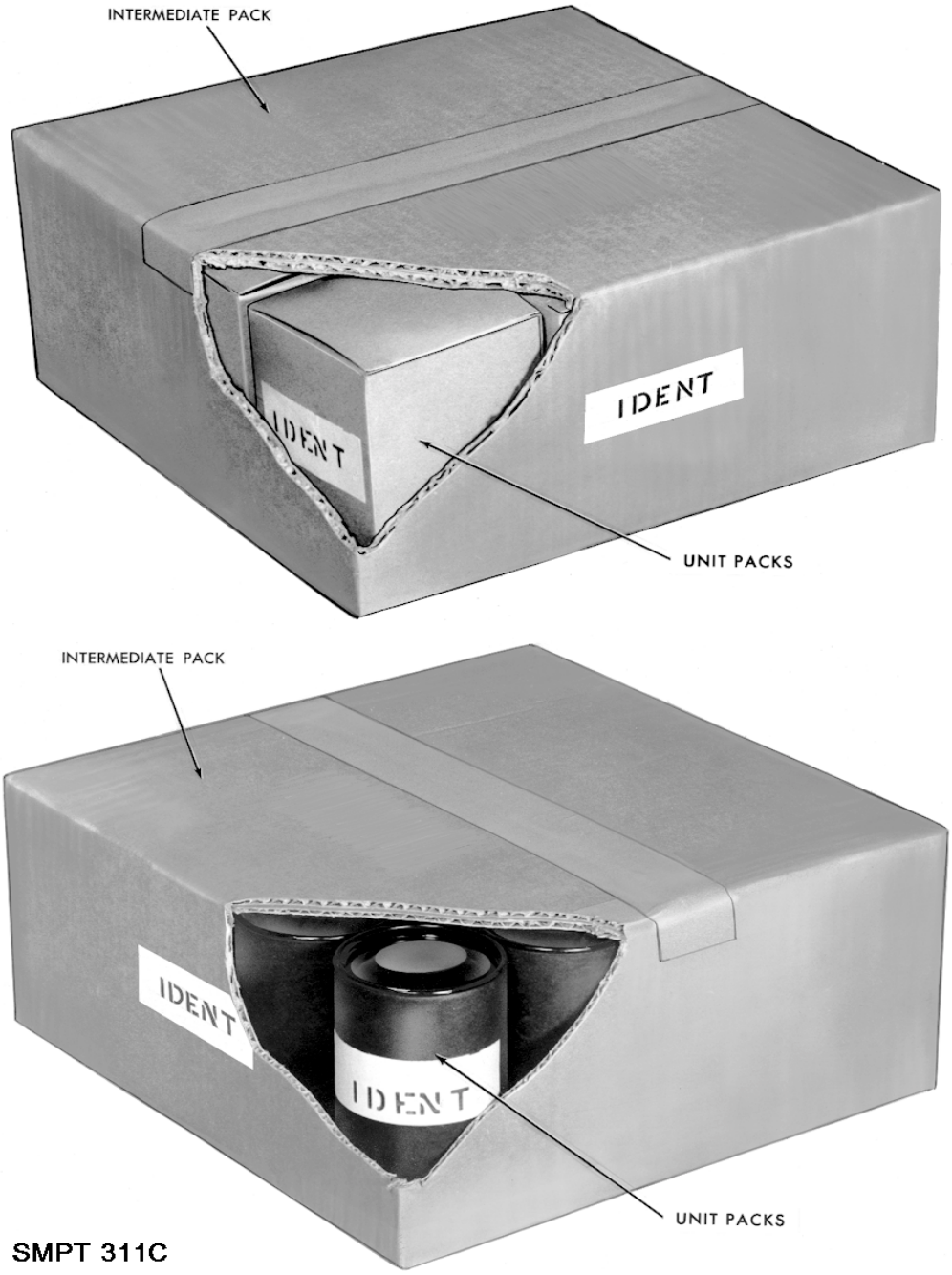


Figure 2-68. Intermediate packs.

Purpose of Preservation

Preservation is a very important part of the military supply program. The protection afforded by proper preservation will give assurance that supplies will remain in a suitable condition until they are needed.

Preservation Assures Usability of Items

Placing of items or supplies in unit packs is for the purpose of furnishing protection. Packs must be constructed properly, materials and methods must be in accordance with official instructions.

Protection Afforded by Unit Packing

Unit packing helps in keeping a preservative coating in contact with the item and also protects the coating. It also helps to prevent damage to items against climatic hazards such as rain, snow, heat, cold, high humidity, and salt spray. Unit packing will help prevent damage to items from abrasion, shock, and impact that occurs during handling, storage, and shipment.

Unit Packing Provides for Identification

The final operation of unit preservation is the labeling of the pack with the correct identification and markings. Items which are not properly identified are useless to the receiver and are a waste of time, money, and effort.

Unit Packing Provides a Logical Sequence

Unit preservation is important because it provides a logical sequence of operations whereby the item is given the necessary protection against external causes of deterioration during shipment and storage. It is necessary that each operation of unit preservation be followed by the subsequent operation so that there is a minimum delay of time between operations. The same emphasis on operational sequence must be applied to methods of unit preservation as was applied to the processes of cleaning, drying, and preserving.

Preservation Goal

In military preservation, the primary goal is to afford the required protection at the least possible cost. The greatest savings in preservation costs are possible through the application of basic preservation knowledge by trained operators and supervisors.

The Need for Different Methods of Unit Preservation

Military items which must be packed are so numerous and so different from each other that there is no one single method by which all can be protected. Since there is such a variety of items, the methods of preservation will vary according to the following factors:

- **Composition of the item:** Whether the item is made of metal or nonmetal or a combination of both.
- **Construction of the item:** Whether the item is of simple or complex construction.
- **Nature of the item:** Whether the item has a critical or noncritical surface, the effect of water and watervapor on the item, and the effect of static electricity on the item.
- **Level of protection:** Whether military or commercial packaging is appropriate based on the anticipated types of storage, handling, and or shipment mode.

General Requirements of Methods of Preservation

Preservation materials used in unit packages must meet the following requirements:

- X Cushioning and dunnage used within waterproof or watervaporproof barriers must be as clean and dry as practicable.
- X Items that are coated with a preservative must have a preliminary wrap conforming to Grade A or C of MIL-B-121, MIL-PRF-22191, Type I or II or A-A-1676.
- X Wrapping, cushioning and dunnage materials in direct contact with bare metal surfaces must meet the requirements of Test Method 3005 of Federal Test Standard 101.
- X When greaseproofness is not a requirement, neutral wrapping papers Paper, Wrapping, Laminated and Creped (MIL-P-130); Paper, Wrapping, Chemically Neutral (noncorrosive) (MIL-P-17667); and Paper, Wrapping, Tissue (A-A-1249) meet the requirement and are available at lower cost. These wrapping papers are intended as an initial wrap where a noncorrosive, dust protective wrap is required prior to, or as a part of, the unit pack.

General Concept of Preservation

Corrosion occurs when the environment that surrounds the item provides the essential ingredients that will attack the material, e.g. water and oxygen. Preservation is the sum total of all the ways that the environment surrounding the item can be altered to eliminate one or both of these factors.

The application of a continuous, unbroken coat of contact preservative achieves this end by surrounding the item with an oily film which is resistant to the entrance of liquid water and also keeps oxygen from the surface.

The various barrier materials limit the amount of moisture within the pack to varying degrees, dependent upon their water or moisture vapor transmission rate (WVTR).

Another common way of altering the environment within the pack is to reduce the amount of moisture within a watervaporproof barrier through the use of a drying agent or desiccant.

Methods of Preservation

The methods of preservation (unit protection) are those protective measures that are approved for the prevention of deterioration of military supplies and equipment. They are established by MIL-STD-2073-1C, and illustrated in figure 2-69, and consist of the following basic methods:

- X Method 10: Physical protection only.
- X Method 20: Preservative coating (with greaseproof wrap as required).
- X Method 30: Waterproof enclosure (with preservative as required).
- X Method 40: Water-vaporproof enclosure (with contact preservative as required).
- X Method 50: Water-vaporproof barrier with desiccant (with preservative when required).

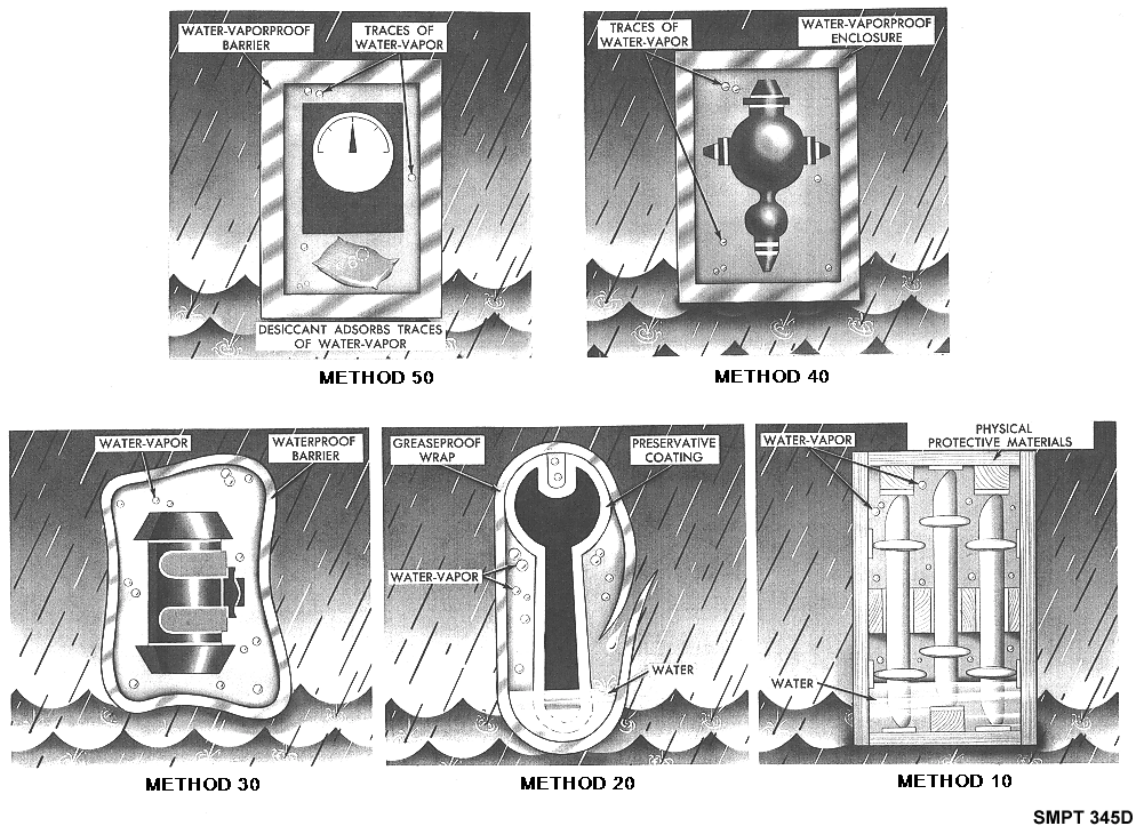


Figure 2-69. Concept of basic methods of preservation.

Methods of Unit Preservation

Various specific techniques have been developed to meet the basic Methods 30, 40, 50 which may be used as appropriate. There are 18 different ways of making unit packs (basic Methods 10 and 20 have no variations). There is no ideal method of preservation which would satisfy all the requirements of military preservation. During this lesson, we are going to discuss examples of each method of preservation as follows:

- X Method 10 Physical protection
- X Method 20 Preservative coating (with greaseproof wrap as required)
- X Method 33 Greaseproof, waterproof bag, sealed
- X Method 42 Container Watervaporproof Bag, sealed, container
- X Method 53 Floating watervaporproof bag, sealed
- X Method 55 Rigid metal container, sealed

Method 10

Physical Protection Only

Physical protection is accomplished by cushioning, blocking, or bolting to prevent movement within containers and physical damage due to shock and vibration. Mechanical protection is provided to an item to prevent damage from any force that will impair the proper functioning of the item. Method 10 does not provide protection from the entry of water, watervapors, gases or fumes, or the growth of microorganisms. No preservative is used on items packed by

Method 10. Items usually packed by this method are of a noncritical nature made of corrosion resistant metals; nonmetals such as crockery, ceramics, and glass; or items that are painted, prime coated, anodized or have other similar corrosion resistant finishes or coatings. Figure 2-70 illustrates various ways to construct a Method 10 pack.

Clean and dry item as required.

Apply wraps and cushioning as close to the item as practicable to control free movement in the container.

Apply, as required, blocking or bracing against areas of the item that are of sufficient strength and rigidity to resist damage.

Apply cartons, bundling, tying, etc. as required.

Apply identification markings to outer container. This completes a Method 10 unit pack.

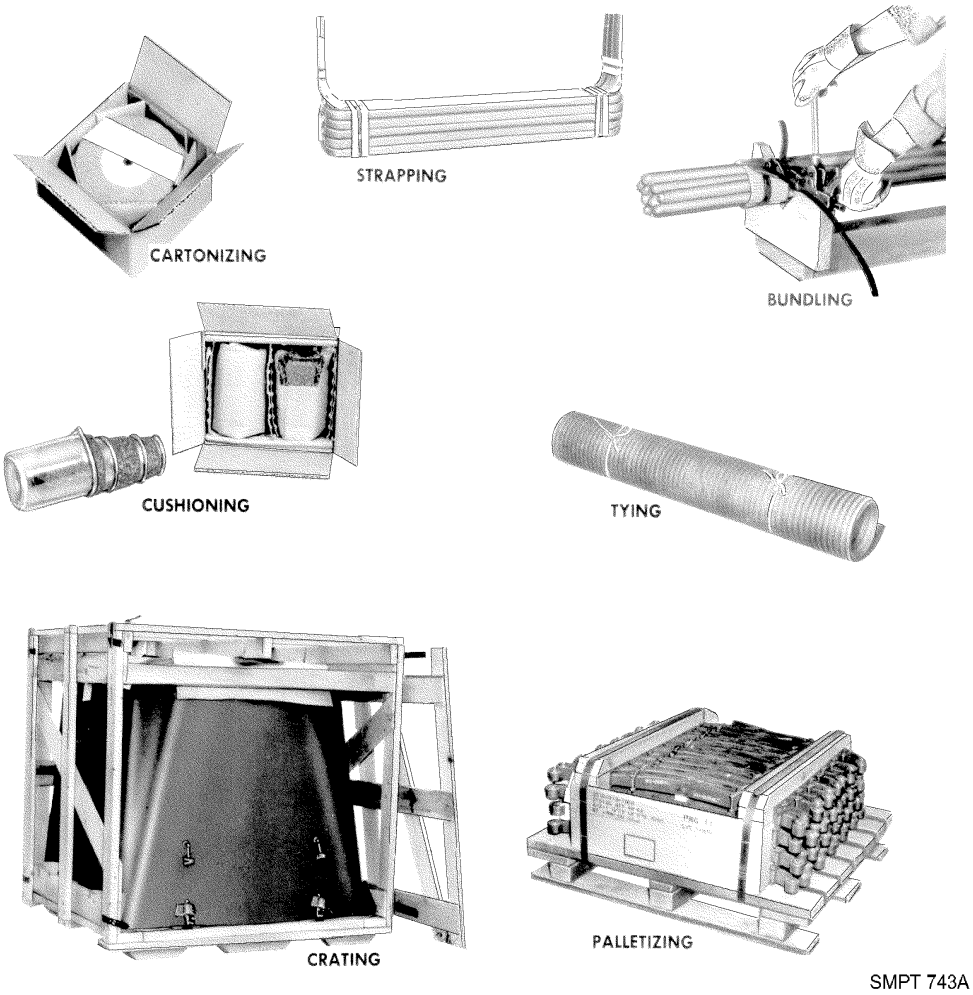


Figure 2-70. Method 10.

Method 20

Preservative Coating (With Greaseproof Wrap as Required)

In Method 20 preservation all the protection given to the item is provided by the preservative coating. This method is used to protect metal items of a noncritical nature where either the removal of the preservative is not required before the item is used, or removal of the preservative can be accomplished without further disassembly or damage to the item. When a soft or oily preservative is used on the item, it must be protected with a greaseproof wrap. Some of the most commonly used preservatives for Method 20 are MIL-PRF-16173, Grades 1, 2, 3 and 4 and MIL-PRF-3240 VCI. A Method 20 pack may be made by use of a hard drying preservative on the item; by use of a soft film preservative on the item, plus a greaseproof wrap; or by use of VCI treated barrier material.

How to Apply Method 20 Preservation Using a Hard Drying Preservative

Figure 2-71 shows the steps required when Method 20 includes the use of a hard drying preservative, and includes cleaning and drying the item; applying MIL-PRF-16173, grades 1 or 4 preservative, to the item, allowing the excess preservative to drain back into the tank; and letting the preservative dry hard on the item; and applying identification markings.

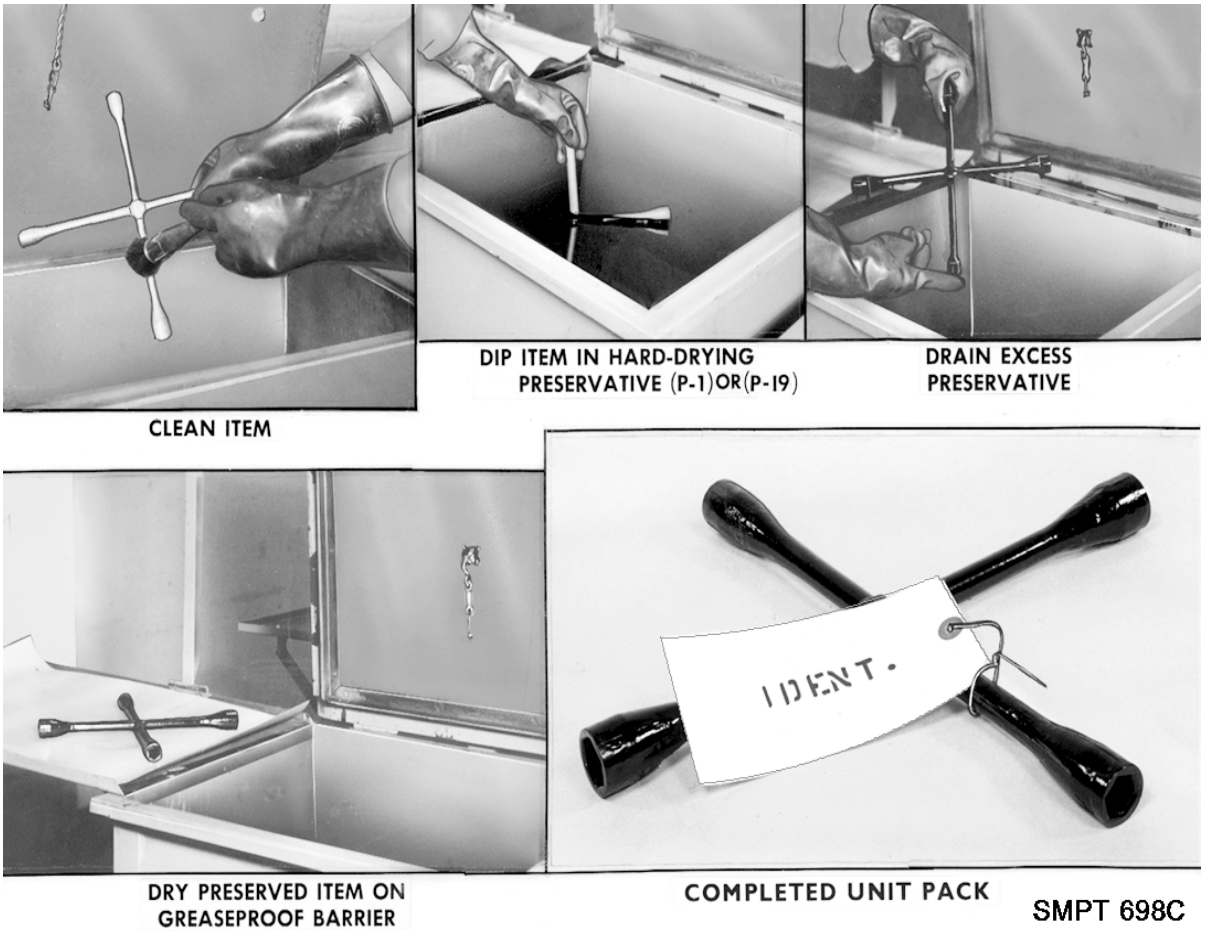


Figure 2-71. Method 20 using hard preservative.

How to Apply Method 20 Preservation Using a Soft Film Preservative

Figure 2-72 shows the steps required when Method 20 includes the use of a soft film preservative and includes cleaning and drying the item; applying an oil or a soft film preservative; draining excess preservative from the item and allowing it to set up; wrapping the preserved item in a greaseproof, noncorrosive barrier of Grade A or C of MIL-B-121, A-A-1676, or Type I or II of MIL-PRF-22191; and applying identification markings.

How to Apply Method 20 Preservation Using VCI Preservative

When VCI is used to accomplish Method 20, the steps include cleaning and drying the item; enclosing the item in VCI treated barrier material forming an air-tight enclosure by taping all the seams; and applying identification markings.

How to Apply Protective Wraps to Preserve Items.

Wraps should be formed to the shape of the item. They must be made to include a minimum of air volume, but should not be so tight that the preservative coating is damaged. Wraps are not applied until the excess preservative has drained from the item and the preservative has set up. The greaseproof side should always be placed against the preservative. Wraps other than VCI are left unsealed so that water will not be trapped against the preservative, and so that condensed water within the wrap will evaporate. However, they should be held in place with pressure-sensitive tape, or by tying.

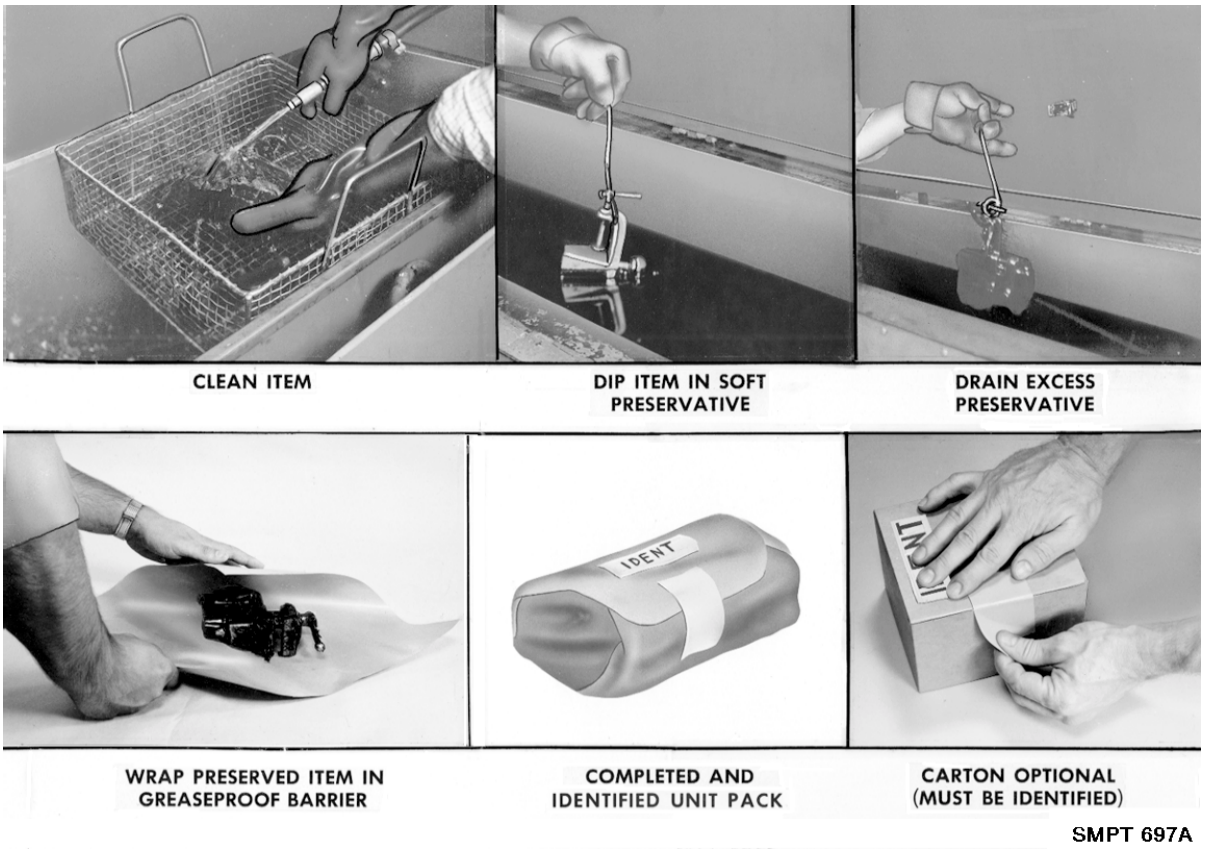


Figure 2-72. Method 20 using a soft preservative.

Method 33, Greaseproof, Waterproof Bag, Sealed

Method 33 consists of enclosing the item in a snug-fitting, heat-sealed, greaseproof, waterproof bag. Figure 2-73 illustrates the procedures for Method 33 preservation.

Clean the item by using one of the approved cleaning processes.

Dry the item using one of the approved procedures.

Preserve the item as required. When a greaseproof initial wrap is required, use MIL-B-121, Grade A or C, Barrier Material, Greaseproofed, Waterproofed, Flexible; A-A-1676, Aluminum Foil; or MIL-PRF-22191, Type I or II, Barrier Material, Greaseproofed, Flexible, Heat-Sealable.

Apply cushioning as required.

Insert the wrapped and cushioned item into a snug-fitting, greaseproof, waterproof bag made from barrier material conforming to MIL-B-121, Grade A, or MIL-PRF-22191, Type I or Type II, or MIL-PRF-22019. Remove excess air from the bag and heat seal the seams.

Apply identification markings. This completes a Method 33 unit pack.

To determine the proper amount of barrier required to fabricate a bag for Method 33, use the formula: barrier length (L) = 2w + 2d + 3" and barrier width (W) = P + d + 3", where

L = Length of barrier material.
W = Width of barrier material.
where:
l = Length of container or item.
w = Width of container or item.
d = Depth of container or item.

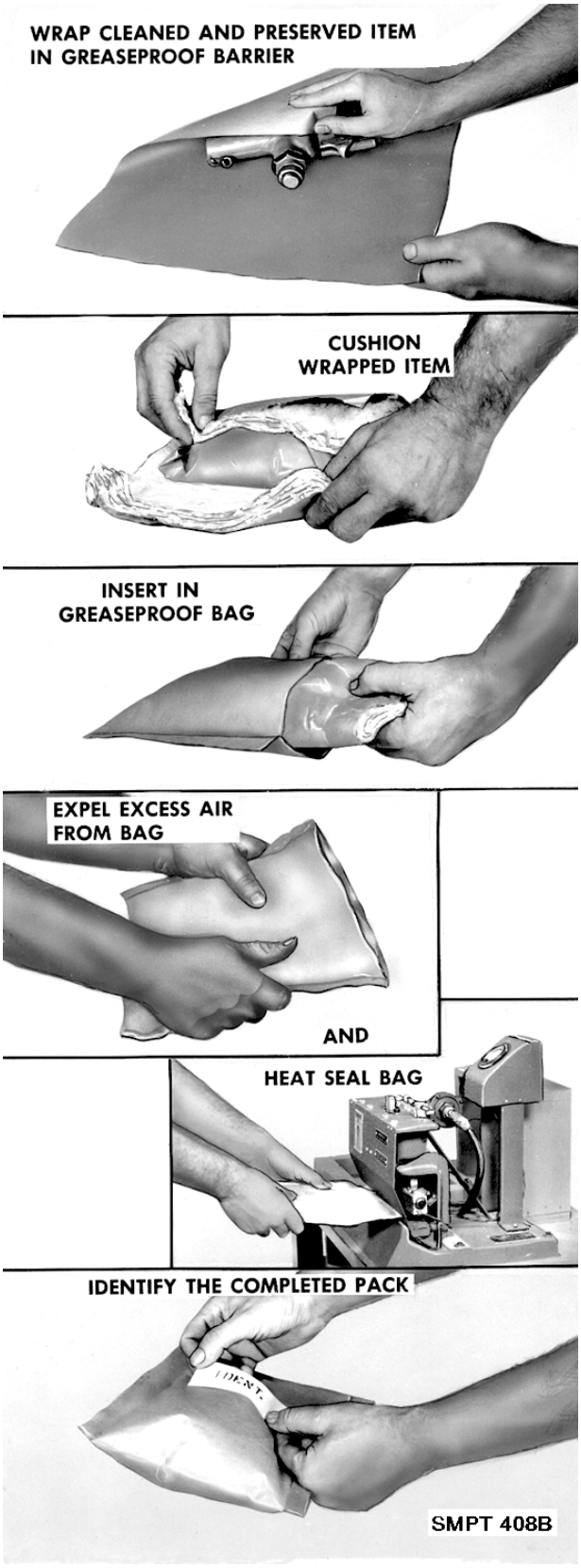


Figure 2-73. Method 33.

Method 42, Container, Watervaporproof Bag, Sealed, Container

Method 42 consists of sealing a container in a watervaporproof bag which in turn is enclosed in another container. See figure 2-74.

Clean the item by using one of the approved cleaning processes.

Dry the item using one of the approved procedures.

Preserve the item as required. When a soft preservative is required, wrap the preserved item in a greaseproof wrap of MIL-B-121, Grade A or C, Barrier Material, Greaseproof, Waterproof, Flexible; A-A-1676, Aluminum Foil; or MIL-PRF-22191, Type I or II, Barrier Material, Greaseproof, Flexible, Heat-Sealable.

When a soft preservative is not required, wrap the item in a neutral wrap of MIL-P-130, Paper, Wrapping, Laminated and Creped or MIL-P-17667, Paper, Wrapping, Chemically Neutral (Noncorrosive).

Cushion item as required.

Insert the wrapped and cushioned item into a snug-fitting container conforming to a fiberboard shipping box (ASTM D 5118), folding paperboard box (PPP-B-566); or setup box (PPP-B-676).

Enclose the boxed item into a snug-fitting, watervaporproof bag made from barrier material conforming to MIL-PRF-131, MIL-PRF-22191, Type I, or MIL-PRF-81705, Type I. Remove excess air and make final heat seal. Apply identification markings to bag. (Compute the required barrier size using the formula given for Method 33.) Insert in outer container.

Apply identification markings to outer container. This completes a Method 42 unit pack.



Figure 2-74. Method 42. Container, Watervaporproof Bag, Sealed, Container.

Method 50, Watervaporproof Barrier With Desiccant

Method 50 provides the best possible protection in preservation. It is used for items of highly critical nature, mechanical or electrical, which would normally not be coated with a preservative. All Method 50 packages must have the special Method 50 label applied to the outer container. Those submethods that use a heat-sealed bag must have room along the opening edge for two additional heat seals. This is for inspection purposes. This Method uses an absorbing material, known as desiccant, to absorb any moisture within the package. It must not be used on any item where the removal of moisture would cause damage to the item. To determine the proper amount of desiccant to be placed in a Method 50 unit pack, you have to use one of the following formulas:

X Formula I. For all Method 50 unit packs utilizing a flexible barrier material:

$U = CA + X_1D + X_2D + X_3D + X_4D.$

X Formula II. For all Method 50 unit packs utilizing a sealed rigid metal container:

$U = KV + X_1D + X_2D + X_3D + X_4D.$

X Values:

U = Number of units of desiccant.

C = .011 when area of flexible barrier is given in square inches or 1.6 when the area is given in square feet.

K = .0007 when the volume of a rigid container is given in cubic inches or 1.2 when the volume is given in cubic feet.

A = Area of container in square inches or square feet.

V = Volume if container in cubic inches or cubic feet.

X_1 = 8 for cellulosic material (including wood) and other material not categorized below.

X_2 = 3.6 for bound fiber.

X_3 = 2 for glass fiber.

X_4 = 0.5 for synthetic foams and rubber.

D = Pounds of dunnage.

X To determine the proper amount of barrier required to fabricate a bag for Method 50 submethods, use the formula:

barrier length (L) = 2w + 2d + 3" or (5")

barrier width (W) = P + d + 3" or (5)".

Note: The 5" dimension is used to allow for two additional heat seals required for Method 50 pack inspection and is used on either the length or width dimension.

Method 53, Floating Watervaporproof Bag, Sealed

Method 53 is used for those items which, because of size, weight, complexity, and construction, necessitate mounting the item to a supporting member or face of a container. Method 53 preservation steps, shown in figure 2-75, are as follows:

X Clean the item by one of the approved cleaning processes.
X Dry the item by one of the approved drying procedures.
X Preserve the item, as required, by application of one of the approved preservatives.

X Prepare mounting base by installing gaskets on protruding bolts and cement gaskets in place by use of gasket cement.

X Place barrier material on mounting base with bolts protruding through barrier material. Barrier material must meet the requirements of Class 1 or 2, of MIL-PRF-131, Type I of MIL-PRF-22191, or Type 1, MIL-PRF-81705.

X Place gaskets on protruding bolts and cement in place against barrier material.

X Place item on mounting base and secure bolts.

X Cushion all sharp edges and corners of the item, as required.

X Attach bags of desiccant to item by means of tape or tying. Care should be taken to prevent desiccant bags from touching critical surfaces of the item.

X Apply humidity indicator, unless otherwise specified.

X Fold barrier material over item and heat seal all edges, except for an opening to exhaust air from the pack. Remove excess air from bag by use of air extracting device using care not to rupture barrier material. Make final heat seal to close barrier. Fold flaps around pack and tape in place.

X Apply identification markings and Method 50 markings.

X Place item in suitable outer container for shipping and apply appropriate markings. This completes a method 53 unit pack.



Figure 2-75. Method 53. Floating Watervaporproof Bag, Sealed.

Method 55, Rigid Metal Container, Sealed

This method uses sealed rigid metal containers which provide watervaporproof protection. Usually reusable metal drums are used in making this method. Figure 2-76 shows the Method 55 preservation steps as follows:

- X Clean the item by one of the approved cleaning processes.
- X Dry the item by one of the approved drying processes.
- X Mount item to a suitable mounting base (if a base is required).
- X Apply cushioning, as required.
- X Attach bags of desiccant to item by means of tape or tying. Care should be taken to prevent desiccant bags from touching critical surfaces of the item.
- X Apply humidity indicator, unless otherwise specified.
- X Seat rubber gasket firmly in lid and place on container. Position locking ring and fasten with nut and bolt. Tap locking ring lightly as nut is being tightened. Attach tamper proof seal through lips of locking ring (when required).
- X Apply identification markings and Method 50 markings. This completes a Method 55 unit pack.



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Figure 2-76. Method 55. Rigid Metal Container, Sealed.

Interior Unit Pack Marking Requirements per MIL-STD-129

Markings on unit and intermediate interior packs and unpacked items must be located so as to allow the markings to be easily read when stored on shelves or stacked, and to insure that the markings will not be destroyed when the pack is opened for inspection or until contents have been used. The marking surface of a unit pack must be the outermost wrap, bag, or container of the unit pack.

As shown in figure 2-77, the following information, as appropriate, must appear on unit and intermediate packs and unpacked items in the order listed:

- X National Stock Number. The National Stock Number is the exact stock number specified in the work order. It consists of 13 digits arranged in groups of 4, 2, 3, and 4, separated by hyphens, e.g., 8905-00-127-4361.
- X Quantity and unit of issue. Quantity is the number or measure of the contents of a unit pack, intermediate pack, shipping container, or bundle. Unit of issue is the standard or basic quantity in which an item of supply is divided, issued, or used. Examples are piece, pair, bottle, can, each, dozen, gross, pound, gallon, foot, yard, set, etc.
- X Contract or purchase order number. The contract, purchase, or delivery order number is that number covering the shipment and titled as such.
- X For military methods, indicate the letter M, and then the number of the method used. The date indicates month and year the unit pack was accomplished.
- X Special markings, when applicable. When applicable, packs must be marked in accordance with MIL-STD-129.
- X When bar code markings are required, they shall be applied above the National Stock Number.

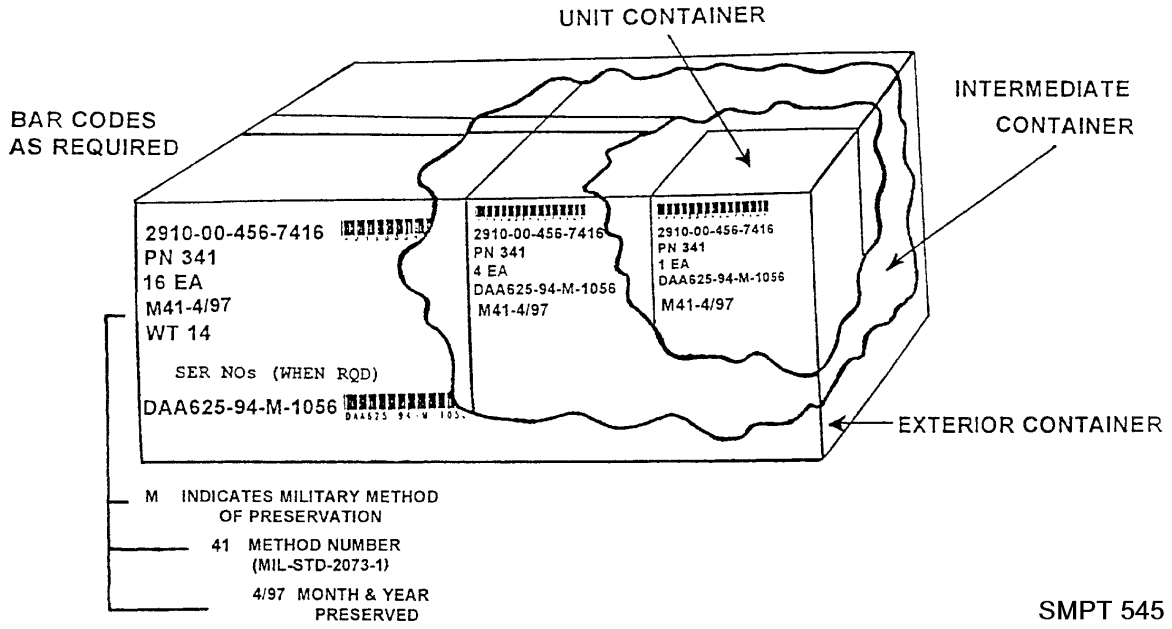


Figure 2-77. Interior unit pack markings.

Checkup

X How is protection provided to an item in Method 20 preservation?

X What method of preservation provides only physical protection?

X How is protection provided to an item in a Method 42 unit pack?

X What material is used inside Method 50 packs to absorb moisture?

X What kind of container is used to make a Method 55?

X What neutral wrap may be used around a bare metal item when making a Method 42 unit pack?

X In Method 20 preservation, items that are coated with a soft film, preservative must have a preliminary wrap. What preliminary wraps may be used?

METHODS APPLICATION PRACTICAL EXERCISE

Objective

As a result of this practice, the student will be able to identify various materials and their application to accomplish preservation and packing operations.

General Instructions

This practical exercise will be conducted in the classroom. It will require 2 class periods. The instructor will hold a critique at the end of the practical exercise.

CONDUCT OF EXERCISE

Situation

As a preservation line operator, you are responsible for fabricating various Methods of Preservation.

Requirement

Answer the following questions:

1. What is the goal of all preservation personnel?

2. How is a unit pack defined?

3. What methods use water-vaporproof barrier materials?

4. What protection do we get from Method 50 packs:

5. What packaging operations provide the protection we get in Method 10 packs?

6. What is the first step in constructing any method of preservation?

7. What are three ways a Method 20 pack may be made?

8. What are the hard drying contact preservatives that can be used to make a Method 20 pack?

9. Describe a Method 33 pack.

10. When making a Method 33 pack, we find that a greaseproof wrap will be used around the preserved item. Name two materials that can be used.

11. What is the difference in the protection provided by Method 30 and Method 40 packs?

12. What is the title of Method 42?

13. What interior containers can be used to make a Method 42 pack?

14. What must be done to the watervaporproof bag in a 42 pack before it is sealed?

15. What equipment is used to seal a watervaporproof bag made from a barrier such as MIL-PRF-131?

16. If an item is not preserved with a contact preservative in a Method 42 or Method 50 pack, what may be used to protect its surface?

17. What material is added to a Method 40 pack to make it a Method 50 pack?

18. What method of preservation is specially designed for giving a low humidity protection to an item which is mounted on a base?

19. What can be applied to the outside of the barrier to indicate that a pack is Method 50?

20. Metal cans are used to make what Method 50 packs?

21. What method is used on metal items having critical surfaces?

22. What is always the last step in making a unit pack?

23. What factors are considered in choosing a method of preservation?

24. What is the purpose of preservation?

25. When a noncorrosive, protective wrap is required as a part of the unit pack, what wraps can you use?

26. What method of preservation provides no protection from liquid water?

27. What greaseproof wraps may be used in a Method 33?

28. Describe in your own words how you would complete Method 33 for an automotive wheel bearing.

Critique

The instructor will call on members of the class to answer the questions.

Care of Area, Training Aids & Equipment

Not applicable.

MISCELLANEOUS PACKAGING REQUIREMENTS

RETURN OF REPAIRABLES

Repairable Returns

Experience has proven that we can repair an item for less than half the cost of a new one. Also, it puts the item back into the supply system in a much shorter time than that time required to purchase a new one. Proper packaging can help in the management of repairable items by:

- X Making certain that all retrograde repairable items are returned promptly and safely to the designated overhaul activity.
- X As shown in figure 2-78, insuring that adequate protection is provided to repairable items that may need only adjustment, calibration or simple repairs. If they are handled carelessly, sometimes a complete overhaul will be necessary or the item is damaged beyond economical repair. It becomes JUNK.
- X Insuring that correct and complete documentation accompanies each repairable item.

Processing of Repairable Items

Most repairable items can be protected during their return to overhaul activities by reusing the packing materials and reusable containers in which the replacement parts are received.

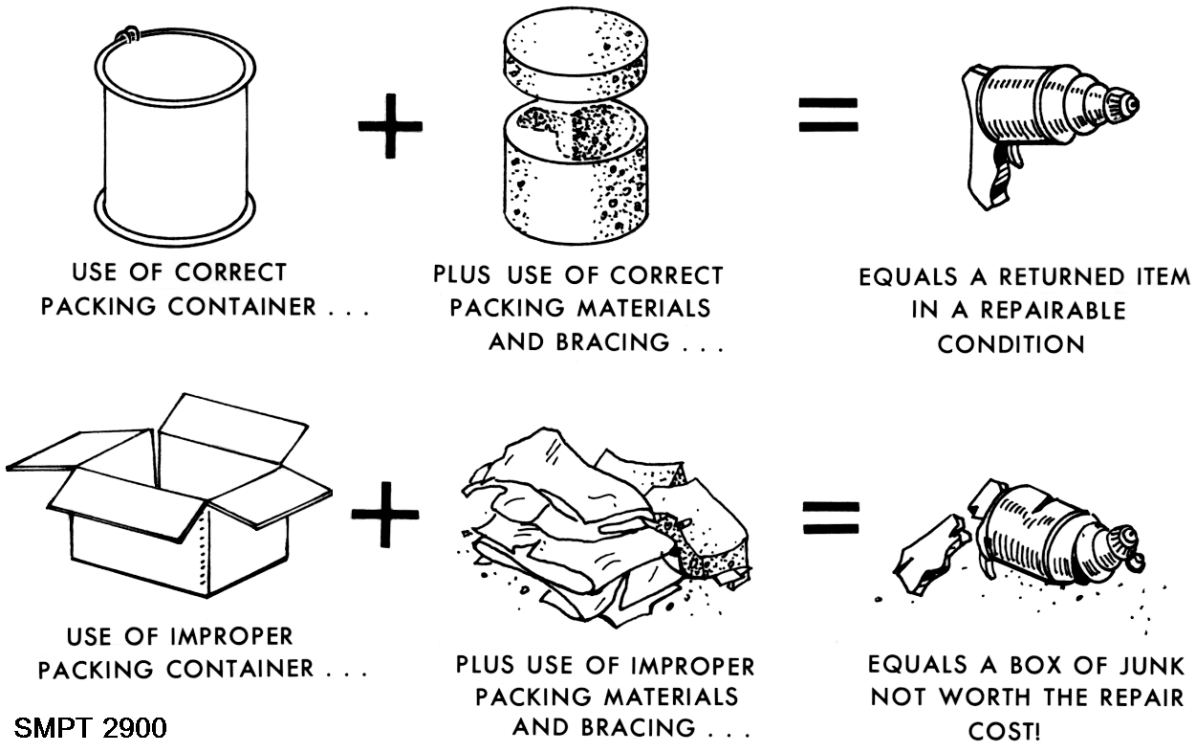


Figure 2-78. Packing of Repairables.

Adequate protection should be given to repairable items and can be accomplished in three ways. First, return the repairable items in their assigned reusable container. Second, provide adequate storage and careful handling until the item can be properly preserved and packed. Third, apply unit packing and/or unitized packing, using available materials, to provide the amount of preservation required (i.e., unit protection). The item may only require Method 10 protection or it may require as much as a Method 50 protection.

Apply identification markings and any special markings to the containers.

When two or more packed repairable items are placed in a single shipping container, place the heaviest or densest item on the bottom. Avoid packing light fragile items with heavy rugged items.

All exterior shipping containers should bear the following minimum markings:

- X Identification markings.
- X Address markings.
- X Special markings that would be necessary for safe shipment.

Additional Processing Information

Additional information on preservation and packing operations, which can be applied to retrograde repairable items, can be found in the preservation and packing sections of the specification or standard.

Detailed preservation information is also contained in FM 38-700/MCO P4030.31D/NAVSUP PUB 502/AFJPAM 24-237/DLAI 4145.14.

Detailed packing information is contained in, FM 38-701/MCO P4030.21D/NAVSUP PUB 503/AFJPAM 24-209/DLAI 4145.2.

Interior Unit Pack Marking Requirements per MIL-STD-129

The marking requirements for repairables are the same as those described earlier.

Special Markings

When applicable, special markings will be as indicated in MIL-STD-129. Unit packs of hazardous material require the proper shipping name to be shown as the last line of the identification data.

FIELD EXPEDIENTS

Field expedients are the improvised methods of preservation and packing used by personnel in the field for returning items of supply to storage or processing area. Generally, the use of field expedients is accomplished at oversea activities.

When the prescribed methods and equipment are not readily available, it is necessary to substitute equipment and use substitute materials. The user in the field must be able to process repairable and returnable items using simple handtools and primitive equipment to prevent further damage to the items.

There are several classes of items that are returned from maintenance and support areas. They include repairable items, unserviceable repairable items, and excess items. The protection given to these items depends upon the condition of the item. Serviceable and unserviceable repairable material will be packaged to maintain the integrity of the degree of serviceability of the material being returned.

Packaging and packing materials should be salvaged from incoming shipments and reused. Examples are shown in figure 2-79. Care should be taken in the opening of containers and the removal of their contents so that the packaging/packing may be reclaimed. The materials may be used to wrap, cushion, block and brace and pack items for outgoing shipments. Original shipping container can be reused for the same item or a similar item of approximately the same size, shape, or weight. Proper tools should be used in opening containers. Carefully remove nails, bolts, and any other attaching hardware. If the container has a caseliner in it, and the liner is torn or ripped, patch or mend it for reuse. If the container is too large, it can be cut down to the approximate size of the item which is then cushioned, blocked, or braced in place.

When cleaning materials and equipment are not available, alternate processes must be selected. Cleaning must be thorough to remove all dirt and rust from the item. The cleaning processes may depend on mechanical or chemical action for the removal of dirt and rust.

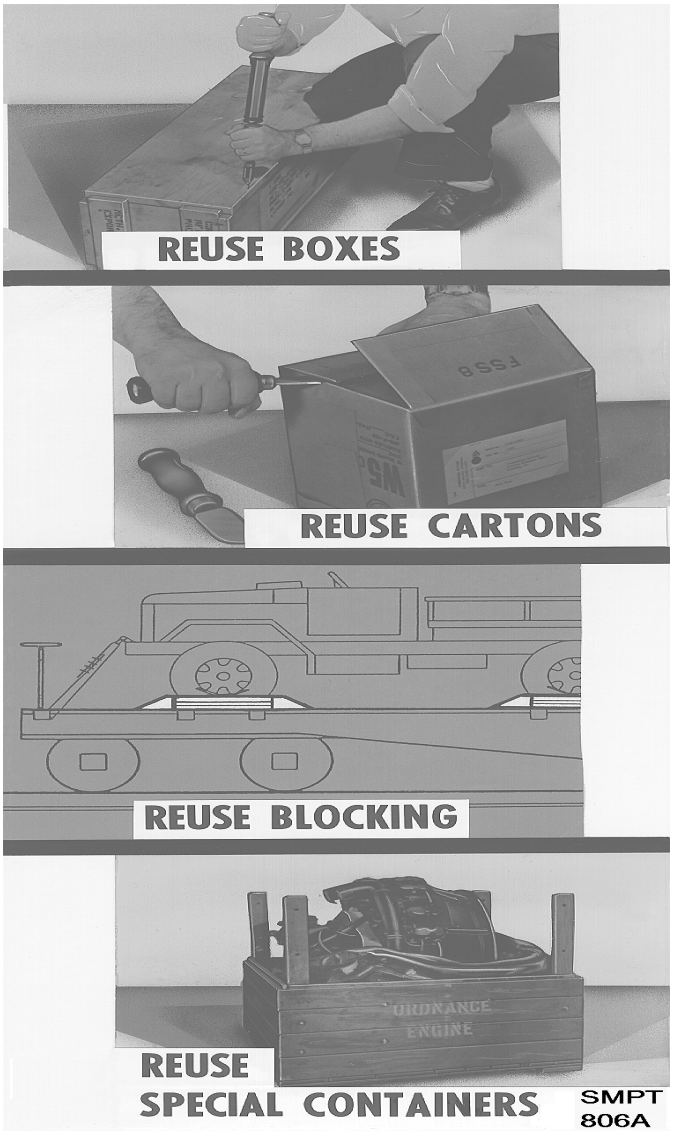


Figure 2-79. Salvaging reusable materials from shipments .

Mechanical Processes

Cleaning by physical or mechanical action may involve the use of one or more of the following operations:

X Wiping. This involves wiping dirt and rust from the item. Old burlap bags may be used to remove dirt and wire brushes will remove rust. When clean cloths are available, use two cloths. Use one cloth to remove heavy dirt and use the second cloth as a final wipe.

X Use of abrasives. Barrel tumbling is a form of abrasive that removes rust, carbon deposits, etc., from dirty and rusty items. It may be used for rugged items. To obtain the scrubbing action needed, nails, staples, bolts, nuts, sand, screened gravel, or crushed stone with water may be used. A barrel to do the tumbling may be constructed from a used 55-gallon drum on an improvised rack. Care should be taken that the items cleaned by this method are not damaged by the abrasive and the water. Hand sanding with sand paper, emery cloth, crocus cloth, and carborundum in the form of discs, sheets, or belts may be used to remove rust, paint, old finishes, and other dry coatings. This process may be used if the surfaces are not marred or injured to the point of making the items useless or unrepairable.

X Impact tool cleaning. The removal of scale, rust, or old dry coatings may be done with cross peen, claw, mason's or ball peen hammers, chisels, sharpened steel stock of appropriate length and width, putty knives, or carbon scrapers. The choice of the proper tool should be governed by the type of material and item to be cleaned. When this method of cleaning is used, it is important that the operator wear safety goggles.

X Use of power tools. If electric or pneumatic hand power tools are available, they can be used for the removal of rust, scale, and dry coatings in conjunction with abrasive discs. Wire wheels and abrasive wheels may also be used. The selection of the tools and abrasive materials should be governed by the type of dirt or rust, complexity of the item, and surface finish of the item to be cleaned. When performing cleaning with the use of hand power tools, the operator should wear safety goggles, shield, and gloves.

Chemical Processes

Cleaning by chemical action may be accomplished by one or more of the procedures that uses a solution.

Solvent Cleaning

Solvent cleaning is based on the dissolving action of solvents on oils, light greases, and other types of dirt. It is used on both critical and noncritical surfaces. Care should be taken to insure that the items are not damaged by the use of the solvent. Caution. Do not use gasoline. Paint thinners may be used. They are highly volatile, colorless, and flammable liquids that evaporate quickly, leaving a corrosion-inducing film on metal surfaces. In the field, the containers in which the thinners are shipped are an excellent storage medium. The empty container may be used as cleaning tanks for small parts after the tops have been removed. Many cleaning compounds, such as household cleaners will remove grease, paint, tar, road dirt, etc. from the item. Diesel fuel is an effective cleaning solvent and will protect the items for a short period of time. Caution should be exercised since the diesel fuel itself is a fire hazard. Alcohol may be used as a thinner and solvent for cleaning pharmaceutical instruments, small parts, or those items that can be totally immersed.

Hot Water

Hot water, when used with soaps and detergents, makes an effective cleaner for parts that are not affected by it. The water must be very hot and may be used with detergents found in the dining hall or kitchen for washing away grease. It is necessary that a hot water rinse can be used to remove the soap and detergent films from the items before drying.

Steam Cleaning

Cleaning with a high-pressure jet of steam, with or without an added cleaning compound, is used to clean metal surfaces.

After the item has been cleaned in a cleaning solution the next step is rinsing. This is done in another tank or receptacle containing clean solvent of the same kind used in the cleaning operation, or hot water, depending on the method and cleaning materials used. The solvent or water used for rinsing should be changed often to keep it as clean as possible.

There are several methods of drying which can be used in the field. Compressed air, ovens, spotlights, and ordinary light bulbs can be used as drying methods. If these methods are not available, you may dry by wiping with a clean, dry cloth. Items may be dried by draining after using most solvents as the final rinse. It is important that the items be handled carefully again after drying to prevent them from getting dirty again.

Preservatives, if required should be applied as soon as possible after drying. Preservative selection should be based on item characteristics and intended uses of the preservative.

There are many ways that material may be processed in the field through the use of field constructed equipment. Some of the more easily constructed equipment are as follows:

- X Field-constructed hot-dip tank. A hot-dip tank may be made by cutting a 55-gallon drum in half to make a round tank and adding a source of heat, as shown in figure 2-80.
- X Field-constructed petroleum-solvent tank. Figure 2-81 shows petroleum solvent tank may be made by cutting a 55-gallon drum lengthwise and placing on stands. A cover should be made to fit the tank as tightly as possible. Two-gallon pails and five-gallon cans may also serve as containers for the cleaning solvent.
- X Field-constructed drying oven. A drying oven can be constructed from a 55-gallon drum. To provide the heat, a good gasoline element from a field kitchen stove can be used. Coal, oil, or wood may also be used to supply the heat required.
- X Field-constructed hot water or alkaline cleaning tank. A 55-gallon drum with the top removed to make a vat may be used as a hot water or an alkaline cleaning tank as illustrated in figure 2-82. To provide the heat for an alkaline solution, the steam from a steam-cleaning unit may be used. Kitchen lye may be used as the alkaline cleaning material.

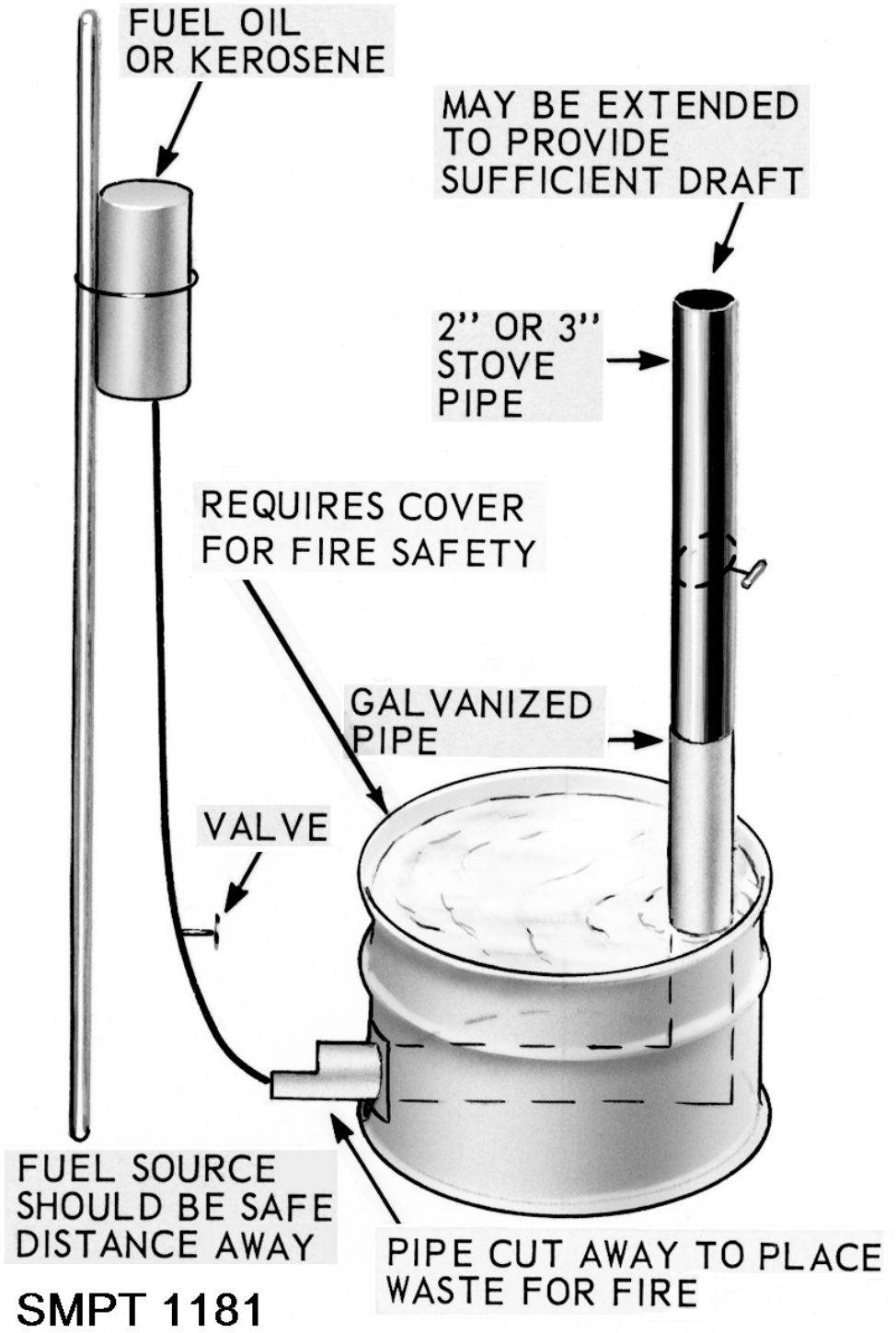


Figure 2-80. Field constructed dip tank.

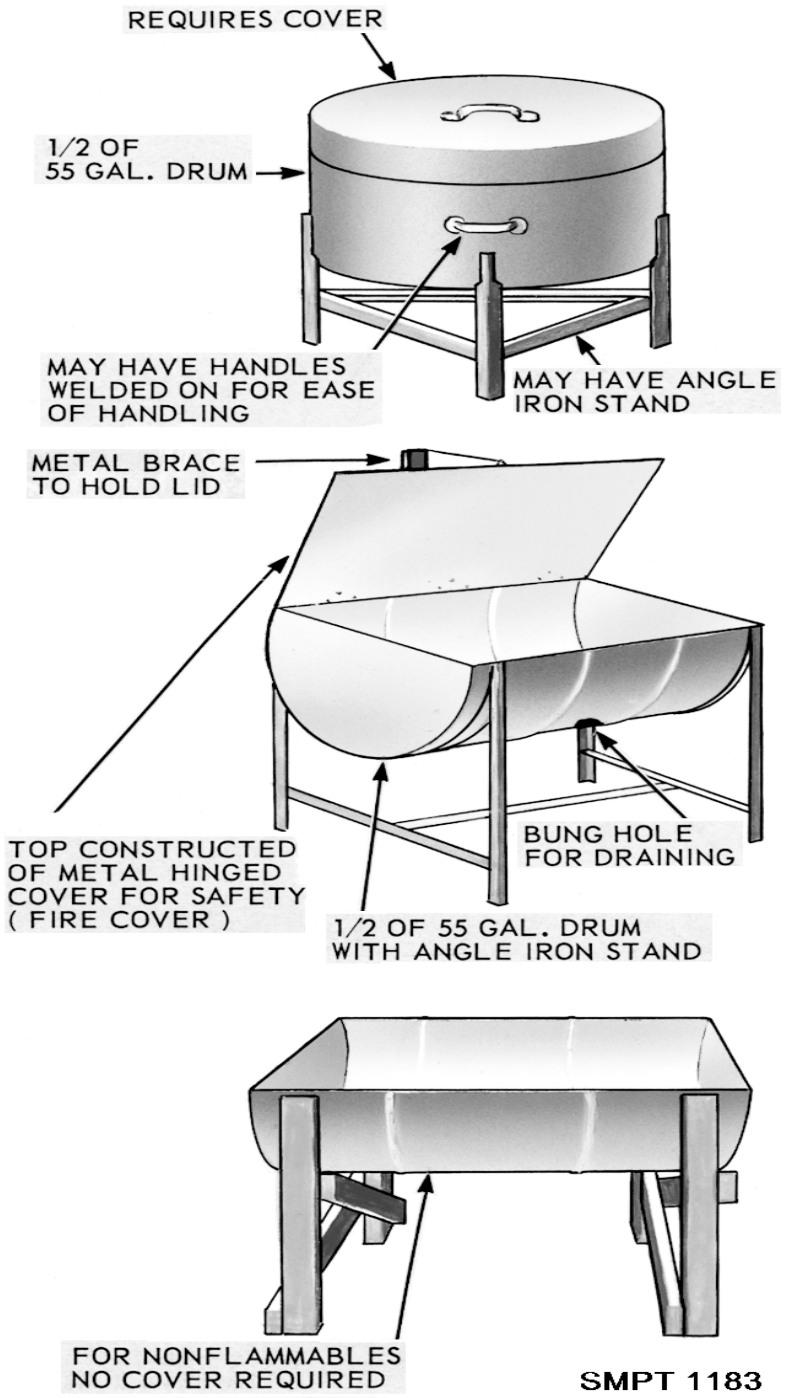


Figure 2-81. Field constructed petroleum solvent tank.



Figure 2-82. Field constructed hot water or alkaline cleaning tank.

X Field-constructed drum-type tumbling cleaner. Figure 2-82 shows how a tumbling cleaner may be constructed from a 55-gallon drum. The drum should be provided with an axle that may be fitted into a bearing surface. One end of the axle should have a handle for turning the drum. In the side of the drum, there should be an opening with a door that can be secured. Inside there should be agitators (fins) to cause the material to tumble. These may be made from angle iron or like materials.

X Field-constructed small parts dipping baskets. Small parts dipping baskets may be constructed from cans with holes punched in the sides and bottom so as not to trap solvent as shown in figure 2-83. A wire handle should be attached for handling of the baskets. Varying size cans might be obtained from the dining facility. These baskets can also be made from screen wire, hardware cloth, etc.

X Extreme care must be used to assure that the proper preservatives, cleaning, and packing materials are not available through normal supply channels before expedients are used. In all cases the field expedients will be used only as a last resort to prevent further damage of supplies and equipment.

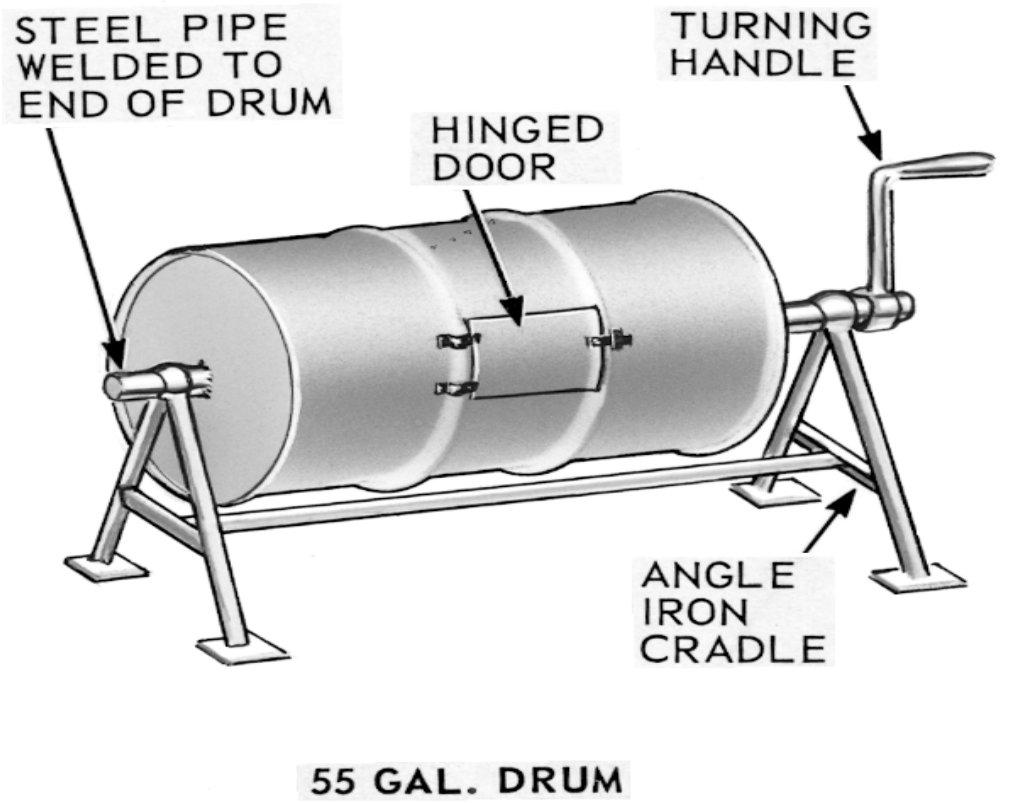


Figure 2-83. Field constructed drum type tumbling cleaner.

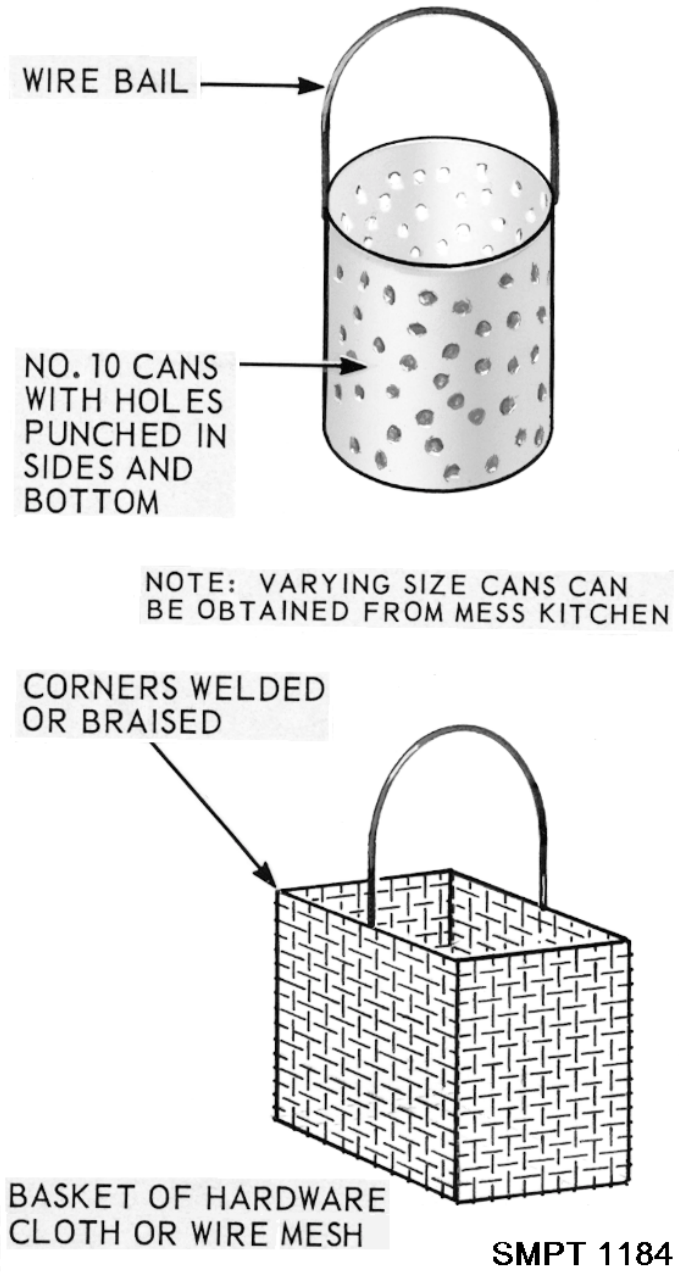


Figure 2-84. Field constructed small parts dipping baskets.

SAFETY

Policy

It is the government's policy, through regulations, that the provisions of the Occupation Safety and Health Act will not be compromised or ignored in accomplishing military packaging functions. The responsibilities for safety procedures starts with the commander of each DOD organization and ends with the individual worker.

Safety Practices

The commander has the responsibility to:

- X Provide a safe and healthful place to work.
- X Provide safe conditions under which packaging operations can be accomplished.
- X Obtain and maintain safety and protective equipment.
- X Require the use of this equipment.
- X Establish a safety program.
- X Periodically inspect the work area to assure the safety program is being accomplished.

It is the individual worker's responsibility to properly use the safety equipment and work in a safe manner.

Safety is everyone's responsibility. You can affect your fellow workers' safety as well as your own by not working "by the rules." The best safety program in the world is of little value if the workers leave it in the conference room. Only you can prevent accidents.

HAZARDOUS WASTE

General

We are all becoming more aware of the tremendous number of hazardous materials being used throughout the world. Well, what happens when containers of hazardous materials are not completely used up by industrial and military installations or materials whose expiration date passed? They become hazardous wastes. In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) which defines a hazardous waste as "a solid waste that may cause or significantly contribute to serious illness or death..."

Wastes

The four characteristics which make a material hazardous are:

- X Ignitability.
- X Corrosivity.
- X Reactivity (or explosiveness).
- X Toxicity.

Many of the materials that are used in packaging operations can end up as a waste product, some hazardous. For example:

- C Plastics may generate organic chlorine compounds.
- C Paints generate heavy metals, pigments, organic residues.
- C Petroleum products (solvents) generate oils, phenols, organic compounds, ammonia salts, acids, caustics.

Regulations

RCRA

Because of the increasing potential hazards of waste products, the Environmental Protection Agency (EPA) has adopted a "cradle-to-grave" control system. This system regulates hazardous waste from the time it is generated through transportation to final disposal.

Control of all aspects of hazardous waste, as regulated by Code of Federal Regulations (CFR) 40, Protection of Environment, is gradually being turned over to the individual states as they develop waste management programs consistent with RCRA.

Each DOD installation is or will be responsible to the state in which it is located. The commander of that installation is responsible for developing a hazardous waste management program, which will establish how hazardous waste will be identified, collected, stored, transported, and disposed.

CFR 40 regulates the documentation, transportation, storage, and disposal of hazardous waste.

CFR 49, Transportation, regulates the packaging and some transportation of hazardous waste between states. This document explains how each container will be marked and labeled. We will have an opportunity to discuss this to a greater extent in a later lesson.

Your Responsibility

To be part of the solution to the hazardous waste problem:

- X Recognize that we are all part of the problem-- hazardous waste inevitably results from the products used in packaging operations.
- X Reduce the amount of materials we waste--this will not only reduce the quantities of hazardous waste generated, but will also conserve natural resources, reduce solid waste disposal problems, and save us money.
- X Understand the many complexities of the hazardous waste problem--EPA, state, and local governments all have regulations.
- X Participate in waste management programs.
- X Recognize that there are no easy solutions.

Checkup

- X What method of preservation do you use to pack small repairable items?
- X What are field expedients?
- X When the necessary equipment and material are not available, what should the individual do?
- X Why is the proper opening of a carton important?
- X If hot water and soaps are used for cleaning, what should be the next step?
- X What may be used as a petroleum solvent tank in the field?
- X What document explains the proper disposal procedures for hazardous waste?

CHAPTER 3
Military Packing

INTRODUCTION TO MILITARY PACKING

PACKING

Proper Packing

There is a definite need for proper packing if we are going to give our supplies maximum protection at minimum cost. How can we do this? It is very simple! Know the characteristics of the item you are packing and apply the protection the item needs. It is important not to over or under pack because:

- X Overpacking costs the Government excessive amounts of money for materials and labor.
- X Underpacking can cause excessive damage to many items and make them useless.
- X Properly packing materiel the first time will save money.

Purpose of Packing

The purpose of packing is to protect the item from damage during handling, shipment, and storage.

How Packing is Accomplished

As shown in figure 3-1, packing is accomplished by inserting unit or intermediate packs or unpacked material into a shipping container after the application, when required, of blocking, bracing, cushioning, and waterproof barriers. Packing is completed with the final closure, strapping, and marking of the shipping container.

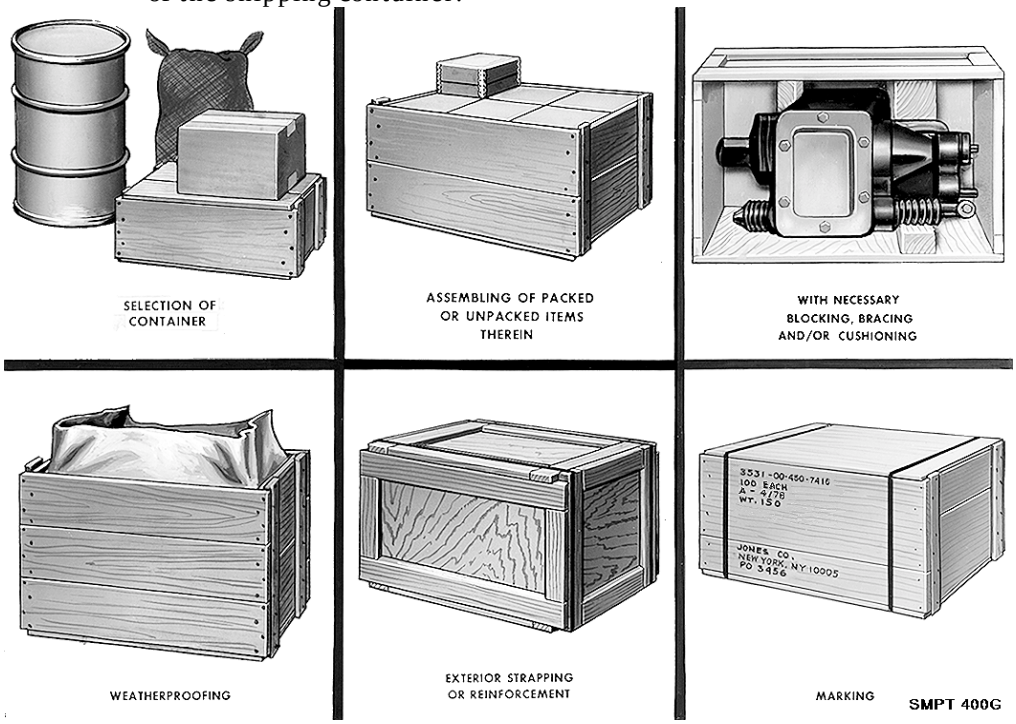


Figure 3-1. Basic steps in military packaging.

Preservation vs. Packing Operations

Preservation and packing operations are sometimes considered as being the same thing, but each one has its own operations, as illustrated in figure 3-2. The preservation operations are known as the preservation cycle. This was covered during the first part of the course. The packing operations are known as the packing cycle. Let's look at each one of these operations individually.

Exterior Shipping Container

The shipping container to be selected and used may be spelled out by authority, specifications, or technical orders. In instances where a group of containers are authorized or when the container is not specified, the responsibility of container selection is then placed on you, the packer.

The factors that should be considered when selecting containers includes the destination (domestic or overseas); mode of transportation; physical characteristics of the item(s), such as weight, size, shape, and fragility; type of load; initial cost of the container; weight and cube of the container; simplicity and economy of assembly; closure; availability of the container; reusability of the container.

Containers available for use are generally fiberboard boxes, cleated panel boxes, modular containers, skid bases, pallets, reusable containers, designated containers for repairable parts, crates, etc. as shown in figure 3-3.

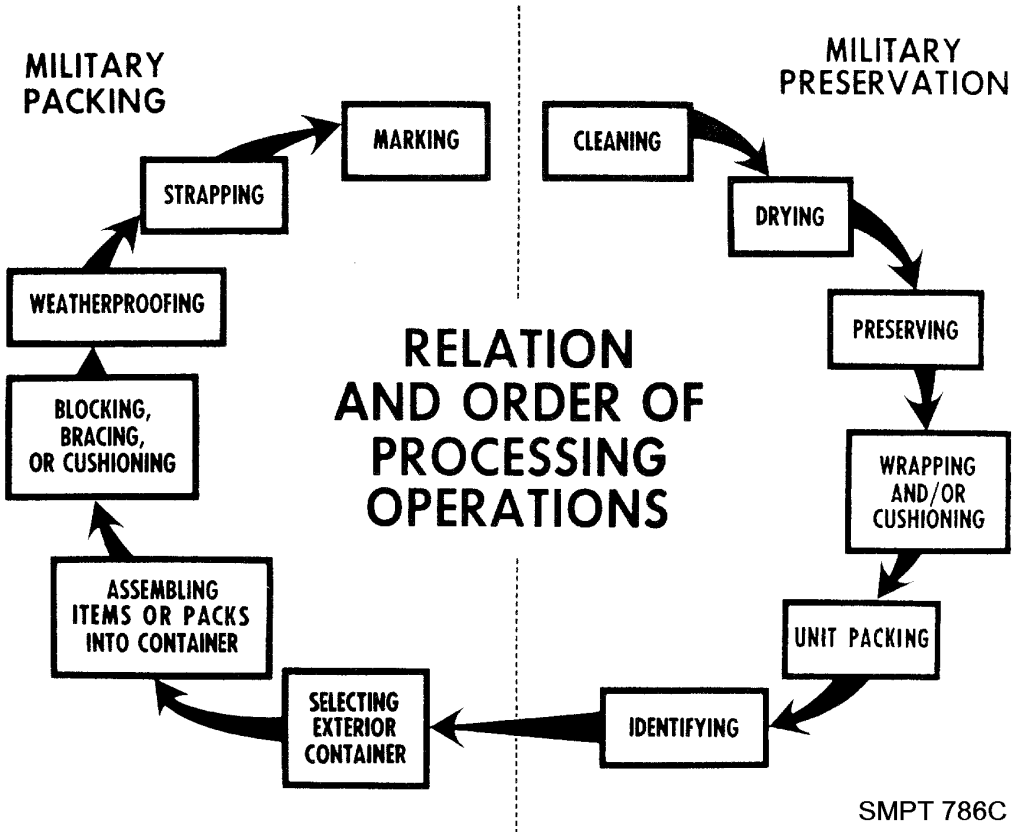


Figure 3-2. Military preservation and packing cycle.



Figure 3-3. Exterior shipping containers.

Assembling of Items or Packs into Container

The packing of items or packs into the exterior container will determine the type of load contained therein. The term "type of load" refers to the physical characteristics of the item, including the nature of the item as it contributes to the support of, or damage to, the container. This may result in a light, medium, or heavy duty container, as necessary. The design of the shipping container to be used is influenced by the type of load. There are three types of loads: Type 1, Type 2, and Type 3, defined in MIL-STD-2073-1C, and depicted in figure 3-4.

Loads

Types of loads are determined by the degree of structural strength supplied to the shipping container by the contents. Loads are classified as Type 1, easy loads; Type 2, average loads; and Type 3, difficult loads, as described below:

X Type 1, easy load. A Type 1, easy load, is developed from an item which completely fills the outer shipping container or from items of moderate density prepackaged in an interior container which completely fills the

outer shipping container. Easy load items are not easily damaged by puncture or shock and do not shift or otherwise move within the package. Examples include items packaged in boxes or cans which are prepackaged in fiberboard boxes prior to overpacking in the shipping container, chests, tool kits, and sturdy instruments which are fully in contact with, and support, all faces of the shipping container.

X Type 2, average load. A Type 2, average load, is developed from item(s) of moderately concentrated weight which are packed directly into the shipping container and provide partial support to all panels thereof. It also includes item(s) prepackaged by wrapping or by positioning in partitions, cells or paperboard boxes, or by other means which provide support to all panels of the shipping container. Examples include items packaged in boxes or cans which are not prepackaged in an interior container and bottles individually separated one from the other by cells or partitions.

X Type 3, difficult load. A Type 3, difficult load, is developed from item(s) which require a high degree of protection to prevent puncture, shock, or distortion of the shipping container. It also includes item(s) which do not provide complete support to the panels of the shipping container. Examples include wrenches, long bolts, and rods which exert concentrated forces on the shipping container; motors, telephones, typewriters, drop forgings, rivets, hardware, or other items that are random packed in bulk; and fragile or delicate items requiring special protection.

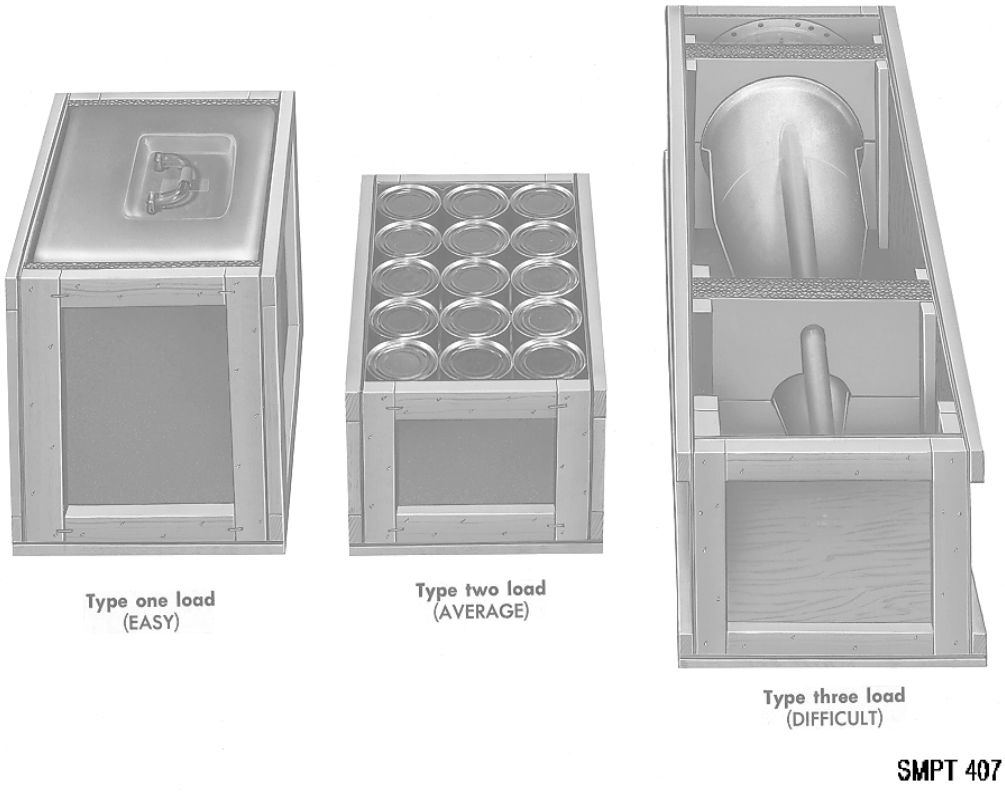


Figure 3-4. Types of loads.

Blocking, Bracing, or Cushioning

To assist in determining whether an item has to be blocked and braced and/or cushioned, the following factors have to be carefully considered: the shape of the item, its size, weight, shock resistance, lack or availability of mounting provisions, degree of disassembly permissible or feasible, and the type of load the item represents. The necessities for blocking, bracing, and cushioning are as follows:

Containers are often subjected to rough handling during shipment and transportation. If the items packed therein are free to move or if they are not properly protected against repeated shocks, jolts, and vibrations, the end result might be damage or complete loss.

Military situations demand that items be packed to withstand all possible hazards encountered in transportation. This includes proper blocking, bracing, and/or cushioning to insure the stability of the contents.

Weatherproofing

Weatherproofing, when necessary, is to provide a waterproof barrier in the form of a case liner, crate liner, shroud, or wrap fabricated of barrier materials such as those in PPP-B-1055 or MIL-B-121, if extreme climatic conditions are involved. Such waterproof barriers are primarily intended to prevent deterioration of the items and the preservation materials used to protect the articles by excluding the entry of free water, or by diverting water from materials which are subject to water damage. In addition, waterproof barriers will afford protection from dust, dirt, and other foreign matter. Waterproof barriers will not be used when the interior packs are already waterproofed, nor when asphaltum in some of the barrier materials or sealouts would be injurious to the enclosed articles.

Strapping

Each military container specification has a section or appendix devoted to requirements for strapping exterior containers. We will cover the strapping requirements for various containers as they are discussed throughout this part of the course.

Marking

Marking is used to speed up the movement of shipments without confusion and delay, and to permit ready identification of contents either at transshipping points or at destination. No matter how well an article is made or packed, it is valueless if it cannot be identified upon reaching its destination.

Packing Policy

Earlier in the course we discussed the levels of protection for the packing of items for shipment or storage. It was noted that AR 700-15/NAVSUPINST 4030.28D/AFJMAN 24-206/MCO 4030.33D/DLAD 4145.7 states: "Materiel will be packaged to prevent damage and deterioration and to provide for efficient and economical handling. Commercial packaging will be used when such packaging is cost effective. Use of commercial packaging should be determined before a contract is awarded or within the life cycle of the contract when substantial savings to the Government may result and adequate protection is provided by the commercial packaging. These decisions will be made by the packaging office at the buying activity."

Economy in Packing

As packing personnel, you should be interested in savings, not only for the Government but for yourself (as a taxpayer). Savings can be realized in packing operations without sacrificing protection of the item. Several factors affecting economy in packing enter into the picture, such as materials, equipment, manpower, etc. Since only three of the most important elements are listed, a few of the highlights will be mentioned.

Materials and Cost

Cost of materials alone is not the only factor. If personnel are familiar with the various types, when, how, and where to use them, substantial savings may be realized. Used packing materials should be reclaimed and reused to the maximum extent.

Equipment and Cost

The cost of equipment alone is not the only factor. Proper arrangement and utilization of equipment, whether manually operated or mechanized units, will have a bearing on the quantity of work performed. Savings may be realized through the use of mechanized units providing the cost of equipment is saved in time, labor, and increased production.

Manpower

The utilization of manpower is the most important single element in any packing operation. As packing personnel, you have the opportunity to learn all phases of packing in order to obtain the necessary knowledge for the growing packing field.

Hazards of Storage

The major hazards to our packs in storage often are the results of extreme temperature changes, high or low humidity, bacteria and fungi, and aging. Some of the damage that can result from these conditions is shown in figure 3-5.

- X Wood decays or rots.
- X Leather cracks.
- X Cork becomes brittle.
- X Metals rust.
- X Food molds and rots.
- X Textiles fade and mildew.
- X Chemicals change with age.
- X Ceramics check or craze.
- X Rubber cracks and splits.

Hazards of Handling

Many containers are "accident prone." The size, weight and shape are such that certain things just seem to happen to them. If we visualize how the container will be handled, and the difficulties that may be encountered in handling, we will be able to estimate what probably will occur and can adjust our packing accordingly.

Deceiving Appearance of an Item

A delicate item such as a wristwatch may be able to take a fairly heavy jolt, while a piece of electronic equipment with a rugged looking case may not be able to tolerate much shock at all. A heavy metal casting may crack when dropped a very short distance.

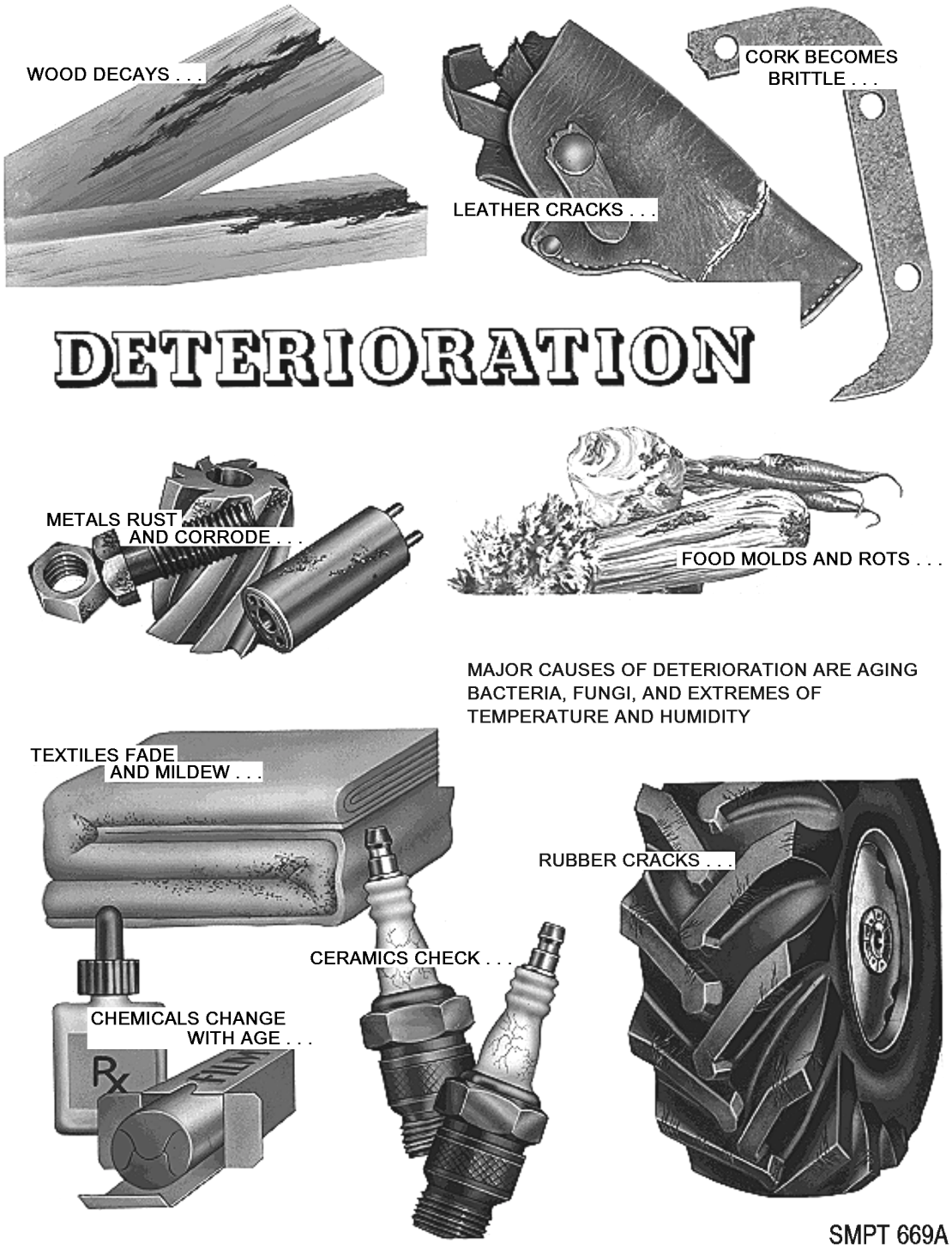


Figure 3-5. Deterioration of items.

Damage by Handling Equipment

Some damages that may result from handling equipment are as follows:

X Hand trucks, fork lifts, and trailers with flat wheels can cause damaging shock and vibration. Hand trucks with hard tires moving over uneven surfaces can cause similar damage.

X The improper use of sling cables can cause damage to containers. They can crush boxes and crates across the top. When long crates or boxes are lifted by cables, they have a tendency to bend in the middle.

Damage to Containers by Grab Hooks (Box Hooks)

Grab hooks cause a crushing action across the top where the points of the hooks tear and rip into the container. Since they lift from the top, they place a vertical strain on crates and boxes. Heavy items on crate bases have a tendency to "drop out" the bottom of the crate.

Damage by Use of Hand Hooks for Handling

Hooks tear and puncture fiberboard boxes. They destroy labels and markings.

Damage by Forklift Trucks

The improper use of forklift trucks often results in damage to shipping and storage containers. Some examples include puncture damage when forklift forks are used for pushing containers; floor board damage when forklift forks are improperly tilted during lifting; and sagging and/or weakening of the container structure when long and/or oversize crates are lifted in the center. Damage may also result when improperly arranged loads are lifted and containers fall.

Damage by Cargo Nets

Fragile containers may be crushed when the net is lifted. When the net is emptied, containers may tumble and roll causing damage.

Damage Due to Improper Manual Handling

Light containers have a tendency to be thrown. Fiber drums can be damaged by rolling them on their sides. Ignoring special handling instruction markings, such as "USE NO HOOKS," "THIS SIDE UP," "FRAGILE," etc., may cause damage. Tall containers have a tendency to fall over when handled. Heavy containers can be damaged by manhandling. They have a tendency to be dropped. Moving heavy containers by "walking" them may cause them to wrack. Sliding heavy containers across the floor can also cause them to wrack. Heavy containers piled on lightweight containers can crush the lightweight containers. Dropping containers from trucks, planes, docks, etc., when loading and unloading can damage materiel.

Checkup

X What is the purpose of packing?
X What are the basic steps of military packing?
X Name the three types of loads.
X Do the levels of protection that apply to preservation apply to packing?
X How can savings be realized in packing operations without sacrificing protection to the item?

FIBERBOARD SHIPPING BOXES (ASTM D 1974/ASTM D 5118)

FIBERBOARD BOXES

Description of Fiberboard Boxes

Fiberboard boxes are probably the most generally used shipping container today. They vary in sizes, shapes, and styles and may be used for either domestic or oversea shipments.

Types of Loads

Earlier, we discussed the three types of loads. Only type 1 and type 2 loads may be shipped in fiberboard boxes. If you have a type 3 load, you must convert it to a type 1 or 2 load by using cushioning, blocking, or bracing.

Materials

Before we discuss fiberboard boxes in detail, we should have some information on the fiberboard box materials.

X Fiberboard

B Fiberboard material (ASTM D 4727) used to make these boxes locally is bought in large sheet stock form. Usually it is stored in the box shop; and whenever a special size box is needed, it is made from this sheet stock.

B This fiberboard material is available in two types. One type is called solid fiberboard (SF) and the other is called corrugated fiberboard (CF). Solid fiberboard is fabricated by gluing several layers of flat fiber sheets together to obtain the desired thickness. Corrugated fiberboard is constructed from facings and corrugated (wavy) sheets glued together. Corrugated fiberboard may be fabricated either as single-wall (SW) or double-wall (DW) stock or triple-wall. Single-wall material consists of one corrugation between two flat facing sheets while double-wall material consists of one flat facing between corrugated sheets sandwiched between two outer flat facing sheets. Triple-wall material consists of two flat facing sheets between three corrugated sheets sandwiched between two outer flat facing sheets. Figure 3-6 shows each of these types.

X Tapes. Many different kinds of tapes are in use today. The tapes that are most commonly used in closing and sealing fiberboard boxes are:

B A reinforced paper-gummed tape (A-A-1492, A-A-1671) to close and seal fiberboard boxes for domestic shipment and storage.

B A pressure-sensitive, water resistant tape (ASTM D 5486) to close and waterproof interior and exterior fiberboard boxes.

B A pressure-sensitive, water-resistant, paper-backed tape (ASTM D 5486) to close fiberboard boxes.

B A pressure-sensitive, filament reinforced tape (ASTM D 5330) to reinforce fiberboard boxes. This may be used instead of metal strapping.

X Adhesive and staples. In addition to the tapes listed above, there are two other materials which can be used to close and seal fiberboard boxes--a water-resistant adhesive and steel staples and/or stitching wire as shown in figure 3-7. The staples or stitching wire must be treated to resist corrosion or rust.

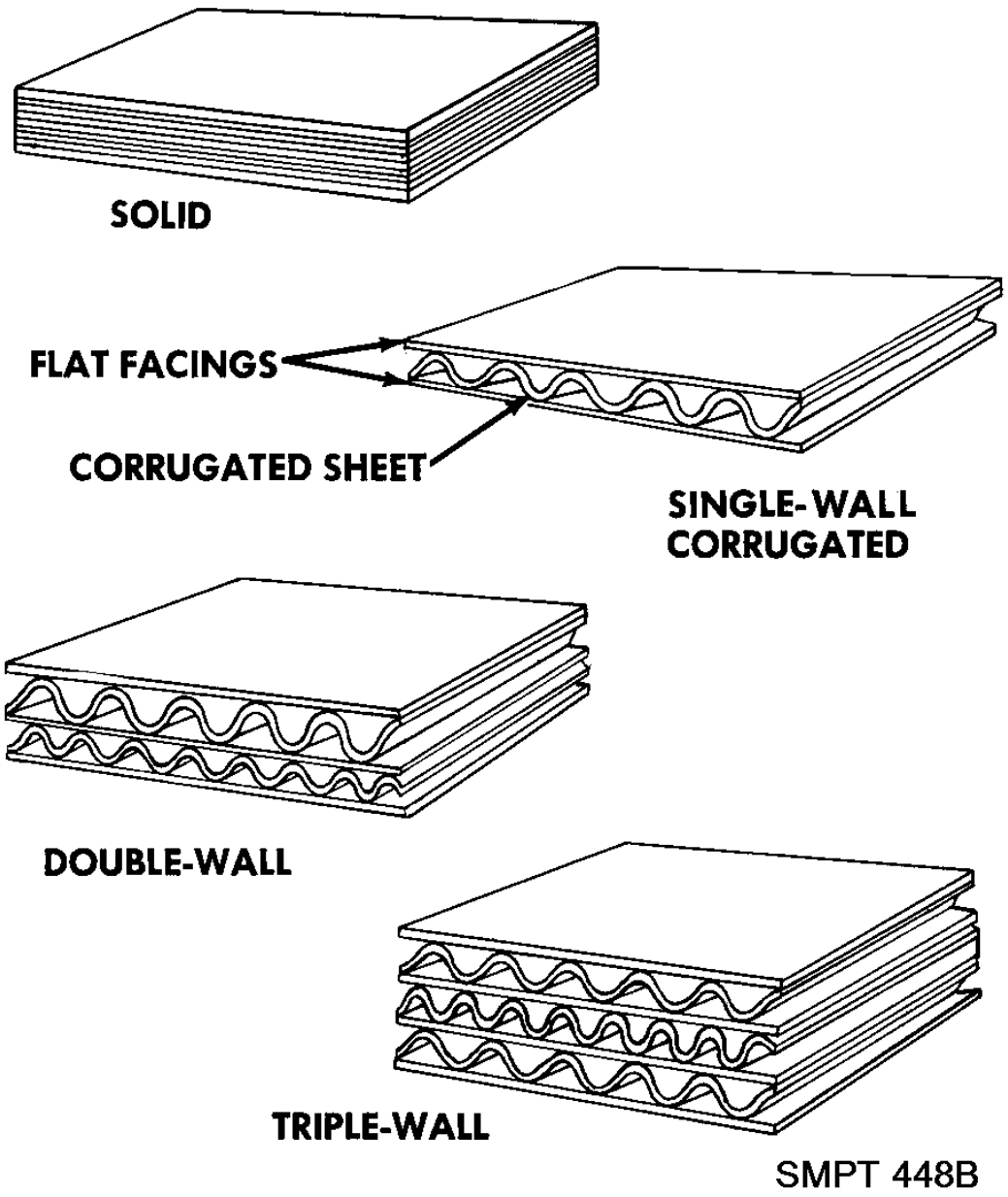


Figure 3-6. Types of fiberboard.

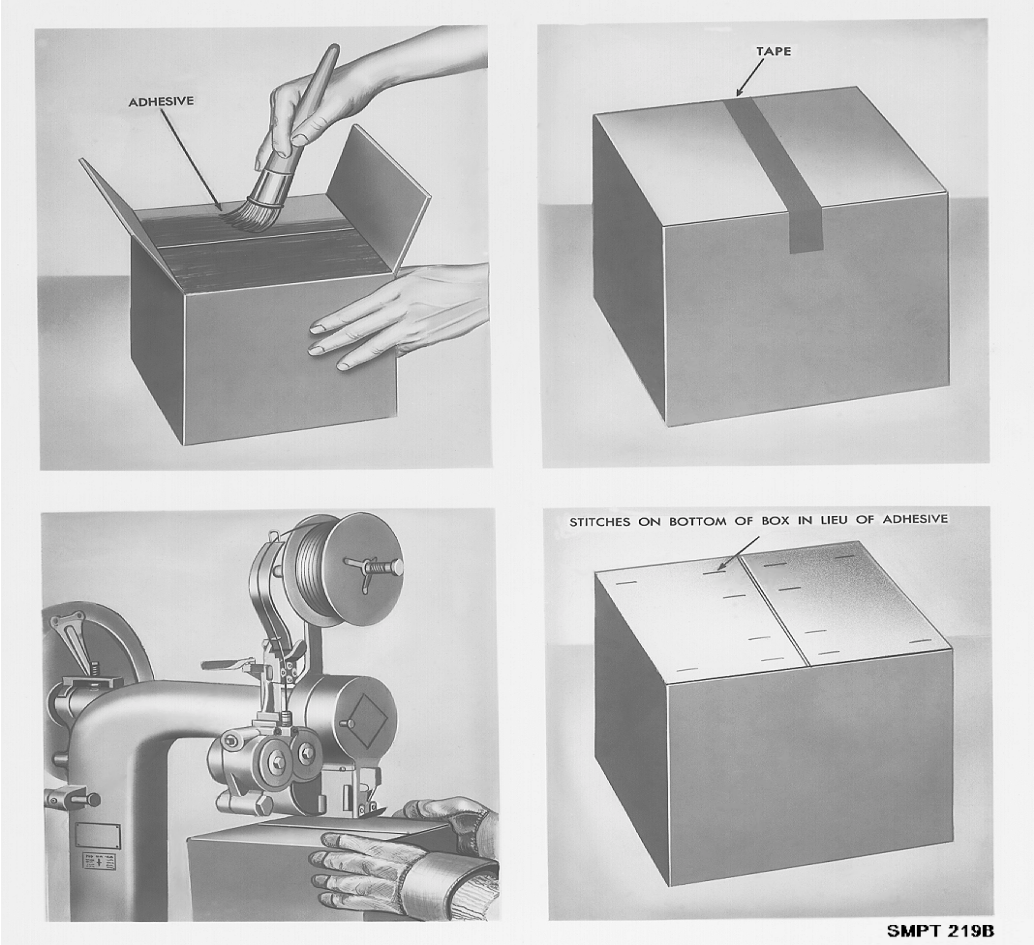


Figure 3-7. Closure of fiberboard boxes with adhesive tape or stitches.

Classification of Fiberboard Boxes (ASTM D 5118)

Fiberboard shall conform to Type, Class, Variety and Grade of ASTM D 4727 unless otherwise specified.

X Type. Fiberboard boxes are constructed from two types of fiberboard material, type CF (corrugated fiberboard) and type SF (solid fiberboard).

X Class. Class designates the amount of weather protection provided. The classes are domestic--slight protection; domestic/fire retardant - slight protection and fire retardancy; weather-resistant (WR)--some protection against liquid water and waterproof and watervapor resistant (WWVR) good protection against water with only moderate protection against watervapor. The facings and outer piles of weather- resistant fiberboard are treated with a water-resistant resin. WWVR fiberboard will be treated with the same resin and has a laminated ply of polyethylene. Both WR and WWVR fiberboard use a water-resistant adhesive to hold the various layers together.

X Variety. Only the type CF boxes can be divided into the varieties which are single wall (SW) and double wall (DW).

X Grade. The designations for grade depend upon the class of the box. Class domestic grades are shown numerically indicating the bursting

strength of the fiberboard material, for example 275. Class WR and WWVR grades are shown as a capital letter (V or W), a number, and a lower case letter (s or c), such as V11c. W or V indicates that fiberboard material is weather resistant, the number relates to the strength of the material, and the s or c designates the type of fiberboard material (solid or corrugated).

Design

There are 15 different styles of fiberboard boxes. These styles are determined by the location of the slots and the construction of the box. Of all the styles, the two most widely used styles are the regular slotted container (RSC) and the center special slotted container (CSSC).

X Style RSC. Figure 3-8 depicts the features of the RSC. All the flaps of a regular slotted container are the same length, and the outer flaps meet at the center of the box. The space between the inner flaps varies depending upon the relation of the length to the width of the box. The flaps along the longer edge of the box opening are called the outer flaps. The flaps along the shorter edge of the box opening are called the inner flaps. Consequently, there will always be a space between the inner flaps when they are folded in place, except if the length and width of the box are the same size.

X Style CSSC. Figure 3-9 illustrates the CSSC. The style CSSC fiberboard box is similar to the style RSC fiberboard box except that it is stronger on the top and bottom due to the double thickness of the fiberboard in these areas. Both the inner and outer flaps meet in the center of the style CSSC fiberboard box. A gap not to exceed 1/4 inch is permitted between the inner and outer flaps when in the closed position.

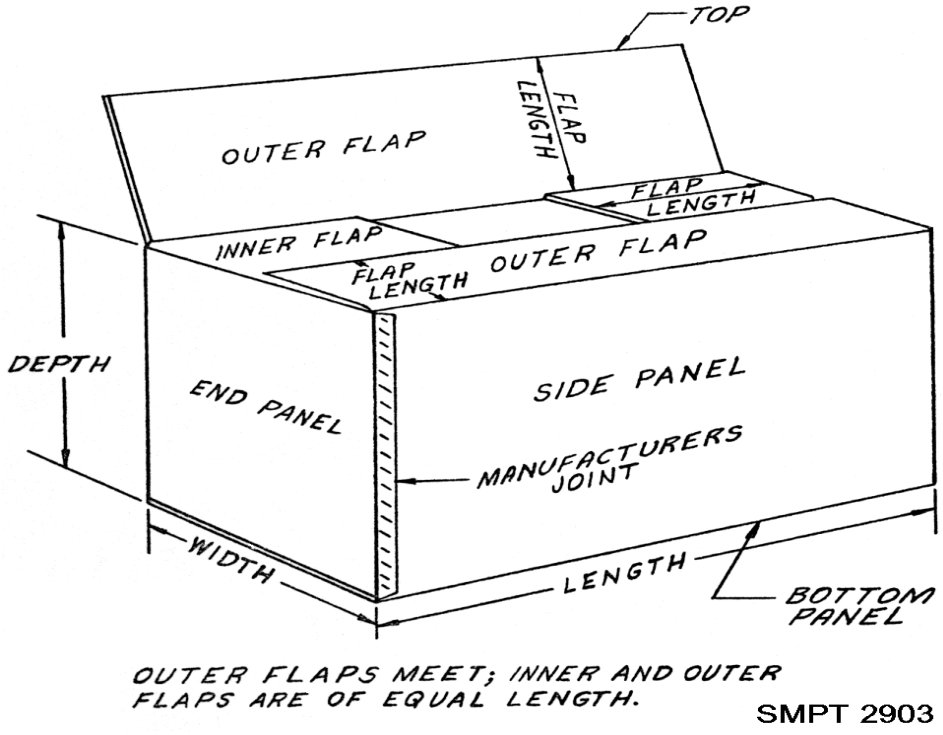


Figure 3-8. Fiberboard box style RSC.

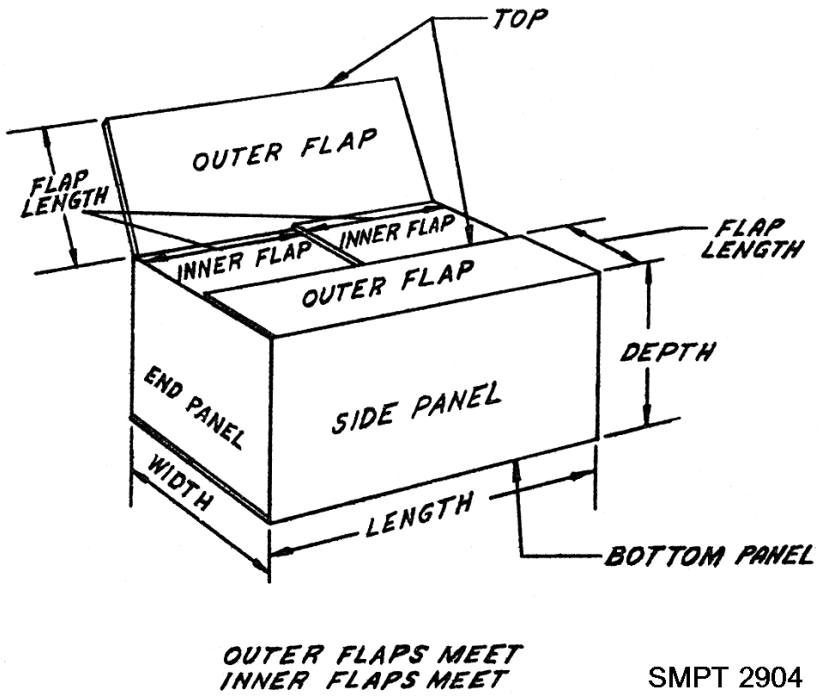


Figure 3-9. Fiberboard box style CSSC.

Construction of Fiberboard Boxes

Fiberboard boxes are constructed through the use of a special machine which cuts, scores, and slots the fiberboard sheet stock to form a fiberboard body blank as show in figure 3-10.

One section of the fiberboard blank is called the body joint or manufacturer's joint. What is the purpose of the body joint? The body joint is used to join the body (side and end panels) of the box together. This can be done by forming butted, overlapped, joints as shown in figure 3-11.

The actual method of construction of a body joint depends upon the class and variety of the fiberboard box.

The body joint for class weather-resistant and WWVR boxes is usually an overlapped joint with a minimum overlap of 12 inches. The overlap may be secured either inside or outside the adjoining panel by the use of staples or waterproof adhesive. In the fabrication of certain grades of WR/WWVR boxes, the construction of butted joints secured with 2 inch-wide, tape, extending the full depth of the box, is authorized.

The body joint for class domestic boxes may be butted or overlapped with a minimum overlap of 1 1/4". The length of the overlapped body joint shall be equal to the inside depth of the box. The joint tab shall be fastened either inside or outside the adjoining panel. The CF domestic boxes may be fastened with adhesive or metal fasteners. When adhesive is used, apply it so as to cover the full area between the joint tab and the adjoining panel. The adhesive shall extend to all edges of the overlap. Type SF boxes shall be fastened with metal fasteners. For CF and SF domestic boxes less than 18" deep, space metal fasteners not more than 3" apart, center to center. Additional (tie stitch) fasteners shall be added not more than 1" from the ends of the joint.

Butted domestic body joints may be put together with gummed tape for boxes less than 45 pounds. The width of the tape also depends on the gross weight of the container. Use 2" tape for containers less than 65 pounds gross weight, and 3" tape for containers over 65 pounds gross weight.

For class weather-resistant (WR) and water and watervapor resistant (WWVR) boxes, the requirements are stricter. The body joint shall be 1/2" wide, extending the full inside depth of the box. Unless otherwise specified, use metal fasteners for the body joint, spaced not more than 2" apart, with tie stitches not exceeding 1/4 - 3/4" from the ends of the joint. Tie stitches won't be required provided the joint is fastened with the same total number of fasteners required (including tie stitches) equally spaced on not more than 2" centers, with the distance between the outer fasteners and the ends of the joint not exceeding 1 inch.

Glued manufacturers joints may be used for grades W5c, W5s, W6c, W6s and V3c boxes. The adhesive must cover 85% of the area between the tab joint and the adjoining panel.

Butted joints for WR/WWVR boxes shall be used when specified on W5c or W6c boxes. The tape shall be centered on the joint, extend the full depth of the box, and shall adhere over not less than 90% of the area of contact.

Upon completion of the body joint, one set of inner and outer flaps are folded down and secured by adhesive, thermoplastic material, staples, or tape to form the bottom of the box.

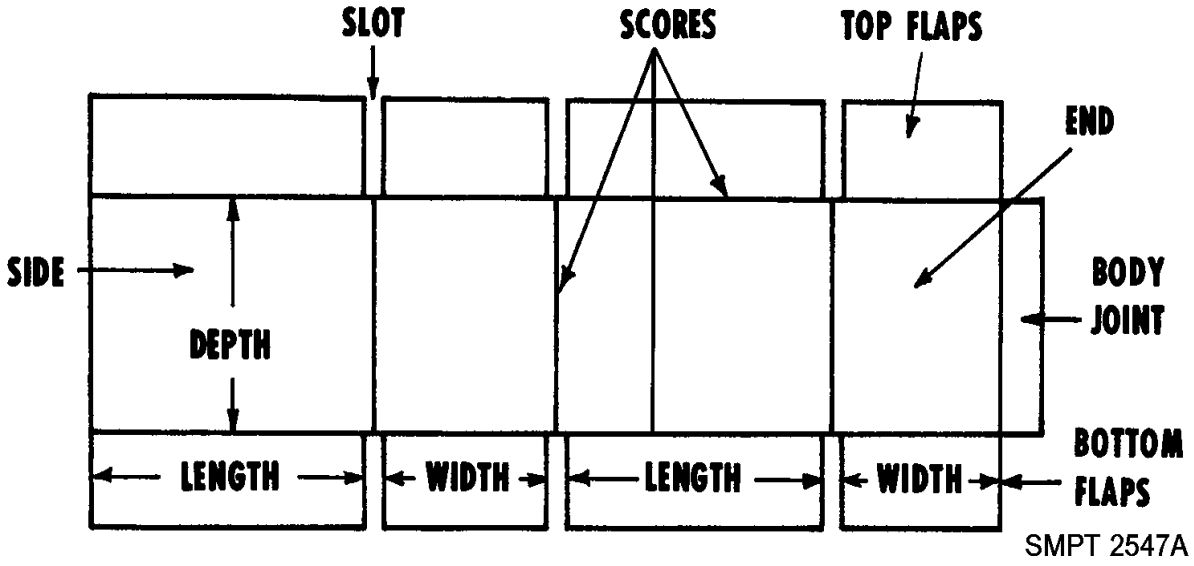


Figure 3-10. Fiberboard box body blanks for style RSC box.

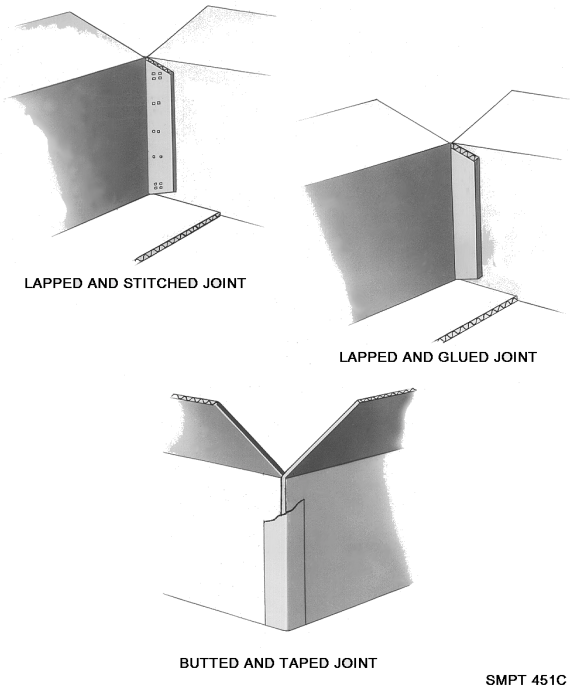


Figure 3-11. Types of fiberboard body joints.

Strengthening Fiberboard Boxes

Suppose you were packing a fiberboard box with heavy items and you decided you wanted to add more strength to the box. What should you do? You could do one of the two things.

- X You could add a sleeve around the outside of the box covering the top, bottom, and both ends as shown in figure 3-12. A sleeve will provide additional strength and rigidity to the box. Sleeves are usually made from the same material as the box. To be effective, sleeves must be equal in height to the inside height of the box.
- X The other way to add strength and rigidity is to place a liner on the inside of the box covering both ends and sides, as illustrated in figure 3-13. Liners are usually made from one piece of single-wall or double-wall corrugated fiberboard.

Boxmaker's Certificate and Specification Compliance Markings

All classes of fiberboard boxes must be stamped with a boxmaker's certificate to indicate that they are fabricated in accordance with the applicable freight classification. The boxmaker's certificate shows the name and address of the boxmaker and the bursting strength and other characteristics of the fiberboard material and box limits as shown in figure 3-14. The specification compliance marking is required only for boxes which are class weather-resistant and WWVR and are made to comply with ASTM D 4727. The minimum bursting strength in the boxmaker's certificate may not always be the same as that shown in the specification compliance markings.

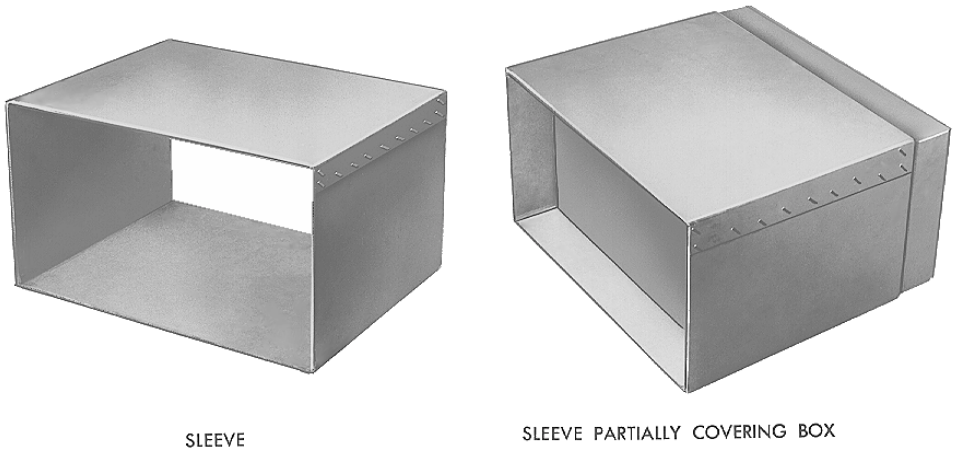


Figure 3-12. Fiberboard box sleeve.

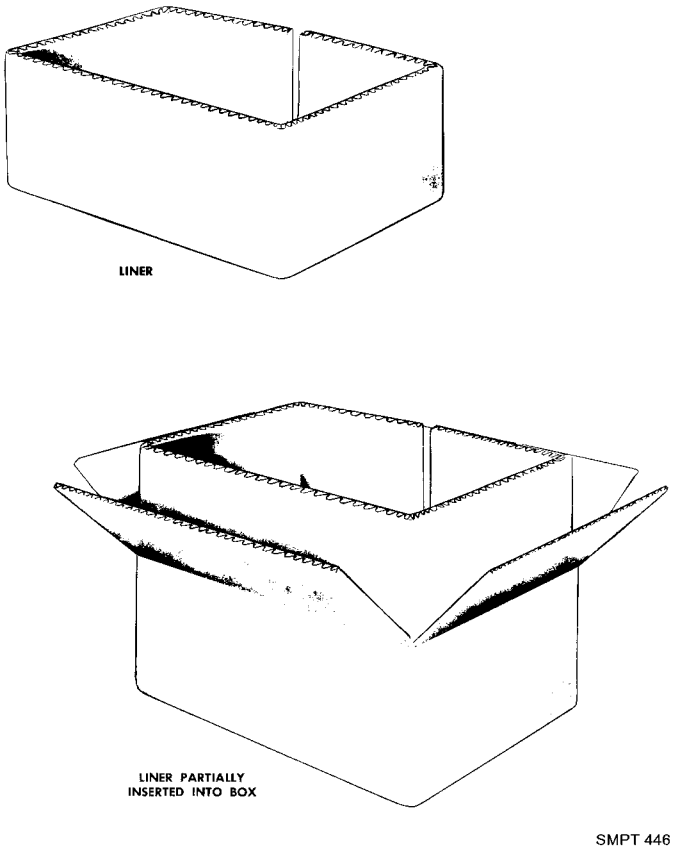


Figure 3-13. Fiberboard box liner.

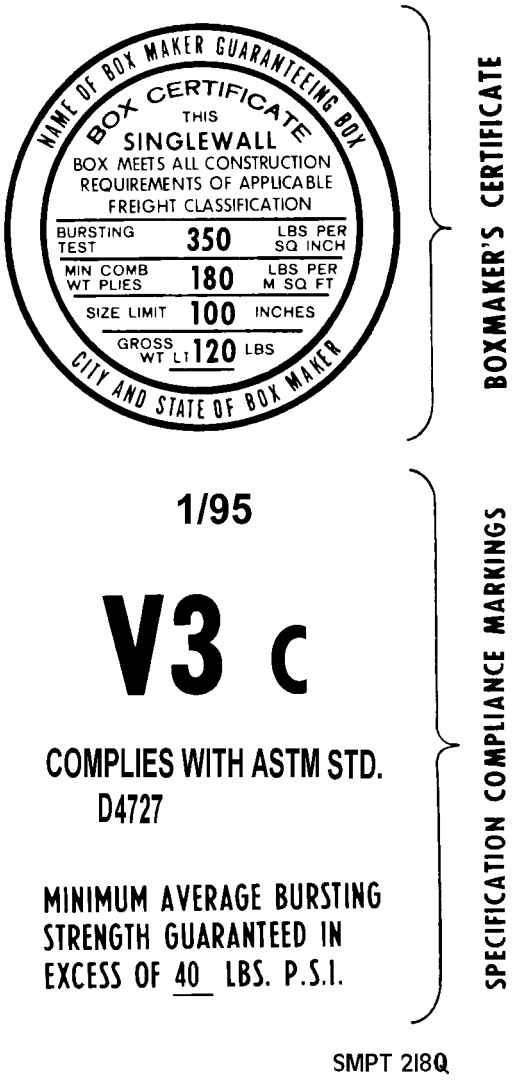


Figure 3-14. Boxmakers certificate and specification compliance markings.

Fiberboard Box Weight and Size Limits

You should be careful when packing fiberboard boxes so that you do not go over the weight or size limits given in tables 3-1 and 3-2.

Table 3-1. Size and weight limitations for types CF[a] and SF[a], Class Domestic Fiberboard Boxes[b]

Type CF Variety		Type SF	Max Weight of Boxes and Contents		Max Inside Dimensions Length + Width + Depth	
SW[a]	DW[a]					
Grade	Grade	Grade	Lb	(kg)	In.	(mm)
125	……..	125	20	(9.1)	40	(1016)
150	……..	……..	30	(13.6)	50	(1270)
175	……..	175	40	(18.1)	60	(1524)
200	200	200	65	(29.5)	75	(1905)
275	275	275	90	(40.8)	90	(2286)
350	350	350	120	(54.4)	100	(2540)
	500	500	140	(63.5)	110	(2794)
	600	600	160	(72.6)	120	(3048)

[a] Explanation of abbreviations in Table 1.
CF – Corrugated Fiberboard
SF – Solid Fiberboard
SW – Single-wall Fiberboard
DW – Double-wall Fiberboard
[b]Size and weight limitations may be modified or waived by the ordering activity, as necessary, when boxes are used for non-shipper or special purpose.

Table 3-2. Size and Weight Limitations for Class Weather-Resistant (WR) and Water and Water Vapor Resistant (WWVR) Fiberboard Boxes Used as Exterior Containers[a]

Note – The gross weight and size limit expressed in the circular or rectangular boxmaker's certificate shall conform to the requirements of the Uniform Freight Classification or National Motor Freight Classification Rules, as applicable, and may not necessarily be the same as those stipulated in table 2.

Grade[b] (Compliance Symbol)	Max Weight of Boxes and Contents		Max Inside Dimensions Length + Width + Depth	
	lb	(kg)	in.	(mm)
V2s	120	(54.4)	100	(2540)
V3s, V4s, and V3c	90	(40.8)	90	(2286)
W5s and W5c	65	(29.5)	75	(1905)
W6s and W6c	30	(13.6)	30	(762)
V11c	160[c]	(72.6)	120	(3048)
V13c	120	(54.4)	100	(2540)
V15c	90	(40.8)	90	(2286)

[a]Not applicable to interior boxes.
[b]Reference ASTM D 4727 for specific details of construction.
[c]Maximum wieght may be increased to 225 lb (102 kg) provided the manufacturer's body joint is fastened with metal fasteners spaced not more than 1 in. (25 mm) apart.

Closure of Fiberboard Boxes

Securing the flaps or covers of a box so that they will not accidentally open during normal shipment handling or storage is accomplished by several different means depending on the style and class of the fiberboard box. ASTM D 1974 provides a complete listing of box closure methods. During this lesson we will be concerned with a few of the listed methods of box closures for Regular Slotted Containers (RSC) and Center Special Slotted Containers (CSSC).

Adhesive Closures of RSC's and Similar Boxes

Closure Method 2A3 - The box shall be closed with a waterborne adhesive by securely bonding at least 50% of the contact area of the flaps. The bonded areas shall extend to within 2 inches of the center seam. (See figure 3-15)

Closure Method 2A4 - The box shall be closed with the application of adhesive conforming with MMM-A-250 by securely bonding at least 75% of the contact area of the flaps. The adhesive shall be applied within 1/4 inch of the edges and score lines of the inner flaps.

Pressure-sensitive Closures of RSC's and Similar Boxes

Closure Method 2B3 - The box shall be closed with 2-inch wide pressure-sensitive film-backed tape applied over the center seams of the box, continuing at least 2 inches onto the box ends. The colored tape shall conform with ASTM D 5486. The box shall be closed with 2-inch wide tape. (See figure 3-16)

Closure Method 2B7 - The box shall be closed with 2-inch wide paper tape applied over the center seams of the box, continuing at least 2 inches onto the box ends. Four additional strips of tape shall be centered over the seam formed by the edges of the outer flaps and the end panels. The tape shall extend within 3/4 inch of the box corners. The tape shall conform to ASTM D 5486, Type V. (See figure 3-17)

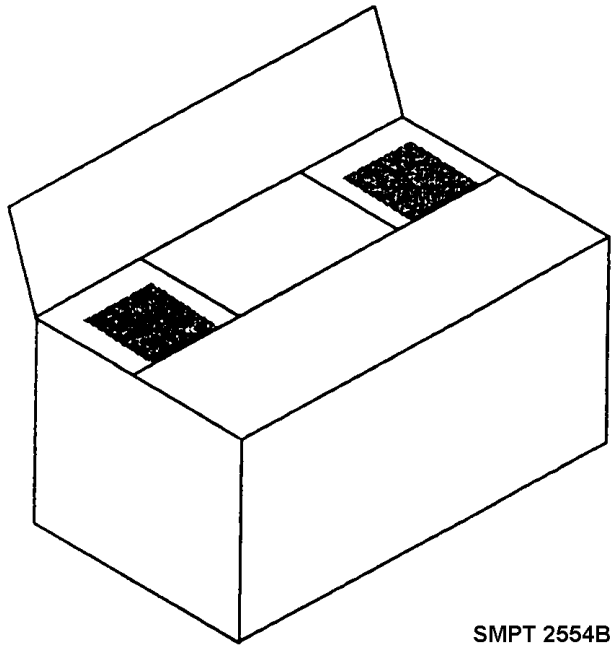


Figure 3-15. Closure Method 2A3.

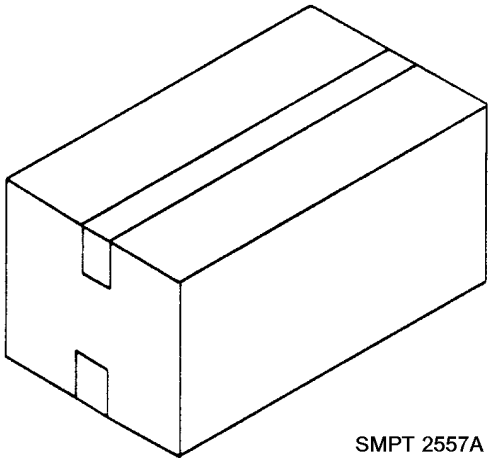


Figure 3-16. Closure Method 2B3.

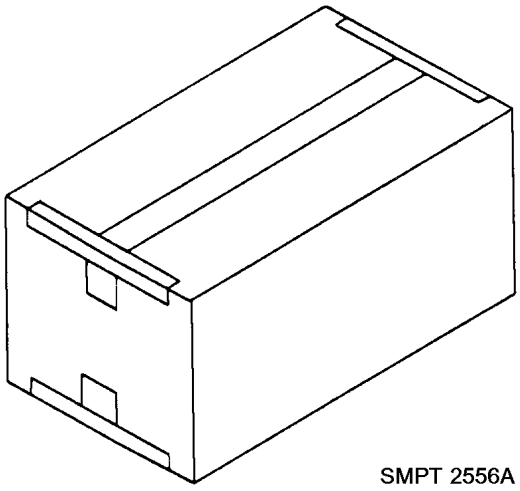


Figure 3-17. Closure Method 2B7.

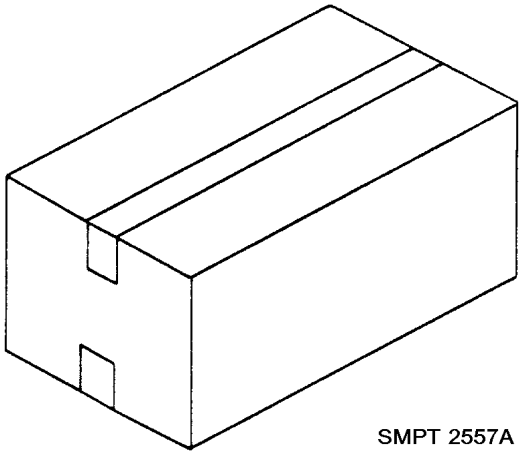


Figure 3-18. Closure Method 2C2 and 2C4.

Gummed Tape Closure of RSC's and Similar Boxes

Closure Method 2C2 - The box shall be closed with 3-inch wide reinforced gummed tape applied over the center seams of the box, continuing at least 2 inches on the box ends, as shown in figure 3-18. The tape shall conform to A-A-1492 or A-A-1671.

Closure Method 2C4 - The box shall be closed with 2-inch wide paper tape applied over the center seams of the box, continuing at least 2 inches on the box ends, as shown in figure 3-18. The tape shall comply with A-A-1492, Grade B.

Staple and Stitch Closure Setup of RSC's and Similar Boxes

Closure Method 2D3 - The box shall be closed with 2-inch crown staples or stitches applied to each side of the center seam in the area where outer flaps overlay inner flaps and to the side of the outside flaps. Fasteners shall not be more than 2 1/2 inches apart.

The number of stitches needed comes from tables referenced in the ASTM D 1974. For closure method 2D3 see figure 3-19. Note the number of 1/2" crown staples for an RSC box is based on the inside width of the box. For a 12" wide box, go down the left column to the number 12. Read right to the far right column under government. For a 12" wide box, 10 staples are required at each end of the box, evenly spaced (see figure 3-20).

Closure Method 2D6 - The box shall be closed with wide crown staples or stitches distributed uniformly over the areas where outer flaps overlay inner flaps as shown in figure 3-21.

	Number of ½-in. Crown Staples or Stitches for Regular Slotted Containers		
	Number of Fasteners At Each End of Box, by Method		
Inside Width of Box, in.	2D1, Commercial,	2D2, Rule 41,	2D3, Government,
6	2	2	6
7	2	4	6
9	4	6	6
10	4	6	8
11	4	6	8
12	4	8	10
14	6	10	12
16	6	10	14
17	6	12	14
18	6	12	16
19	8	14	16
20	8	14	18
22	8	16	20
24	10	16	22

Figure 3-19. Determining Number of Stitches.

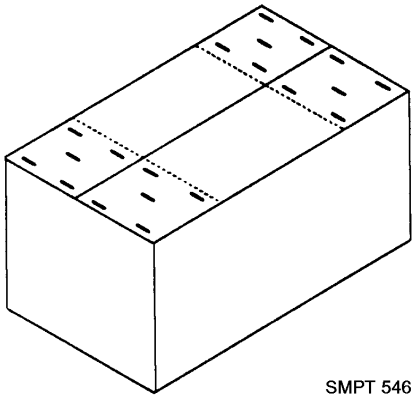


Figure 3-20. Closure Method 2D3.

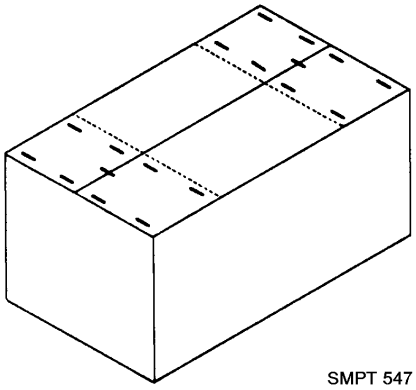


Figure 3-21. Closure Method 2D6.

Methods of Box Sealing

In some instances, a sealing method also conforms with a closure method. When strapping is used as a closure, the sealing material shall be placed on the box prior to the application of the strapping.

Sealing method A. The box shall be sealed with 2-inch wide pressure-sensitive film-backed tape applied over all seams and corners of the box. (See figure 3-22)

Sealing method B. The box shall be sealed with 2-inch wide pressure-sensitive tape meeting the requirements of ASTM D 5486 or ASTM D 5330 applied over all seams, corners and joints of the box. Tape applied to a manufacturer's joint shall cover the joint but not extend beyond the corners. The tape applied to the seams shall be centered over the seams and shall extend over the corners and edges of the box a minimum of 2 1/2 inches onto adjacent box panels. (See figure 3-22)

Sealing method D. The box shall be sealed with 2-inch wide gummed tape meeting the requirements of ASTM D 5486 or A-A-1492 or A-A-1671 applied over all seams, corners and joints of the box. Tape applied to a manufacture's joint shall cover the joint but not extend beyond the corners. The tape applied to the seams shall be centered over the seams and shall extend over the corners and edges of the box a minimum of 2 1/2 inches onto adjacent box panels. (See figure 3-22)

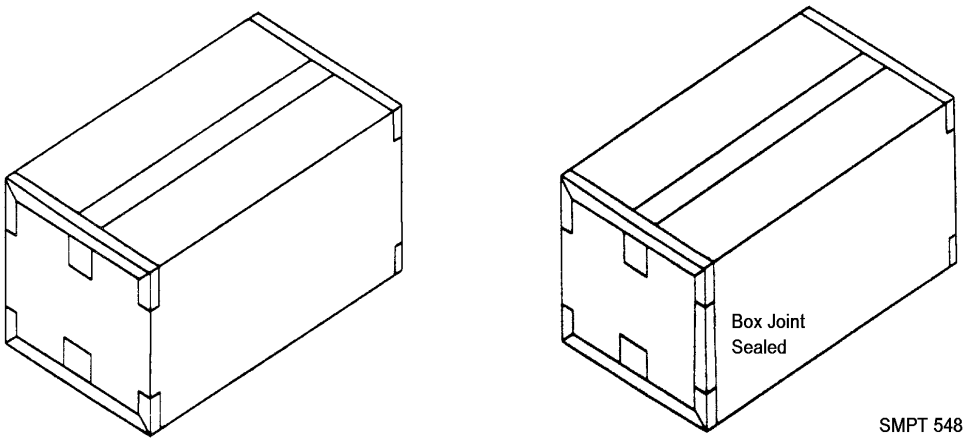


Figure 3-22. Sealing Methods B, C, and D.

Methods of Fiberboard Box Reinforcement

The purpose of reinforcing a box is to protect the box from rupturing during handling and shipment. Reinforcement can be accomplished through the use of filament reinforced tape, flat steel or twist tie wire strapping, round wire strapping, and nonmetallic strapping. The number and location of reinforcing bands are governed by the size of the box.

Filament Reinforced Tape

Figure 3-23 shows the reinforcement of class domestic boxes using filament reinforced tape. Strips of tape placed across the seam will be sufficient length to extend to a maximum of 2 inches down each side. The number of strips depends on the length of the box. This is in addition to tape used for closing the box. Strips placed on the ends of the flaps must extend a minimum of 2 inches down the side and across the flap. The number of strips depends on the width of the box. One piece of tape on opposite ends of the box equals one strip. The minimum number of strips required on the top or bottom of the box is two, one in each direction.

Metal Banding

ASTM D 4675, Standard Guide for Selection and Use of Flat Strapping Material, covers two common categories of strapping materials, flat carbon steel and nonmetallic strapping. The size of metal banding is determined by the gross weight of the box and its contents. The number and location of the bands is determined by the outside length, width, and depth of the box. When cross banding is required, apply the longest band first. Bands will be applied straight and tensioned sufficiently to embed the bands into the edges of the box but not enough to tear the fiberboard or crush the contents, as in figure 3-24. Boxes shall have a closure based on ASTM D 1974 and, if specified, also conform with a closure method. When strapping is used as a reinforcement, the sealing material shall be placed on the box prior to the application of strapping.

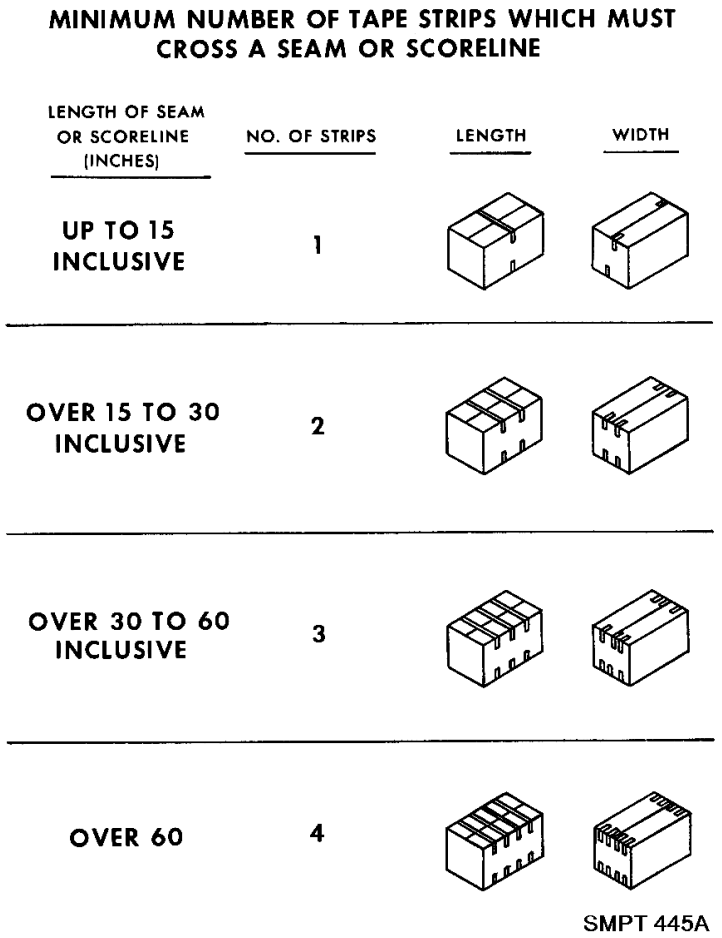


Figure 3-23. Reinforcement of RSC and CSSC class weather-resistant fiberboard boxes with tape.

Reinforcement Method 2A

The box shall be reinforced with pressure-sensitive filament tape of 2-inch wide bands placed around the girth of the box. Bands shall overlap onto themselves at least 2 inches with at least one band for each 15 inches of box length. Boxes over 70 pounds shall use 3/4-inch wide tape. Tape shall comply with A-A-1687 or ASTM D 5330.

Reinforcement Method 2B

The box shall be reinforced with pressure-sensitive filament tape of 3/4-inch wide bands placed around the girth of the box. Bands shall overlap onto themselves at least 3 inches with at least one band for each 15 inches. Boxes over 70 pounds shall use 3/4-inch wide tape. Tape shall comply with A-A-1687 or ASTM D 5330.

Reinforcement Method 2E

The box shall be reinforced with pressure-sensitive filament tape in 2-inch wide by at least 4 inches long strips placed onto adjacent box panels. At least one strip shall be applied to each end flap. Boxes over 70 pounds shall use 3/4-inch wide tape. The tape shall conform with A-A-1685 or ASTM D 5330.

GENERAL PROPERTIES OF STRAP TYPES

Steel Strapping

This product is described in ASTM D 3953 and is generally classified into regular-duty and heavy-duty strapping. Steel strapping has the highest tensile strength of all the types of strapping. It is better suited to expanding or rigid units than it is to units that settle because it has low settling tolerance. Heavy-duty steel strapping is suggested for applications where break strength or elongation and high-temperature are considerations.

Nonmetallic Strapping

Corded Strapping (Types I and Ia)

The two basic types of corded strapping are described in ASTM D 3950. Rayon and polyester are the most common, although polyoefin, nylon and polyester plastics are also available. Care should be given to choosing a strapping which won't stretch out of shape in prolonged storage.

General Uses

Strapping may be used to secure a handling base (skids, pallets, etc.) to a unit to expedite handling. Strapping may be used for load securement to or within the transport vehicle. It is then applied under tension to restrain or control the movement of lading, and thus must accommodate in-transit shocks or irregular movements. Carrier regulations provide guidelines or minimum requirements, or both. Strapping may provide security against accidental loss or theft or indicate a loss or theft.

Strap Selection

Strap size, type, placement, and number required are all a function of the work to be done, that is determined by a number of factors. These factors include: size, shape, and weight of unit load; expected severity of handling nature of transport equipment; and exposure to environmental conditions, particularly if prolonged outdoor exposure is anticipated.

Class Weather-Resistant and WWVR Fiberboard Boxes

Reinforcing bands shall be applied so that it does not cover or obliterate any markings on the shipping container. When only one band is required on a box, in a given direction, it shall be centered, except in the case of lengthwise bands on style RSC or CSSC boxes. Lengthwise bands on RSC and CSSC boxes shall be slightly offset from the seam. When two or more bands are required on a box, in a given direction, they shall divide the box into equal parts.

Metal Banding

The number and location of the bands are determined by the outside length, width, and depth of the box as shown in figure 3-25. When cross banding is required, apply the longest band first. Bands shall be applied straight and tensioned sufficiently to embed the bands into the edges of the box but not enough to tear the fiberboard or crush the contents.

Safety Hazards

Cutting Strap

All strapping is under tension when in use. Sudden release of this tension will produce a hazard when the loose ends snap free after the strap is cut or otherwise released. Cutting tensioned strap is hazardous. Use caution and follow approved safety procedures.

When cutting a tensioned strap always stand to one side of the strap being cut, pressing the strap against the package above the cut. THINK SAFETY!

Improper Use

Strapping should be used only as intended. Strapping should not be punched by nails, staples, or other sharp objects. This may cause premature strap failure. Attempting to nail through steel strapping may present a hazard especially when power nailing or stapling. Type 2 steel strapping has pre-punched holes intended for nail-on applications. Never use strapping as a means of pulling or lifting packages on unit loads, unless specified by strapping supplier.

X Filament reinforced tape. Tape shall be applied in strips completely encircling the box. The number and location of the strips is the same as for metal banding.

X Nonmetallic strapping. Buckle connectors shall not be used. The number and location of the straps is the same as for metal banding.

Usage

Fiberboard boxes are intended for use as either shipping (exterior) or packing (interior) containers. The selection of the proper style and strength of fiberboard box is determined by the expected shipping and handling hazards including the type of load. For example, WWVR boxes are intended to be used where extreme weather conditions exist or for long-term storage in damp climates.

When you are packing a fiberboard box, use the right size box. Do not force items into a fiberboard box that is too small. You will weaken the box and cause it to buckle. Figure 3-26 shows both correct and incorrect packing.

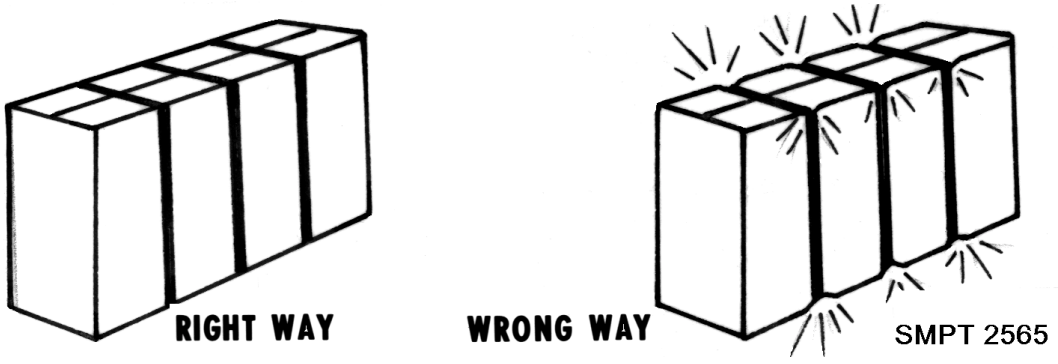


Figure 3-24. Right and wrong way of strapping fiberboard boxes.

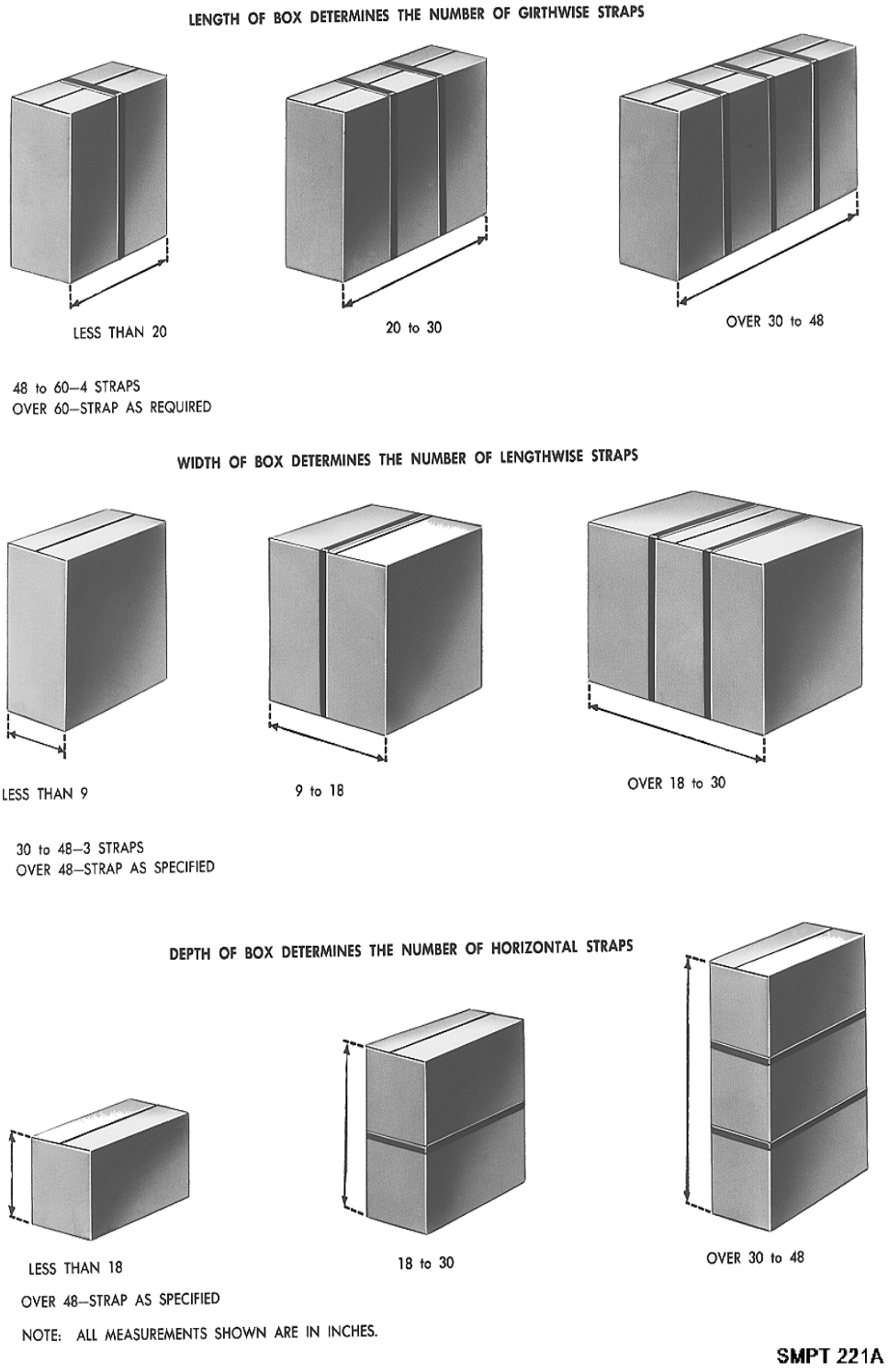


Figure 3-25. Requirements for strapping fiberboard boxes.

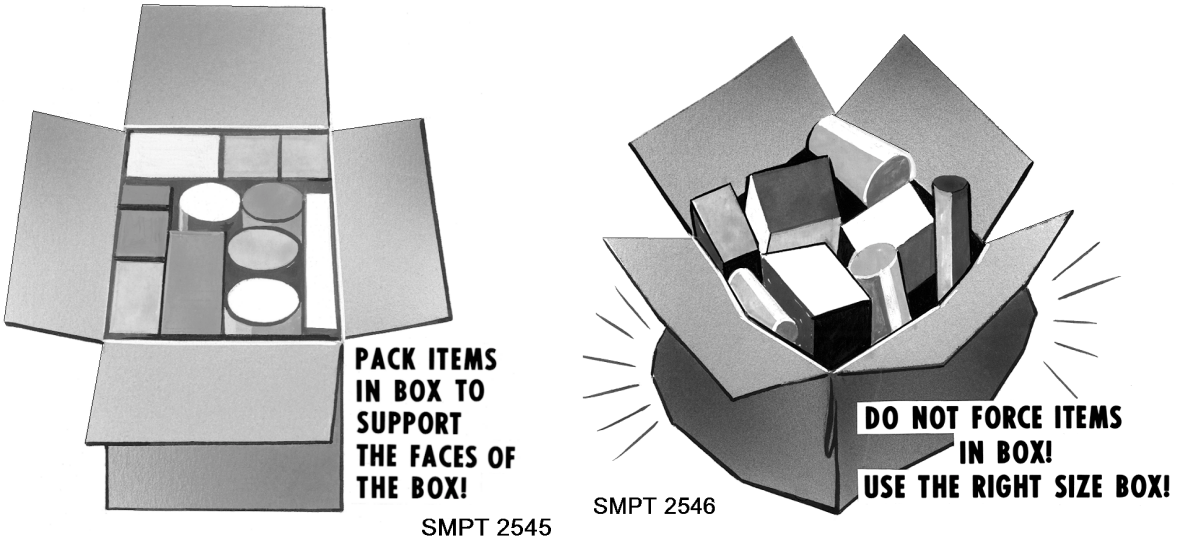


Figure 3-26. Fiberboard box packed correctly and fiberboard box packed incorrectly.

Procurement

For installations which do not fabricate boxes from sheet stock, fiberboard boxes are available from the General Services Administration (GSA). To procure fiberboard boxes from GSA, you must order by National Stock Number. This stock number can be obtained from applicable documents such as the Federal Supply Catalogs, FEDLOG, etc. To determine the proper National Stock Number, you must know the Type, class, and variety of board; strength (grade) of material; style of box; and the size of box, length, width, and depth.

Checkup

- X How many classes of fiberboard boxes are there? What are they?
- X What type of loads may be packed in fiberboard boxes?
- X What must you do if you have a Type III load to ship in a fiberboard box?
- X How do we convert a Type 3 load to Type 1 or Type 2 load?
- X What materials may be used to close class domestic fiberboard boxes?
- X When closing class domestic fiberboard boxes, how much of the flap surface area must the adhesive cover?

FIBERBOARD BOX FABRICATION PRACTICAL EXERCISE

Objective

As a result of this training, the student will be able to make, pack, close, and reinforce a single-wall fiberboard box.

General Instructions

This practical exercise will include a demonstration of closing and reinforcing a fiberboard box.

The practical exercise will be conducted in the classroom and will require 2 hours.

Conduct of Exercise

Situation

As a packer you are responsible for making, packing, closing, and reinforcing a single-wall fiberboard box.

Requirement No. 1

Demonstration by instructor.

- X Demonstrate the closure of the top flaps using ASTM D 5330 pressure-sensitive adhesive tape.
- X Demonstrate the reinforcement of fiberboard boxes using pressure-sensitive adhesive, filament reinforced tape.
- X Demonstrate the weatherproofing of a fiberboard box using ASTM D 5486, Type 5 tape.

Requirement No. 2

Answer the following questions.

- X From what two types of material are fiberboard containers made?
- X As a packer, when and why would you strap a class domestic fiberboard box?
- X Is a boxmaker's certificate needed on a fiberboard box?
- X Of all the fiberboard boxes in the system, what two styles are the most often used?
- X How many different styles of fiberboard boxes are there?
- X What are the types of fiberboard body joints?
- X Where is a liner used to obtain added strength and rigidity?
- X What are the classes of fiberboard boxes?
- X Which classes of fiberboard box require a compliance symbol?
- X How many and in which direction are reinforcing straps on a box 22" x 17" x 8"?
- X What must be done to an irregular-shaped item, such as a large brass water valve, in order to ship it in a fiberboard box?
- X When closing a class WWVR box with glue, how much of the surface of the box flaps must be covered?
- X If a fiberboard box is reinforced with metal banding, what determines the size of the banding?
- X If a sleeve is used to add strength to a fiberboard box, it should cover which surfaces?
- X What does class designate in classification of fiberboard boxes?
- X What does the letter C designate in a grade V11C fiberboard?
- X What are the two varieties of corrugated fiberboard?
- X Describe an RSC fiberboard box.
- X What are two ways of strengthening fiberboard boxes?
- X Identify the methods used to close a class domestic box.

Critique

The instructor will call on class members to give the answers to the questions.

Care of Area, Training Aids & Equipment.

Not applicable.

TRIPLE-WALL CORRUGATED FIBERBOARD BOXES (ASTM D 5168)

DESCRIPTION OF TRIPLE-WALL BOXES

Description of Triple-wall Boxes

Triple-wall boxes are bought either partly assembled or knocked down and in bundles. This permits easy storage at the depot. They are generally used as consolidation containers or as multipacks. Triple-wall boxes are available in a variety of shapes, sizes, and styles, and there are no weight restrictions. In many cases, the box that you use will depend upon the size and shape of the load that you have to pack. If you will recall, only Type 1 and 2 loads can be packed in SW or DW fiberboard boxes. However, we can pack all three types of loads in triple-wall boxes.

Materials

When we were discussing fiberboard boxes earlier, we described the single-wall and double-wall fiberboard material. Note the three rows of corrugations. See figure 3-27. This is why it is called triple-wall. Usually, an activity buys triple-wall boxes in standard sizes which will suit their needs. Other materials that are used in assembling and reinforcing triple-wall boxes are the same as those used for fiberboard boxes, e.g., staples water-resistant tape, filament reinforced tape, and strapping.

Classification of Triple-wall Fiberboard Boxes

Triple-wall boxes are classified by class and style as follows:

X Class

B Nonweather-resistant.
B Weather-resistant.
B Fire retardant

X Styles - A through G (based on construction features of the boxes).

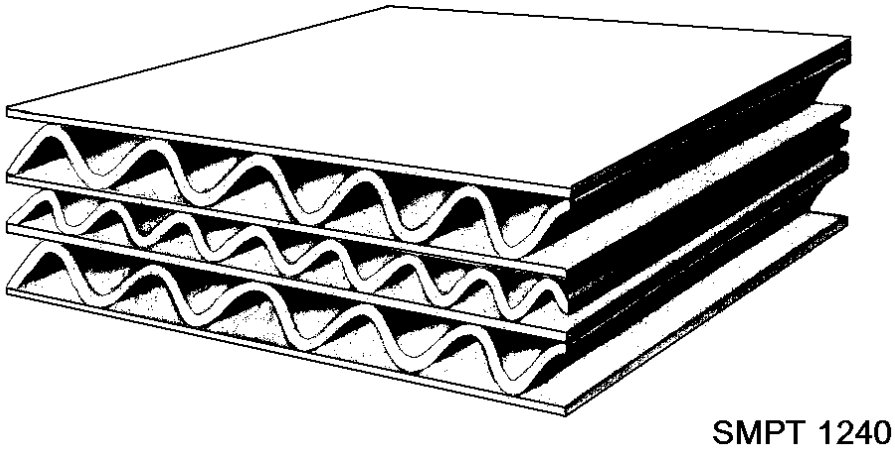


Figure 3-27. Triplewall corrugated fiberboard material.

Use of Triple-wall Boxes

Undoubtedly, you have packed many triple-wall boxes without giving any thought to the destination and hazards the box will encounter. Ordinarily, your supervisor or the packing specialist will supply you with the correct box to use.

Suppose your supervisor or the packing specialist were not around and you had to make the selection on your own. What would be helpful to you in deciding what box to use? The answer, of course, would depend on the destination of the box.

If it was a domestic shipment and no extreme weather conditions were expected, you could use a class nonweather-resistant box and class fire retardant. These triple-wall boxes are intended primarily for domestic shipments.

If it was an overseas shipment and extreme weather conditions and/or high humidity were expected, you could use a class weather-resistant box. The class weather-resistant triple-wall box is intended primarily for overseas shipments or shipments involving extreme weather conditions.

When packing a triple-wall box, you should place the regular shaped items next to the side and end panels so that they can provide support to the box. Irregular shaped items should be placed toward the center and cushioned or blocked in place. By doing this, you have made a good tight load as shown in figure 3-28, and it will help prevent damage to the items being shipped.

Construction of Triple-wall Boxes

Perhaps you will never be called upon to make a triple-wall box. If you are, then you should know about the styles and how they are made.

There are seven different styles of triple-wall boxes which are identified by the letters A through G. We are only going to concern ourselves with the two styles most commonly used--styles E and G.

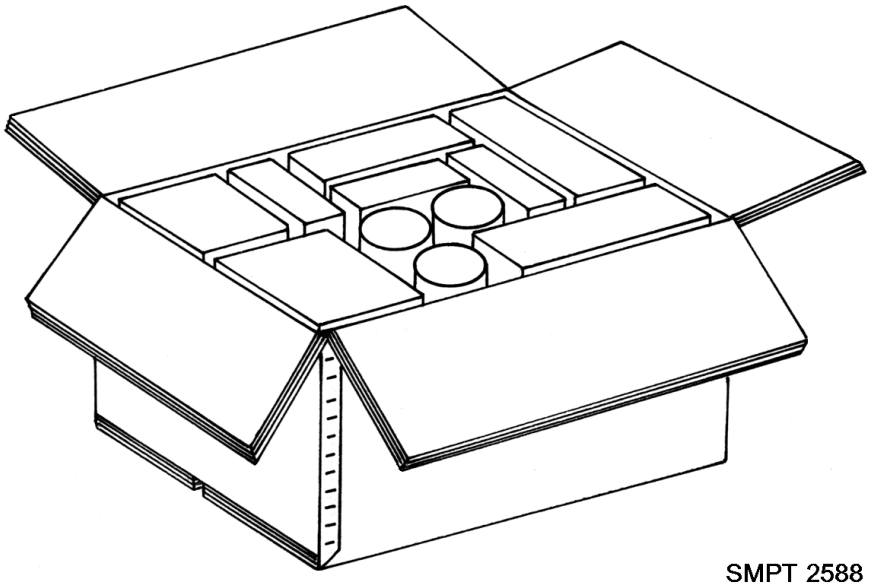


Figure 3-28. Triple-wall corrugated fiberboard box packed to make a tight load.

Style E

The style E, described as a RSC container, triple-wall box can be made in one of two ways as shown in figure 3-29.

One way is the regular construction of the slotted box and is made the same way as the RSC fiberboard box on special machinery that cuts, scores, and slots the fiberboard stock. The other way is the alternate construction of the regular slotted box. The identifying feature of this box is the overlapping flaps which are crushed 1-1/2 inches from the edge. This crushing of the flaps will provide you with an even surface on both the top and bottom of the box.

Style G

The style G triple-wall box is described as a two-piece triple-wall corrugated fiberboard box consisting of a half slotted container body with two flaps four inches wide and a separate flanged cover, as illustrated in figure 3-30.

The style G box body is made the same way as the style E except the top flaps are only four inches wide. The bottom flaps may meet in the center or may overlap. If the bottom flaps overlap, they must be crush rolled 1-1/2 inches from the edges so that they form a smooth surface on the bottom. The cover must be at least 6 inches deep. The cover may be made using one of the two types of corner construction.

Often, you will see style G triple-wall boxes with a pallet base, as in figure 3-31. Pallets are used to make handling easier by using forklift equipment.

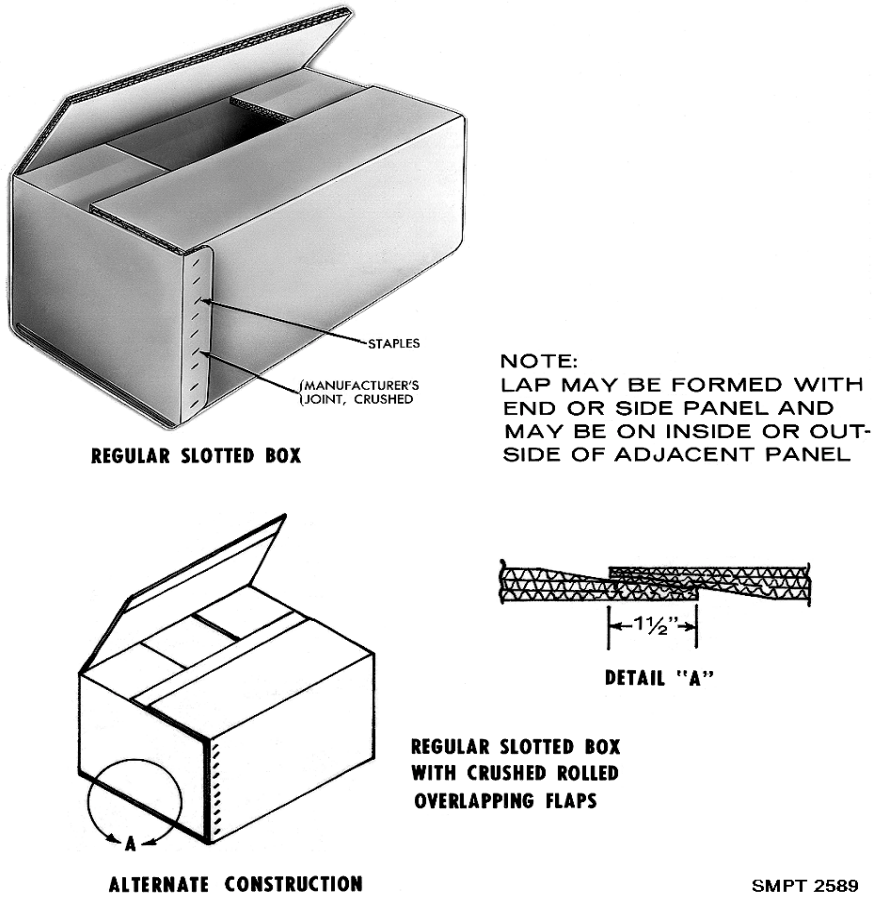


Figure 3-29. Triple-wall corrugated fiberboard box style E box.

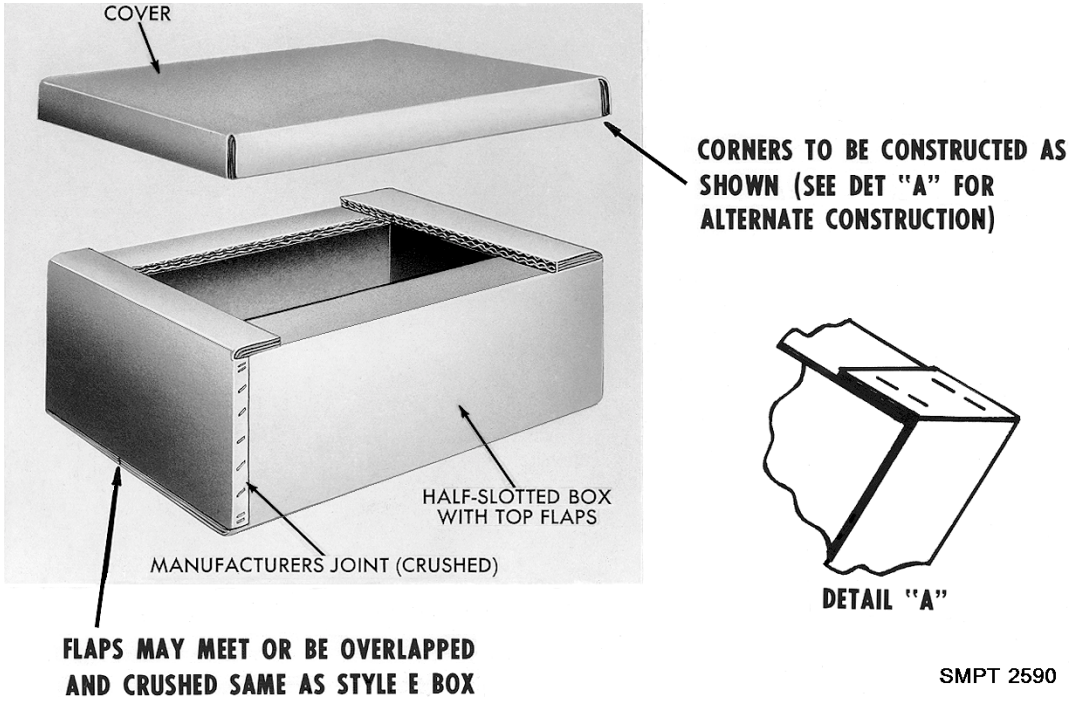


Figure 3-30. Triple-wall corrugated fiberboard style G box.

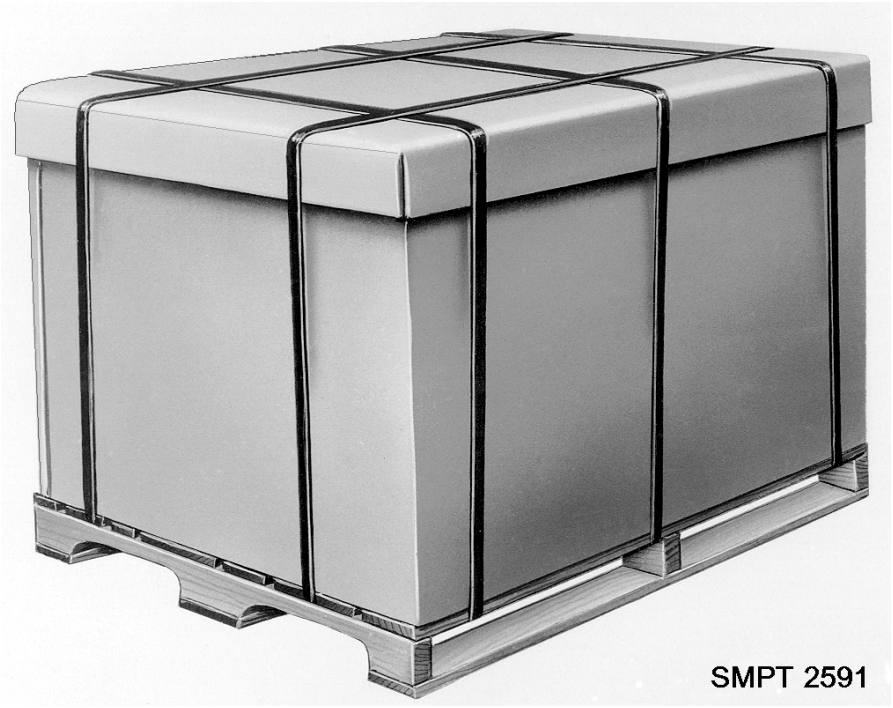


Figure 3-31. Triple-wall corrugated fiberboard style G box with pallet base.

Markings

Figure 3-32 shows the markings the box maker will place on the container. Weather-resistant containers made to comply with this specification shall be imprinted with the following data:

- X **Boxmaker's name or certificate.** Whether you buy or make triple-wall boxes, the boxmaker's certificate must be shown stating that the box has been made according to applicable freight classification rules.
- X **Month and year of manufacture**
- X **Individual grade or identification symbols**
- X **Compliance symbol.** Markings indicating that the box complies with specification ASTM D 5168 and identification of the class of box must be placed below the boxmaker's certificate.
- X **NSN and dimensions.** Unless otherwise specified, for shipments to Government Agencies, the National Stock Number (NSN), inside dimensions, and outside cube shall be marked below the specification data on all exterior-type boxes procured as an item of supply. MIL-STD-129 also requires capital letters WT which will precede the gross weight. The gross weight will be expressed in pounds rounded up to the nearest pound.

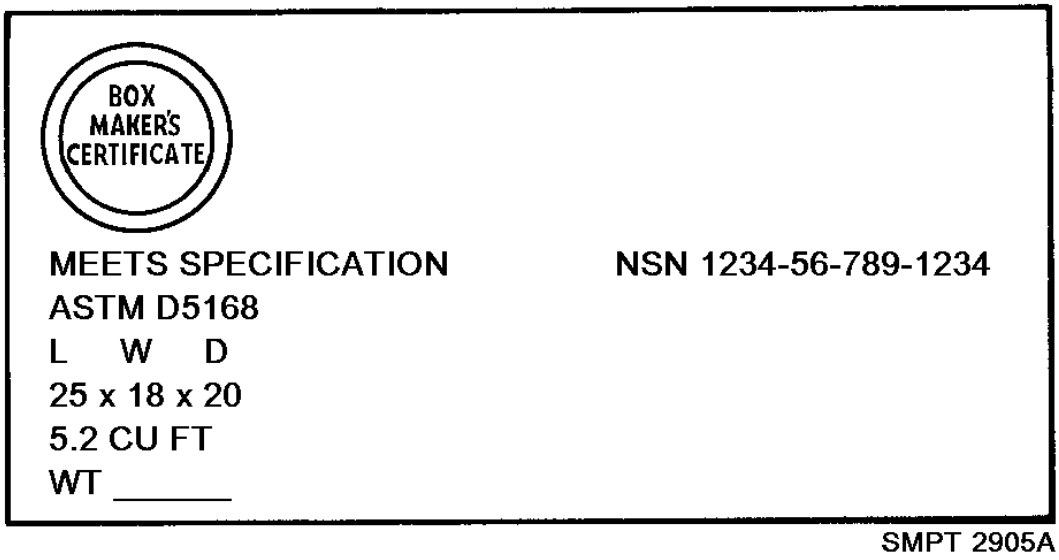


Figure 3-32. Compliance markings.

Closing and Reinforcing Triple-wall Boxes

After you have packed a triple-wall box, the next step is to close and reinforce the box. The way you close the box will depend upon the style of the box. Each style of triple-wall box has its own closure requirements. The materials used are nails, staples, steel and nonmetallic strapping, filament reinforced tape, or a combination of them. When you reinforce a triple-wall box, you may use steel strapping, nonmetallic strapping, or filament reinforced tape.

Style E Box Closure and Reinforcement

Figure 3-33 illustrates the closing and reinforcing of the style E box.

If you use staples to close the box, they will be placed on each side of the center seam in the area where the inner and outer flaps overlap and along the edges of the outer flap. When the alternate construction of the box is used, the staples will be placed along the entire length of the overlapped seam plus the edge of the outer flaps. The staples will normally be placed a maximum of 2-1/2 inches apart.

If you use metal or nonmetallic strapping to close the box, you must apply two girthwise straps. Each strap will be located no more than 3 inches from the ends of the box. If the length of the box exceeds 24 inches, an additional strap is required around the center.

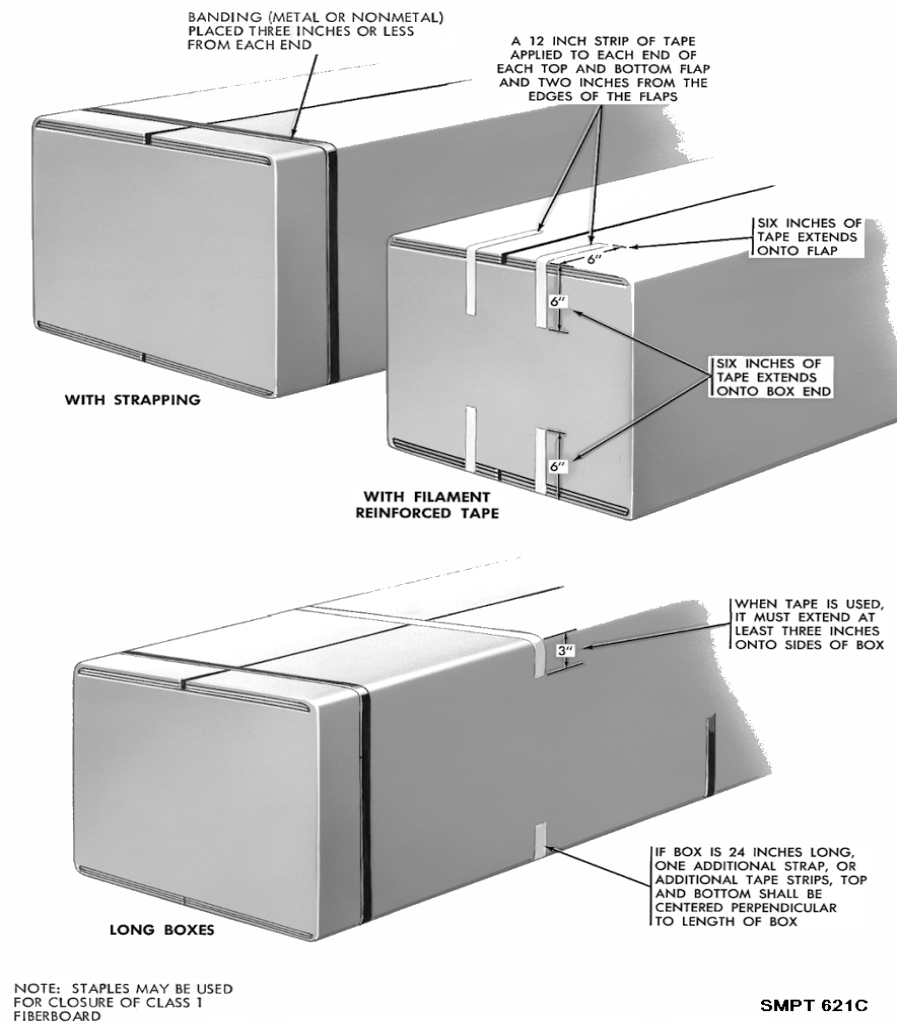


Figure 3-33. Closure and reinforcement of triple-wall fiberboard style E box using either banding or tape.

If you use tape to close the box, you must place a 12-inch strip of tape on each end of the top and bottom flaps, so that 6 inches of tape is attached to the end. The tape should be located 2 inches from the inner edge of the flap. When the length of the box exceeds 24 inches, a strip will be placed girthwise across the top and bottom of the box. Each strip will extend a minimum of 3 inches on each side.

When you reinforce a style E box, you place one reinforcement (either tape or strapping) band on boxes greater than 24 inches long. The band is placed girthwise around the box and is located in the center of the box. For each additional 18 inches of length, an additional reinforcement should be added. These additional reinforcements should be spaced evenly along the length of the box. You may apply lengthwise strapping (as required) to hold the flaps flat.

Style G Box Closure and Reinforcement

There will be times when you will have to close and reinforce the style G triple-wall box. If this is the case, then you want to know what has to be done and how to do it. See figure 3-34.

If the style G box is used with a pallet base, the procuring activity will tell you how to close and seal the box.

When the style G box is used without a pallet base, you may close it with either steel or nonmetal straps, as shown in figure 3-34. One lengthwise strap should be centrally located and should circle the top, bottom, and ends of the box. Two girthwise straps should be placed at a distance from the ends equal to 3/4 the length of the inner bottom flaps. A total of three straps are necessary to close the box.

You may use either steel or nonmetallic strapping to reinforce the style G box. When the distance between the two girthwise straps (used for the closure) is more than 24 inches, additional reinforcing straps should be used. The additional reinforcing straps should not be spaced more than 24 inches apart.

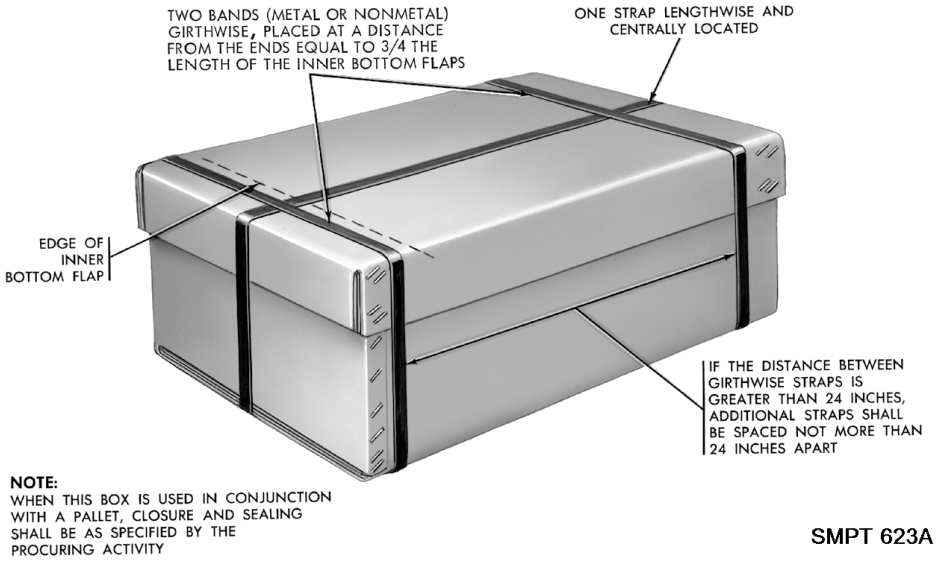


Figure 3-34. Closure and reinforcement of triple-wall corrugated fiberboard style G box.

Edge Protectors

Frequently, edge protectors are used under metal strapping to prevent the strapping from cutting into the box. You may use either metal edge protectors, fiberboard angleboards, or a piece of scrap fiberboard.

Sealing of Triple-wall Boxes

There will be times when you will have to seal the box against the entry of water or dust. This can be done by sealing all seams and joints with water-resistant tape, as in figure 3-35. The tape should be at least 2 inches wide.

Checkup

- X What are the three classes of triple-wall corrugated fiberboard boxes?
- X What are the two most commonly used styles of triple-wall corrugated fiberboard boxes?
- X What types of loads may be shipped in triple-wall corrugated fiberboard boxes?
- X How should you pack a triple-wall corrugated fiberboard box?
- X What materials can you use to reinforce a triple-wall corrugated fiberboard boxes?

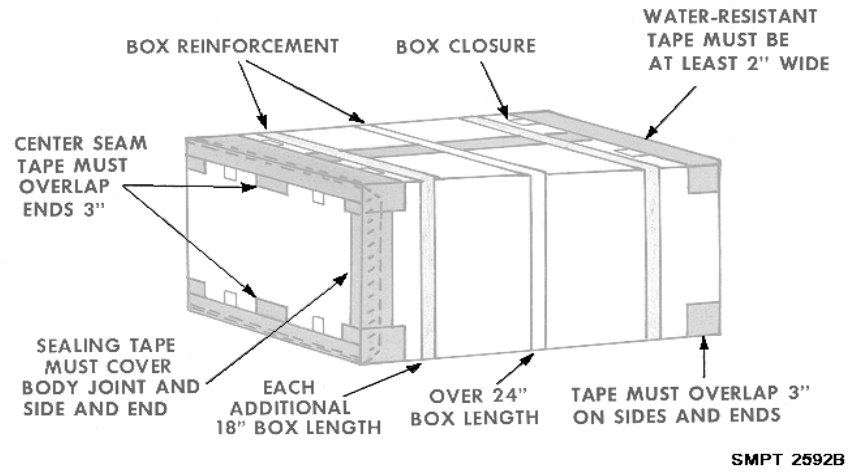


Figure 3.35. Styles E and G triple-wall boxes closed, sealed, and reinforced.

Triple-wall Boxes Practical Exercise

Objective

As a result of this training, the student will be able to pack, seal, close, and reinforce a triple-wall corrugated fiberboard box.

General Instructions

The time to accomplish this practical exercise is 1 hour.

The practical exercise will be conducted in the classroom.

Conduct of Exercise

Situation

As a packer, you are responsible for packing, sealing, closing, and reinforcing a triple-wall corrugated fiberboard box.

Requirement No. 1

Answer the following questions.

X What style of triple-wall box is the same as an RSC box?
X How is the Style G triple-wall corrugated fiberboard box described?
X What types of loads may be shipped in triple-wall corrugated fiberboard boxes?
X Why do you seal a triple-wall, corrugated fiberboard box with water-resistant tape?
X How deep must the cover of a style G triple-wall corrugated fiberboard box be?
X When sealing, closing, and reinforcing a style G triple-wall corrugated fiberboard box, what is applied first, water-resistant tape or strapping?
X Which style of triple-wall box may include a pallet base?
X Triple-wall fiberboard boxes may be obtained in 3 classes. What are they?
X In closing a style G triple-wall box with metal banding, what is the maximum distance allowed between bands?
X If you use banding to close a style E triple-wall box, where is it placed?
X How many styles of triple-wall fiberboard boxes are there?
X How many strips of carton sealing tape are used to seal a style E triple-wall box?
X How far down the end of the box must center seam tape extend when sealing a style E triple-wall box?
X How many bands are required to close a style G triple-wall box that is 23" long, 20" wide, and 10" high?
X What is the preferred way to pack a triple-wall box?
X How would you close a style E triple-wall box 26 inches long using filament reinforced tape?
X How would you reinforce this style E triple-wall fiberboard box?
X What materials may be used to prevent the metal strapping from cutting into the box?

Critique

Instructor will orally critique the practical exercise questions.

Care of Area, Training Aids & Equipment

Not applicable.

WOODEN BOXES

WOODEN BOX MATERIALS AND FABRICATION

General

Wood is a common material used to make containers for shipping military supplies and equipment. Wood boxes are strong and rugged and hold up well under shocks and impacts during shipping and handling.

Wood Groups

For purposes of making boxes, wood is divided into four groups, in accordance with ASTM D 6199.

- X Group I woods are the softer woods, such as cedar, fir, chestnut, and most types of pine.
- X Group II woods are the harder soft woods, which include Southern yellow pine, Douglas fir, and hemlock.
- X Group III woods are the medium density hardwoods, such as ash, (except white ash), elm, and sycamore.
- X Group IV woods are the true hardwoods, including oak, hard maple, hickory, and beech.

Characteristics of Wood

Each of the wood groups offers four important characteristics in different ways. These characteristics are illustrated in figure 3-36.

Strength as a Beam

This is bending strength of a piece of lumber. Examples are shovel handles, framing members for crates and boxes, stadium seats and scaffold planks.

Resistance to Splitting

Splitting may occur when nailing or from a sudden shock.

Shock Resistance

This is the capacity to withstand suddenly applied loads, repeated shocks, jolts and blows. Golf club shafts and ax handles are examples of implements able to withstand a lot of shock.

Nail Holding Ability

This ability depends upon the kind of wood used (pine, fir, oak). It also depends upon the surface treatment of nails (coating or etching) and method of nailing (side grain, edge grain, or end grain). These last two points will be discussed later in the lesson.

Comparison of Wood Groups

Nail holding ability, beam strength, and shock resistance generally tend to be greater in Groups II, III, and IV woods than in Group I woods, but splitting occurs more readily in the harder woods.

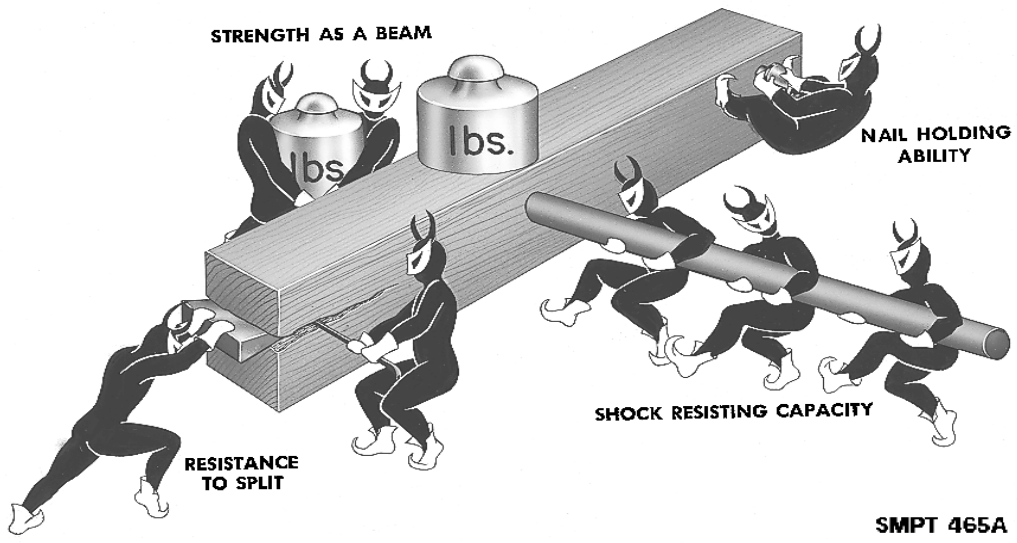


Figure 3-36. Characteristics of wood.

Groups I and II Woods

Over 90 percent of all wood boxes are made from Groups I and II woods. These groups have adequate characteristics for boxmaking and their comparatively lesser weight means lower transportation costs.

Wood Defects

Wood may have certain defects which, if allowed to find their way into the construction of a box, may cause damage to the box when subjected to the stresses of handling. Figure 3-37 shows several of the more common defects in wood which may be easily spotted in the boxmaking shop or on the packing line are oversize knots, knotholes, and bark (sometimes called wane). Another defect in wood is too much moisture. In time, the wood will dry and this causes the box to shrink. As a result, nails and strapping begin to loosen.

Nails

Nails are used to hold the panels of a wood box together. Many different kinds of nails such as those in figure 3-39 are used to make and close wood boxes. Other kinds of fasteners used in making wood boxes include screws, corrugated fasteners, staples, wire fasteners, and bolts.

During handling, nails holding a box together are subjected to two basic kinds of forces. These are direct withdrawal and lateral or shear forces, as shown in figure 3-39.

The holding strength of nails depends upon several factors.

The Size of the Nail

This is written, for example, as six penny (6d).

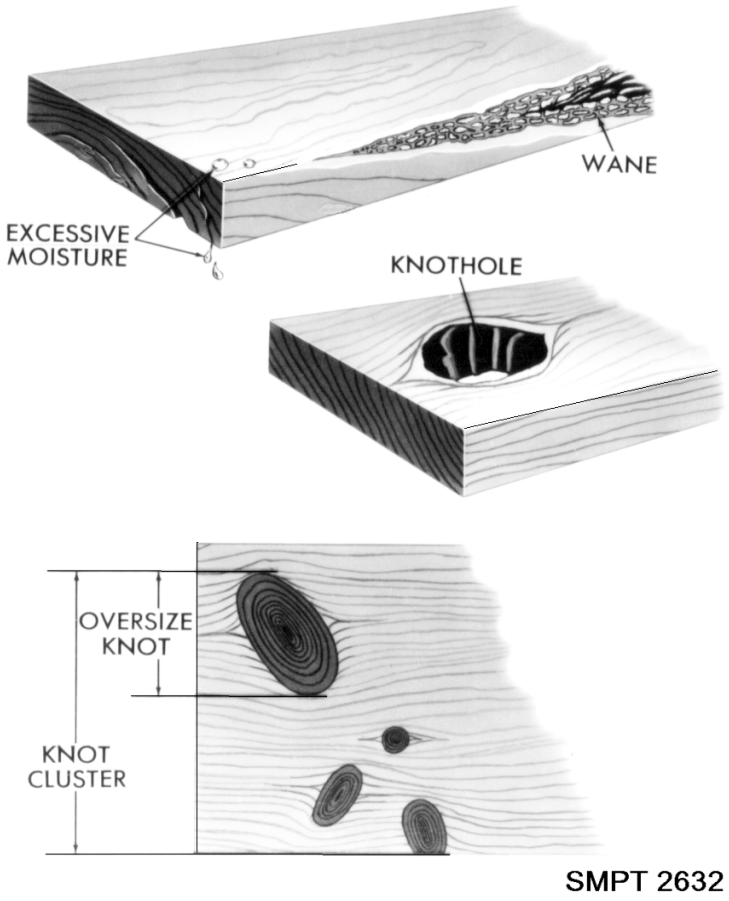


Figure 3-37. Defects in wood.

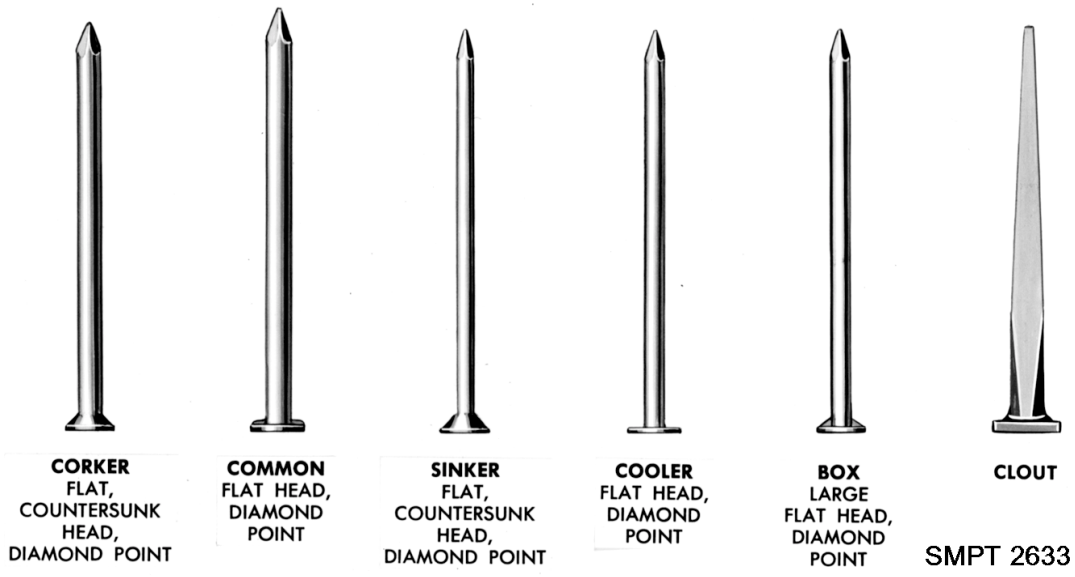


Figure 3-38. Kinds of nails used in making and/or closing wood boxes.

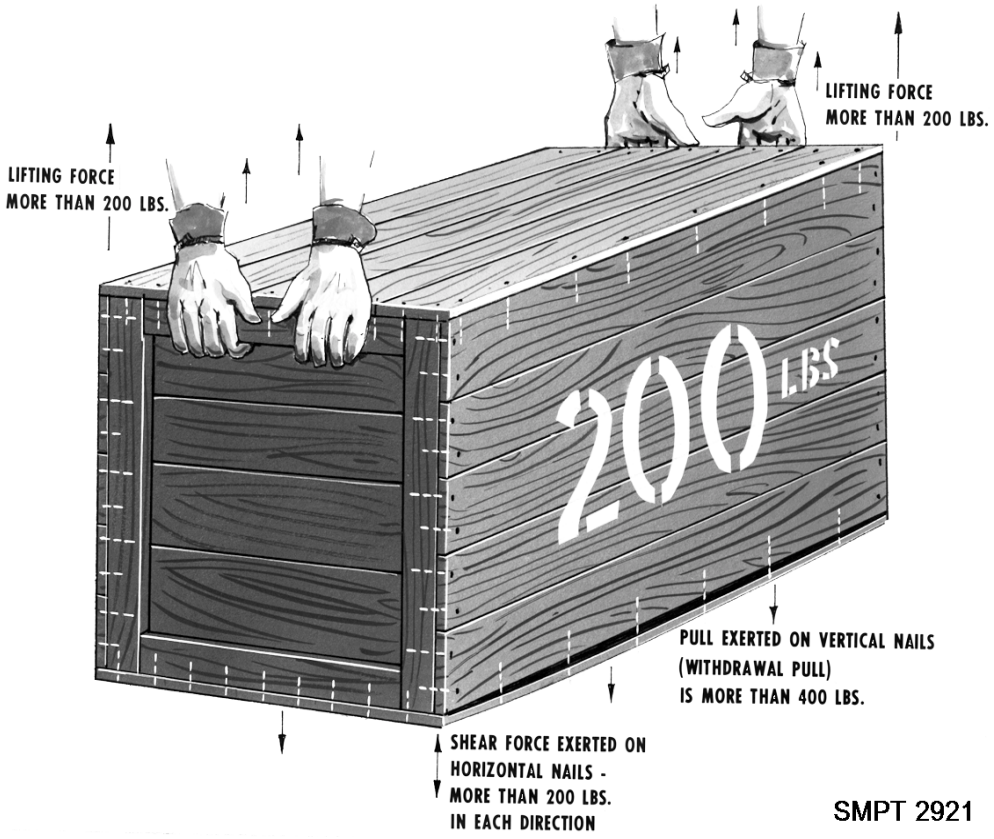


Figure 3-39. Nail stresses.

The Wood Group and Condition of the Wood

Whether the nail is driven into the side grain, edge grain or end grain of the lumber as in figure 3-40

Side and edge grain nailing have more holding ability because, upon withdrawal, fibers in the wood "bunch up" around the nail to form a locking action. End grain nailing gives about one-half the holding strength of the other two nailing methods because the nail is driven between the wood fibers and little gripping action occurs upon withdrawal. When boxes are made and/or closed, side and edge grain nailing should be used wherever possible to increase the holding strength of the nails. Side grain nailing is the best method of nailing.

The surface treatment of nails also increases holding ability. This treatment may be in the form of a chemical etching or a coating of some kind. This coating is usually a cement coating.

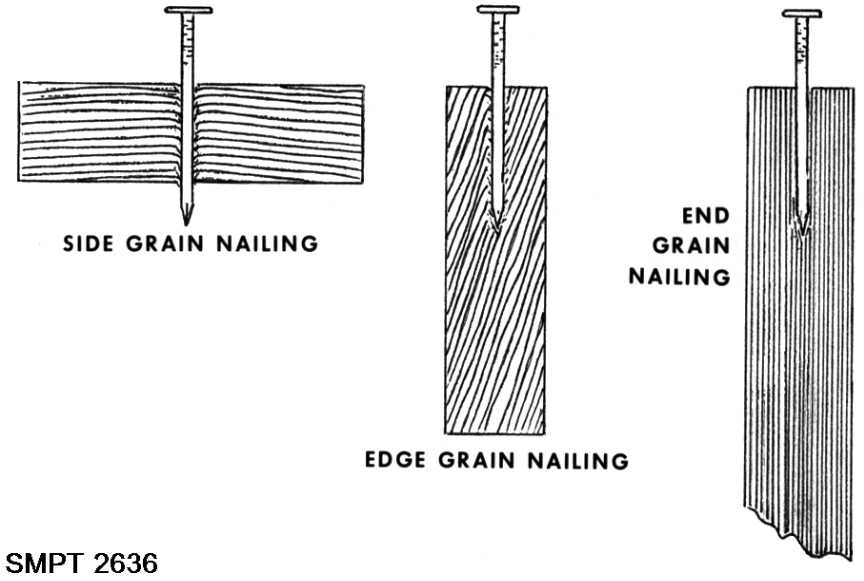


Figure 3-40. Methods of nailing.

Etchings on nails are like tiny barbs that grip the wood.

Cement or other coating on a nail provides an "adhesive" action. This surface treatment is not effective when the nail is driven into hard woods, since the coating is usually stripped off.

Untreated nails, referred to as "bright" nails, may be used in place of treated nails but only in those instances when the point can be mashed over (clinched) against the grain lines of the wood. A clinched nail has the greatest holding strength.

Incorrect nailing practices can seriously weaken a wood box. When closing the box, the packer should use the right nail size and drive it to the proper depth. Nailing too close or too far from the edge of the wood should be avoided. Figure 3-41 illustrates both correct and incorrect nailing.

Types of Wood Boxes

Many kinds and styles of wood boxes are used to ship military supplies and equipment. Three of the most widely used boxes are nailed wood boxes, cleated plywood boxes, and wirebound wood boxes. After discussion of each type and certain styles, emphasis will be placed on closing the box and the strapping requirements.

Boxes, Wood, Nailed and Lock-Corner (PPP-B-621)

Description

These boxes are used to ship a wide variety of commodities. They provide high resistance to crushing, puncturing, and mashing at the corners. The boxes stack well and are relatively easy to make in the box shop. The parts of the boxes may be varied in thickness and width so as to permit carrying a range of weights up to 1,000 pounds.

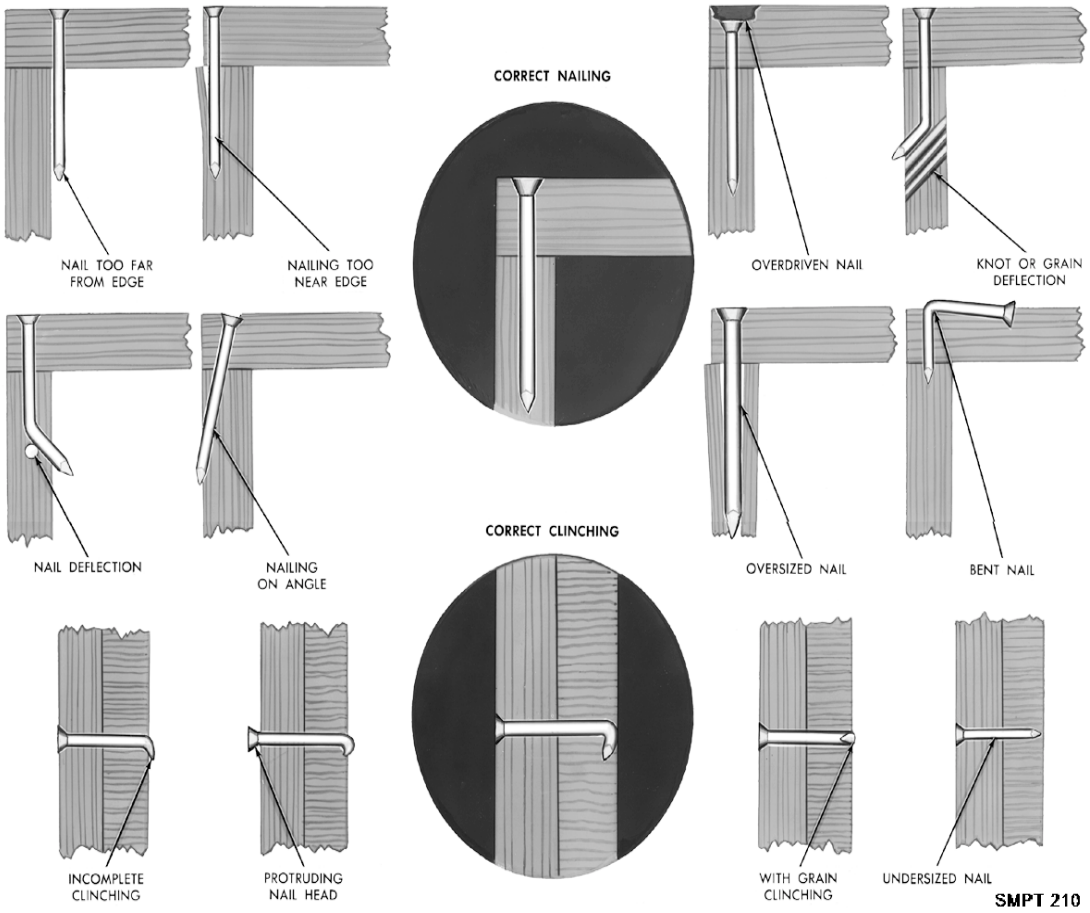


Figure 3-41. Nailing practices.

Components

Nailed wood boxes are made of face boards, end boards, cleats, and battens, as shown in figure 3-42. Cleats and battens are pieces of wood attached to the ends and sides of the box for the purpose of making the box stronger.

Styles

Styles 2, 4, and 7 nailed wood boxes, seen in figure 3-43, and shallow boxes are commonly used in military packing, although five other styles are found in this kind of box. A style 2 box has two sets of cleats on each end. One set consists of two horizontal (filler) cleats. Another set comprises two vertical (through) cleats. A style 4 box has two vertical (through) cleats on each end. A style 7 box is an internally reinforced box consisting of a skidded base and a separate hood. The side, end, and top panels are prefabricated and then assembled as a hood to be placed over the item. The hood is nailed to the base and then strapped. Shallow boxes are boxes with an inside depth of 5 inches or less. Cleats are not used. Each side and end of the box is made of one piece, except, when the end is nearly square, it may be made of two pieces. The two pieces are placed together so that the grain lines in one is at right angles to the grain in the other.

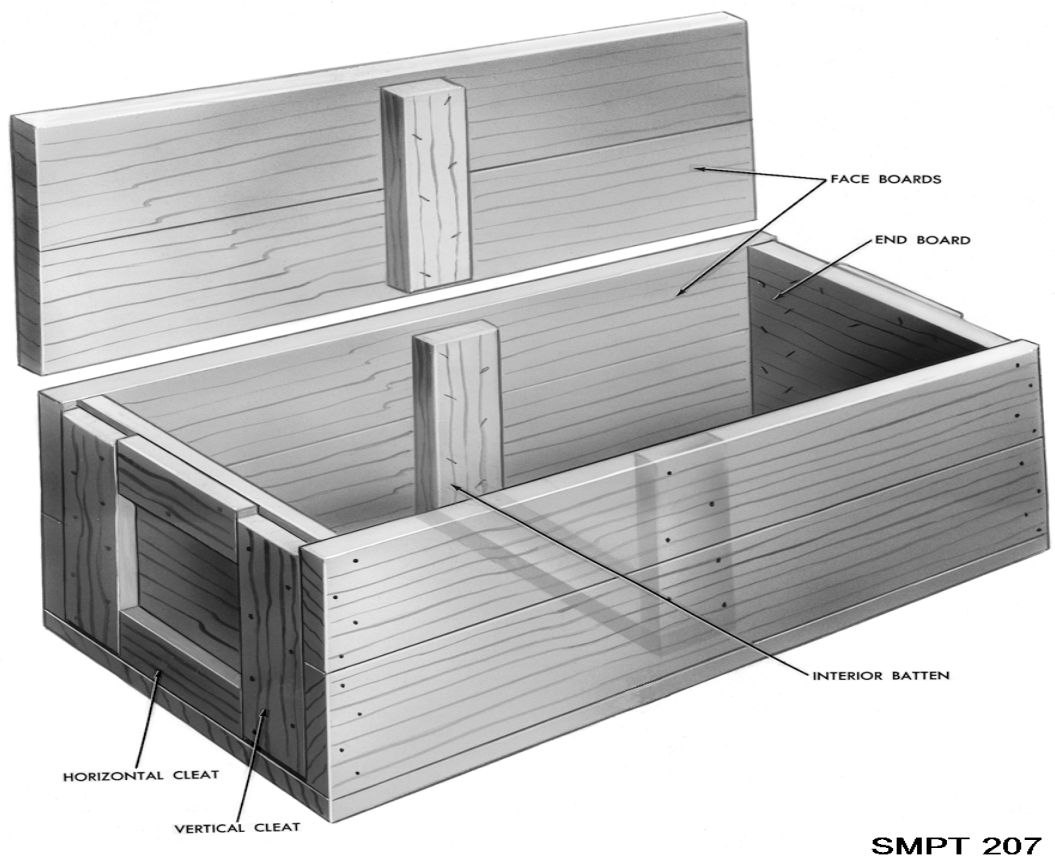


Figure 3-42. Nailed wood box components.

Classes of Nailed Wood Boxes

Figure 3-44 shows that nailed boxes are classified as class 1, for domestic shipments, and class 2, for overseas shipments.

Weight Limitations

The amount of weight that a nailed wood box may carry varies with the style and its destination. For example, a style 2 oversea box may carry 1,000 pounds whereas a style 4 oversea box is limited to 400 pounds. Although the same style box is used for domestic and overseas shipments, more weight is permitted in the oversea box because its top, bottom, sides, ends and cleats are made of thicker and wider materials.

Grades of Boxes

Overseas boxes are made in two grades. These are grade A boxes made of lumber treated with wood preservative and a grade B boxes that have no preservative added. A preservative helps prevent deterioration of the box from weather.

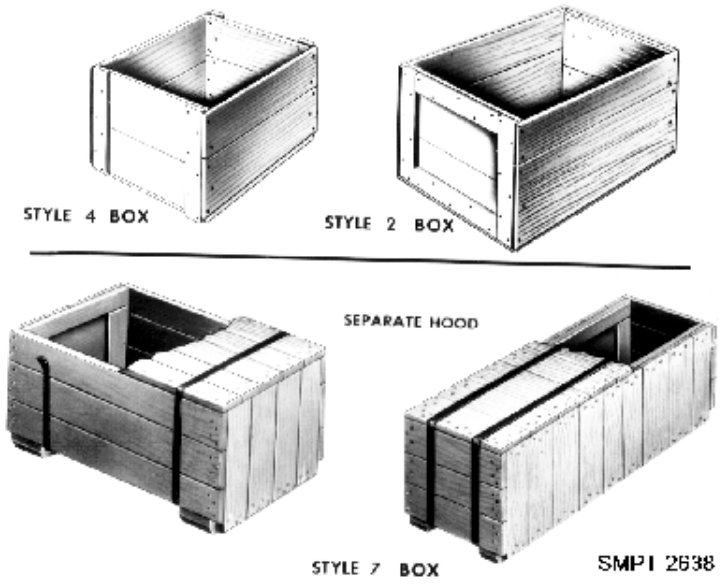


Figure 3-43. Styles 2, 4, and 7 nailed wood boxes.

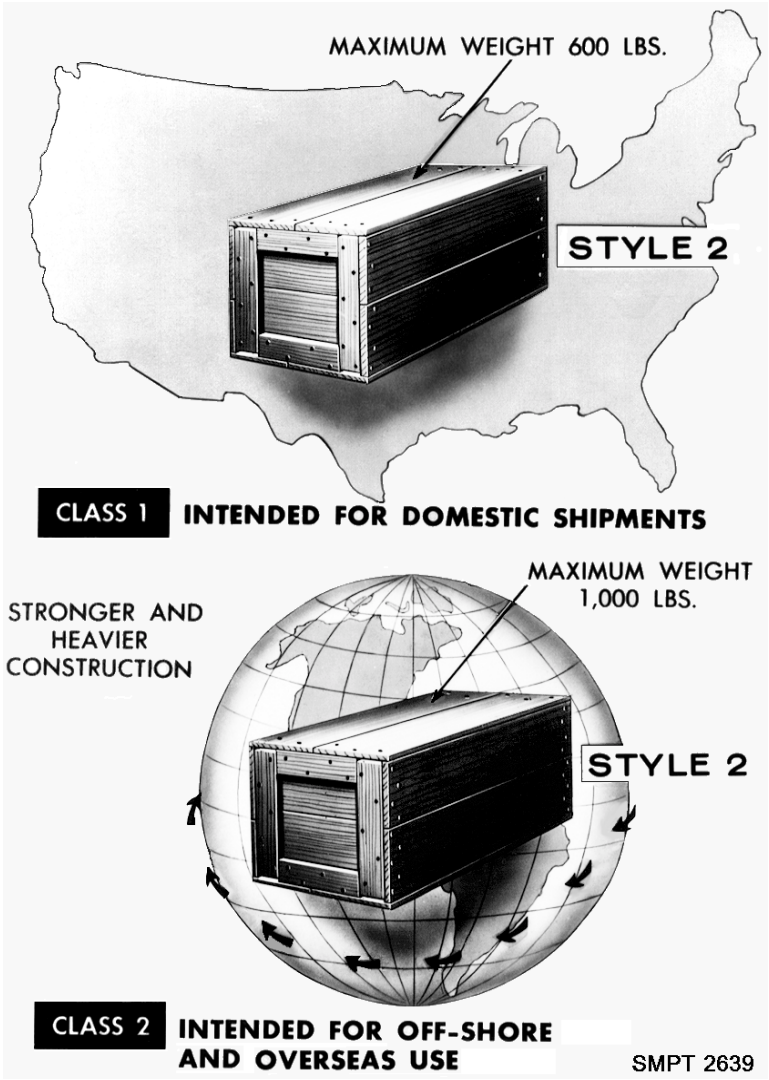


Figure 3-44. Styles 2, 4, and 7 nailed wood boxes.

Closing of the Nailed Wood Box

The box is not ready for shipment until the lid or the hood (for style 7) is attached by nailing. This job is frequently done by the packer who should be thoroughly familiar with good nailing practices. In the style 2 box, the top covers the side and end panels are attached by driving nails in a straight line into the sides and by using a staggered pattern on the end cleats and ends. For the style 4 box, the top covers the sides and fits inside the protruding cleats on the ends. The top is attached by straight line nailing into the ends and sides. If a side or end of a nailed wood box is less than 3/4 inch thick, nails should not be driven into that member because of the likelihood of splitting. The hood of the style 7 box is attached to the base of the box by staggered nailing running through the sheathing of the hood into the two skids.

Strapping the Nailed Wood Box

After the box is closed, it should be strapped. Strapping is one of the most important elements of packing because it helps to protect and reinforce the box and its contents during handling. Straps should be applied just before shipping, mainly to allow time for evaporation of moisture that may be in the box lumber. It was earlier stated that a box with excess moisture will shrink and cause straps to loosen. For this reason, straps when applied to wood boxes should "bite" into edges of the wood. The size of the flat metal strapping used depends upon the net weight of contents of the box. A 70-pound load, for example, requires a band 3/8 inch wide and .015 inch thick whereas a 400-pound load needs a band 3/4 inch wide by .020 inch thick. Either flat metal banding or round wire strapping may be used. Many kinds of strapping equipment are used in military packing as shown in figure 3-45, basically, the equipment consists of a tensioner for drawing the straps tightly around the box and a sealer which crimps a piece of metal (seal) to join the two ends of the tightened strap. For styles 2 and 4 nailed wood boxes, straps are placed girthwise (over the top, bottom, and sides of the box) at a distance from the ends equalling about one-sixth the length of the box and never more than 9 inches, as in figure 3-46. To illustrate, if the box is 24 inches long, the girth straps should be positioned about 4 inches from each end. If the distance between straps is more than 24 inches, an additional strap should be placed so as to divide the distance between them. This is necessary because the long unsupported area between the end straps needs to be reinforced.

For the style 7 box, straps are placed to run in the same direction as the skids and should be right next to the inner edge of the skids.

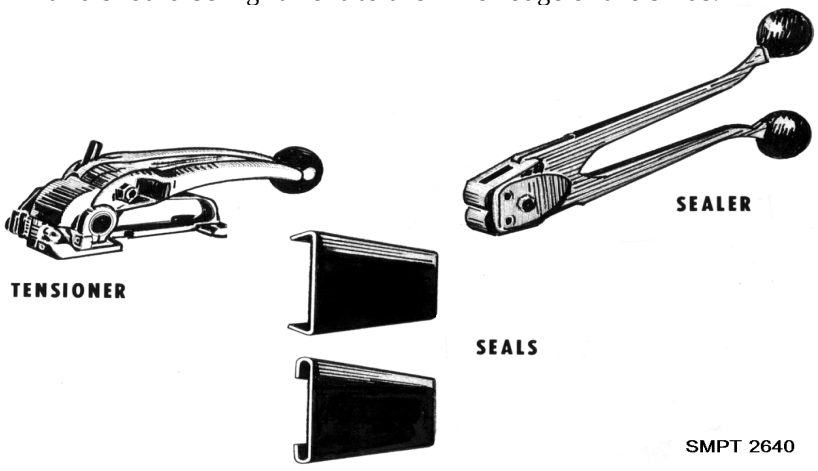


Figure 3-45. Strapping equipment.



Figure 3-46. Nailed wood box strapping.

Cleated Panel Boxes

Description

These boxes are lightweight, yet hold up well under rough handling. Being strong on the edges, they resist distortion or twisting when stacked. Because the panels that form the body of the box are solid materials, dust and dirt are prevented from getting into the box. An important characteristic of the cleated panel box is its reusability.

Cleated Box Paneling Material

Three kinds of paneling materials are used to make these boxes. These materials are plywood, fiberboard and paper-overlaid veneer (thin sheets of wood covered on both sides with paper). Plywood is the strongest of the three materials. Therefore, we will only discuss the Cleated-Plywood Boxes (PPP-B-601).

Box Styles

The styles of cleated panel boxes are designated by letters of the alphabet. For example, there are 4 styles of cleated plywood boxes and they are lettered A, B, I, and J. Our discussion will be limited to cleated plywood box styles A and B since they are generally more widely used. Regardless of paneling material used, cleated panel boxes are made practically the same.

Intended Use

Like nailed wood boxes, cleated plywood boxes are made for either domestic or oversea shipments. Styles are A, B, I, and J. Overseas boxes are made with or without preservative treatment. Cleats and paneling material in the overseas boxes generally are thicker and wider for greater strength because distance invites more and greater shipping hazards. An important requirement is that *cleats must be single solid pieces*.

Forming Cleated Panels

The cleated plywood box is made by attaching wood cleats to sheets of plywood to form sides, ends, top, and bottom of the box. The finished panels are then fastened together at the cleats, as shown in figure 3-48. Each side, end, top, and bottom of styles A and B boxes have two through cleats and two filler cleats. Cleats are positioned on the edges of the paneling material to give the box a strong framework. See figure 3-47. Thru cleats run the entire length, width, or height of a box. The style A box has a "squared" corner while the style B has an interlocking corner. The latter effect comes from making the side shorter than the ends and from placing the top and bottom panels between the ends.

Extra Cleat Support for Large Boxes

Packers should be alert to the necessity for using additional (intermediate) cleats between the edge cleats on boxes with oversize dimensions. For a domestic box carrying Types 1 and 2 loads, an additional cleat is required if the distance between the vertical edge cleats is greater than 24 inches. For an overseas box, packed with a Type 3 load, the distance is reduced to 20 inches. The extra cleats help to strengthen large unframed or unsupported areas of the box. A box whose contents are concentrated near the center of an unframed area should likewise be reinforced with additional cleats. Intermediate cleats should be the same width and thickness as the edge cleats.

Weight Limitations

One of the main causes of wood box failure during shipping, handling, and storage is too much weight for the strength of the box. There is a relationship between the amount of weight that a box can carry and the size (thickness and width) of its panel material and cleats. For example, a box intended to carry 1,000 pounds will require larger size cleats and panel materials than a box carrying 400 pounds.

Use of Skids

Heavy boxes can best be handled by forklift equipment. To provide for fork handling, boxes and contents weighing 200 pounds and more should be equipped with at least two skids.

Closing the cleated plywood box

Nailing the top to the box requires certain size nails and a definite spacing between nails. Size and spacing are governed by such factors as thickness of cleats and wood group used. For example, on a domestic cleated plywood box, if the cleat has a thickness of 5/8-inch and is made of Group I wood, six penny

(6d) nails will be driven into the wood every five inches. Remembering a few points will help packers to do more efficient nailing. As the thickness of cleats increases, closer spacing of nails is permitted. Larger nails should be used as cleat thickness increases. Nail sizes can be reduced when harder woods are used.

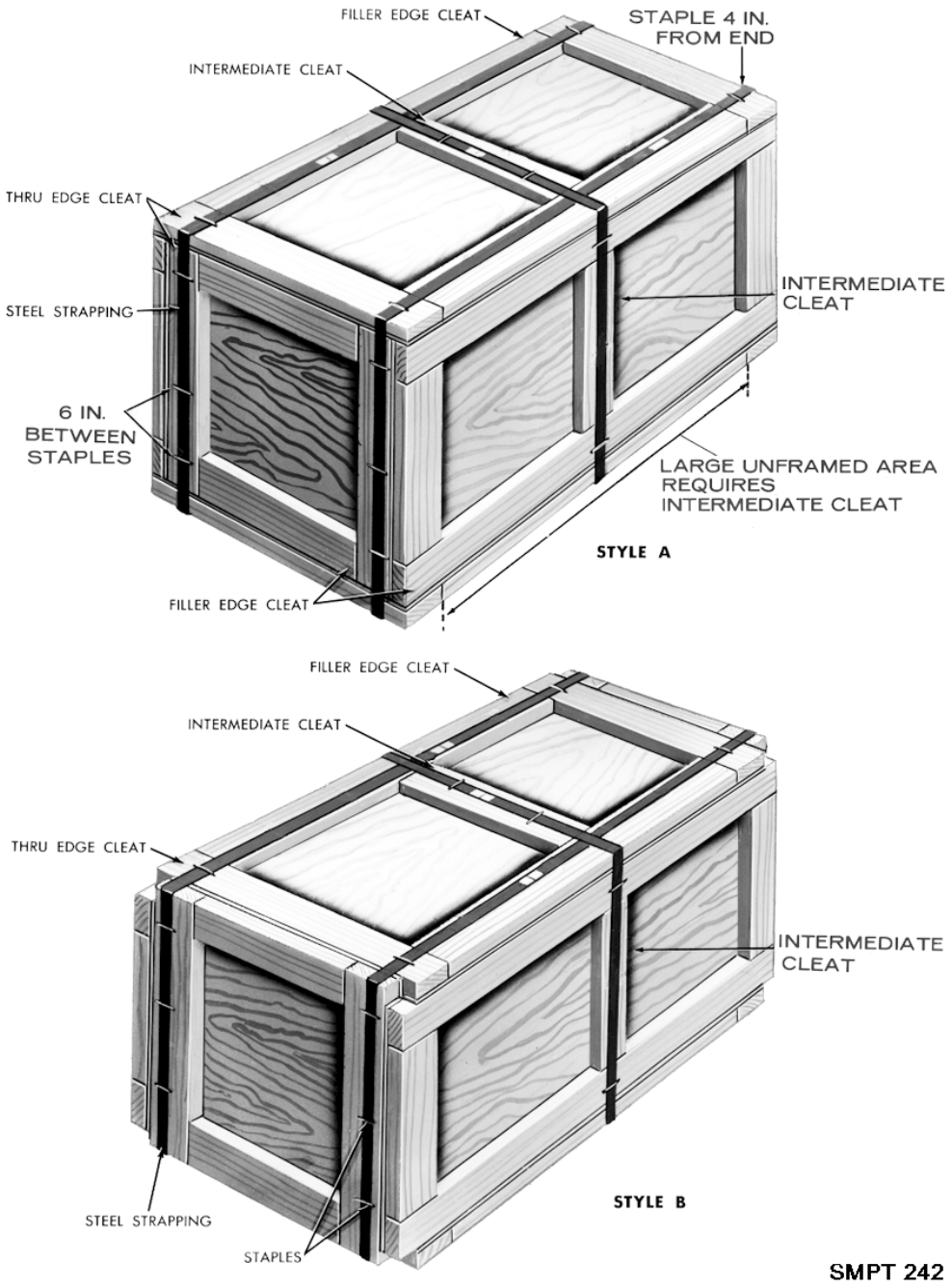


Figure 3-47. Cleated plywood boxes styles A and B.

Strapping

Like nailed wood boxes, cleated plywood boxes are strapped just before shipping. Flat steel bands or round wire may be used. When strapping a Style A or B cleated plywood box, the bands travel in a lengthwise direction, that is, they pass over the edges of the cleats of the top, bottom, and ends. Should the box have intermediate cleats, a girthwise band will encircle the box over the cleats. Metal bands are stapled to the box on all surfaces except the bottom. Stapling is not permitted on the filler edge cleats of the top. Spacing of staples is about 6 inches but no farther from an edge than 4 inches. The purpose of the staples is to hold the bands tightly against the panels of the box to prevent snagging and possible breaking of the bands.

Wirebound Wood Boxes (PPP-B-585)

Description

Wirebound wood boxes are made by commercial manufacturers and are bought through supply channels. The boxes are supplied in flat-mat form (unassembled) and later are set up to form a box. They are rugged in construction and will take considerable "punishment" during shipping and handling.

Components

Figure 3-48 shows how the box is put together using cleats, faceboards, liners, and binding wires. Cleats form the framework of the box and faceboards are the thin boards that form the six faces of the box. Binding wires hold the box together and carry most of the load. The ends of the box may be plain or may have liners and battens attached to give the box greater strength.

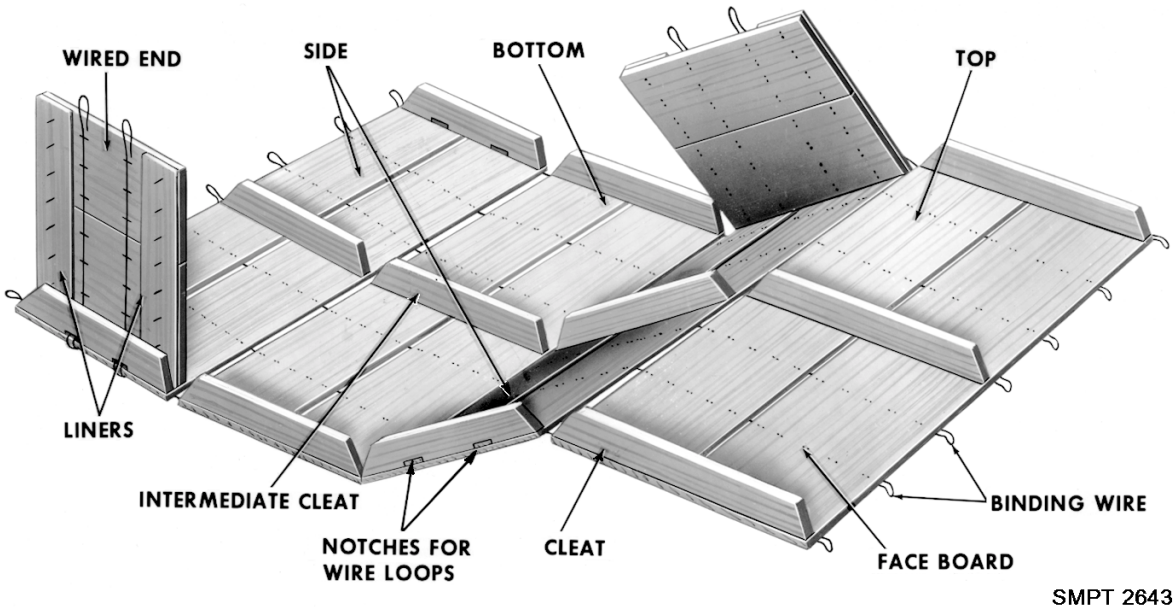


Figure 3-48. Wirebound box components.

Uses of Wirebound Boxes

These boxes are suitable for shipping a variety of general military materials and supplies such as ammunition, hardware, and canned foods. In using wirebound boxes, care shall be exercised to use a box designed for the type of load to be carried. For Types 1 and 2 loads, the inside dimensions shall be sufficiently exact so that the contents fit into the box when packed and give support to the faces of the box. For Type 3 loads, other than bulk loads, the contents shall be firmly bolted, blocked, braced, or otherwise anchored to the frame of the box in such manner that shifting of contents will not occur during handling or shipment. Fragile items and delicate instruments, which require special protection, shall be protected by proper internal cushioning and dunnage. The boxes are classified according to the weight they are intended to carry and their ultimate destination. The class 1 box has a weight limit of 500 pounds and is intended for domestic shipments. The class 2 box is intended for offshore and overseas destinations where there is protected storage. It has a weight limit of 400 pounds. The class 3 box has a weight limit of 300 pounds and is intended for overseas destinations where there is no protective storage, and extreme climatic conditions exist.

Styles of Boxes and Tools for Closing

The packer may recognize the style of the box by the way it is closed and by the presence of wire ends on one of the styles. The style 1 box has a twisted wire closure. It is closed with a hand twister, a crank twister, or with a power twister, as shown in figure 3-49. Style 2 has a looped wire closure and nailed ends. It is closed with a tool called a Sallee closer. Figure 3-50 illustrates the closure. The style 3 box has a looped wire closure and is closed the same way as the style 2. The difference between the styles is that the style 3 has a separate end which is joined to the box body by means of a tool called a bon ender, shown in figure 3-51. Use of this tool will be described later.

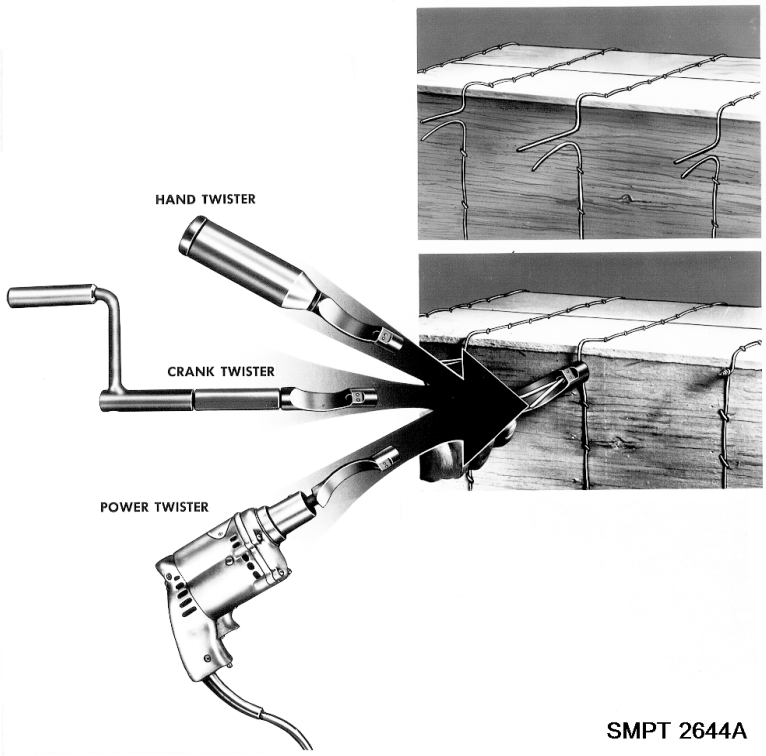


Figure 3-49. Closure of style 1 wirebound box.

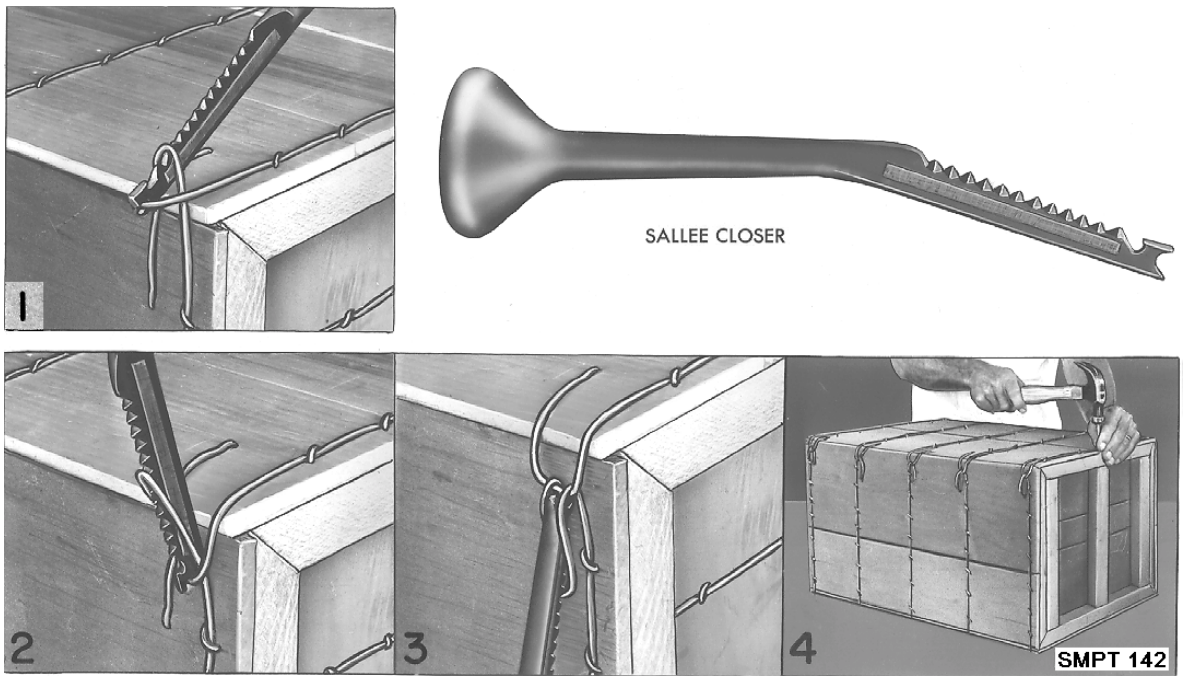


Figure 3-50. Closure of styles 2 and 3 wirebound boxes.

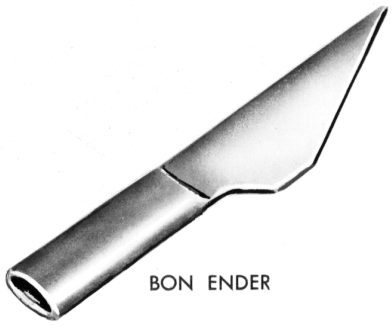


Figure 3-51. Bon ender used with style 3 wirebound box.

Setting up Style 3 Wirebound Box

As stated, the wirebound box comes through supply channels in flat-mat or unassembled form. The sides, top, and bottom of the box are one unit, while the two ends are separate and must be inserted in the body of the box during assembly. The four steps involved in setting up a style 3 are shown in figure 3-52. First, bend upright the loops attached to the ends of the box using the hollow handle of the bon ender for this purpose. Second, lift the sides of the box mat slightly before folding the sides at right angles to the bottom. Third, insert ends in the box by passing the upright looped wires, attached to the ends, through two notches in each of the two cleats. With the tapered and notched end of the bon ender tool, bend the loops over the binding wires of the sides. Fourth, if there are battens (reinforcing members) on the ends, drive a seven penny cement-coated or etched nail through the faceboard and cleat into the batten.

Strapping the Wirebound Box

The number and size of straps for wirebound boxes will depend upon the class (1, 2, or 3), weight of contents, and the construction of the box. Figure 3-53 illustrates the strapping of a style 3 wirebound box. Depending upon these factors, strapping may be applied lengthwise, girthwise or horizontally (a horizontal strap passes over the sides and ends). Strapping must be applied before the looped wire closures are made. This is important because reverse procedures may cause the closure to become loose.

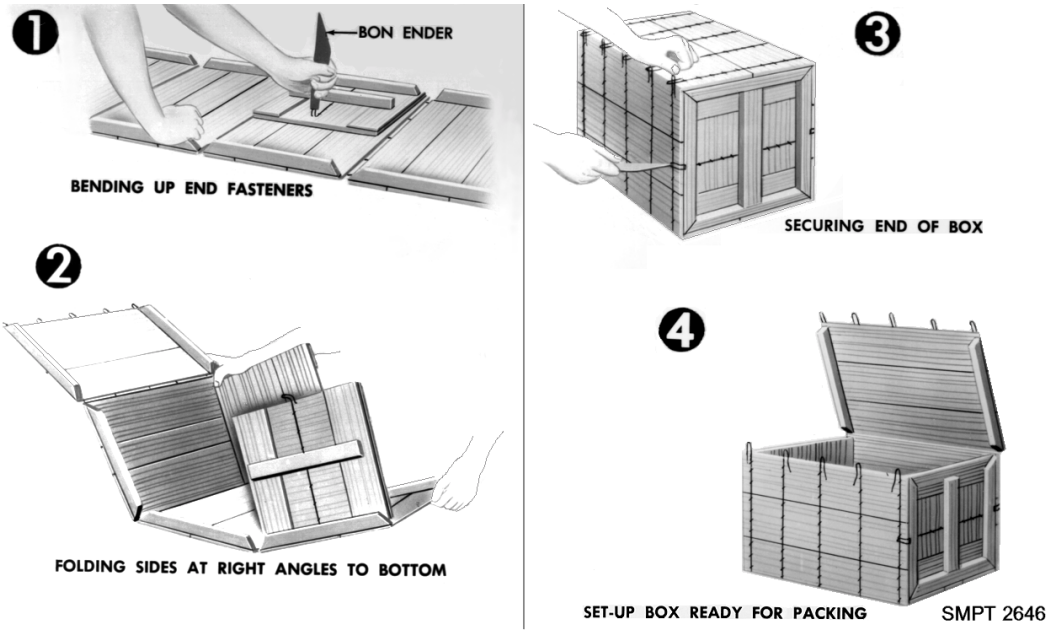


Figure 3-52. Setting up of style 3 wirebound box.

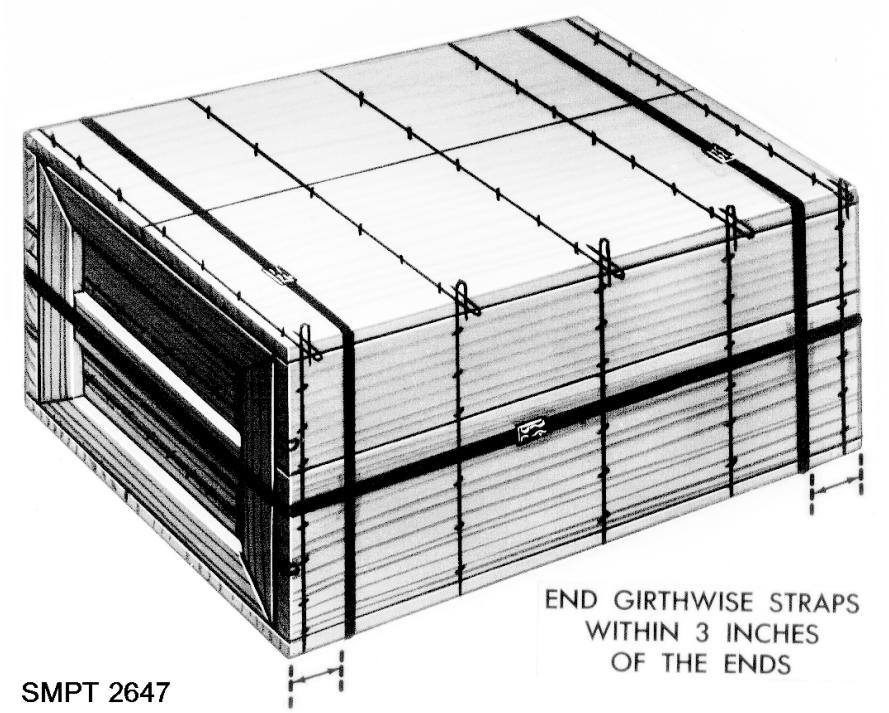


Figure 3-53. Girthwise straps on style 3 wirebound box.

Checkup

- X What are three wood defects that may cause a wood box to become damaged?
- X Which method of nailing is preferred, side grain or end grain?
- X What may happen when nailing the top to a side panel whose thickness is less than 3/4 inch?
- X In which direction are straps applied to styles 2 and 4 nailed wood boxes?
- X What factors govern nail sizes and spacing when nailing the lid to a cleated panel box?
- X What is the maximum distance from the edge of a cleated panel box for the placement of staples over banding?
- X What tools are used to set up and close a style 3 wirebound box?

WOOD BOXES PRACTICAL EXERCISE

Objective

As a result of this practice, the student will be able to close and reinforce a nailed wood box, reinforce a cleated panel box, and set up, close, and reinforce a wirebound box.

General Instructions

This exercise will be conducted in the classroom.

It will require approximately 2 class periods to complete.

The instructor will conduct the critique when the students have completed the questions.

Conduct of Exercise

Situation

As a packer, you are required to set up, close, and reinforce nailed wood boxes, cleated plywood boxes, and wirebound wood boxes.

Requirement No. 1

Answer the following questions.

- X Into how many groups are the various woods used in packing divided?
- X Wooden boxes are usually made from Group II woods. Name some of these woods.
- X Oak or hickory are classified as what type of wood?
- X Name four characteristics of the wood groups.
- X Name four defects that may be found in lumber that are unwanted when used in the construction of wooden boxes.
- X What is wane?
- X What do we use to hold the pieces of a wood box such as the ends, cleats, or top, together?
- X Name the three methods of nailing pieces of wood together.
- X Which is the best method of nailing?
- X Nails may have one of three surface finishes. What are they?
- X What are two advantages we get by using nailed wood boxes?

X In general, the style of a nailed wood box determines the number and direction of end cleats. How many cleats does a style 2 box have?
X How many cleats does a style 4 box have?
X In which direction do the cleats on a style 4 box run?
X How much weight can overseas style 4 box carry?
X What is any nailed wood box with an inside depth of 5 inches or less called?
X What style nailed wood box looks more like a crate?
X What styles of cleated panel boxes may be used for both overseas and domestic shipment?
X From what three materials may the panels of a cleated panel box be made?
X In cleated panel boxes, a piece of lumber which runs the entire length, width, or height of the box is called?
X What is the difference between a style A and a style B fiberboard cleated panel box?
X How many styles of wirebound boxes are there?
X How are the styles of a wirebound box determined?
X What tool is used to close both a style 2 and 3 wirebound box?
X What type of closure does a style 1 wirebound box have?
X How are the ends attached to sides of a style 3 wirebound box?
X What types of loads may be shipped in a style 2 wirebound box?
X When should a wirebound box be strapped, before or after the closure is made?
X Explain where girthwise straps are placed on a wirebound box?
X In which direction is a style A cleated panel box, that does not have any intermediate cleats, strapped? How are the straps placed?
X How do we make sure the straps, described in the above question, stay in place?
X In which direction are style 2 or 4 nailed wood boxes strapped?
X What determines the number of straps required to reinforce a nailed wood box?
X What is the weight limit of a style 2 nailed wood box?
X What kind of base does a style 7 box have?
X Why is having too much moisture in wood considered a defect?
X What are the key factors that determine the size and spacing of nails in a cleated plywood box?
X What types of materials may be shipped in wirebound boxes?
X In closing a cleated plywood box, why are the metal bands stapled to the box surface?
X What is the purpose of an intermediate cleat, and when would you use them to construct a cleated panel box?

Critique

Instructor will call on the students to give the answers to each question.

Care of Area, Training Aids & Equipment

Not applicable.

CRATES

TYPES OF CRATES

There are two general types of crates in use today, sheathed and open. They differ in the protection they provide.

Sheathed crates are frame structures completely covered with lumber or plywood. Sheathed crates not only give protection against weather hazard but also are stronger and more rigid than open crates.

Open crates are used largely to provide ease of transportation, handling, and storage. Open crates consist of frame members only or, at times, partial sheathing for added strength and rigidity. Partially sheathed crates will carry heavier loads than the completely open crates. Open crates may be covered with plywood or paper-overlaid veneer to give added protection from the elements. They are called covered crates instead of sheathed crates.

The selection of the proper type of crate will save in both construction and shipping cost. An open crate costs less than a sheathed crate. Open crates generally involve less material, lower construction costs, and a lower shipping cost because of less weight and cube. The main savings of an open crate compared with a fully lumbered sheathed crate result from the following:

- X The reduction of sheathing in the top, sides, and ends.
- X The elimination of joists except the lifting joist.
- X The elimination of most of the flooring material except the diagonals and crosspieces.

CRATE MATERIALS

Lumber

The requirements for lumber to be used in crate construction are described in ASTM D 6199.

The lumber must be sound and free from all defects that would interfere with fabrication or assembly. Any form of visible decay shall not be permitted. At least one surface of lumber sheathing (the surface to be placed on the outside) must be sufficiently smooth to permit legible markings. Moisture content of the lumber should be between 9 and 19 percent.

There are specific requirements limiting the size of knots. All framing and structural members must be free from knots having a width greater than one-fourth the width of the board. Lumber for sheathing must be free from knots having a width greater than one-third the width of the board. The width of a knot is measured across the width of the board. Knot holes and knot clusters are generally restricted on the same basis as knots.

Cross-grain divergence of more than 1-inch in a maximum of 10 inches along the length of the piece is not permitted.

PLYWOOD

All plywood shall be performance-rated paneling manufactured in accordance with APA PRP-108, or ANSI A 208.1. Plywood for covered crates must be a minimum thickness of 1/8”.

NAILS

Nails used in the construction of crates shall be steel and be sinkers, corkers, or common nails, in accordance with ASTM F 1667.

BOLTS

Figure 3-54 shows the kinds of bolts used for crates construction and includes carriage bolts and lag bolts. The general rules for the use of bolts are:

- X Holes shall be prebored to receive carriage bolts and shall be the exact diameter of the bolt.
- X Plain cut washers are used under the nut of each carriage bolt.

Lag Bolts

Lag bolts are used to fasten together the panels of demountable crates. The general rules for the use of lag bolts are:

Lead holes for the shank portion of lag bolts shall be the same diameter as the shank. Lead holes for the threaded portion of lag bolts must be smaller than the diameter of the threaded portion.

If for any reason the thread in the wood is stripped when the lag bolts are placed, the lag bolt shall be removed and placed in a new hole near the old position.

Lag bolts may not be hammered in.

A flat washer must be placed under the head of each lag bolt.

Nut-sleeve Assembly

The nut-sleeve and bolt combinations, shown in figure 3-55, may be used as an alternate for lag bolts when specified by the procuring agency. Bolts must be of the same diameter and spaced the same distance as specified for lag bolts.

Roofing Felt

This felt is used to weatherproof the tops of some crates by placing it between a plywood layer and the top sheathing boards. When a joint is required, the felt must overlap at least 3 inches and be sealed with asphalt mastic, which is a sealing compound.

Weatherproof Barrier

Weatherproof barrier materials are used as crate liners, crate top covers, and interior shrouds. Additional information on weatherproof barriers is covered in the lesson on Weatherproofing the Pack.

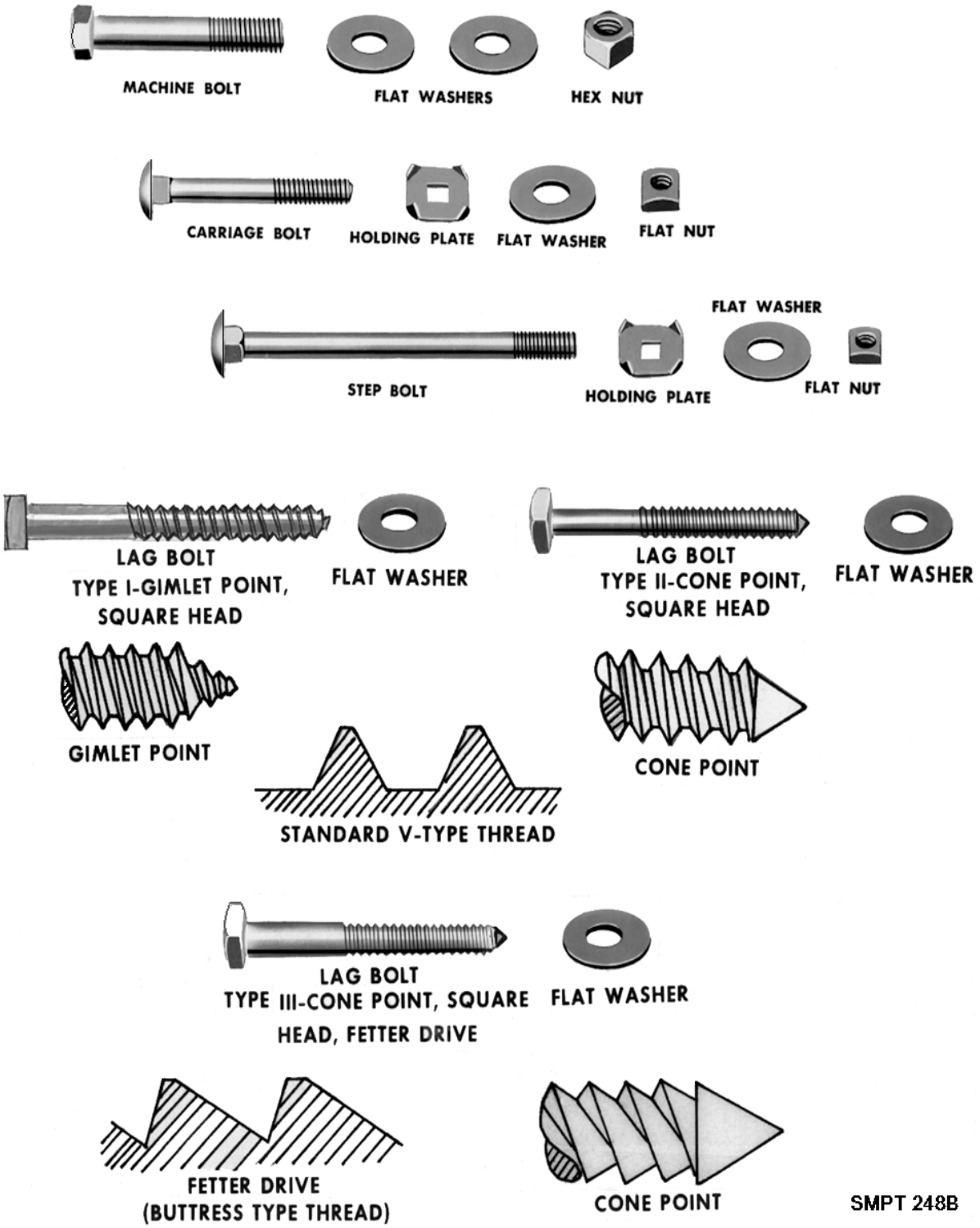


Figure 3-54. Bolts and accessories.

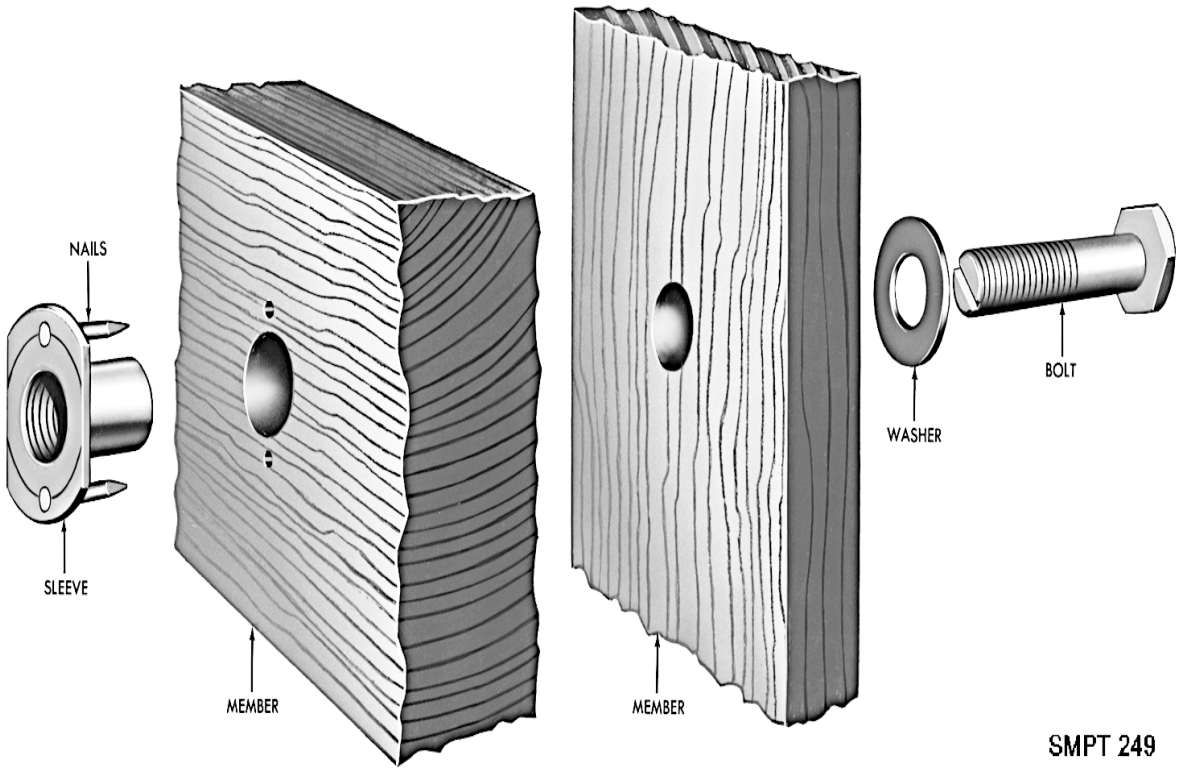


Figure 3-55. Nut-sleeve assembly.

Strapping

As seen in figure 3-56, strapping is used in the form of tension straps, corner straps, lag screw reinforcing straps, and metal hangers. Strapping must be coated-finish (painted or zinc coated (galvanized)) to resist corrosion.

SHEATHED CRATES (MIL-C-104)

Description

Sheathed crates are made of six component parts: a base, two sides, two ends, and a top. Sheathed crates are identified by Type, Class, and Style (as follows), or a combination thereof, as shown in figure 3-57.

- X Type I - nailed crate.
- X Type II - bolted crate.
- X Class 1 - lumber sheathed crate.
- X Class 2 - plywood sheathed crate.
- X Style a - skid base crate.
- X Style b - sill base crate.

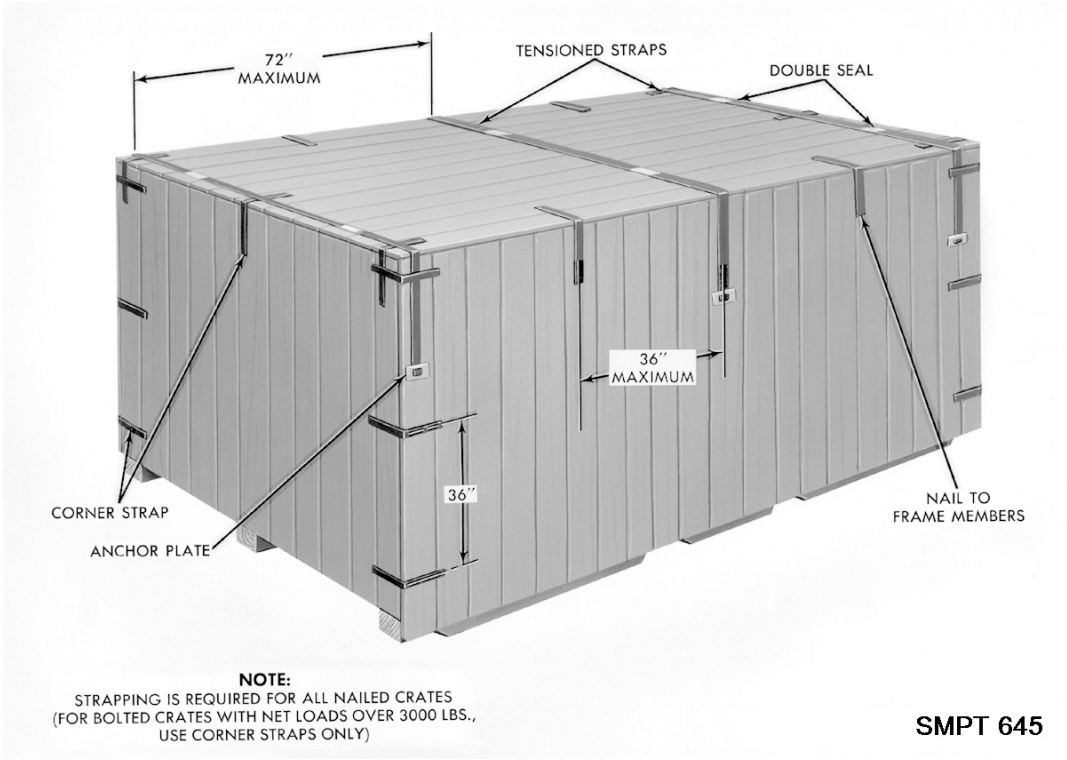


Figure 3-56. Strapping of a MIL-C-104 crate.

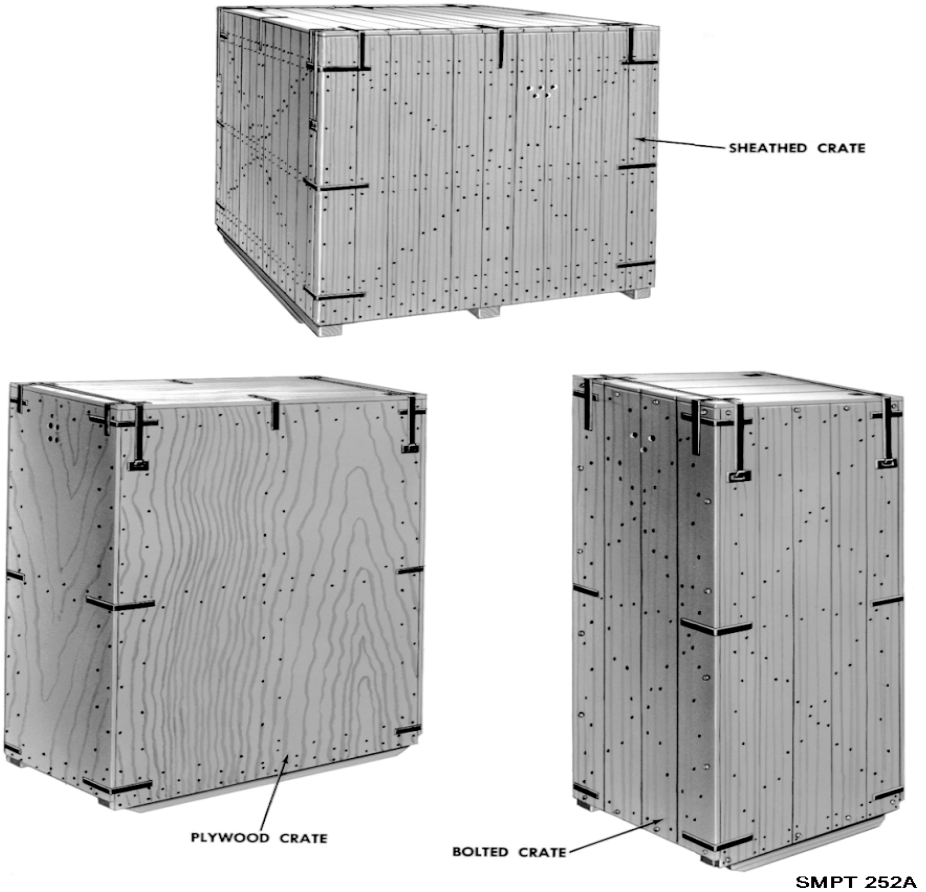


Figure 3-57. Sheathed crates.

Weight Limitations

The gross weight shall not exceed 20,000 pounds. When this limitation is not practical, the gross weight on skid base crates only may go to 30,000 pounds.

Dimensional Limitation

The exterior dimensions of the crate must not be greater than the following overall dimensions, unless specified for overseas shipment:

X Length 30 feet
X Width 9 feet
X Height 10 feet

Clearance

A clearance of not less than 1 inch must be allowed between the item and the closest member of the sides, ends, and top of the crates. Fragile items or items within floating bag barrier (Methods 43 and 53) must be protected with clearance of 2 inches or more.

Bases

The base is the supporting component of the crate. The contents of the crate are always placed on and tied down to the base. There are two styles of bases. They are Style a (skid base) and Style b (sill base).

As shown in figure 3-58, the Style a (skid) base consists of longitudinal skids, rubbing strips, headers, load bearing floorboards, and flooring. The construction of a skid base is the same for both bolted and nailed crates. The skid base can be constructed to carry loads up to 30,000 pounds.

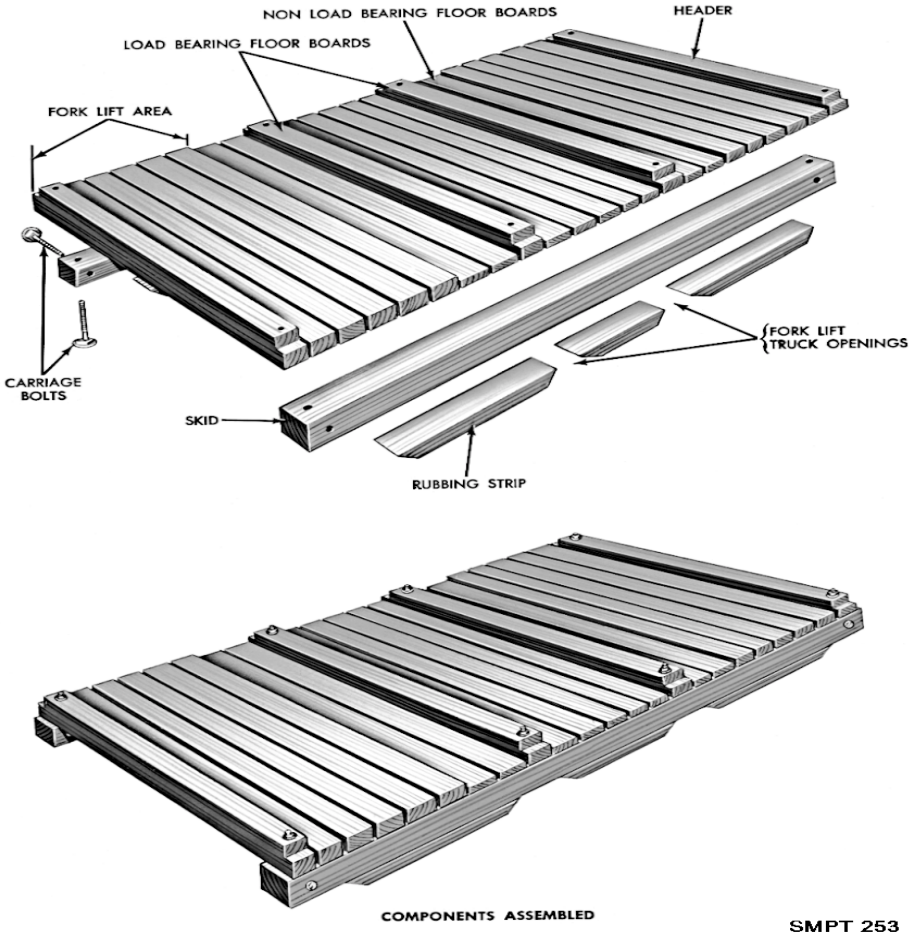


Figure 3-58. Skid base.

The Style b (sill) base consists of side sills, end sills, intermediate sills, load-bearing headers, bridging, bottom sheathing, and rubbing straps, as seen in figure 3-59.

The sill base can be constructed to carry loads up to 20,000 pounds.

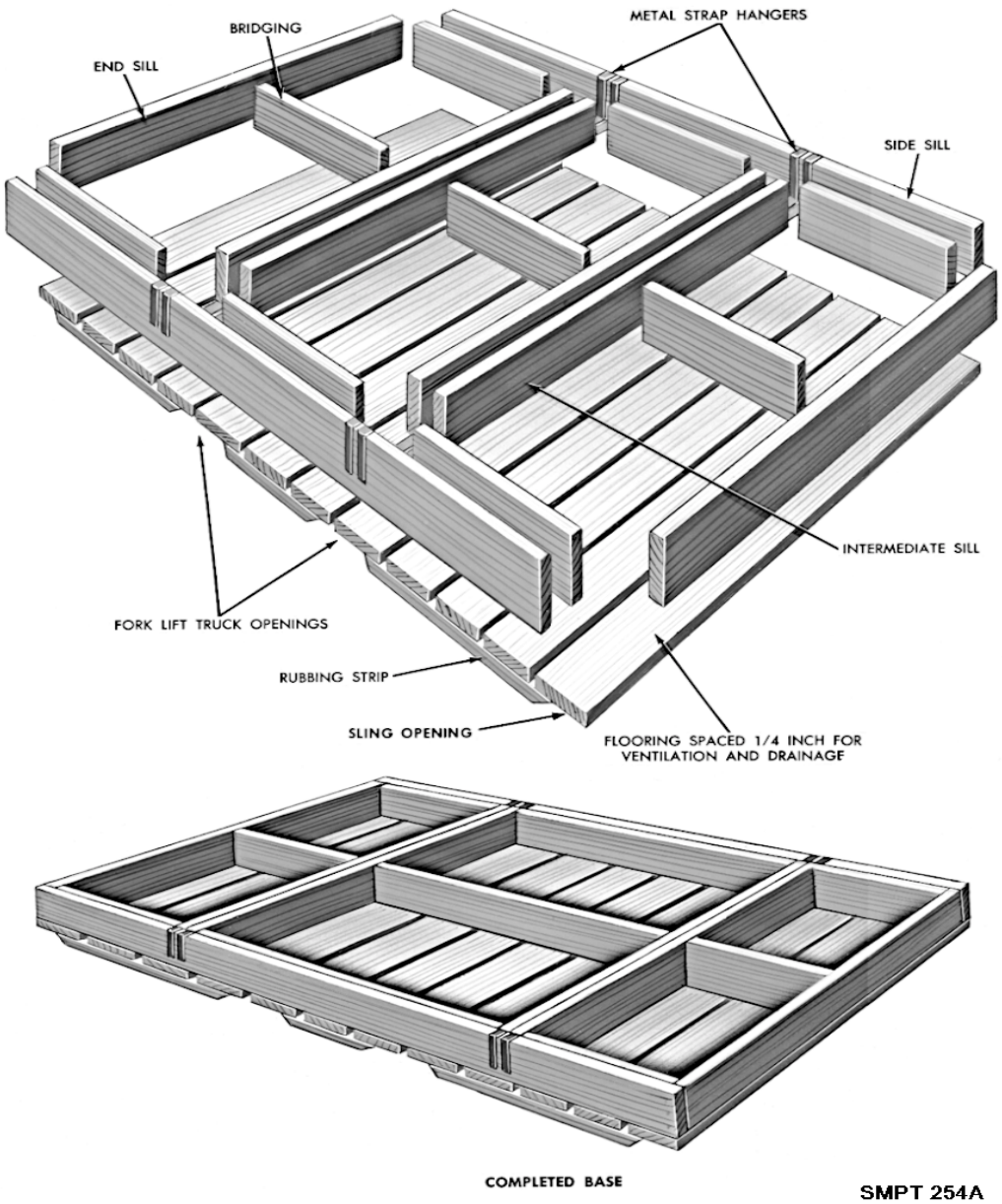


Figure 3-59. Sill base.

Sides and Ends

The sides and ends of the crate provide physical protection to the contents and transmit external forces to the base.

The sides and ends of the crate are similar to each other in construction features. For example: the sides and ends of a Type II (bolted), class 1 (lumber sheathed) crate would consist of the following, as shown in figure 3-60.

- X Upper frame members.
- X Lower frame members.
- X Vertical struts.
- X Diagonals.
- X Joist supports.
- X Horizontal braces.
- X Liners.
- X Sheathing.
- X Lag bolt reinforcing straps.

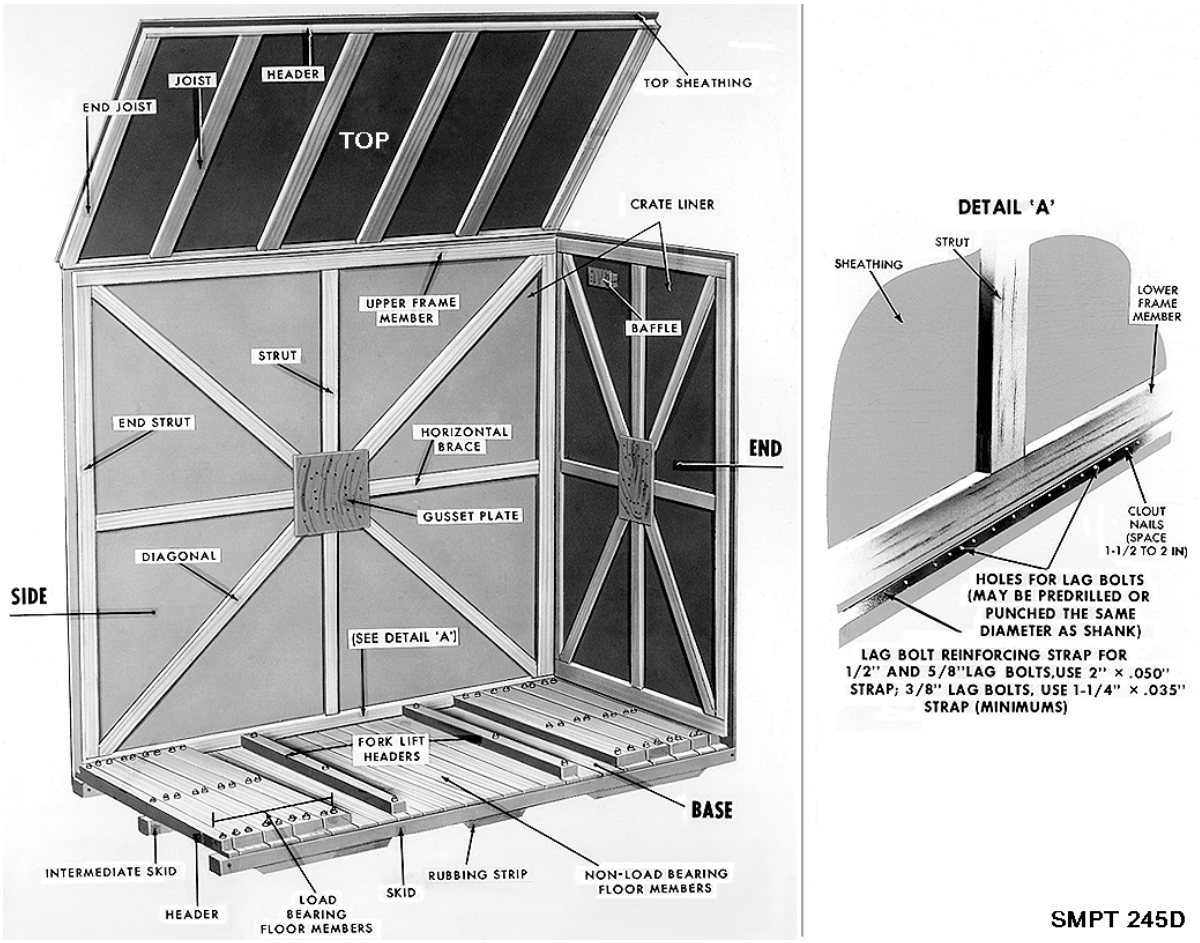


Figure 3-60. Component parts of the side and end panels.

The Type of side and end panels is determined by the inside height of the crate, as shown in figure 3-61.

The number of side panels for each full length side is computed by dividing the inside length of the crate by the inside height of the crate and using the nearest whole number.

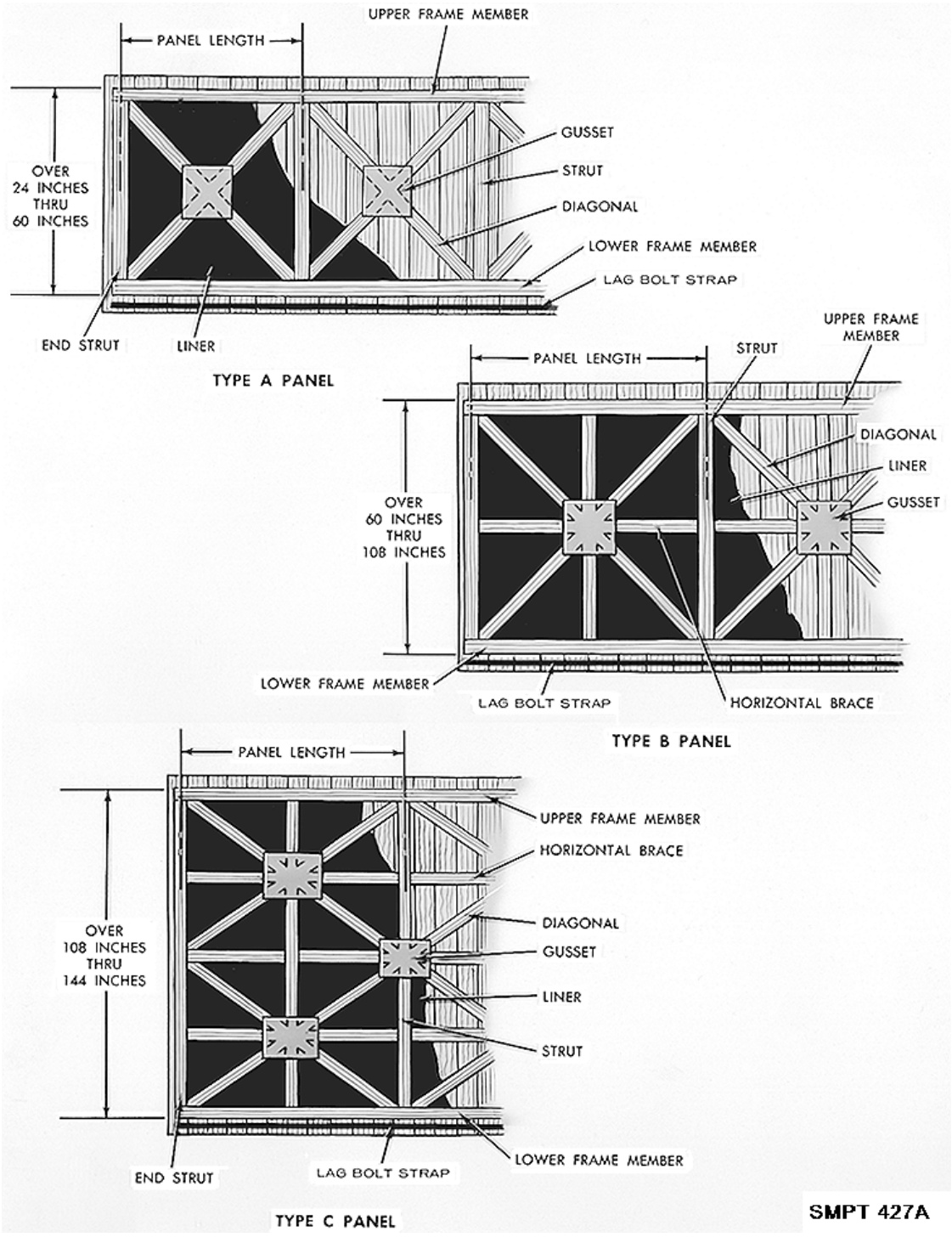


Figure 3-61. Types A, B, and C panels.

Tops

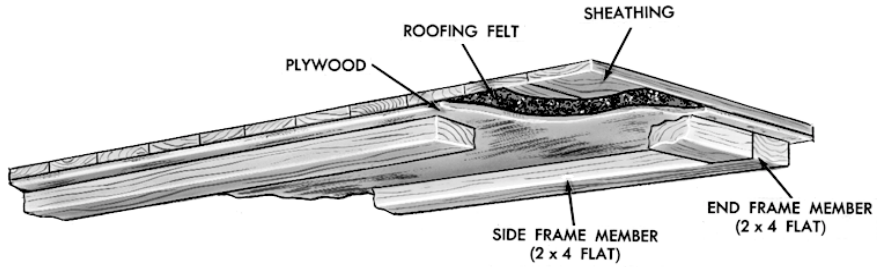
Figure 3-62 shows the three different tops used on the MIL-C-104 crate. The use of the correct top depends upon the width of the crate.

The narrow crate top is used for crates with the width up through 54 inches.

The intermediate crate top is used for crates with the width over 54 inches through 60 inches.

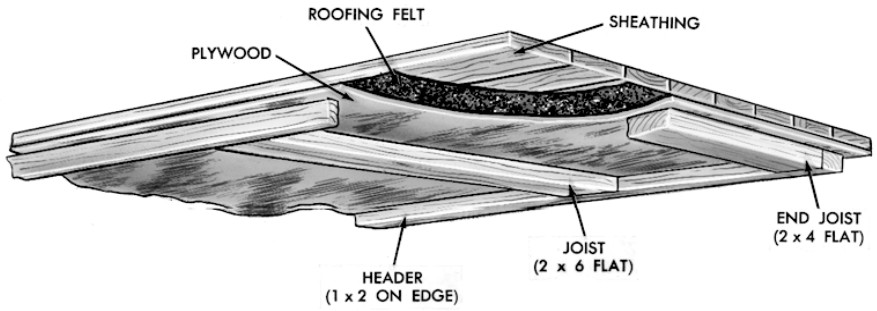
The wide crate is used for crates with the width over 60 inches through 120 inches.

Tops up to 96 inches wide may be either double sheathed (plywood, roofing felt, and lumber) or 1/2 inch plywood sheathed (with waterproof barrier).



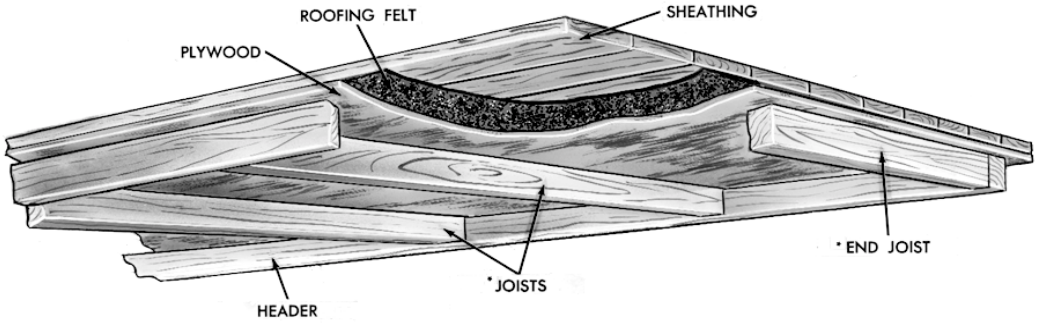
NARROW CRATE TOP

WIDTH UP THRU 54 INCHES



INTERMEDIATE CRATE TOP

WIDTH OVER 54 INCHES THRU 60 INCHES



*SIZE DEPENDS UPON CRATE WIDTH

WIDE CRATE TOP

WIDTH OVER 60 INCHES THRU 120 INCHES

SMPT 428B

Figure 3-62. Top construction of MIL-C-104 crate.

Ventilation

Ventilation is provided to sheathed crates to prevent the buildup of moisture or condensation from damaging the contents, as shown in figure 3-63.

Ventilation to lumber sheathed crates may be provided by one of the following methods:

- X End ventilation. Ventilation holes (3/4 inch in diameter) drilled at each end of the crate in one or more clusters and provided with a baffle.
- X Perimeter ventilation. As an alternate to end ventilation, the 3/4-inch ventilation holes may be spaced evenly in a single line around the perimeter of the crate, just under the top frame members of the sides and ends.

Ventilation for plywood sheathed crates is provided by cutting out a small section in each end, then applying screening and a baffle to the opening.

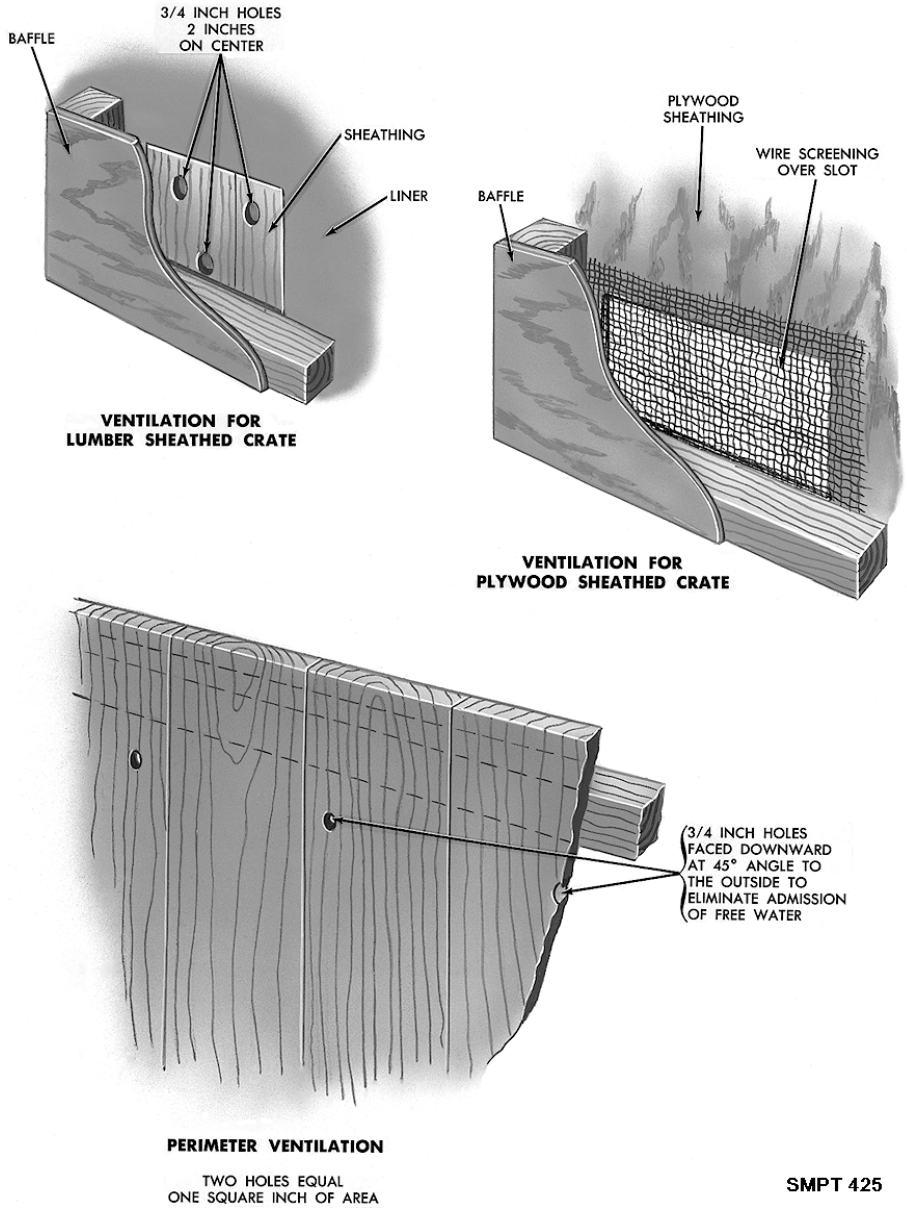


Figure 3-63. Ventilation of sheathed crates.

OPEN AND COVERED WOODEN CRATES (ASTM D 6039)

General

Open crates are suitable for the shipment of items which would not easily be damaged by outside forces and require only limited protection from the elements. Shrouds may be used in open crates to provide watershed protection to the contents.

Covered crates are suitable for the shipment of items which require more positive weatherproofing than is provided by an open crate and shroud.

Open and covered wooden crates must fit each major unit being shipped. The size of the crate must allow for any required blocking, bracing, and cushioning.

Description

The ASTM D 6039 for open and covered wood crates covers the requirements for five types and two styles of crates with provisions for covering one type with lightweight material.

During this lesson we will only discuss the most generally used crates: Types II, IV, and V.

Before we discuss the types of crates, we should know something about the styles and their characteristics.

In general, style A crates have heavier components and are able to withstand rather severe handling and multiple shipments (heavy-duty)

The style B crates should be confined to handling and shipping that impose only light to moderate hazards on the container (light-duty).

Types and Styles of Open Crates

Figure 3-64 shows the Type II, style A crate which may be used for the shipment of items such as ladders, tubing, extrusions, or wallboard, that requires no blocking, bracing, or cushioning. The Type II crates will carry a maximum net load of 1000 pounds.

Figure 3-65 illustrates the Type IV crate. Like the Type II, it comes only in style A and is a general purpose crate. It will carry a maximum net load of 1000 pounds.

Type V, styles A and B crates are general purpose crates and will carry net loads up to 4000 pounds depending upon the style of crate. Either style is further clarified as non-demountable or demountable.

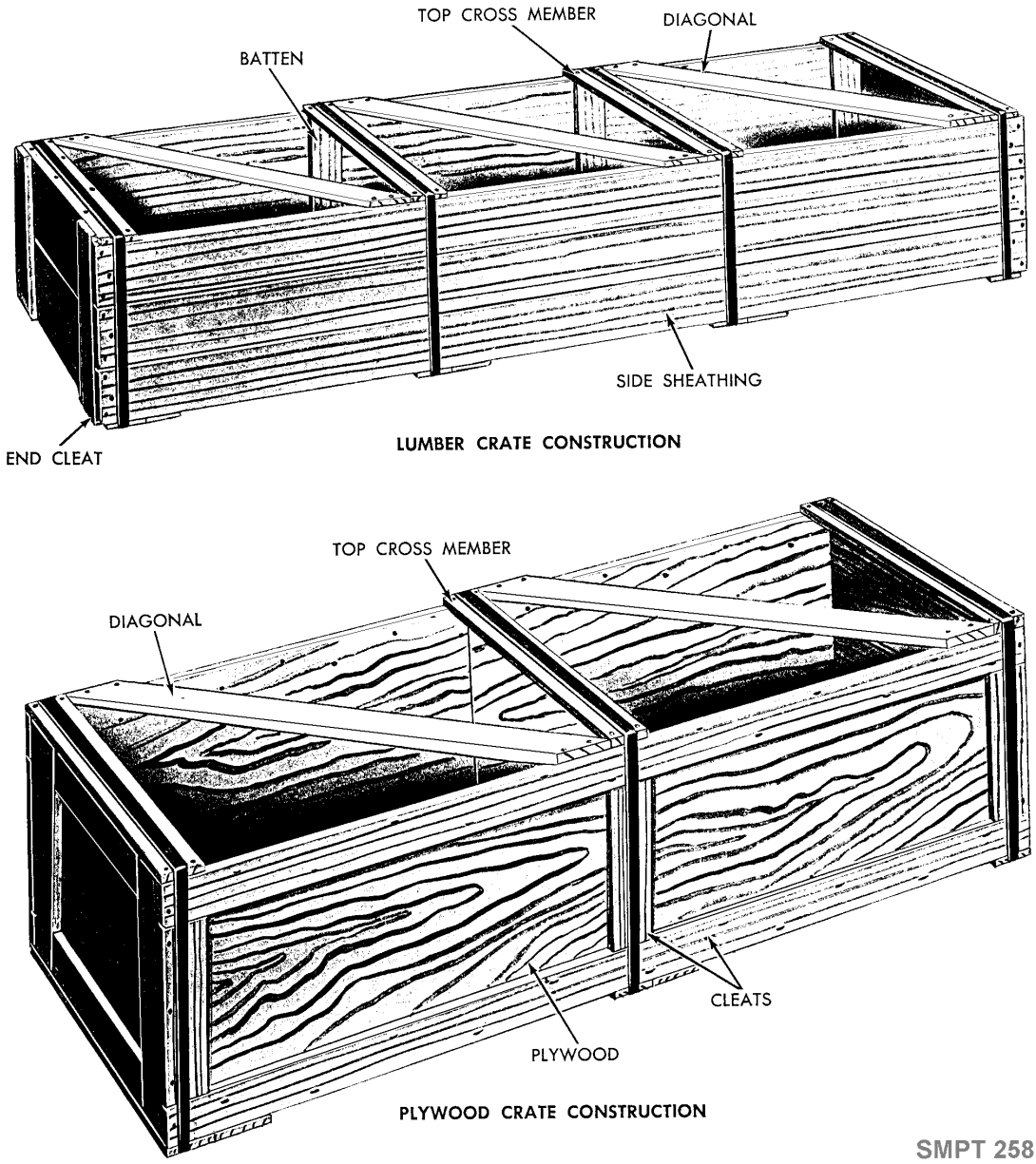


Figure 3-64. Type II, style A crate (ASTM D 6039).

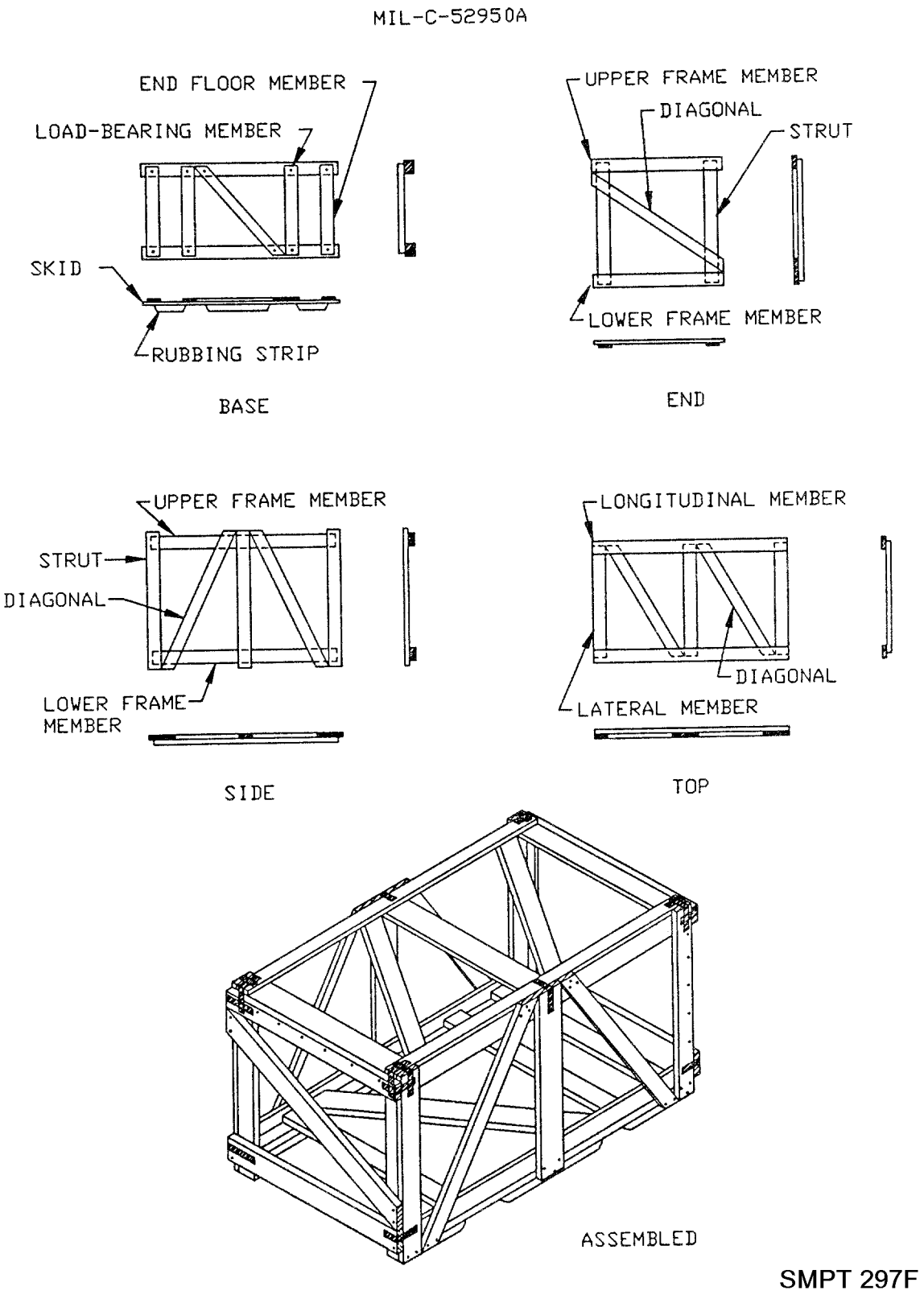


Figure 3-65. Type IV, style A crate (ASTM D 6039).

The Type V, style A crate, shown in figure 3-66 will carry a maximum net load of 2500. The outer skids of the base shall consist of 4 x 4 inch lumber. An intermediate 4 x 4 inch skid shall be used when the distance between the outer skids is greater than 36 inches.

The Type V, style B light duty crates may be either an open or covered crate. The covering on covered crates shall consist of either plywood or paper-overlaid veneer material as seen in figure 3-67. This covering is used to protect the contents of the crate from the weather. These crates are usually assembled by nailing, but may be made partially demountable by bolting the sides and ends to the base. These crates will carry a maximum net load up to 4000 pounds based upon the construction features of the crate. The size of the outer skids of the base ranges from 2 x 4 inch lumber up through 4 x 4 inch lumber depending upon the weight of the net load. An extra (intermediate) skid, same size as used in the preceding paragraph, shall be used when the distance between the outer skids is greater than 42 inches.

The style B (light duty) crate will carry a higher net load (maximum weight of contents) than the style A (heavy duty) crate due to the construction features of the base.

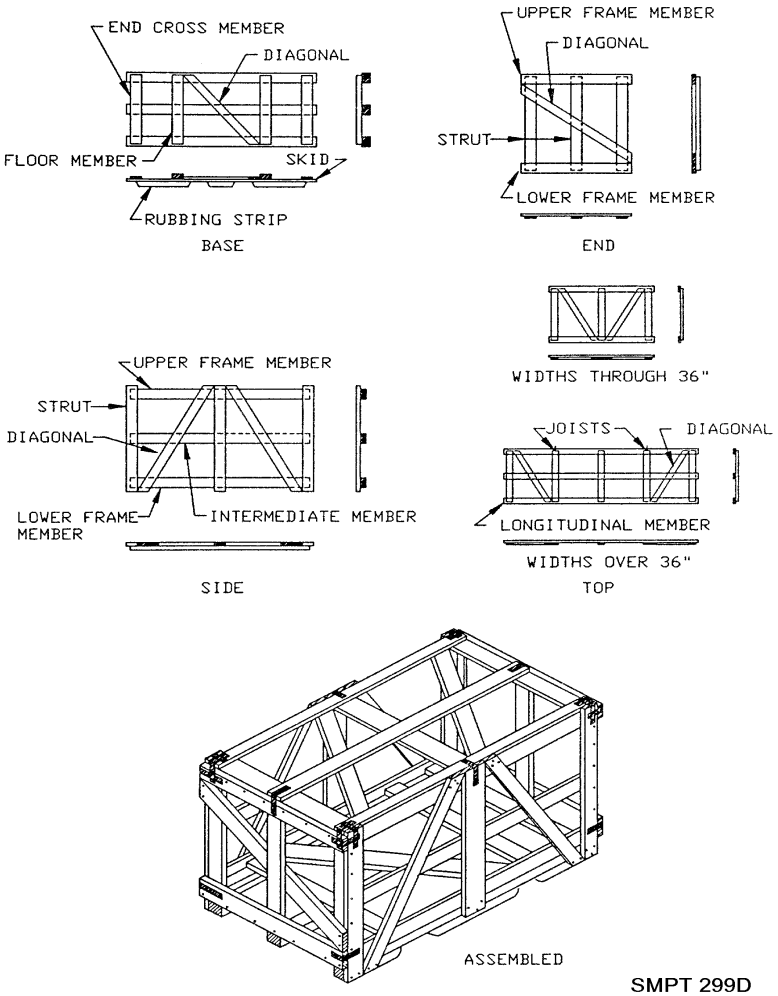


Figure 3-66. Type V, style A crate (ASTM D 6039).

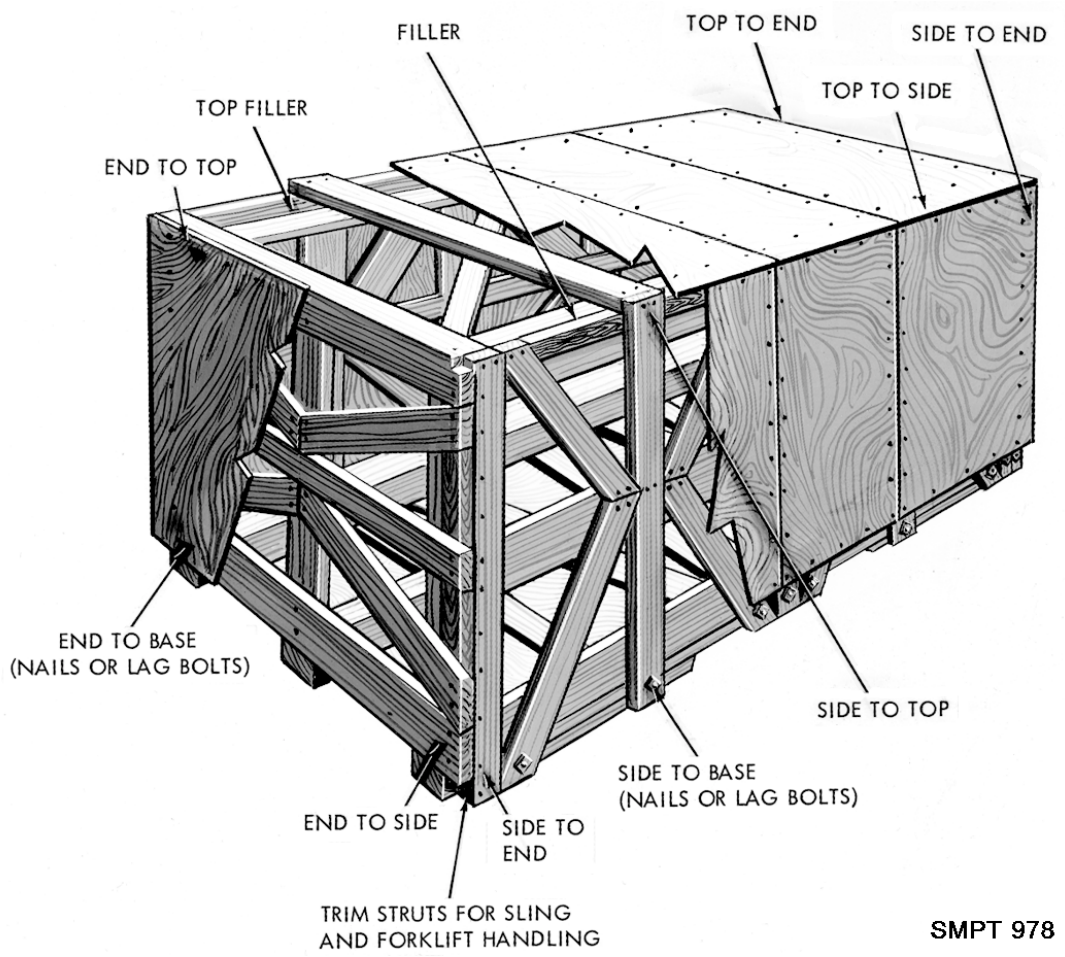


Figure 3-67. Type V, style B double-panel crate assembly, covered.

OPEN WOOD CRATES (MIL-C-3774)

General

These crates are also called open wood crates. Do not confuse them with the open and covered wooden crates (MIL-C-52950) which we just discussed. If you will recall, the open and covered wooden crates (ASTM D 6039) will carry a maximum net load of 4,000 pounds. These open wood crates (MIL-C-3774) will carry a maximum net load of 16,000 pounds depending upon the type of crate used. These open wood crates are often referred to as long narrow crates. The guidelines for use of open wood crates (MIL-C-3774) are similar to those for the open and covered wooden crates (ASTM D 6039).

Description

The specification for open wood crates covers the requirements for two types of crates. They are known as Type I and Type II. The Type I crate is a nailed crate. The Type II crate is a bolted crate.

The Type I (nailed) crate shown in figure 3-68, may be made by using one of two bases. The two kinds of bases are known as style A and style B. The style A is a skid base that is nailed together. The style B is a sill base that is nailed together. This crate will carry net loads up to 12,000 pounds. The size of the crate must not be greater than 16 feet in length, 8 feet in width and 8 feet in height.

The Type II (bolted) crate is made only with the style A (skid) base, as shown in figure 3-69. This crate will carry net loads up to 16,000 pounds. The size of the crate must not be greater than 40 feet in length, 8 feet in width, and 16 feet in height.

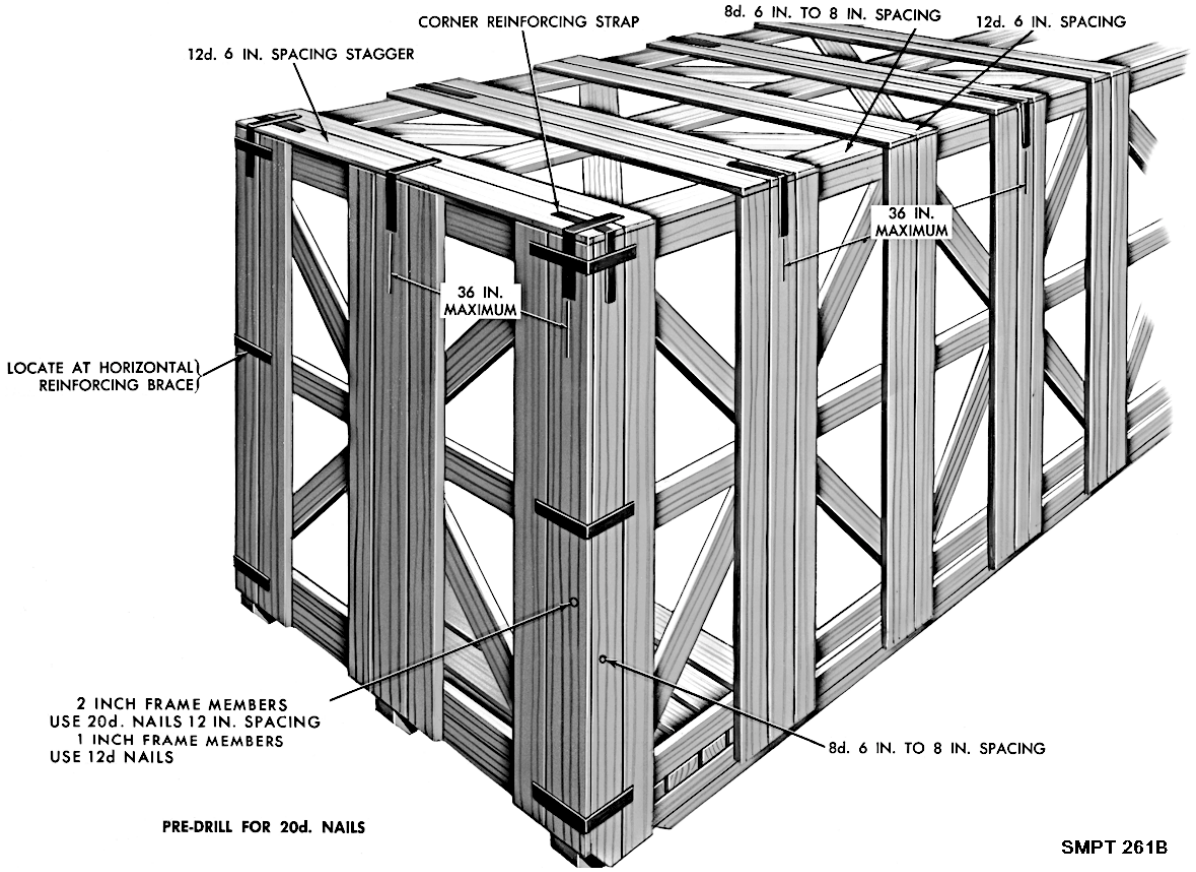


Figure 3-68. Type I open wood crate (MIL-C-3774).

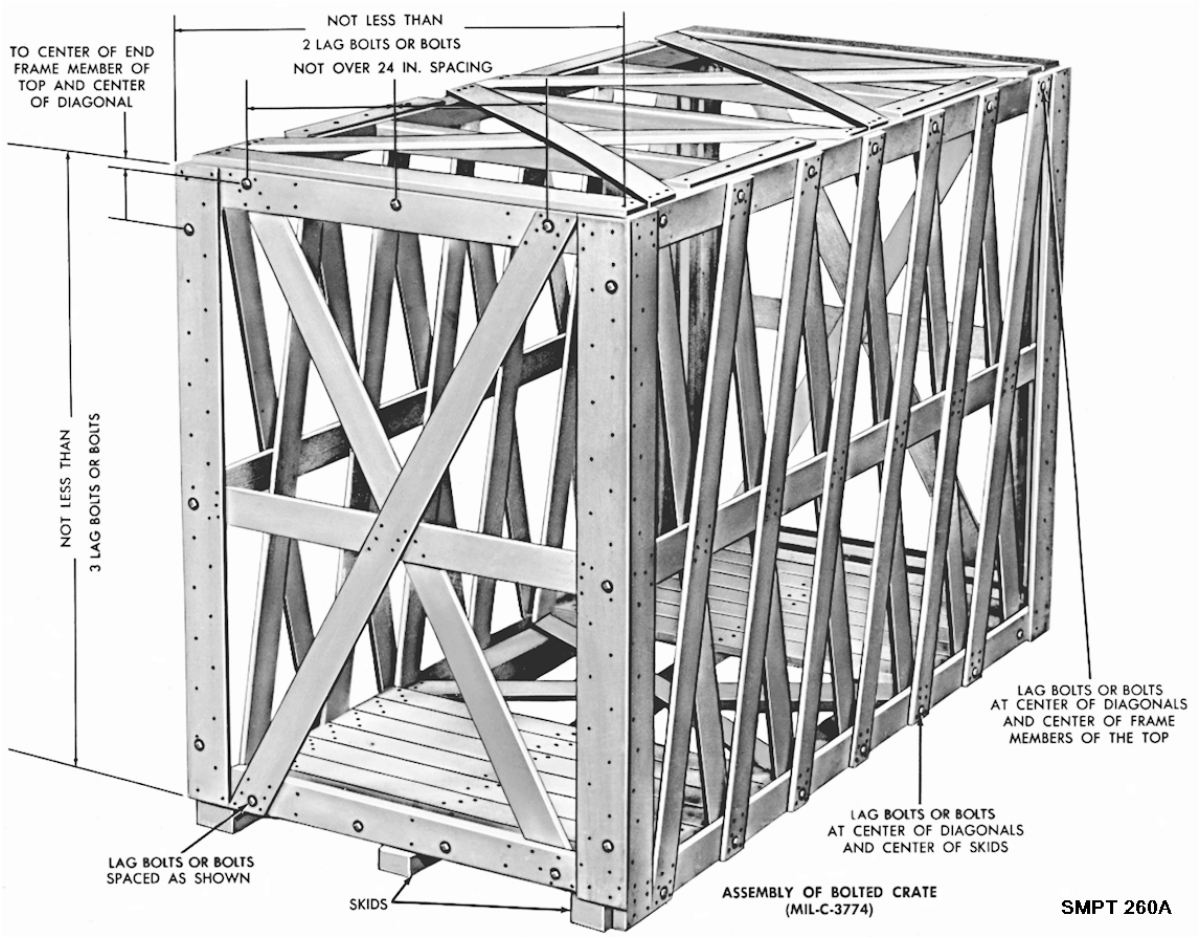


Figure 3-69. Type II open wood crate (MIL-C-3774).

Checkup

- X What are the two general types of crates in use today?
- X Which costs more to build, an open or a sheathed crate?
- X Describe a sheathed crate.
- X Describe an open or unsheathed crate.
- X What kind of bolts may be used in crate construction?
- X What are lag screws (bolts) used for?
- X What are the six components of a MIL-C-104 sheathed crate?
- X What is the maximum net weight of a load that can be carried in a MIL-C-104 crate?
- X What is the purpose of the ventilation holes in the MIL-C-104 crate?

CRATES PRACTICAL EXERCISE

Objective

The student will be able to identify by name the components which make up a crate and will be able to properly assemble those components.

General Instructions

X The purpose of this exercise is to have the students identify the numbered parts of a crate.

X This exercise including the critique will take 2 class periods.

X The exercise will be conducted in the classroom.

Conduct of Exercise

Situation

As a packer you are required to identify and assemble the component parts of various crates.

Requirement No. 1

Identify the numbered parts in figures 3-70, 3-71, 3-72, and 3-73.

X What crate does figure 3-70 represent?

X Identify the parts

X Identify parts

X What is shown in figure 3-71?

X For what size crate is this top used?

X Identify the crate pictured in figure 3-72.

X Identify the parts

X What style is this crate?

X Identify the crate in figure 3-73.

X How much weight may be shipped in this crate?

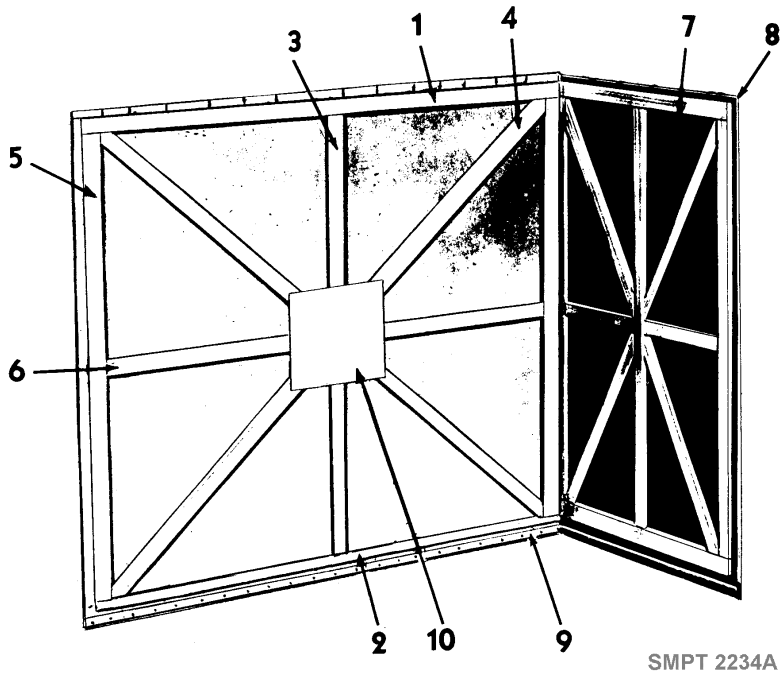


Figure 3-70.

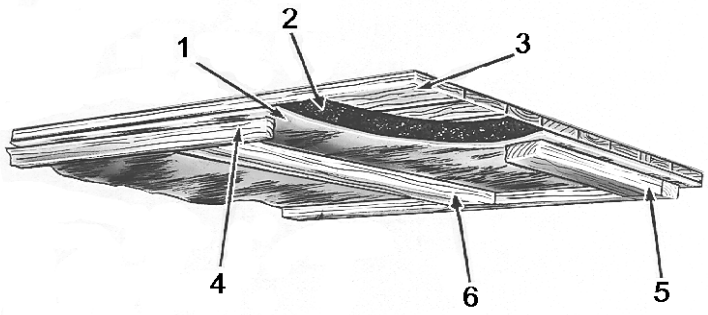
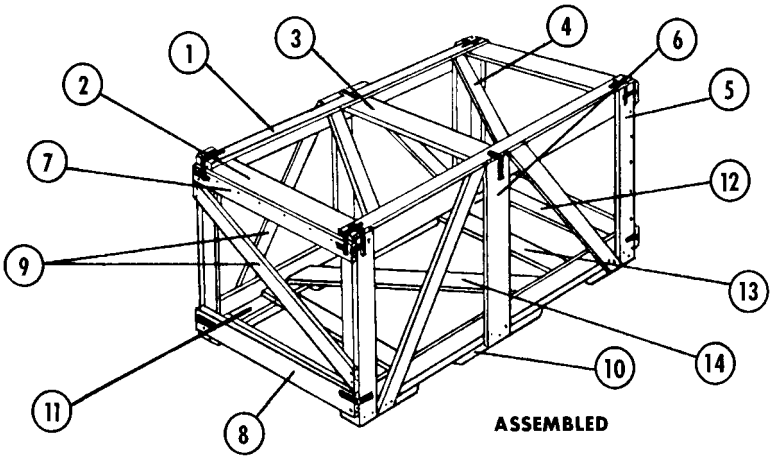


Figure 3-71. SMPT 2233



SMPT 2430D

Figure 3-72.

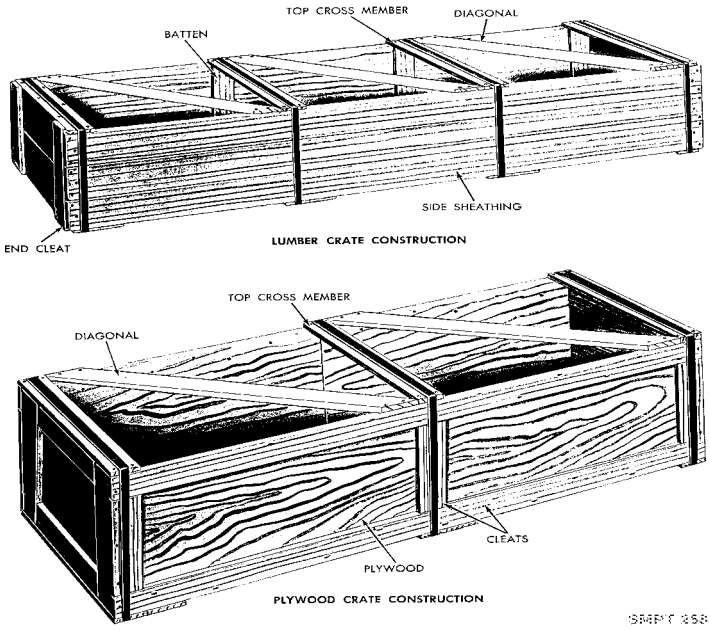


Figure 2-73.

Requirement No. 2

Answer the following questions on crates.

- X Crates come in two general types. Name them.
- X Sheathed crates are covered (sheathed) in what materials?
- X If I build a sheathed crate to ship an item preserved by Method 54, how much room must I leave between the item and the closed frame member?
- X List the styles of open wooden crates (ASTM D 6039).
- X Describe the style A open wooden crate (ASTM D 6039).
- X What is maximum size of MIL-C-3774 open wooden crates?
- X If style B is a light duty open wooden crate (ASTM D 6039), why then can a type V style B crate carry more weight than a style A crate?
- X What is the load limit of the MIL-C-104 crate?
- X Describe how we obtain perimeter ventilation in a sheathed crate.
- X Why do we provide a sheathed crate with ventilation?
- X What name do we give to an open crate if we add some plywood to the outside?
- X Why do we add plywood to an open crate?
- X What kinds of bases can we have in a sheathed crate?
- X Which base can carry more weight?
- X What are the size limits of a sheathed crate?
- X What type of panel would you construct for a lumber sheathed crate 10 feet high?
- X List and describe the bolts and accessories used in crate construction.
- X How are MIL-C-104 sheathed crates identified?
- X What types of items may be suitably shipped in open crates?
- X Which crate is most commonly used to carry long narrow items?
- X What are the advantages in using an open crate over using a sheathed crate?

Critique

Instructor will call on students to give answers to the individual questions.

Care of Area, Training Aids & Equipment

Not applicable.

MISCELLANEOUS CONTAINERS

TYPES OF CONTAINERS

Packing personnel should know about the special types of containers they may have to use. Knowing about these containers shown in figure 3-74 will help you make the right selection when a problem arises.

Envelopes (Kraft)

Kraft paper envelopes may be used for shipping lightweight flat items such as pamphlets, papers, gaskets, as depicted in figure 3-75.

The weight of the item shipped in kraft envelopes should not exceed 5 pounds.

Kraft paper envelopes will carry all three types of loads.

As shown in figure 3-76, closure of the envelopes may be made by adhesive, staples, or tape.

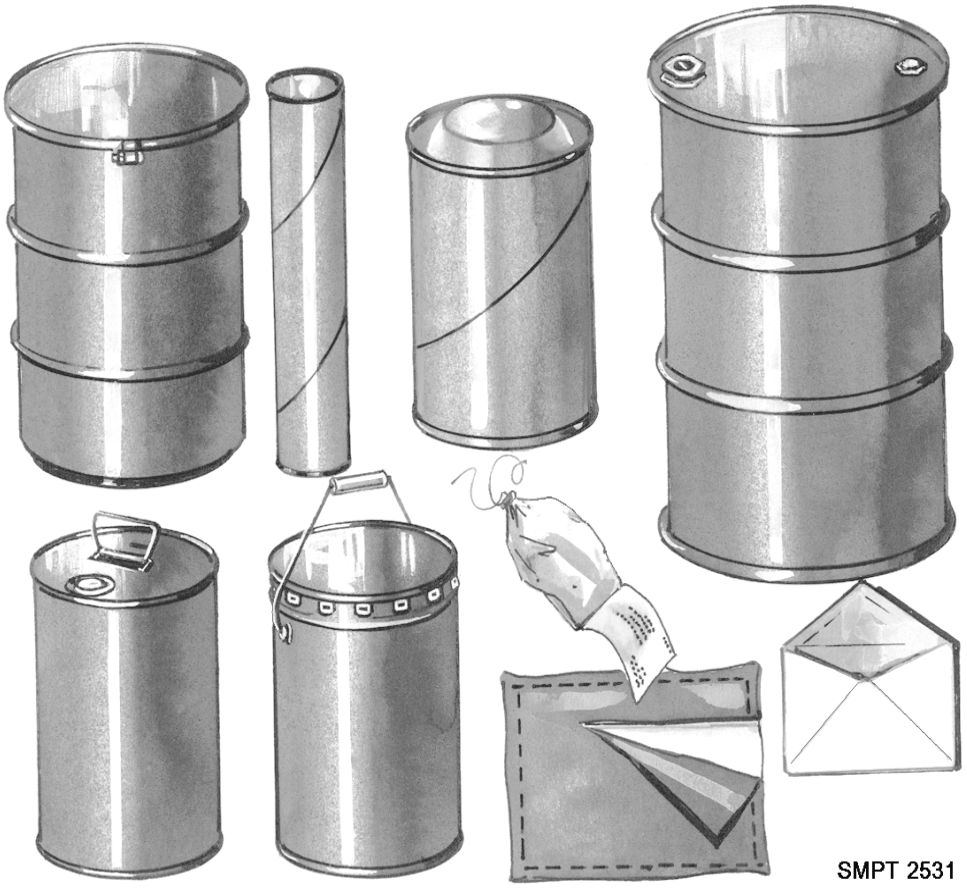


Figure 3-74. Special purpose containers.

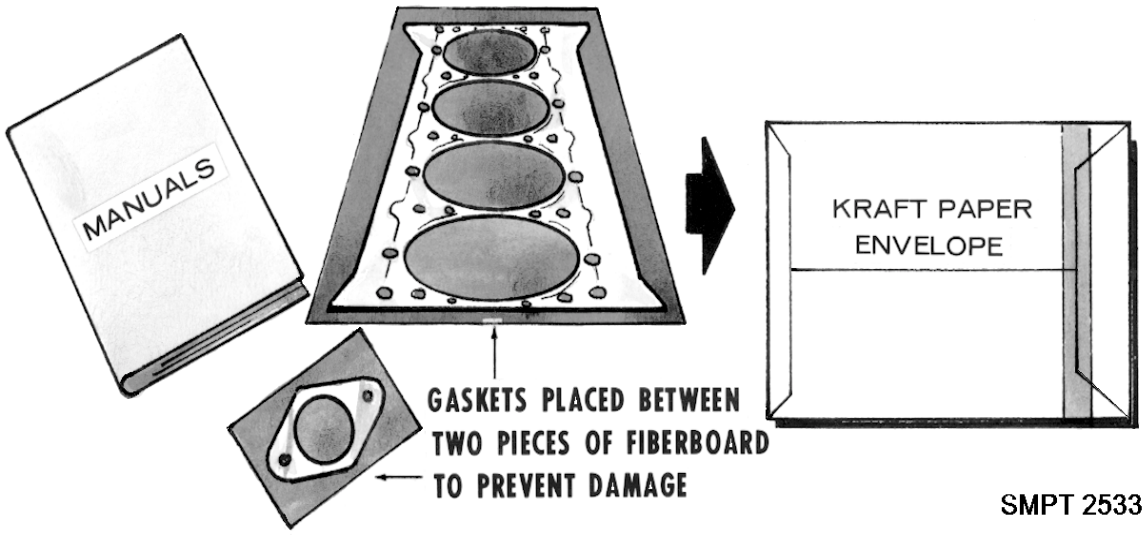


Figure 3-75. Kraft paper envelopes used for shipping flat items.

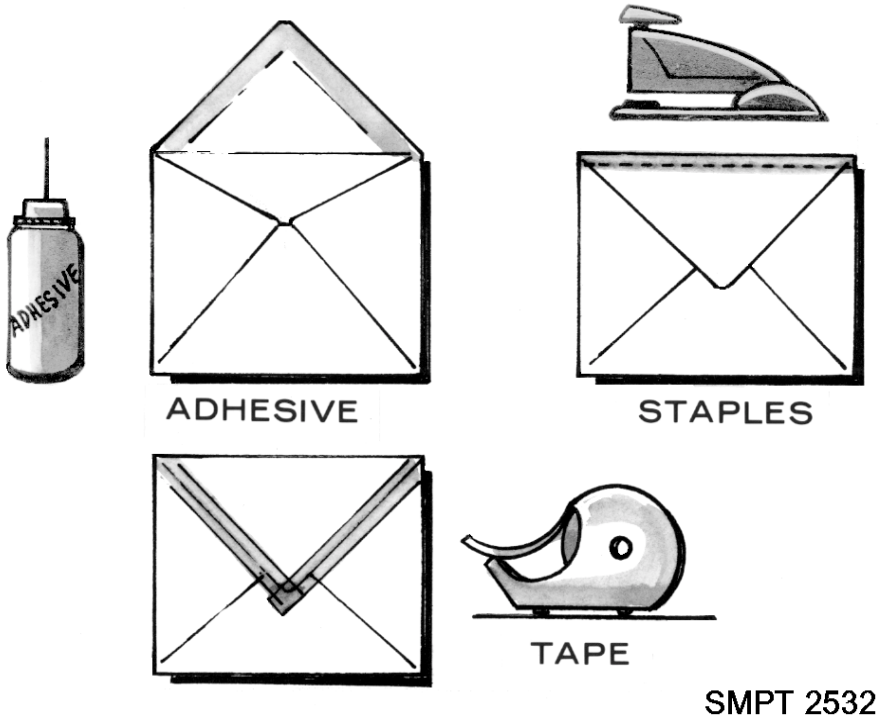


Figure 3-76. Types of closure of kraft paper envelopes.

Cushioned Paper Shipping Sacks

Cushioned paper shipping sacks, like those in figures 3-77 and 3-78, may be used to protect an item from water and shock during handling, shipment and storage.

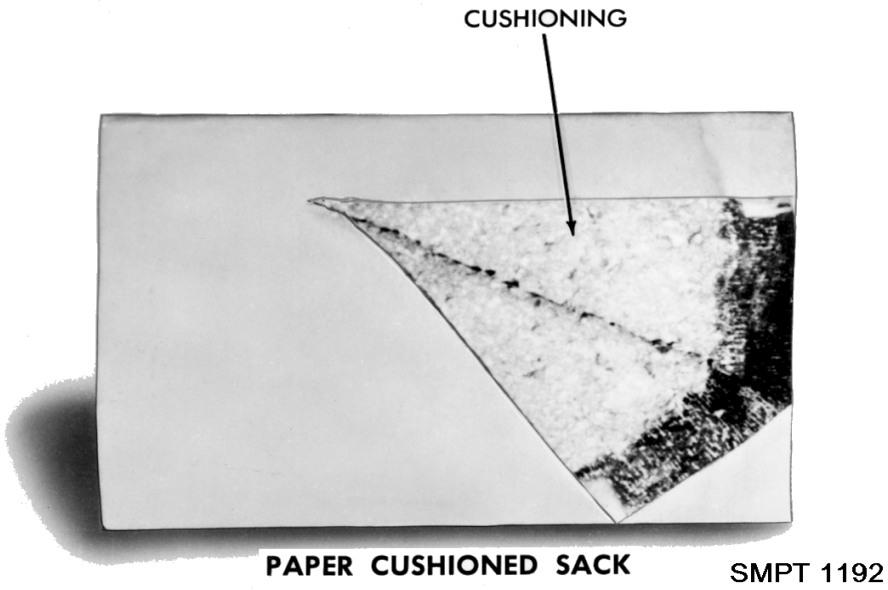


Figure 3-77. Cushioned Paper Sack.

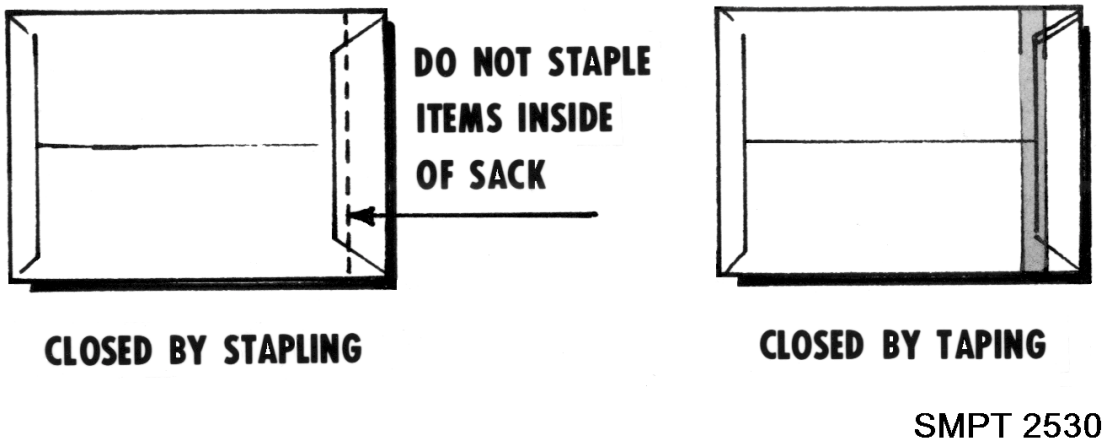


Figure 3-78. Closure of cushioned paper shipping.

Cushioned paper shipping sacks may be used as either interior or exterior containers where protection from water or a light cushioning effect is needed.

These shipping sacks are used to ship a variety of items as long as the weight of contents does not exceed 10 pounds.

All three types of loads may be shipped in cushioned paper shipping sacks.

Closure of these shipping sacks is usually accomplished by stapling or taping.

Cotton Mailing Bag

Cotton mailing bags may be used for shipping and storage of lightweight items, as shown in figures 3-79 and 3-80.

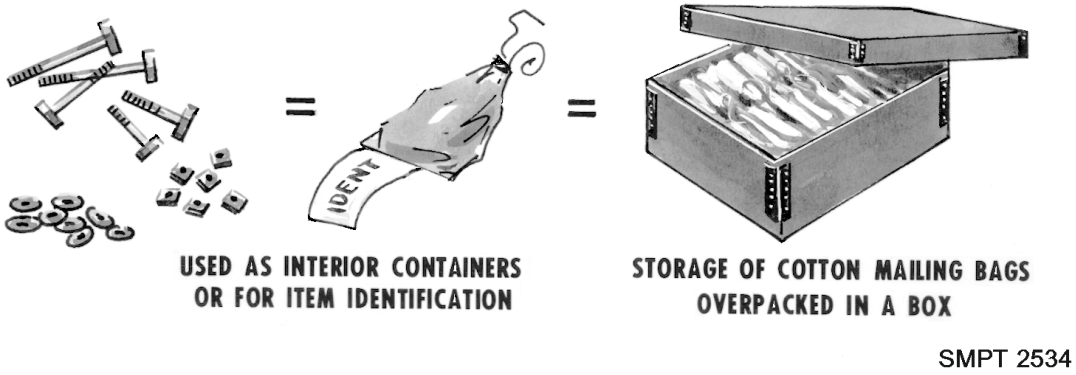


Figure 3-79. Use of cotton mailing bags.

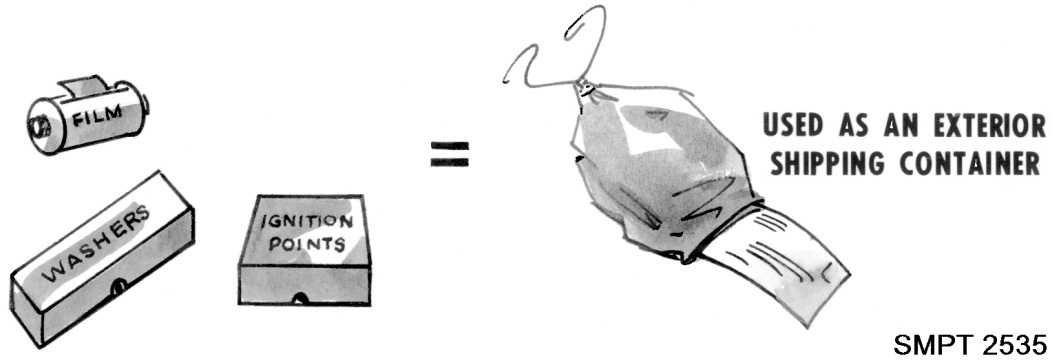


Figure 3-80. Cotton mailing bags used as exterior container.

Cotton mailing bags may be used as either interior or exterior containers.

They are also used for air shipment of lightweight items or for consolidation of loose parts for easy handling and identification.

All three types of loads may be carried by these bags as long as the weight does not exceed five pounds.

Cotton mailing bags are closed by tightening the drawstring at the bag opening. After the bag is closed, the drawstring should be tied in a knot to prevent the bag from opening.

Paper Mailing and Filing Tubes

These tubes may be used for filing, storing and mailing of drawings, blueprints, maps, personal records, and various other items, as illustrated in figures 3-81 and 3-82.

You may use any one of the following four different kinds of paper mailing and filing tubes for shipping small articles:

- X Plain end tube. It may be closed by using wooden plugs or tape over open end or a combination of both.
- X Tube with paper cuffs. It is closed by tucking the paper cuffs into the end of the tube or by taping the ends.
- X Tube with metal screw-on cap. It is closed by screwing the metal screw-on cap onto the tube body.
- X Three-piece telescope tube with metal ends. It is closed by sliding the outer tube over the inner sleeve and taping in place with water-resistant tape.

Normally, these tubes are used when the weight of contents is 5 pounds or less.

Special liners of cellophane or greaseproof paper, special spray treatments, or asphalt coating make these tubes capable of carrying oily or greasy materials.

These tubes may be used for all three types of loads.

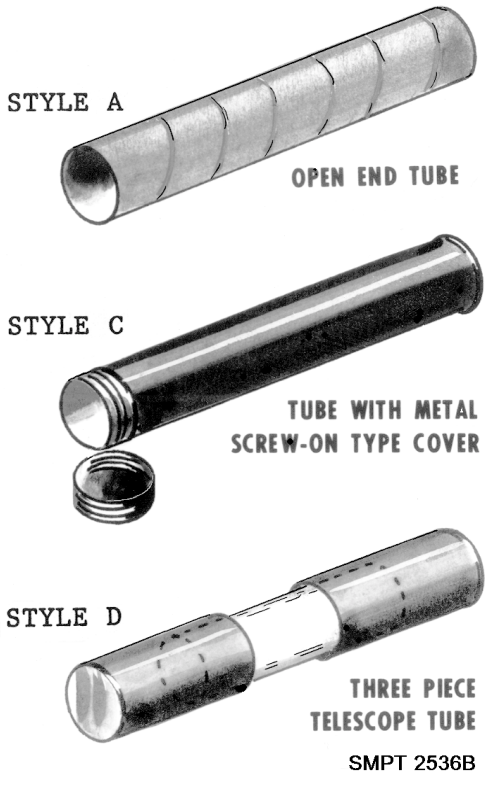


Figure 3-81. Types of mailing and filing tubes.

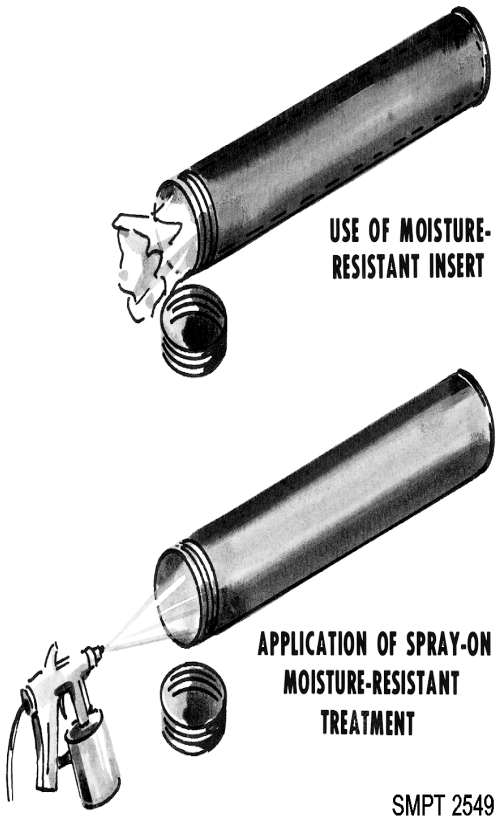


Figure 3-82. Application of liner and coating to tubes.

Fiber Drums

Fiber drums are lightweight containers used for shipping different types of military items.

Fiber drums may be used for domestic shipments for such materials as semiliquids, hot-poured materials which solidify on cooling, and for rolled or cylindrical items.

In normal overseas type shipments, they may be used for the shipment of semiliquid or hot-poured materials that solidify on cooling.

For military overseas type use, they may be used to carry dry, solid, or hot-poured materials that solidify on cooling.

Figure 3-83 shows fiber drums may be used for carrying weights from 10 gallons or 60 pounds to 75 gallons or 550 pounds whichever is higher.

Fiber drums may be ordered with the kinds of closures shown in figure 3-84. Fiber drums may have the following types of covers:

- X Friction cap type cover.
- X Metal lever actuated locking ring cover.
- X Press on metal cover with metal clips for hold down.
- X As seen in figure 3-85, the closure of fiber drums may be made in three different ways, depending upon the kind of cover used.



Figure 3-83. Weight limits of fiber drums.



Figure 3-84. Fiber drums.

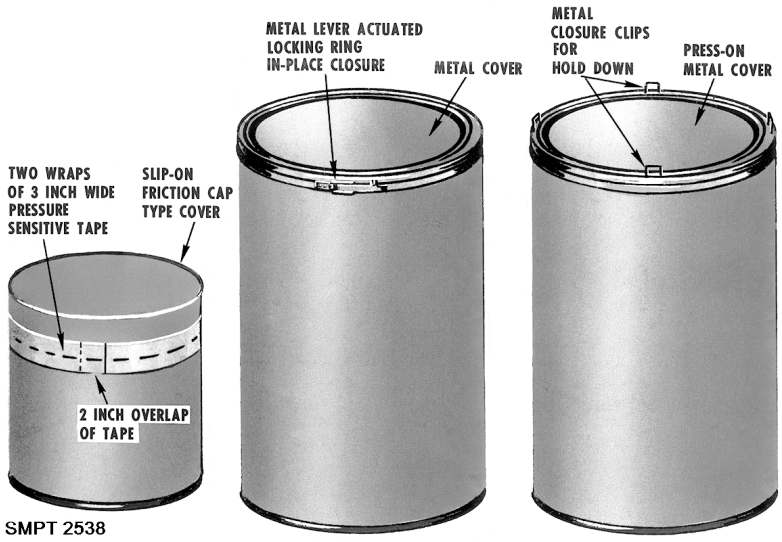


Figure 3-85. Fiber drum closures.

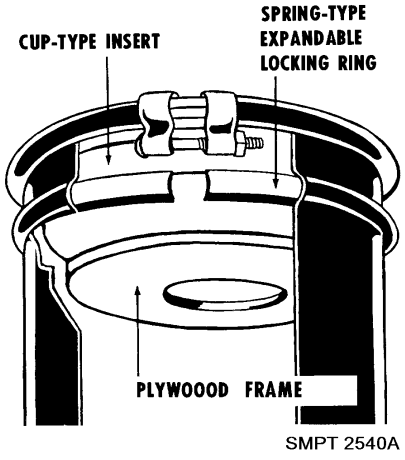


Figure 3-86. Reusable metal shipping and storage drum with cup-type insert.

Friction Cap Type Cover

Friction cap type cover is slipped on over the top and sleeve and is held in place with two wraps of 3-inch pressure-sensitive tape with a 2-inch overlap upon itself.

Metal Lever Actuated Locking Ring Cover

Metal actuated locking ring closure is made by placing the locking ring in position, pressing down on the lever, and fastening tight the metal clip.

Press on Metal Cover With Metal Clips

Metal clip closure is made by pressing the clips through the cover slots and down against the rim of the metal top.

Metal Shipping and Storage Drums

These reusable metal shipping drums are divided into two styles. The style of drum is determined by its closure. The style 1 drum has a bolted ring closure and the style 2 drum has a lever actuated locking ring closure.

Each style has a full removable head.

The style 1 drum has the cover, with gasket beneath, held in place by a locking ring, which is secured by means of a bolt and nut.

The style 2 drum has a lever actuated locking ring which is drawn tight and secured by means of a hinged lever.

Rolling hoops, which increase the strength, rigidity, and ease of handling, also provide the means of anchoring internal blocking and bracing through the use of split steel expanding rings which fit in the grooves of the rolling hoops.

Blocking and bracing can also be accomplished by the use of cup-type and crate-type inserts.

Cup-type insert

Use of the cup-type insert is by mounting the item in a suspended position between the locking ring and the top cover to prevent movement, as illustrated in figure 3-86.

Crate-type insert

This insert is also used for mounting items. The item is bolted to a frame in an upright position. The frame is designed to fit snugly between the top and bottom of the container, as shown in figure 3-87.

The closure of the metal shipping and storage drums can be accomplished by the following methods:

The closure of the style 1 (bolted ring), depicted in figure 3-88, drum is made by applying the locking ring on the cover and drum and tightening the bolt and nut. Tapping around the locking ring with a mallet (rawhide or rubber) will help make an effective seal.



Figure 3-87. Reusable metal and shipping storage drum with crate insert and mounted item.



Figure 3-88. Tapping lock ring while tightening bolt to ensure an effective seal.

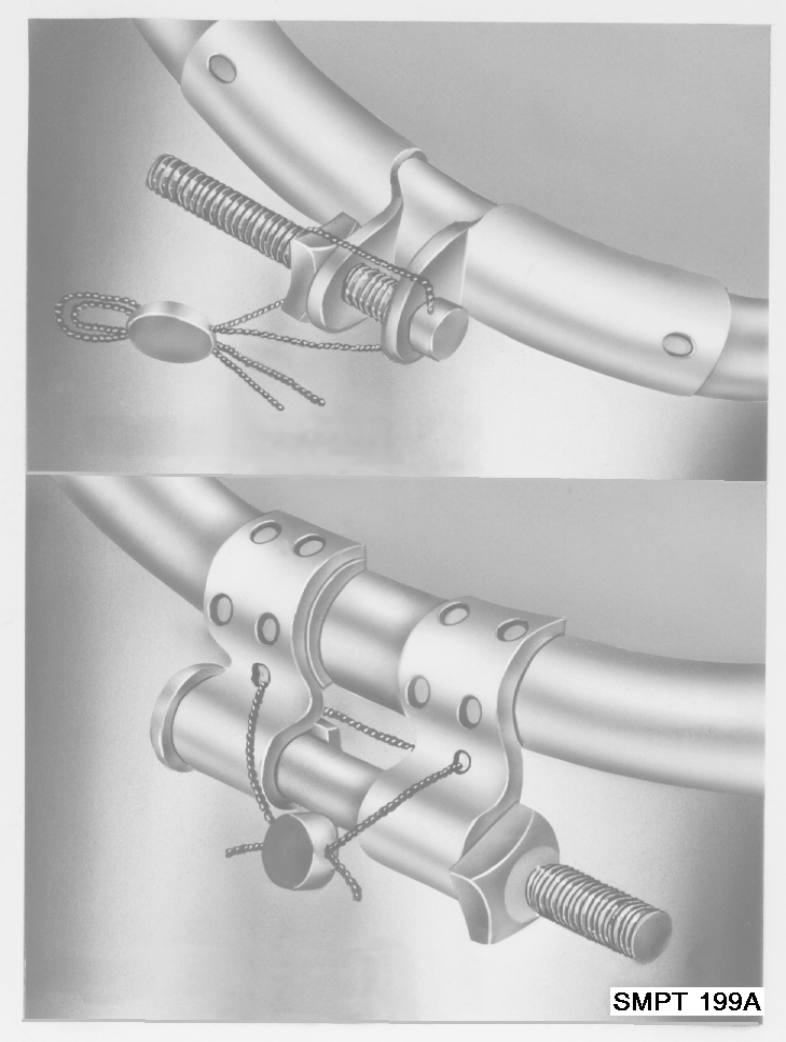


Figure 3-89. Sealing of metal drums.

The closure of the style 2 (lever actuated locking ring) drum is made by moving the locking lever to the locked position. The lever is held in place by a wire and lead seal.

Sealing of the drums, for security reasons, is made by applying a wire and lead seal to the locking ring after the closure has been made. Figure 3-89 shows the sealing wire inserted through the holes in the locking ring and the lead seal applied.

When properly closed, the drums provide a highly effective water-vaporproof container.

This container is available in a number of sizes depending on the need.

Steel Shipping Pails, 1 Through 12 Gallons

The steel shipping pails are round containers made of steel. As shown in figure 3-90, they have a handle on the top or attached from the sides, and are called

tight head pail or lug cover pail.
Tight head pails are provided with spouts for pouring or removal of powder, granules and flake material.

Lug cover pails are provided with a full removable head to allow easy removal of contents such as greases and molasses.



Figure 3-90. Tight head and lug cover pails.

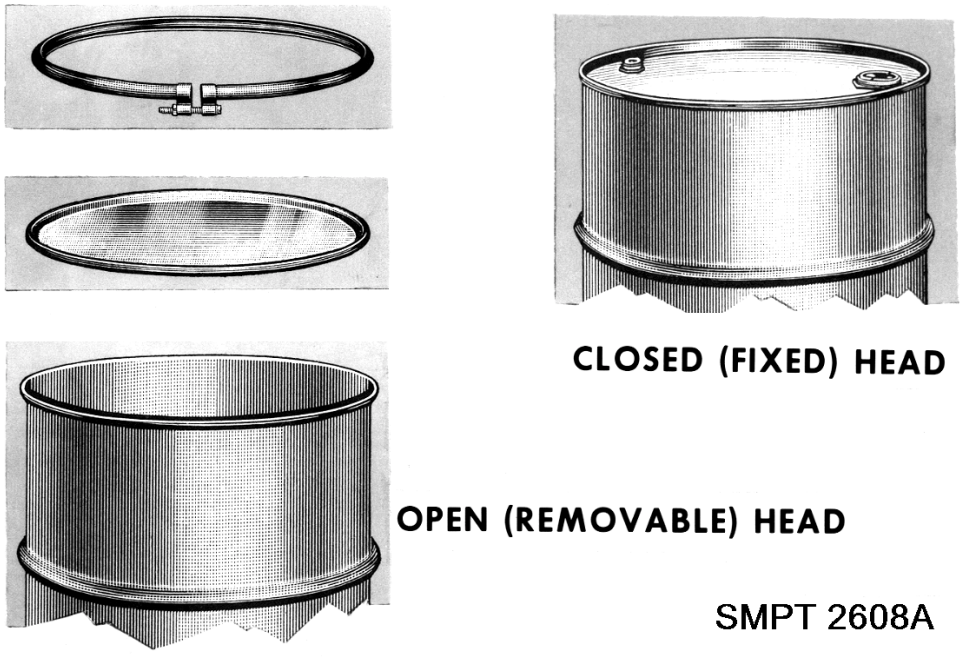


Figure 3-91. Kinds of 55 gallon metal drums and their closures.

Drums, Shipping and Storage, Steel

The steel drums shown in figure 3-91 are cylindrical shipping containers with a rated capacity of 55 gallons. These drums may have either openheads (fully removable) or closed heads (fixed).

A drum with a closed head is provided with a filler hole for filling and emptying the contents and a vent hole.

These openings may be on the drum head or in the drum body.

The closed head drums are primarily used for the shipment of liquids. Emptying may be through either the filler vent hole, although the vent hole is most commonly used in conjunction with either a hand pump or a hydraulically operated pump.

Drums with the full removable head provide the easiest access to the contents. A variety of items e.g., greases, dry powdered, flaked, or granular materials may be shipped in these drums.

Closure of these drums may be made in the following two ways:

- X Apply plug to the filler and vent openings.
- X Apply full removable cover to drum and secure in place with bolted locking ring.

Boxes, Shipping, Reusable, with Cushioning, (PPP-B-1672), "FAST-PACK"

These reusable boxes are used in connection with the FAST-PACK System.

FAST-PACK

Fast-Pack is a system which utilizes a family of standard size cushioned shipping containers like those in figure 3-92.

These containers use polyurethane foam cushioning which, in most cases, is bonded to the container to assure the integrity of the complete pack.

Because of their construction and closure features, these boxes are reusable.

The FAST-PACKS are especially useful for return of repairable components since each size and type is suitable for shipment of a large number of different items within certain limits of size, weight, and fragility.

All FAST-PACK containers must be marked by printing or stenciling in black letters, REUSABLE FAST-PACK, to alert users that the container must be reused if the integrity of the pack has not been diminished.

Materials

Fiberboard for all boxes shall conform to type CF, class WR, of ASTM D 4727, Fiberboard, Corrugated and Solid, Sheet Stock (container grade) and Cut Shapes.

Boxes of Type I, Type III, and Type IV shall be made of grade V3c material, except for the two largest box sizes of Type III, which require V13c material because of dimensions.

Type II boxes shall be made of material grade V5c.

Cushioning shall be polyurethane conforming to Type I, class 2, grade C, of MIL-PRF-26514, Polyurethane Foam, Flexible, except for Type II packs which shall be Grade A, B, or C and antistatic.

Types and styles

There are four types and five styles of boxes used in the Fast-Pack System. They are as follows:

- X Type I - Vertical Star Pack.
- X Type II - Folding Convoluted Pack.
- X Type III - Telescoping Encapsulated Pack.
- X Type IV - Horizontal Star Pack.
- X Style A is a Regular Slotted Container (RSC).
- X Style B is a modified Double Cover Container (DBLCC).
- X Style C is another modified Double Cover Container (DBLCC).
- X Style D is a modified Triple Slide Box (TS).
- X Style G is a modified Full Telescope Design Box (FTC).

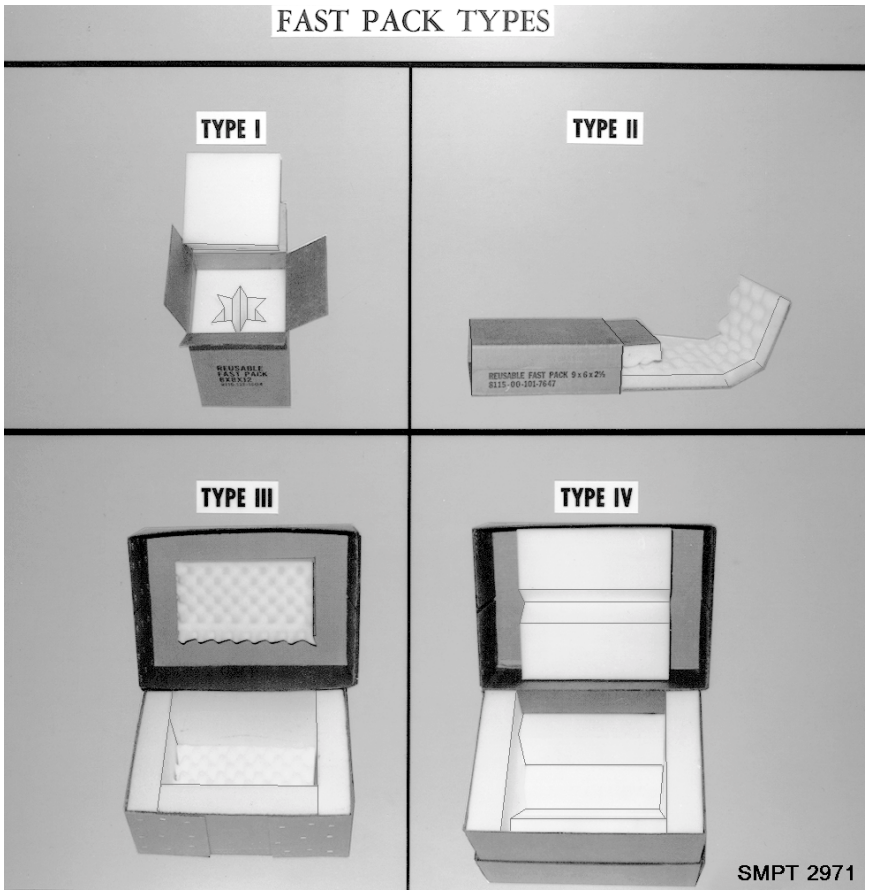


Figure 3-92. Fast pack containers.

Closure and Marking of Fast Packs

Closure of FAST PACKS shall be effected when the item(s) is placed therein and packed for shipment and storage. Marking for military shipment and storage of packs shall comply with MIL-STD-129. Marking of packs for civil agencies shall be in accordance with FED-STD-123. The tape used for reinforcement and sealing shall be of the specification, type, and size as specified for each type and style of box to provide Level B packing as specified. Insofar as practical, no preprinted markings, except container certification marking, shall be obscured by taping or reinforcement. Obscured or obliterated markings that are preprinted on reused boxes need not be remarked except for the pack code.

Closure and Reinforcement for Level B packing

Figure 3-93 illustrates the closure and reinforcement requirements for Level B packing by type and style.

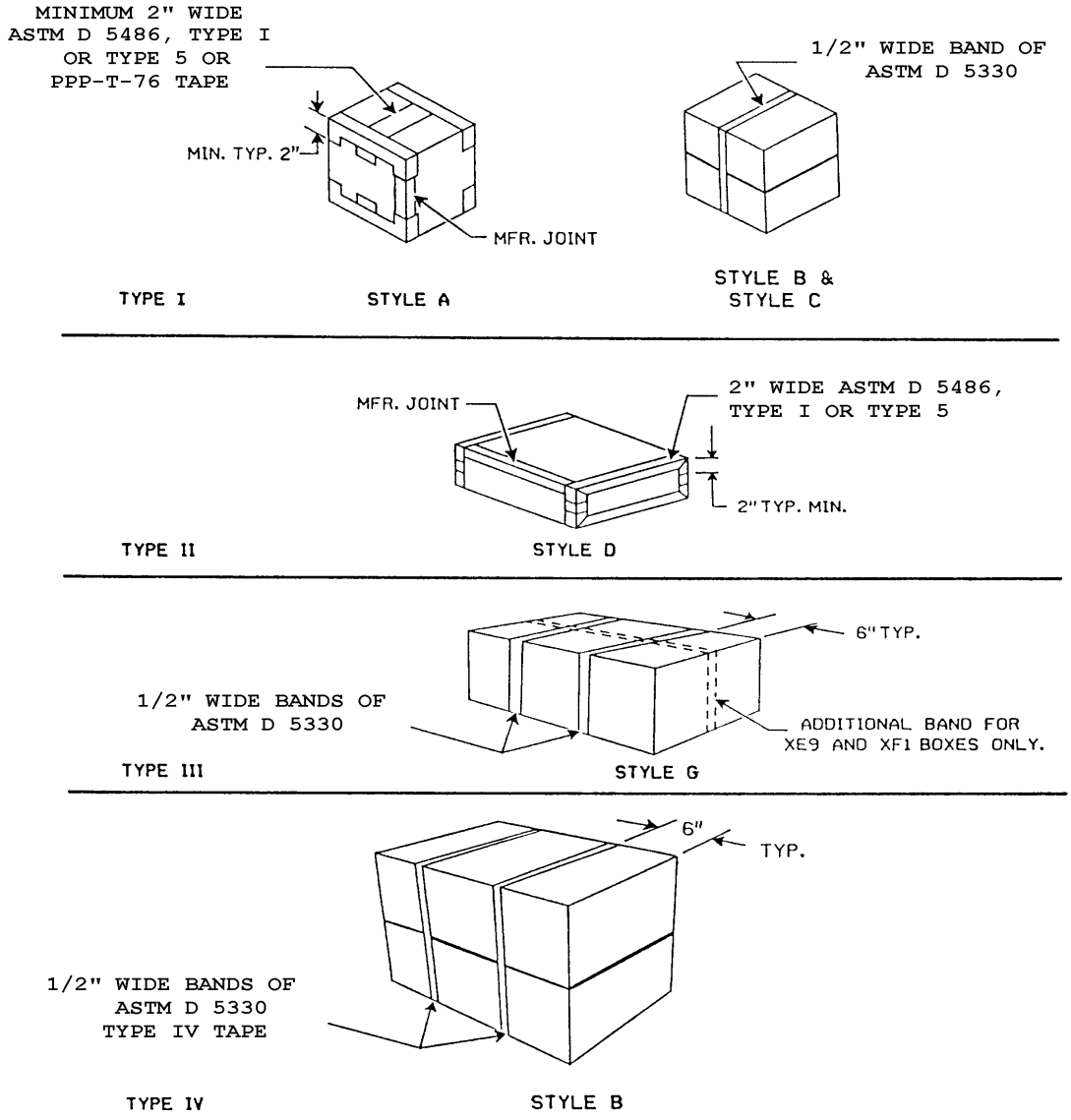
Type I, style A packs shall be sealed with minimum 2-inch wide tape conforming to ASTM D 5486, Type III or IV applied over all seams, corners, and manufacturer's joints. The tape shall be centered over the seams and joints and shall extend over all the corners and edges of the box a minimum of 2 inches onto the adjacent box panels. Tape shall be applied over the lengthwise seam of the outer flaps, sealing the opening of the box and over the manufacturer's joint prior to the tape being applied to the edge seams of the box. The tape applied to the manufacturer's joint shall cover the joint but not extend over the corners of the box onto the adjacent panels. This method also serves as the closure.

Type I, styles B and C shall be centrally reinforced with one fully encircling band of 1/2-inch wide tape conforming to ASTM D 5330, Type II or III. This method serves as the closure. Sealing is not required.

Type II, style D packs will have all open seams and the manufacturer's joint sealed with two inch wide tape conforming to either ASTM D 5486. Type III or IV, or ASTM D 5330. This method also serves as the closure.

Type III, style G packs shall be reinforced with fully encircling bands of 1/2-inch wide tape conforming to ASTM D 5330, Type II or III. Two bands shall be positioned six inches from the ends over the top, bottom, and side. Add one lengthwise band over the top, bottom, and ends for XE9 and XF1 FAST PACKS. This method serves as the closure. Sealing is not required.

Type IV, style B. A reinforcement shall be as specified except that the lengthwise band shall not apply. This method serves as the closure. Sealing is not required.



LEVEL B FAST PACK CLOSURE AND REINFORCEMENT

SMPT 3091A

Figure 3-93. Closure of Fast-Pack boxes for Level B packing.

Special Marking Requirements

Type I, II, and IV packs shall be identified with the following data:

X REUSABLE
X FAST-PACK (Appropriate pack size and NSN)

Type II packs require the following markings:

X REUSABLE
X FAST-PACK (Appropriate pack size and NSN)

Each end of the style D box shall be marked with the words: PUSH TO OPEN. In addition, the word "ANTISTATIC" shall be marked on both ends of the slide in 1/4" high letters 3/8 inch below and not to extend beyond the left margin of the word "OPEN".

Application and Use

Fast-Packs are intended for use as standard, exterior, reusable packing media in the preservation, packing, handling, shipping, and storage of serviceable and repairable items.

Type I packs may be used for items such as meters, gauges, and instruments.

Type II packs may be used for items which are essentially flat (1/4 to 2-1/2 inches thick) such as circuit boards, electronic modules, and tubes.

Type III packs may be used for black-box type items such as receiver-transmitters, amplifiers, power supply units and electronic indicators.

Type IV packs may be used for electrical/electronic items generally having a small cross section relative to length, such as control generators, amplifiers, voltmeters, protection panels, transformers, and regulators.

Opening of Fast Packs

To open the Fast Pack boxes, the closure and reinforcing tape(s) shall be cut with a shallow knife at the minimum number of seam locations which will permit opening and preclude any damage to the box. Do not remove totally adhered tape.

Reuse of Fast Packs

In reusing of Fast Packs, the following procedures should be observed:

Surfaces to which tape for closure or reinforcement is to be applied must be free of loose soil, oil, or grease. These surfaces should be wiped clean prior to application of tape.

Tape applied to reused containers should be applied directly over the existing tape.

Loose ends of existing tape should be cut off, not torn loose. Tearing the tape from the box damages the box surface and weakens the container walls.

Checkup

X What container may be used for shipping pamphlets, papers and other small flat items?

X What is the weight limit of the load a kraft envelope may carry?

X How are cushioned paper shipping sacks closed?

X How is a Type I, style A, Fast-Pack container described?

X How are blocking and bracing accomplished in metal shipping and storage drums?

CHAPTER 4

Packing Procedures and Operations

WEATHERPROOFING THE PACK

GENERAL

Throughout the text, we have stated that we must protect our military supplies and equipment from the effects of water, either in its liquid or vapor form.

We can protect the contents of our packs through the use of certain barrier materials in various applications.

When these materials are properly applied to the pack, it is called Weatherproofing the Pack. Examples of weatherproofing are shown in figure 4-1.

KINDS OF PROTECTION

There are three different kinds of protection that can be applied to packs when they are weatherproofed. It can be waterproof, watervaporproof, or watershed, depending upon the extent of protection required.

Waterproof

This term indicates that the barrier will prevent the direct entry of water but does not prevent the penetration of watervapors through the barrier. If the barrier is completely sealed, it will provide waterproof protection. Examples are case liners and interior wraps.

Watervaporproof

This term indicates the material is resistant to passage of watervapor, though not necessarily a complete barrier. If the barrier is completely sealed, it will provide watervaporproof protection. Examples are case liners and interior wraps.

Watershed

When the waterproof material is placed over or around the items and left unsealed, it provides watershed protection. Watershed applications permit free circulation of air around the item. Examples are crate liners, interior shrouds, and temporary tarpaulins.

CASE LINERS

Case liners are used for liners of boxes to protect contents against the entrance of water or watervapor depending upon the barrier material used. Caseliners are furnished as prefabricated or "tailor made" bags. As shown in figures 4-2 and 4-3, case liners can be constructed as a double-top pad or high top liner.

The joints, seams, and closures must be sealed to afford water-resistance equal to that of the barrier material itself. This may be accomplished by heat sealing, adhesive, or tapes. Case liners form a continuous barrier which is a separate part of the box.

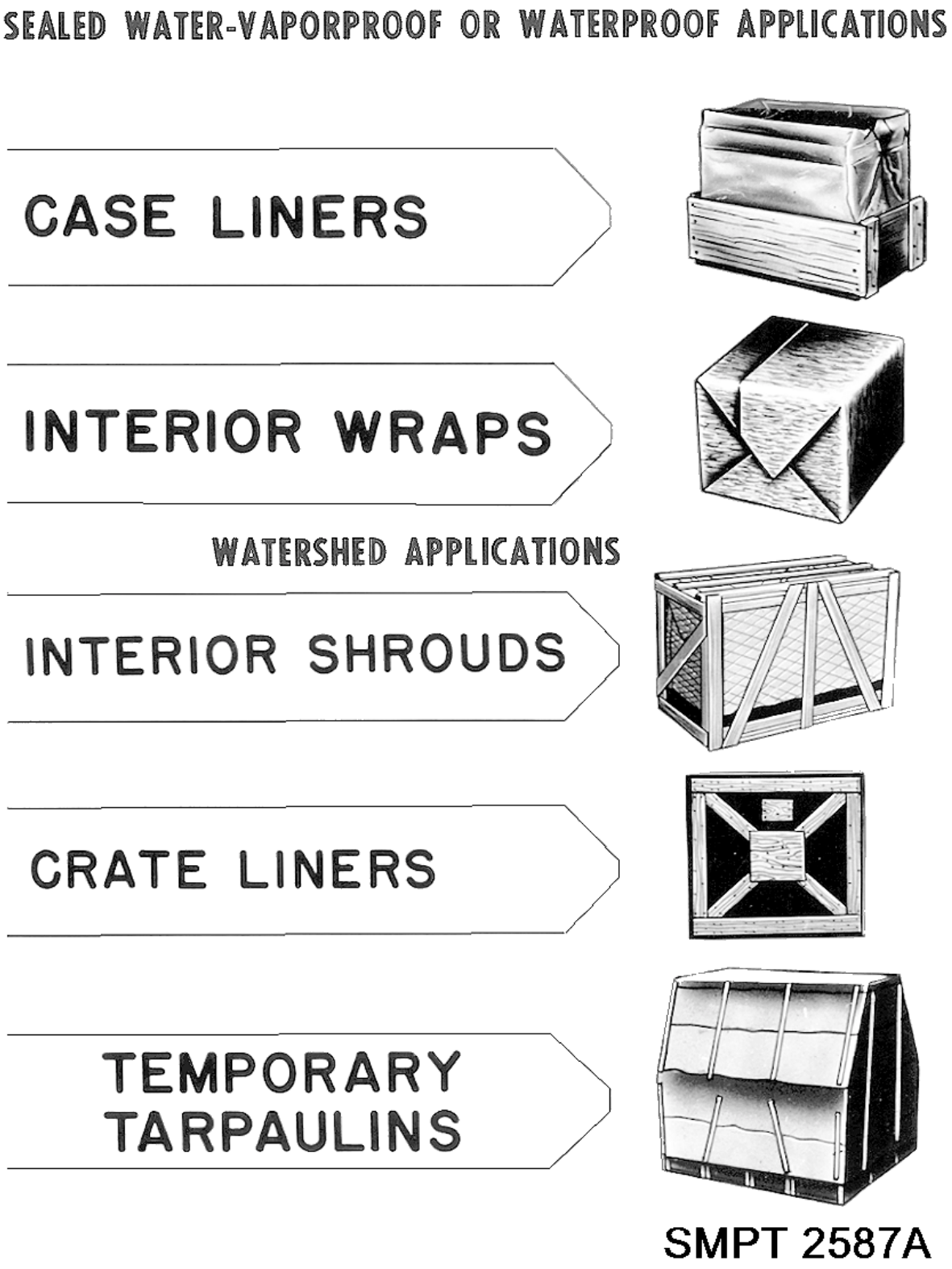


Figure 4-1. Examples of weatherproofing the pack.

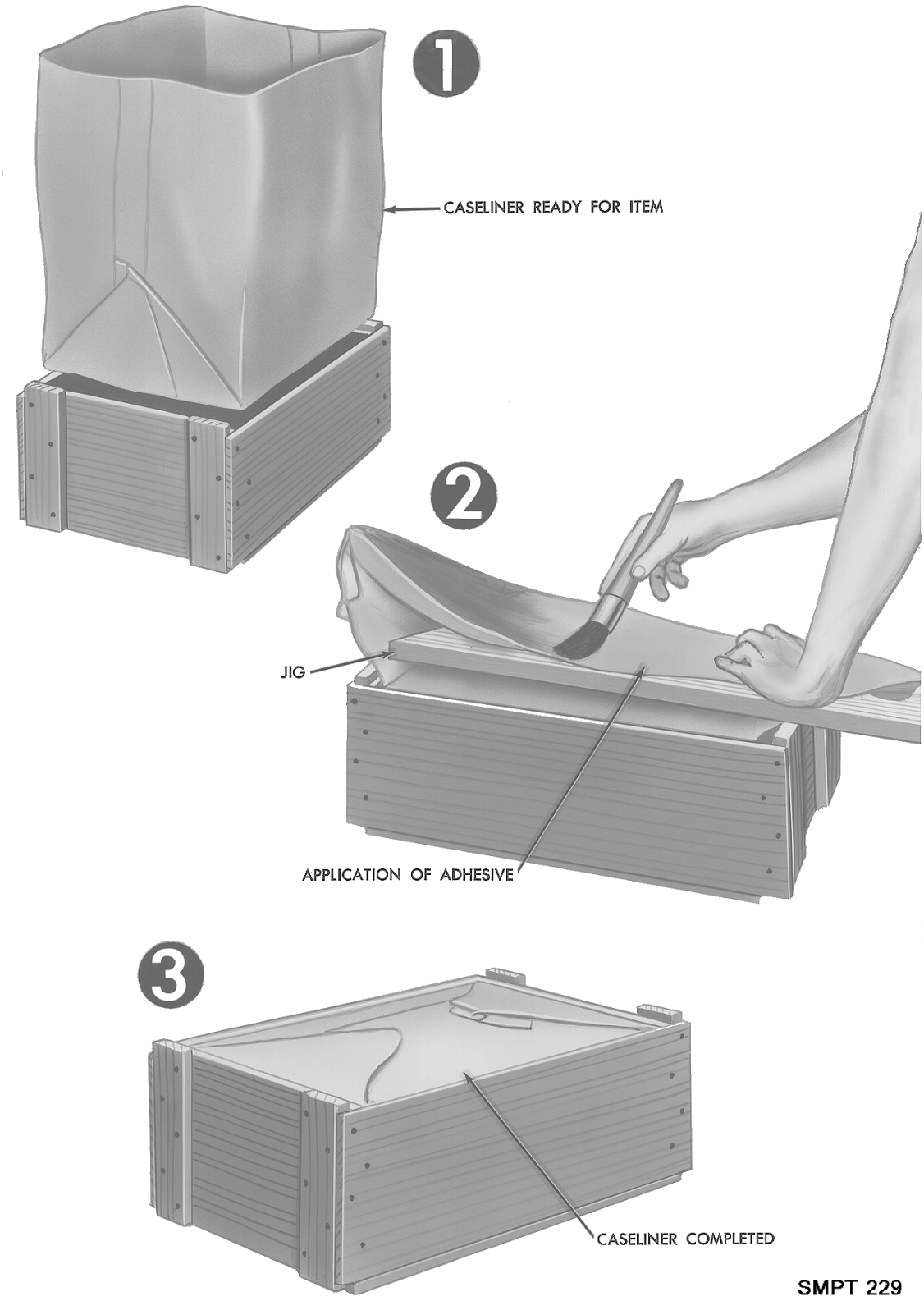


Figure 4-2. High top caseliner.

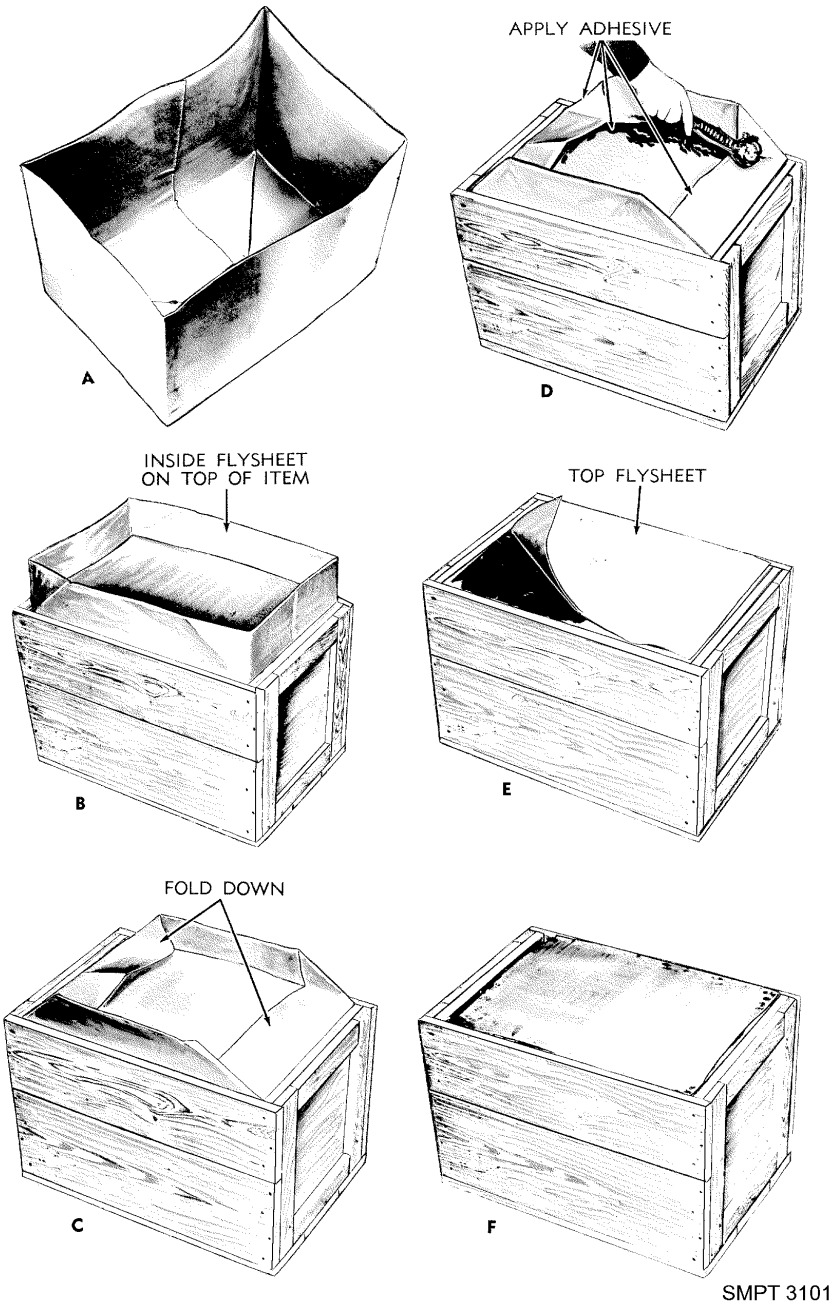


Figure 4-3. Double top pad caseliner.

Barrier material may be kraft paper or plastic film and affords protection equal to that of the wrap or bag.

Experience has shown that under some conditions, especially when the contents do not completely fill the case liner, case liners do more harm than good by trapping and holding water rather than preventing its entry.

It is not necessary that there be openings in a sealed case liner for this to happen.

If the case liner has a low resistance to watervapor, water can enter in the form of vapor and condense on the contents within the liner.

It has been found that case liners opened after extended outdoor exposure were partly filled with liquid water.

When packed items need protection against water, it is preferred the protection be provided by individually wrapped unit packs instead of case liners.

INTERIOR WRAPS

Interior wraps, as illustrated in figure 4-4, are used to protect individual packs or light parts, or sections of items, against penetration of water or watervapor, depending upon the barrier material used.

All seams, joints, and closures are heat sealed or sealed with other suitable materials to afford protection equal to that of the wrap or bag.

Barrier materials may be kraft paper or transparent plastics, giving either waterproof or watervaporproof protection.

CRATE LINER

Crate liners are used to line the side and end panels of crates, as in figure 4-5.

The material is placed between the lumber sheathing of the crate and the inner framing members.

The material is applied to the separate panels and does not form a continuous barrier.

Crate liners provide watershed protection.

INTERIOR SHROUD

Interior shrouds are generally used to cover material packed in open crates to protect the item against direct entry of water.

The shrouds should hang free, when possible, without the use of binding ties (such as strings, strapping, etc.) and should extend to approximately 6 inches from the base of the crate to provide ventilation, as shown in figure 4-6.

Seams should be sealed with water-resistant adhesive.

All sharp points of contact between the item and the shroud should be cushioned to prevent rupture or chafing of the shroud.

The shroud should be placed over the item in such a way as to prevent the formation of water pockets.

In this application the shroud provides watershed protection and is so constructed that it does not interfere with free circulation of air around the item.

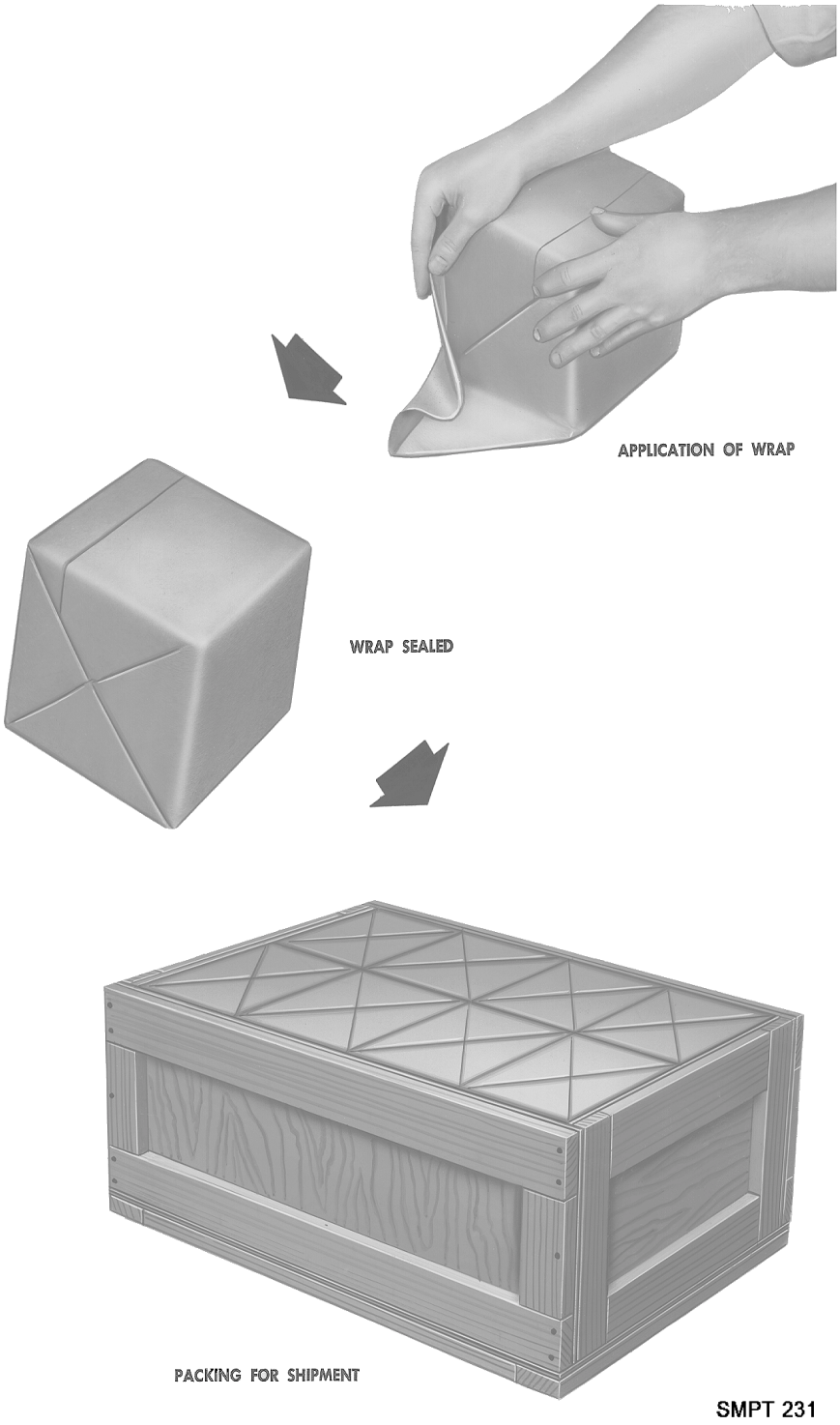


Figure 4-4. Interior wraps.

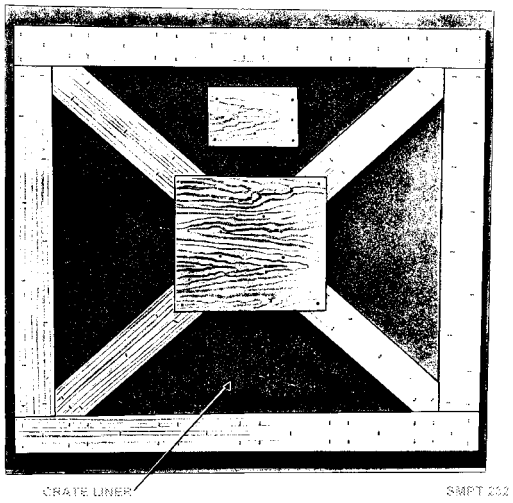


Figure 4-5. Crate liner.

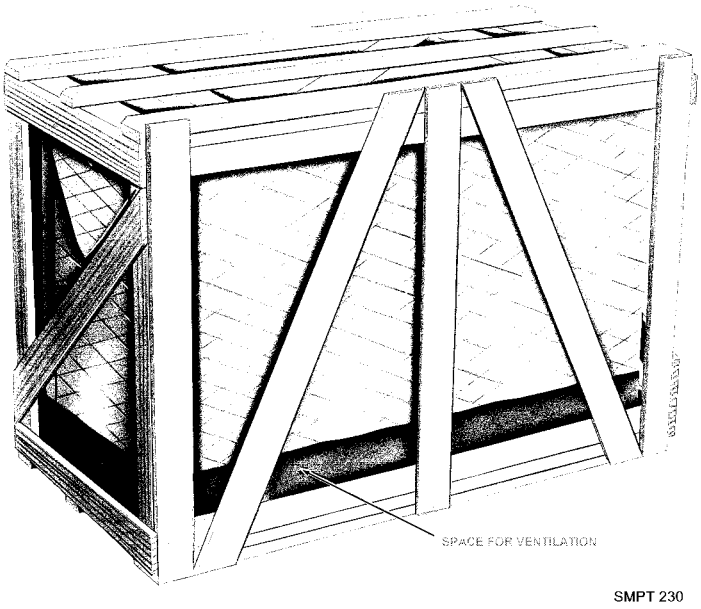


Figure 4-6. Interior shroud.

TEMPORARY TARPAULINS

Temporary tarpaulins are applied as coverings of material in outdoor storage. They provide watershed protection against the penetration of rain.

The temporary tarpaulin should cover the top, sides, and ends of the material to be protected.

Temporary tarpaulins are generally secured by tying or weighting down in place.

Figure 4-7 shows the preferred attachment of temporary tarpaulins through use of a wooden framework over the container or to the container with wooden holddown strips. They should be placed in such a manner to permit free circulation of air around the material and to avoid wind damage to the tarpaulin.



Figure 4-7. Temporary tarpaulin.

SUMMARY

In summary, there are five different ways to weatherproof the pack depending upon the extent of protection required. They are caseliner, crateliner, interior wrap, interior shroud, and temporary tarpaulin.

Checkup

X What are the three different kinds of protection you can give to your packs when weatherproofing the pack?
X What type of protection does a case liner provide?
X What kind of protection is provided by a crate liner?
X What type of protection does an interior shroud provide?
X How far should an interior shroud extend from the base of the crate?
X What are temporary tarpaulins used for?

WEATHERPROOFING THE PACK PRACTICAL EXERCISE

Objective

As a result of this practical exercise, the student will be able to identify the various methods of weatherproofing the pack.

General Instructions

This exercise will be conducted in the classroom.

It will require approximately 1 class period.

The instructor will conduct a critique at the end of the exercise.

Conduct of Exercise

Situation

As a packer you are responsible for making interior shrouds and case liners in weatherproofing the pack.

Requirement No. 1. Answer the following questions.

- X What is the most damaging factor to items exposed to the weather?
- X Name the five methods of weatherproofing the pack.
- X What type of weather protection do you get when you use a crate liner?
- X How many types of caseliners are there and what are they?
- X What kind of weather protection does a case liner give a pack?
- X What determines the kind of protection we get from a case liner?
- X Identify the method of weatherproofing in figure 4-8.
- X Identify the method of weatherproofing in figure 4-9.
- X Why must the bottom of the material in the above method be six inches above the base of the crate?
- X List and define (in your own words) the 3 different kinds of protection which may be provided by weatherproofing a pack.

Critique

Instructor will orally critique questions.

Care of Area, Training Aids & Equipment

Not applicable.

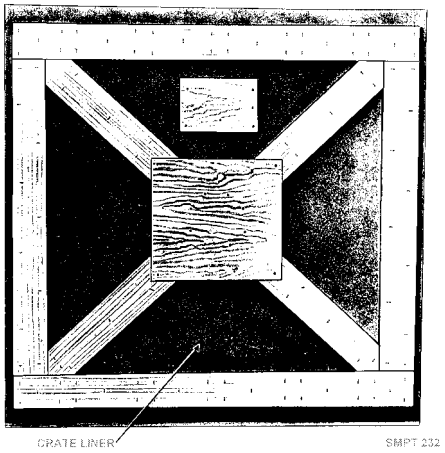


Figure 4-8. Weatherproofing #1.

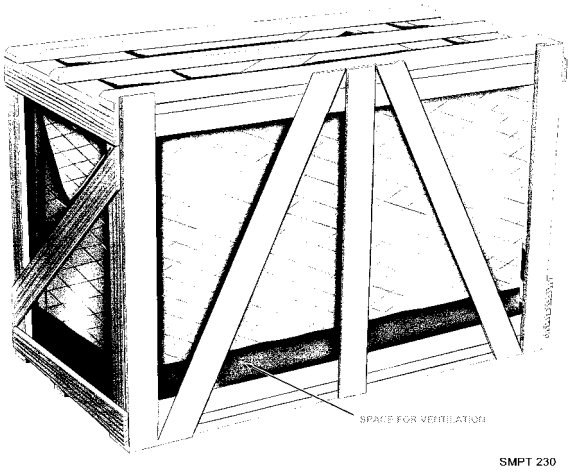


Figure 4-9. Weatherproofing #2.

CARGO UNITIZATION

METHODS OF UNITIZATION

Unitization

Involves methods and means by which items of supply are shipped from origin to destination as a single unit. Definitions that follow describe elements of the unitization process.

Unitized Load

The assembly into a single load of more than one package of one or more different line items of supply in such a manner that the load can be moved in an unbroken state from source to distribution point or user.

Palletization

Palletization is unitization by means of a unit load using a pallet for a base. A quantity of any item or items, packed or unpacked, is arranged on a pallet and securely strapped or fastened to it so that it can be handled as a single unit as shown in figure 4-10. It may also be stretch wrapped or shrink wrapped.

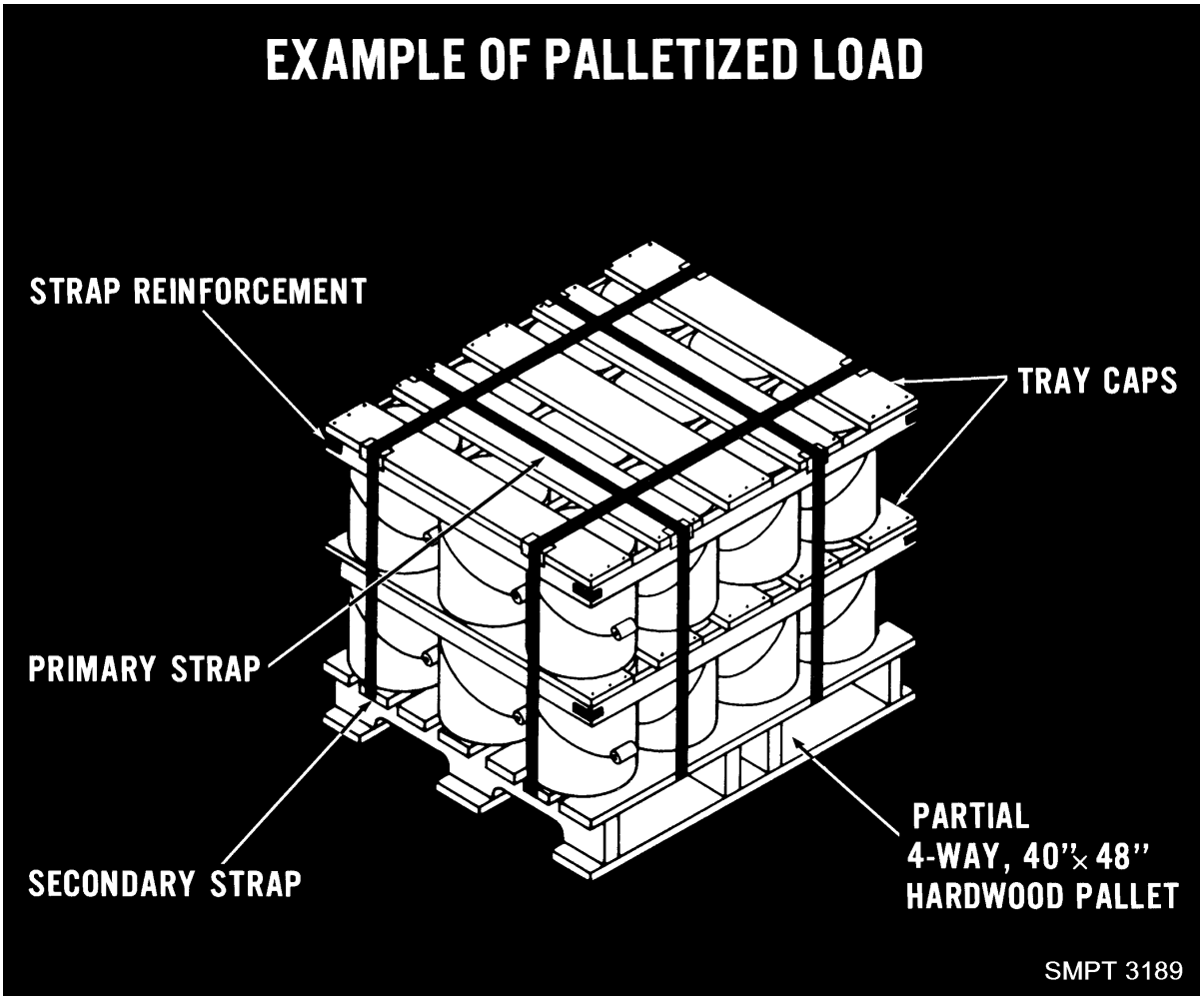


Figure 4-10. Examples of palletized load of pails.

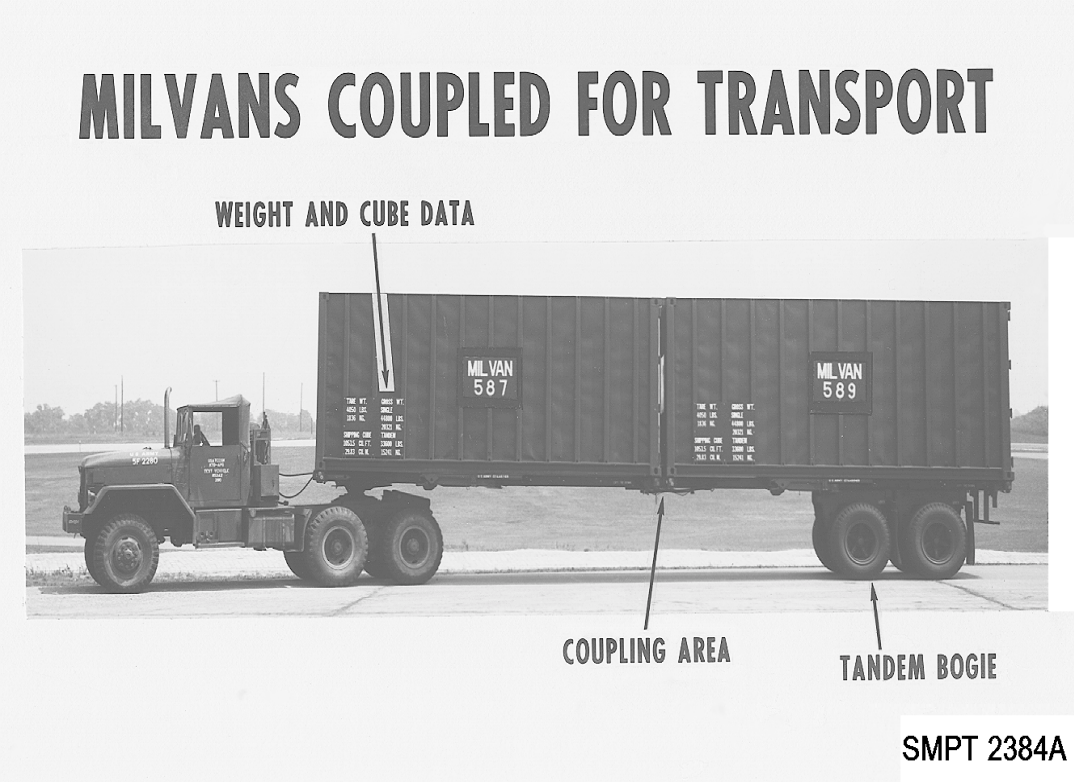


Figure 4-11. Milvans coupled for transport.

MILVAN

A military-owned van used for containerization, as shown in figure 4-11.

SEAVAN

A commercial or Government-owned (or leased) shipping container as shown in figure 4-12 is used for containerization which is moved via ocean transportation with bogey wheels detached. It is similar in design to MILVAN.

Consolidation boxes

Shown in figure 4-13 are boxes used as inserts in MILVANS or SEAVANS or as separate exterior shipping containers.

Containerization

In this lesson, the term is intended to refer both to the placing of commodities in plywood, wirebound and fiberboard containers, as well as to the loading of containers in SEAVANS and MILVANS in such a manner as to assure their protection during shipping, handling, and storage



Figure 4-12. Seavan moving over the road.



Figure 4-13. Wood cleated plywood consolidation boxes.

Advantages of Unitization

Economy

Unit loads provide an economical manner of handling, storing, and transporting small items or packs by eliminating a lot of manual handling of individual items.

Greater Speed in Handling

With unit loads, more tonnage can be moved in less time than is possible with other handling methods.

Utilization of Cubic Space

Material in unit loads can be stacked to greater heights in the warehouse with limited use of manpower, thus utilizing the greatest percent of available cubic storage space in the building.

Decreased Damage to Material

When compared to single item shipments, materiel handled in unit loads receives less damage and is more likely to reach its final destination in a serviceable condition.

Safety

Handling of material in unit loads is safer for personnel. Many of the accidents most common to storage operations occur where manual or individual pack handling is involved.

Pilferage

Unitization discourages attempts at pilfering the contents of a load or in the loss of individual items or packages.

Protects Against Environmental Hazards

Unitizing cargo helps protect supplies and equipment against severe environmental conditions.

Flexibility

Unitization leads to efficient and flexible supply support.

Unitization Methods

Earlier in this lesson we said there were five different ways we can accomplish the unitization of cargo. Let's discuss each one individually. They are palletization, consolidation, boxes, MILVAN and SEAVAN.

Palletization

Pallets play a key role in the unitization of cargo. Many types of items and small boxes may be secured to a wooden or metal platform either for independent shipping or as inserts in large shipping media such as van containers or closed rail cars.

There are three different kinds of pallets as shown in figures 4-14 and 4-15 in use today. They are known as four-way (partial) stringer, four way entry (post) pallet, and four-way partial stringer (softwood) pallet. All three of the above listed pallets may be used for long-term storage in both covered and uncovered areas.

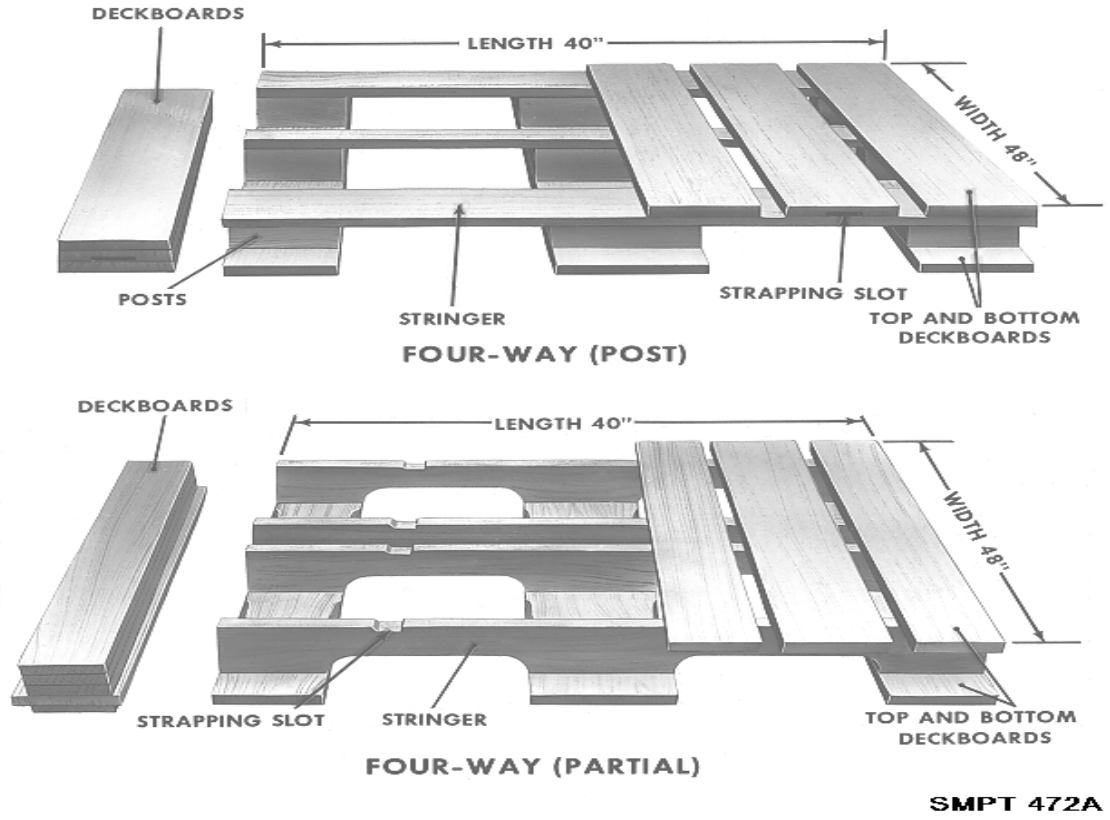


Figure 4-14. Pallets.

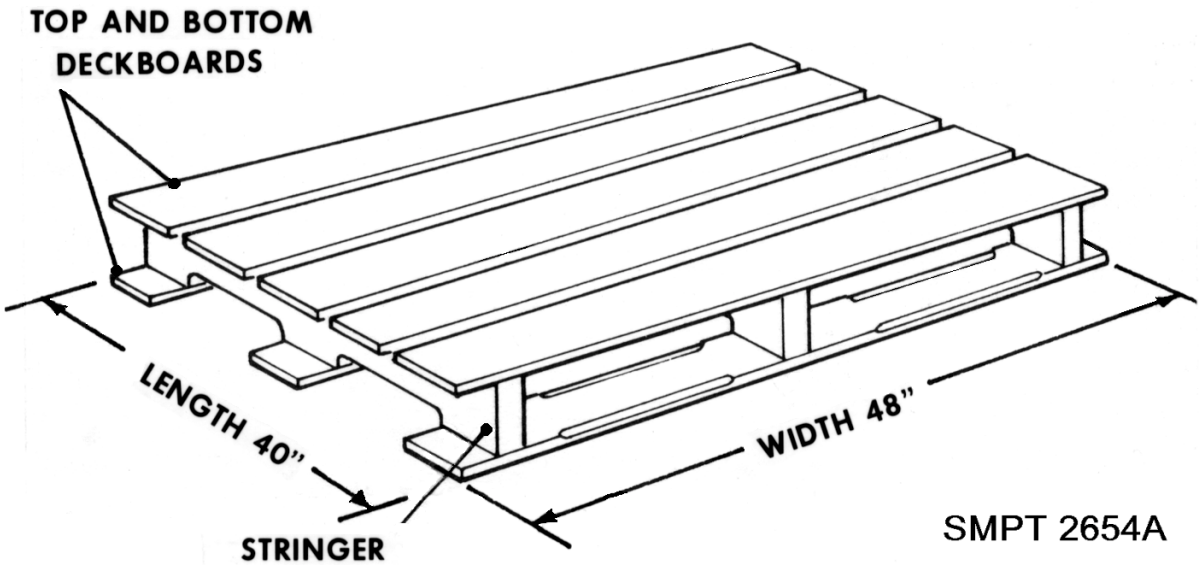


Figure 4-15. Softwood pallet.

Size Limits of Pallets

There are many different size pallets in use today. The one we are concerned with is known as the standard size pallet. It measures 40" x 48". The 40-inch dimension identifies the length of the pallet. The 48-inch dimension identifies the width of the pallet.

Load Limits of Pallets

When loading pallets, there are certain limits to which they can be loaded as shown in figure 4-16. A load cannot exceed 52 inches (widest dimension) which permits an over-hang of 2 inches at each end of the 48-inch dimension. Load units prepared for shipment in SEAVAN and MILVAN should not exceed 48 inches in width. A load cannot exceed 43 inches (narrow dimension) which permits an over-hang of 1-1/2 inches at each end of the 40-inch dimension. Loads for shipment in SEAVAN and MILVAN will not exceed 40 inches in length. A load should not exceed 54 inches in height, except for loads of compressed gases in cylinders. Loads prepared for shipment in SEAVANS should not be higher than 43 inches. Loads prepared for shipment in MILVANS should not be higher than 41 inches. Load limits are established in MIL-HDBK 774.

Weight Limits of Palletized Loads

When loading pallets, we must remain within the weight limitations for palletized loads. Weight limits apply to the entire load including pallet, bonding, storage aids, and units. The maximum weight of a load for domestic, intercoastal, or overseas shipment will not exceed 3000 pounds per single pallet load.

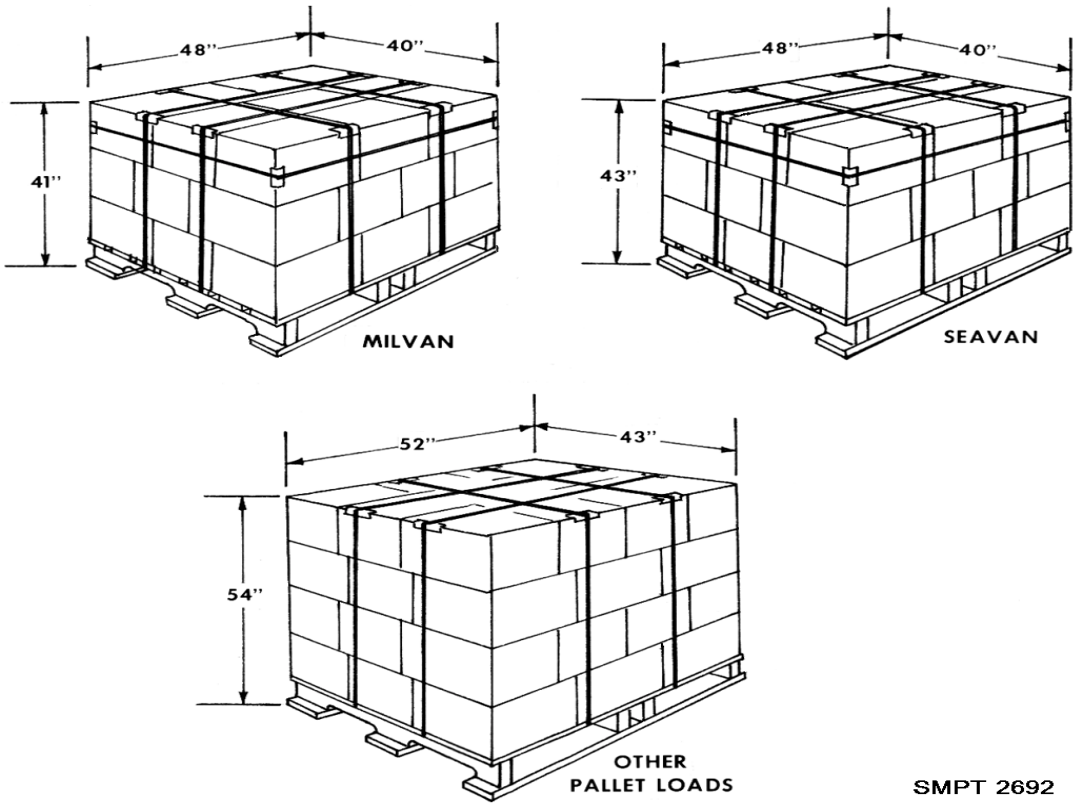


Figure 4-16. Other pallet loads.

Items To Be Palletized

Types of supplies that can be palletized are: items which are identical and identified by the same stock number; items uneconomical or impractical to pack otherwise; rugged and durable items that require minimum physical protection; boxed items uniform in size requiring additional protection; and items that are moved in large quantities. (See figure 4-16.)

Loading of Pallets

The arrangement of items on pallets must provide a rigid, compact, uniform size load. The items must be strongly secured to prevent shifting, and must be capable of resisting impact, vibration, wracking, and compression encountered during handling, storage, and shipment. To properly load a pallet, consideration must be given to the type of item, its weight, and destination.

Pattern For Palletization Loads

Containers or items are arranged on the pallet in a particular pattern for each type of item. When possible, the pallet pattern should be arranged to utilize all the pallet area with the least amount of margin on the pallet. When the pattern and the loading method have been determined for palletizing items into a secure load, that pattern and method should be used in preparing similar items into a load. The length, width, and height of each rectangular package must be considered in determining the pallet pattern to permit the formation of interlocking patterns and provide stability to the unit load. MIL-HDB-774 contains 124 different kinds of pallet patterns. We will only cover a few at this time to familiarize you with the pallet patterns. Determine length and width of the container to the nearest 1/2 inch. Locate the length of the container at the top and the width of the container on the left side of the index chart, as shown in figure 4-17; the container pattern will be found at the intersection of the two columns.

Using the pattern number which is given, locate this number on the pallet pattern illustration to find the number of containers that can be arranged on each pallet as shown in figure 4-18.

Load Classification

There are 18 different load classifications for palletized loads listed in MIL-HDBK-774. The ones most generally used are Load Type I and Ia which consist of fiberboard boxes, wood boxes, or other suitable hard surface units stacked in single or multiple layer loads as shown in figure 4-19.

Load Type III consists of closed head nesting type cylindrical or rectangular cans, pails or buckets that are stacked in multiple layer loads using an inverted wood cap under the load and a wood cap over the load as shown in figure 4-20.

TABLE III , LOAD PATTERN DETERMINATION

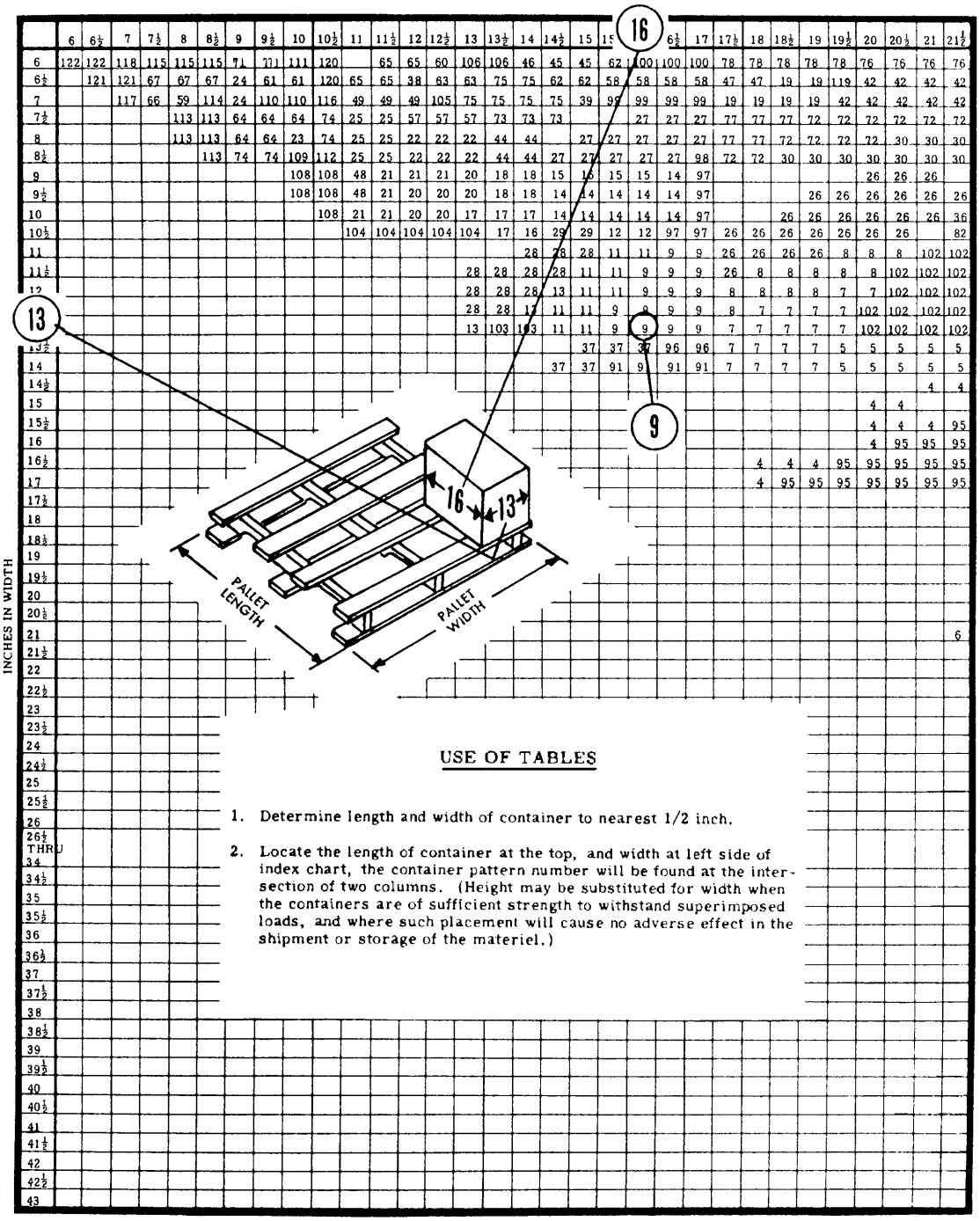


Figure 4-17. Index chart for pallet patterns.

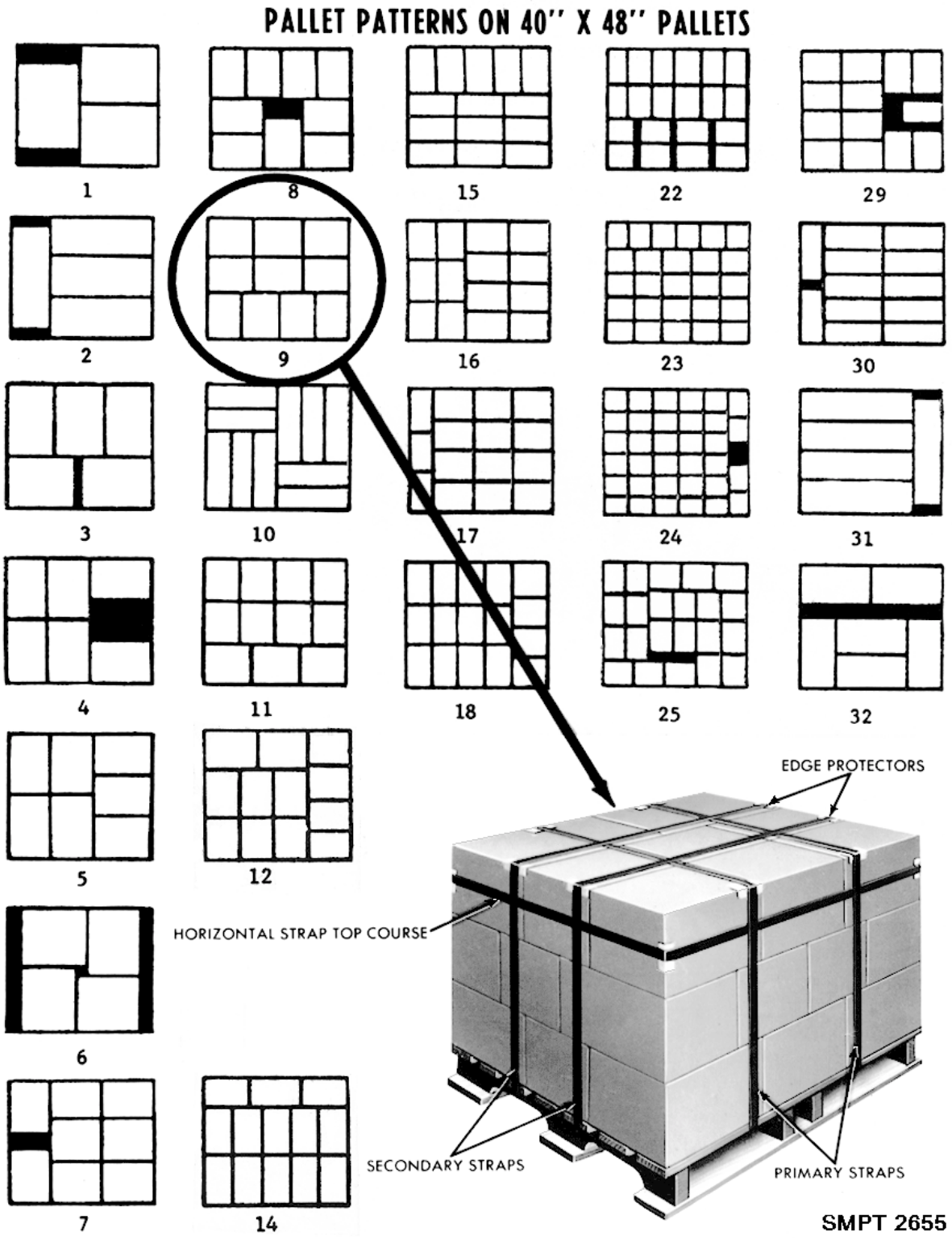
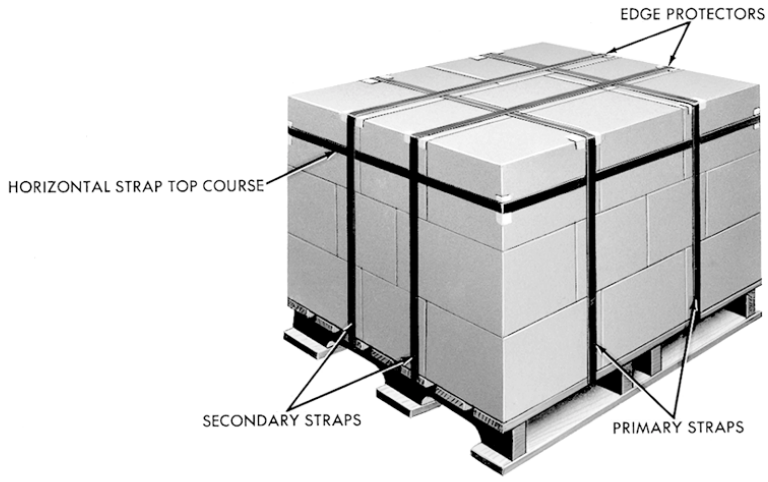


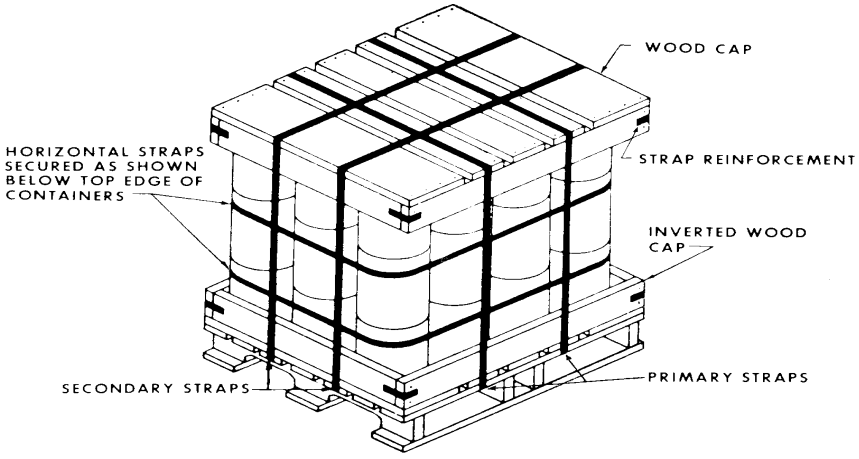
Figure 4-18. Finding correct pallet pattern.



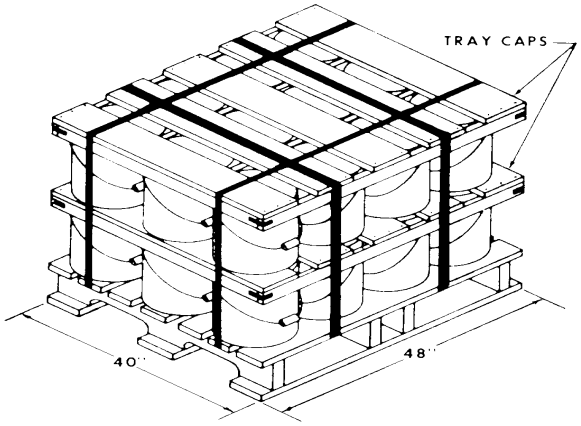
LOAD TYPE Ia (FIBERBOARD CONTAINERS)

SMPT 552

Figure 4-19. Load Type Ia.



LOAD TYPE III (CLOSED HEAD PAILS)



LOAD TYPE IV (PAILS WITH REMOVABLE COVER)

SMPT 2211

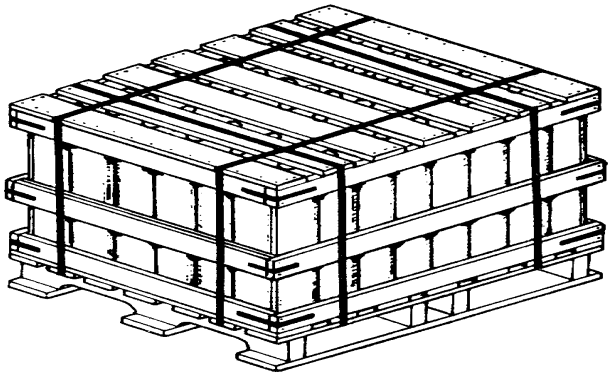
Figure 4-20. Load Types III and IV.

Load Type IV consists of cylindrical and rectangular cans with removable covers containing plastics, paints, and semi-liquids (grease and lard), and nontop nesting closed head cans that must be stacked in multiple layers with wood tray caps between layers as shown in figure 4-20. Load Type XIII consists of cylindrical shaped items such as wire, cloth, canvas, wrapping paper, building paper, and sheet metal in rolls that must be stacked vertically in single or multiple layers with a wood cap over and under the load and with a double tray cap between layers as shown in figure 4-21.

Bonding Methods per MIL-HDBK-774

The following methods are used to secure units on, and to, a pallet such as over-the-load straps:

- X Over-the-load straps are placed over the load and are used to secure items vertically into a unit load. When possible, the straps should be centered over rows of items being bonded. When over-the-load straps are used on a load where horizontal straps are also required, the horizontal straps will be applied and secured prior to the over-the-load straps.
- X Tie-down straps consist of two over-the-load straps, which are used for loads intended for domestic shipments (except glued loads). The straps will be positioned over the load and under the deck boards inside the outboard pallet stringers in the 40-inch direction.
- X Tie-down straps, secondary. The secondary tie-down straps are also over-the-load straps. The two straps are used for domestic shipments (except for glued loads and gas cylinders). The straps will be positioned over the load and under the pallet deck boards in the 48-inch direction, through the strapping slots in the stringers.
- X Horizontal straps, when required, will be secured girthwise around a layer of items or a framed load. In certain instances, the horizontal strap will be secured around an unframed, but battened, capped, or collared load. Also, the horizontal strap will be used to provide supplementary bonding to wooden collars or to the double tray cap. When used on a load having over-the-load straps, the horizontal strap must be applied and secured before such other straps are applied.
- X Any over-the-load strap, either tie-down or load, which is not a primary or secondary strap, is identified as an auxiliary strap.



LOAD TYPE XIII
(DOUBLE TRAY CAP APPLIES TO MULTIPLE COURSES ONLY)
SMPT 3188

Figure 4-21. Load Type XIII.

Storage Aids

Storage aids must always be used when bonding alone is insufficient. They are constructed of paper, canvas, fiberboard, wood or steel, and may be in the form of caps, collars, battens, and frames.

- X The caps and the items covered must be centered on the pallet to achieve an equal degree of margin or overhand on the pallet and to provide squared loads.
- X The fiberboard cap will be used on nonframed loads containing lightweight rectangular stable units. The plain (nonpartitioned) wood cap must be used, when required, on nonframed loads containing heavy rectangular items or on nonframed loads requiring caps.
- X The double tray cap will be used between layers in multiple layer nonframed loads containing stable units. This cap will be used only in loads which are capped over and under with plain caps.
- X The special tray cap is recommended in loads (usually two layer loads) containing filled 5-gallon paint-type pails. One cap is used over the top load and one over the lower layer of the load. A cap will not be required over the bottom of the load when the special tray cap is used.
- X The purpose of the wood collar is to secure the upper portion of loads of cylinders of compressed gases or loads of similar items. It provides a guard to protect the caps or tops of such units and to provide a substantial base for superimposed loads. Also, the loads should be secured with horizontally strapped wooden battens at the lower portion and with over-the-load straps. The collar must be made to fit each specific type of load snugly over the top; to enclose snugly the caps or valves of the cylinder and extend slightly above the tops of the caps or valves on the cylinders; and to rest on the outside perimeter of the units. The collar is partitioned at strategic places to enclose intermediate rows of cylinders and must be fitted exactly.

Wood battens will be used in conjunction with horizontal strapping to secure the lower portion of loads of cylinders of compressed gases (or loads of similar units), loads of bags which cannot be glued, or loads of rectangular metal units in multiple layers. Also, loads of cylinders of gas should be secured with a wooden collar over the top of load and with over-the-load straps. Battens are secured flatwise against the four sides of the load or on top of certain loads with horizontal or over-the-load straps, which are secured with doubly crimped seals and strapped. The battens are leveled on one side at each end and must be cut to exact size.

Frames may consist of a wood framework which may be sheathed or open. Frames should be constructed of the lightest weight material that will support three or more superimposed loads. Crosspieces and sheathing, added for additional strength or containment of small items, should be kept to a minimum.

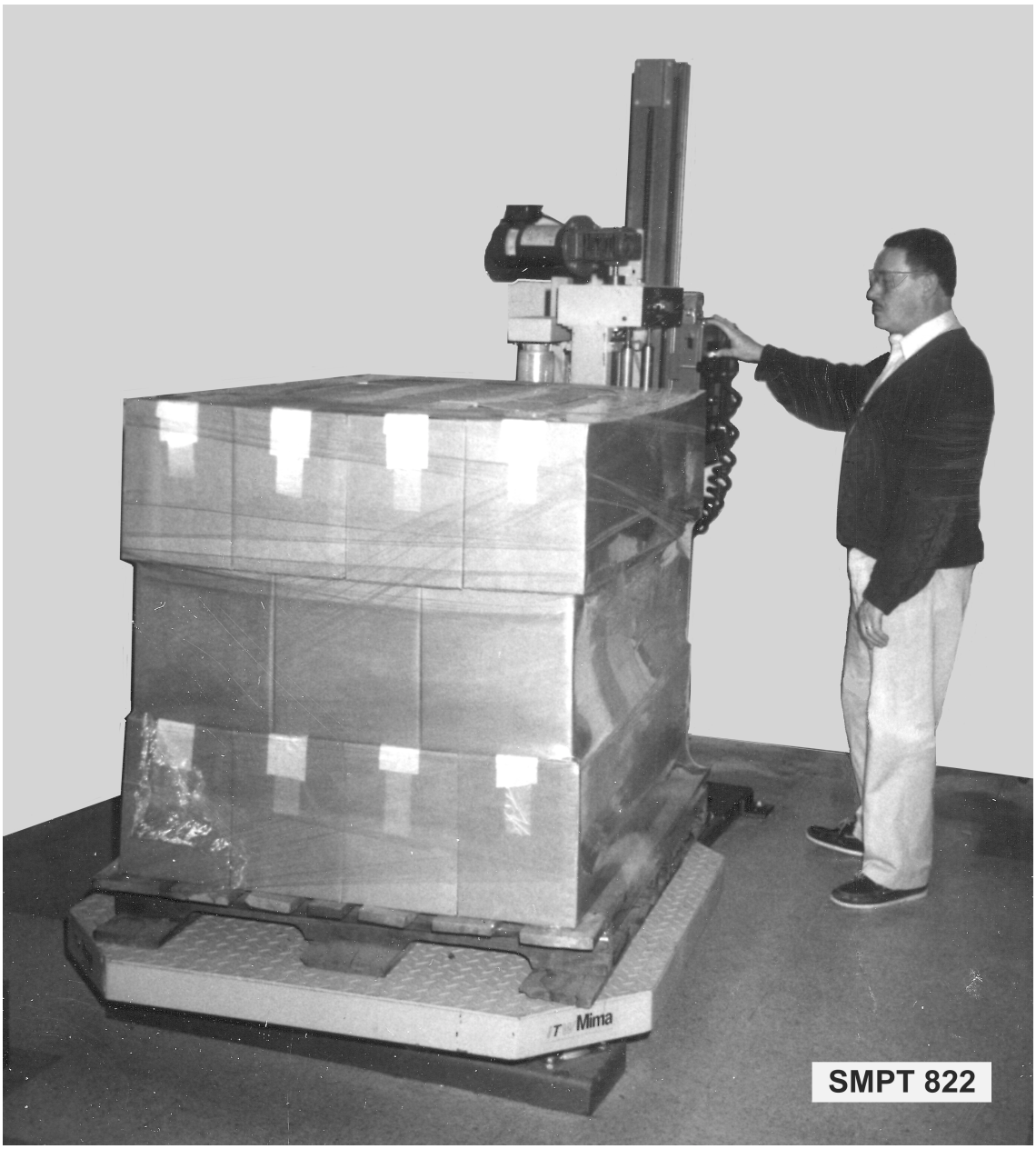


Figure 4-22. Examples of stretch wrap palletizing.

Stretch wrap can be used as a means of bonding palletized loads for many commodities. The film is wrapped around the load in multiple layers from the top of the bottom deckboard to not less than two inches above the height of the load. The required thickness of the wrap is determined by the kind of film being used and the weight of the load. Additional strength can be provided by placing a sheet of weather-resistant fiberboard on top of the load prior to stretch wrapping.

Air Force 463-L Pallets

The Air Force uses a series of aluminum pallets in the 463-L air cargo materials handling system. See figure 4-23. The pallets are used with the 25,000- and 40,000-pound aircraft cargo loaders and palletized cargo trailers.

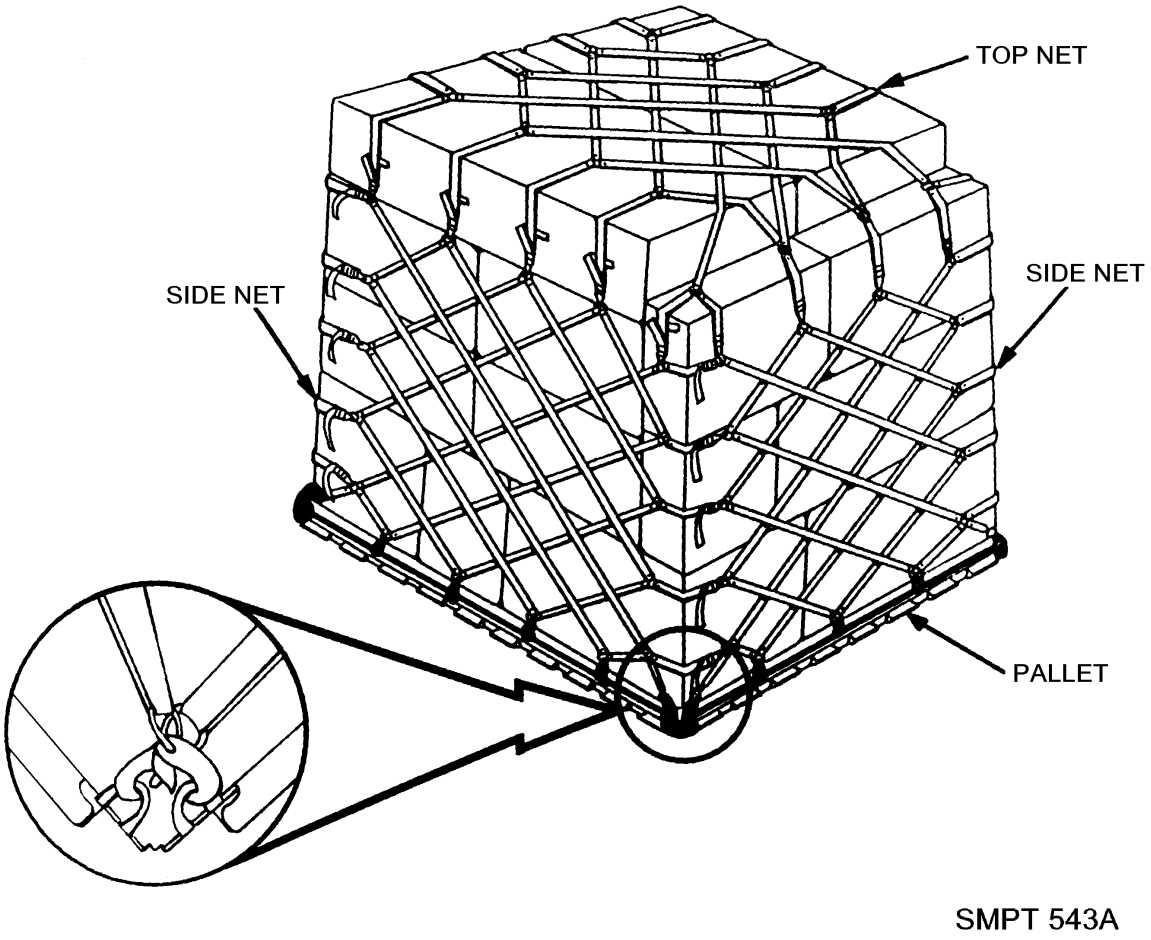


Figure 4-23. 463-L pallet.

Consolidation Boxes (MIL-B-43666)

A major advance on the road to more efficient unitization has been the development of a family of "sized" consolidation containers. There are 22 different sizes of containers in three basic types which are designed to make maximum use of shipping space in MILVAN and SEAVAN containers. The containers are also adapted to independent shipments.

Wood Cleated Boxes

Consolidation boxes can be wood cleated plywood boxes with block-type or notched runner skid bases depending upon their style. Wirebound plywood boxes with block-type or notched runner skid base depending upon their style. Fiberboard boxes are furnished with pallet base unless otherwise specified.

Sizes and Weight Limitations

Twenty-two sizes of boxes are available with weight limits ranging from 1,000 to 2,600 pounds.

Types of Loads

These boxes may carry Type 1, 2, or 3 loads.

Intended Uses

These boxes are designed to improve packing and unitizing of overseas shipments; compensate for shortage of terminal handling facilities, equipment, and personnel; protect against material pilferage, physical loss, and damage in transit; compensate for lack of covered storage and other severe environmental factors; and consolidate shipments of like and unlike stock numbered commodities.

MILVAN

The MILVAN, as shown in figure 4-24, is a military demountable cargo container that has been developed by the Army for containerized shipments. It is an important and widely used method of shipping unitized loads in vans worldwide.

The MILVAN is 20 feet long, 8 feet wide, and 8 feet high and is similar to commercial container vans. One or two vans can be coupled to a semi-trailer for towing. The vans are capable of being stacked six high.

As the case with commercial vans, the MILVAN is intermodal, that is, the van may be changed from one mode of transportation to another without its contents having to be unloaded or reloaded.

The MILVAN (ISO) is intended for transporting high density military cargo, when security and pilferage are of paramount consideration.

Construction features of the van include the following:

- X It is equipped with corner fittings for lifting and coupling.
- X The interior of the van is lined with plywood, which may be easily replaced if damage occurs during loading or unloading.
- X The van may be fabricated of steel, aluminum, plywood, or plastic or a combination of these materials.
- X It is sufficiently wide to allow forklift trucks to enter the van, and it has double doors at the rear.

The tare weight of the van is 4,400 pounds. Gross weight rating for each 20 foot container is 44,800 pounds, and the gross weight when two vans are coupled together is 33,600 for each container. Shipping cubic space is 1,053 cubic feet.

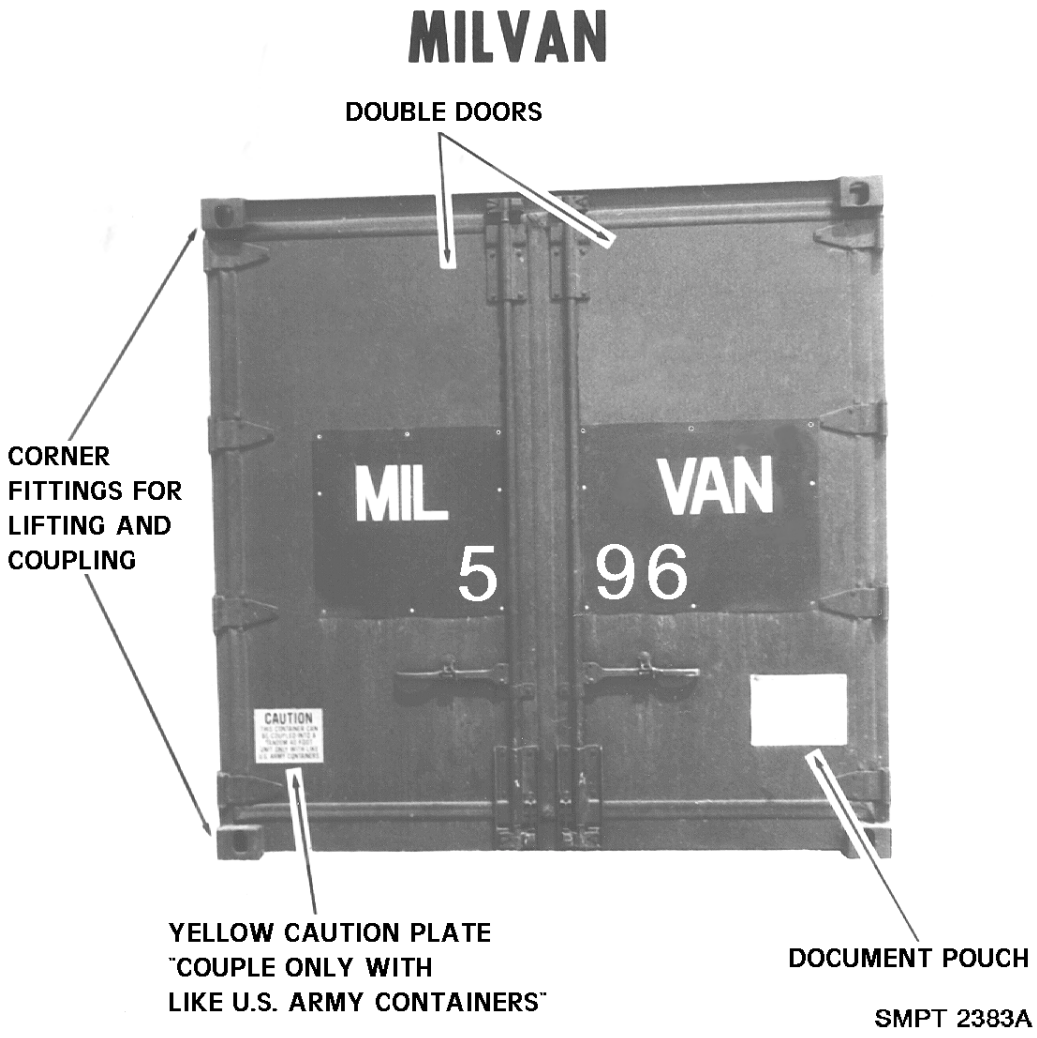


Figure 4-24. Rearview of MILVAN.

SEAVAN

The SEAVAN is a large demountable and intermodal container and is in wide service to many foreign ports. These vans are available in many lengths ranging from 20 to 40 feet. Generally, they are standardized to 8-foot widths and 8-foot heights. These vans are fabricated of different materials including steel, aluminum, wood, fiberglass, and combinations of these materials. The vans are compatible for movement by motor, rail car, and can be stored, for shipment, on specially containerized ships. SEAVANS can be loaded at the source in the United States and be delivered to the user in Europe in a little over one week. Modern materials handling equipment and large cranes at dock sites are used in the movement of SEAVANS as shown in figure 4-25.

Containerization as a method of unitization

A variety of containers from small consolidation containers to large demountable vans is contributing effectively to the unitization movement in the world-wide distribution of supplies.



Figure 4-25. Container ship.

Checkup

X What is a unitized load?
X What is containerization?
X What are key advantages of cargo unitization loads?
X When two MILVANS are transported together, what is the permissible gross weight for each van?
X How many pallet patterns are cited in MIL-HDBK-774?

CARGO UNITIZATION PRACTICAL EXERCISE

Objective

As a result of this practice, the student will be able to palletize unit loads and pack consolidation containers.

General Instructions

This exercise will be conducted in the classroom.

It will take approximately one class period.

A critique will be held at the end of the exercise.

Conduct of Exercise

Situation

As a packer, you are required to consolidate, unitize, and containerize loads for shipment. You are required to determine and apply the correct loading and packing procedures and the application of special cap trays, blocking and bracing, and strapping so that the loads will be properly prepared for shipment.

Requirement

Answer the following questions.

- X What is cargo unitization?
- X Name three ways of unitization.
- X What is a base on which items are consolidated for shipment called?
- X What is the size of a standard pallet?
- X What two methods are used to hold items on a pallet?
- X You are going to ship a load of items packed in boxes 19 x 8-1/2 x 2 inches, each weighing 40 lbs.
  - B What pallet pattern would you use?
  - B What are the length and width limitations for the pallet load if it is going into storage?
  - B What is the overall height limit if it is to be shipped in a MILVAN?
  - B If the pallet is 6" high how many boxes can be loaded on each pallet if it is being loaded in a MILVAN?
- X In addition to the pallet pattern what other information can you obtain by reading MIL-HDBK-774?
- X In which direction do the secondary straps run?
- X What is the most weight you can put in a MIL-B-43666 consolidation box?
- X What name is given to a cargo container, which, after it is packed, can be carried by any mode of transportation without repacking?
- X What is the military intermodal container called?
- X What is the maximum gross weight of a single MILVAN?
- X If two MILVANS are coupled together, what would be their maximum gross weight?
- X What is the size of a single MILVAN?
- X What is the height of a standard pallet load?
- X What is the maximum weight that can be shipped on a single pallet?
- X What items may be palletized using load classification type XIII?
- X What is the purpose of a wooden collar?
- X What are the primary advantages of cargo unitization?
- X What are the advantages of shrink film palletization over conventional unitization?

Critique

Instructor will ask the students to answer each questions orally.

Care of Area, Training Aids & Equipment

Not applicable.

MARKING AND LABELING

MARKING REQUIREMENTS

Purpose

Marking is the application of numbers, letters, labels, tags, symbols, or colors to provide identification and expedite handling during shipment and storage.

No matter how well an item is made or packed, it has no value if it cannot be identified at its destination.

General Marking Requirements

All shipments should be marked and labeled in a manner suitable for the mode of shipment to be used.

Unauthorized markings on shipping containers should be obliterated (blanked out, covered with paint, stencil ink, etc.).

Each palletized unit and unpacked unit should bear the address of the intended receiving activity.

Labels should be used in preference to tags, except when it is impracticable to apply a label.

MIL-STD-129, MIL-HDBK-129, and MILSTAMP provide the requirements for the uniform marking of military supplies and equipment for shipment and storage.

Markings, Marking Materials and Methods

Marking Materials

Marking materials used shall be those materials specified in MIL-STD-129 or alternate choices approved by the cognizant activity. Contractors may obtain the DOD-unique labels discussed herein from commercial sources after obtaining samples from either the procuring activity or the local Defense Contract Management Command (DCMC) office.

Waterproofing Materials Used as Protective Coatings

Waterproofing materials such as spar varnish, acrylic coating compound, sealing compound, label adhesive, polyurethane coatings, and pressure-sensitive tape, that does not restrict or preclude legibility or readability of the package markings, shall be used as protective coatings on container markings.

Stencil-Marking Material

Any opaque, nonfading, fast drying, weather resistant stencil ink, lacquer, paint, or enamel shall be used for stencil marking. When applied directly to the item, removable paint that is used for marking unboxed/uncrated equipment, conforming to MIL-P-52905, shall be used. A MIL-C-46168 or MIL-C-53039 coating shall be applied when stenciling containers that have had a top coat of chemical agent resistant coating (CARC) applied to them.

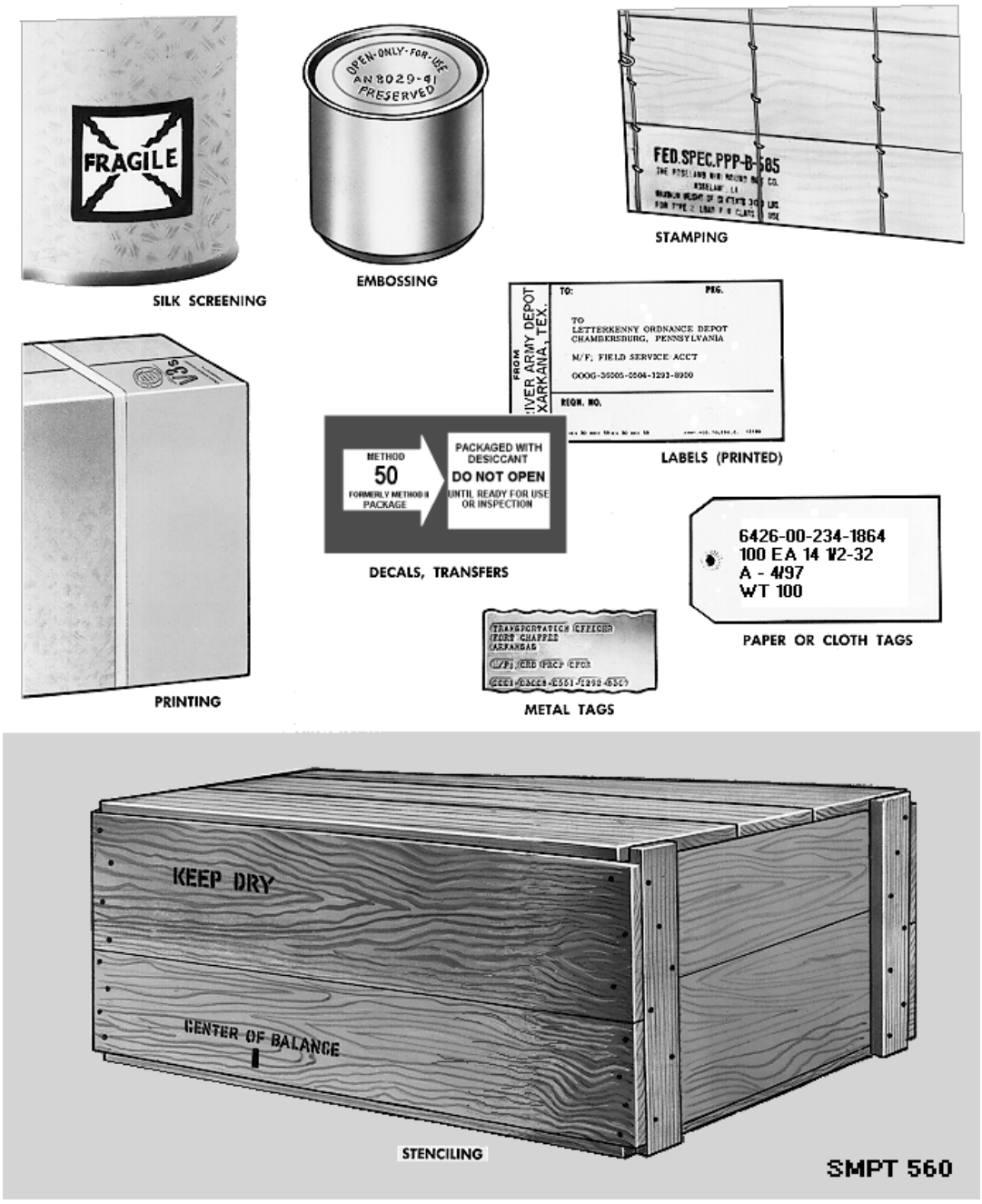


Figure 4-26. Methods of marking.

Obliterating lacquer, enamel, or paint (See figure 4-27.)

Any quick-drying, opaque lacquer, ink, enamel, or paint that approximates the color of the container shall be used for the obliteration of markings. When obliterating CARC painted markings on metal reusable container, paint conforming to MIL-C-46168 or MIL-C-53039, paint chip color Green-383 or Tan-686 of FED-STD-595, shall be used. Green shall be used on green or green camouflage, and tan shall be used on tan or desert sand camouflage colored containers.

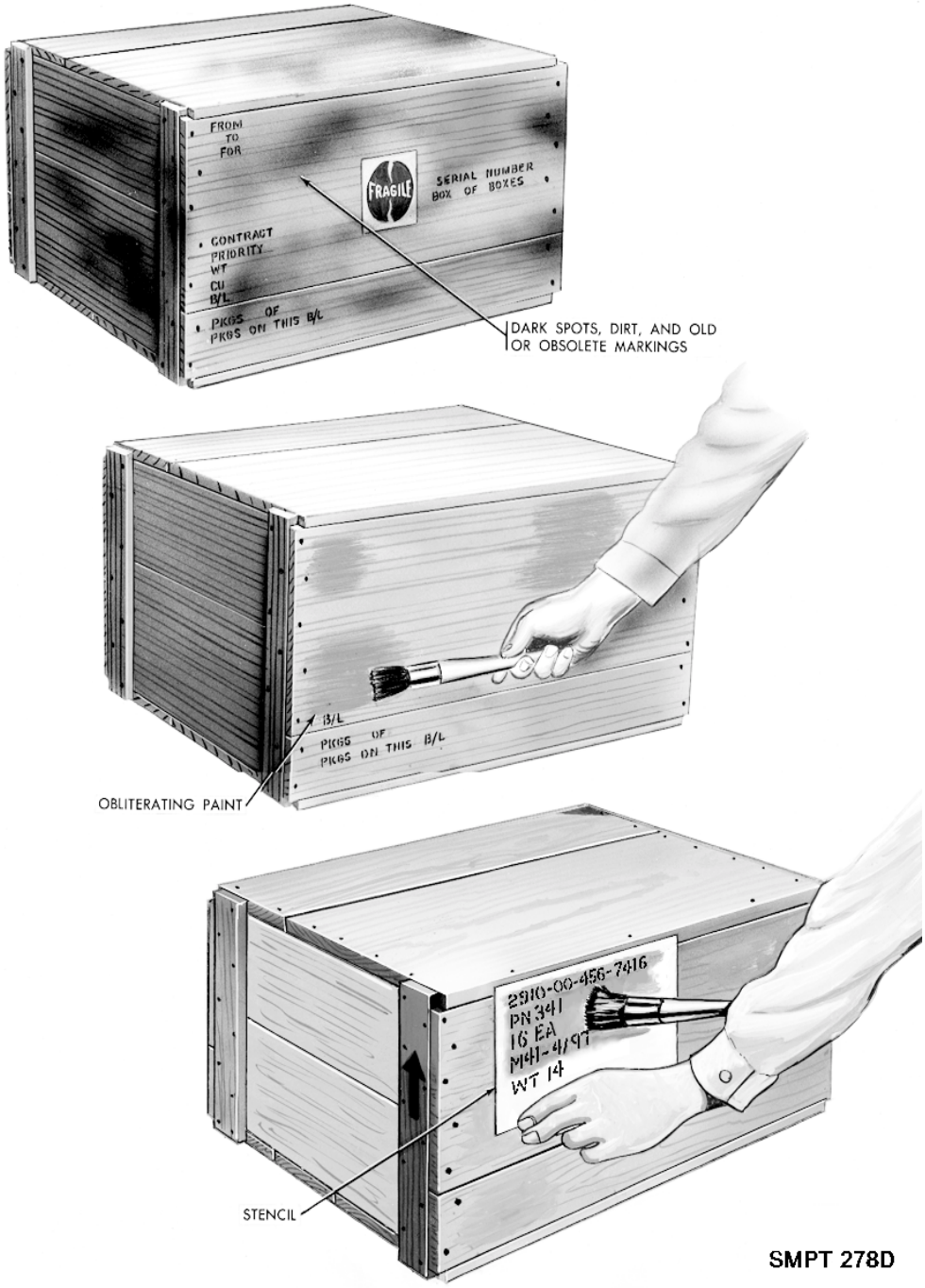


Figure 4-27. Use of obliterating material.

Lithographing, Embossing, Roller Coating, Or Stamping

When lithographing, embossing, or roller coating of markings is authorized, commercial enamels, lacquers, or inks in the color specified shall be used. When stamping is specified, commercial waterproof and petroleum-resistant inks, in the color specified, must offer sufficient durability on exposure to field service.

Labels, Paper, Pressure-Sensitive, Water-Resistant

Labels should be made of a water-resistant grade of paper, film, fabric, or plastic, coated on one side with water-insoluble, permanent type adhesive. The adhesive shall adhere to metal plastic, or fiberboard surfaces under high and low temperatures. Labels shall have a finish suitable for printing and writing on with ink without feathering or spreading, shall be capable of withstanding normal handling and storage conditions, and shall remain securely in position. If labels for exterior containers, except vehicles and related items, are not inherently waterproof, they shall be waterproofed by coating the entire outer surface of the label with a transparent, waterproofing material.

Tags

A metal, cloth, plastic, paper, or other suitable durable material shipping tag, bearing the required markings, shall be used when specified herein or when it is impractical to stencil mark or apply a label on the container or unpacked item. Tags conforming to A-A-900 or UU-T-81 are recommended.

Water-Resistant Envelopes

Water-resistant envelopes shall be used for packing lists and materiel release/receipt documents. Securely affix or fasten the envelope to the package or container. Water-resistant envelopes such as those conforming to A-A-1658, A-A-1659, or A-A-1660 are recommended for containing packing lists and other documents.

General

Marking of unit packs, unpacked items, and exterior packs may be accomplished by the use of labels, stamping, stenciling, printing or tagging. Other processes such as lithographing, stamping, embossing, roller coating, bar coding laser marking, and applying decals may be used, when specified, or upon approval by the cognizant activity.

Condition of Surfaces to be Marked

Surfaces to be marked must be dry and free of oil and grease and shall be in a condition so that markings remain permanent, legible, and nonfading.

All markings not applicable to the shipment shall be obliterated. When shipping containers are consolidated into container vans for shipment to an ultimate consignee, obliteration of current address markings is not required. When original unopened packs are readdressed for shipment by a DOD shipping element, contract data markings shall not be obliterated unless they interfere with other required markings.

X Legibility, color and durability of markings. Markings shall be applied by any means that provides clear, legible, durable, and nonfading markings sufficient to withstand normal exposure to environments and handling to which the package/container might be subjected. The size of the lettering shall be proportional to the size of the container.

X Use of labels.

B Labels are permitted for markings on shipping containers when the type or size of shipping container does not permit stenciling.
B When labels are used, the required markings must be printed, typed, and reproduced.

B Pressure-sensitive labels may be used on containers other than wood.
B When it is impractical to use a label, markings may be shown on tags.

X Use of tags.

B A metal, cloth, plastic, or paper shipping tag bearing the required markings may be used when specified or whenever the container or unpacked item is such that it is impracticable to stencil marking thereon or impractical to use a label. Tags may be attached with wire or twine. Wires should not be smaller than 23 gage tag wire or other suitable corrosion resistant metal fastener. When rusting of tag wire will affect or damage the item to which the tag is attached, then twine must be used for attaching tags. Markings on cloth or paper tags shall be printed with waterproof ink or typed. Markings on metal tags shall be accomplished with dies or punches. Markings on plastic tags shall be accomplished by use of stamping, stenciling, printing, perforating, embossing, or, when specified, by other processes such as lithographing, screening, photo marking, and applying decals or transfers.
B The methods of securing plastic tags may be accomplished by adhesion, cementing, sewing, clipping, stapling, tacking, or nailing.

X Securing and protecting labels.

B Labels will be securely affixed in place with water-resistant adhesives placed on complete underside of label, except when pressure-sensitive labels are used.
B Labels shall be waterproofed by coating the entire outer surface of the label with waterproof lacquer, varnish, clear acrylic coating compound, label adhesive or transparent tape. The label adhesive shall not smear or blur the markings.
B When vinyl or plastic coated pressure-sensitive labels are authorized for use, no further protective coating is required as long as all of the marking is an integral part of the label and not added after the original printing.
B An alternate method of affixing and protecting labels on fiberboard containers, metal containers, polyethylene, rubber products, and vehicles is through use of ASTM D 5486 transparent pressure-sensitive tape over the entire surface of the label.

X Labels for unit packs.

B The required markings on labels on unit packs shall be printed, typed, or reproduced.
B Pressure-sensitive labels may be used in lieu of paper labels.
B When clear (untinted) plastic containers are used for unit protection, the labels may be inserted or affixed inside the container if the label will not affect or be affected by the method of preservation and will not obscure more than 50 percent of one surface of the container.

Size of Markings

Lettering for all markings shall be capital letters of equal height and proportionate to the available space of the container.

Interior Containers and Unpacked Items

Marking on interior containers and unpacked items should be located to allow the markings to be easily read when stored on shelves or stacked, and to insure that the marking will not be destroyed when the pack is opened for inspection or until contents have been used. The marking surface of a unit pack shall be the outermost wrap, bag, or container of the unit pack. When a barrier bag is used within another unit container, both the bag and the outermost container must be marked.

The following minimum identification markings shall appear on unit and intermediate packs and unpacked items in the order listed. This requirement applies to all unit packs and intermediate containers repacked for shipment by military installations. Any additional identification markings required by the contract shall be placed either below these markings or in a conspicuous location on the identification-marked side of the container. Unit packs used as exterior containers at the time of packaging shall be marked in accordance with exterior markings. Hazardous items shall be marked with identification markings as specified herein and in 5.4 of MIL-STD-129.

- X NSN/NATO stock number (to include spaces or dashes and any prefix or suffix shown in the contract or requisition), in-the-clear and bar coded. If no NSN is assigned, then this line may be omitted. For ammunition, when a DOD Identification Code (DODIC) is specified, it shall be paced on the same line as the NSN/NATO stock number.
- X Part number (PN). The part number cited in the contract shall be shown (except for ammunition items with NSN/DODIC designations). If the item has no PN assigned to it or if no PN is required, then nothing is shown.
- X Quantity and UI. A nondefinitive UI shall be accompanied by a quantitive expression such as “1/RO (100 FT).”
- X Contract number or purchase order number including four-digit delivery order or call number.
- X Military method and date of unit preservation (e.g., “M41-4/97" - Method 41, from MIL-STD-2073-1C, was provided in April 1997). Use of the letter M in the first position indicates that the pack is a military preservation method; “41" is the method number; “4/97" indicates the date of preservation.
- X Serial number, when required. See figure 4-28.

Special Markings

Hazardous materials and supply type labels shall be applied as required.

Shelf-life markings. There are two types of shelf-life markings:

- X Type I. An item of supply having a definite (nonextendable) storage time period terminated by an expiration date which was established by empirical and technical test data.
- X Type II. An item of supply with an assigned storage time period which may be extended after the completion of prescribed inspection and/or restorative action.
- X Placement of markings. When shelf-life markings are required, they

shall be shown below the item identification data on unit packs, intermediate containers, exterior containers, and unpacked items. Shelf-life markings shall include the manufactured, cured, assembled or packed date (apply on date), and the expiration or inspect/test date, as appropriate. Guidance on shelf-life markings can be found in MIL-HDBK-129.

All method 50 unit and intermediate packs must bear a precautionary label or stamp.

All unit and intermediate packs of hazardous chemicals and materials must have the applicable warning label attached to the packs.

All unit and intermediate packs containing flammable (flashpoint not more than 141EF) liquids must be marked with the flashpoint of the material. The marking must be expressed in degrees Celsius and degrees Fahrenheit, in parenthesis, such as "FLASHPOINT 30EC (86EF)", and must be applied on the identification marked side by means of labeling, printing, stamping, or stenciling.

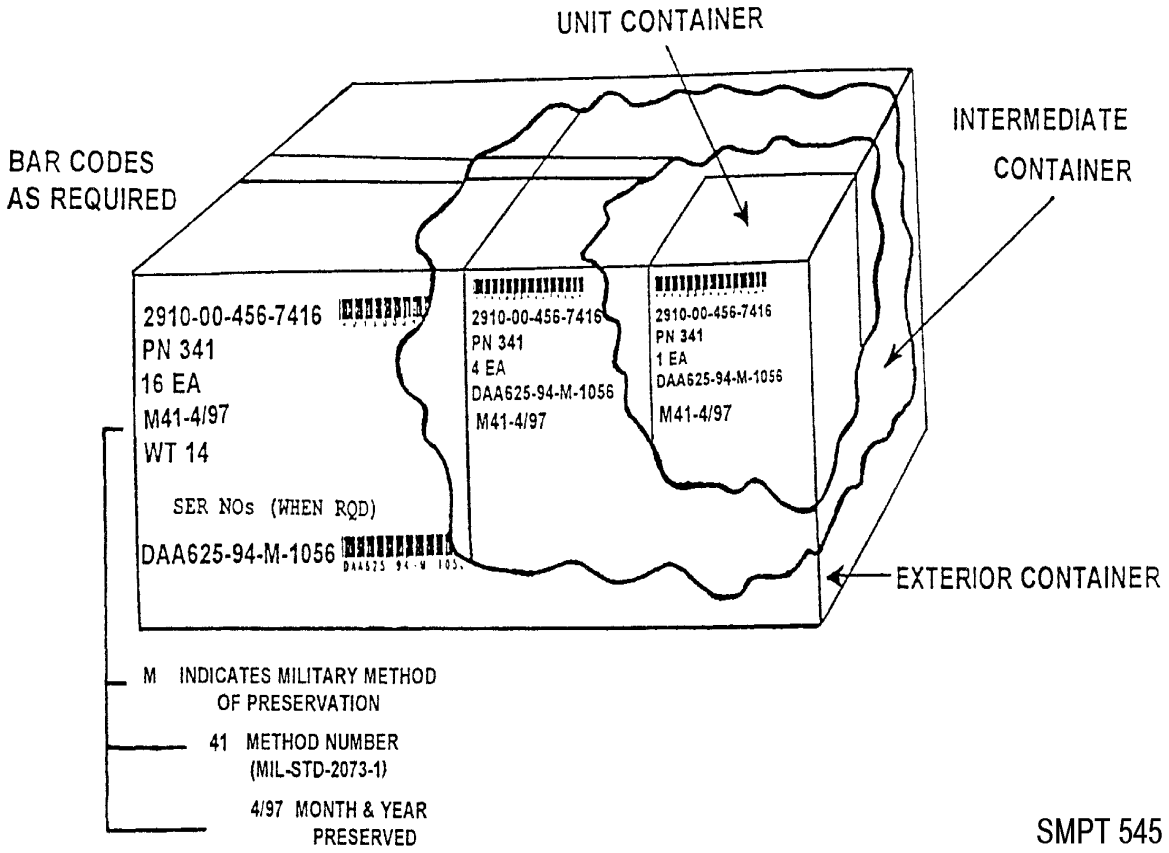


Figure 4-28. Unit, intermediate, and exterior IDENT and contractor markings.

Exterior Container Identification and Contract Data Markings

Required markings. The required markings shall be placed so as not to be obscured by cleats or strapping. Unless otherwise specified, one end and the top and bottom of containers shall always be free of any markings.

Exterior identification markings. Exterior identification markings shall be composed of the following information in the order listed. The words "national stock number," "part number," "quantity," "unit of issue," "method of pack," and "date" shall not be made a part of the marking.

- X NSN/NATO stock number (See unit markings).
- X Part number, (See unit markings).
- X Quantity and unit of issue.
- X Military method and date of unit preservation (e.g., “M41-4/97" - Method 41, from MIL-STD-2073-1C, was provided in April 1997). Use of the letter M in the first position indicates that the pack is a military preservation method; “41" is the method number; “4/97" indicates the date of preservation.
- X Serial number(s), when required.
- X Gross weight.
- X Proper shipping names and identification number (United Nations) for hazardous items only. The proper shipping name shall be placed below the gross weight.

NOTES: 1. The inspect/test date and other shelf-life markings, when required, shall be applied below the identification markings.

2. Boxes and crates 10 cubic feet and over shall have identification markings placed on the end of the container to the left of the identification-marked side, in addition to the identification side (figure 4-29).

Exterior Container Contract Data Markings (See Figure 4-28).

Contract data markings shall include the contract or purchase order number and delivery order or call number, and the modification for change order number (when used). Additional information may be required by the procurement contract or order. When more than one contract is applicable to a multipack, contract data markings are not required on the exterior container but shall be applied to each container in the multipack. Contract data markings shall be placed below the identification markings on the various exterior containers and unpacked items.

Unless specifically required by a military service or defense agency directive, contract data markings are not required on exterior containers when items are repacked for shipment by military installations.

For Defense Supply Center, Philadelphia (DPSC) Clothing and textile (C&T) items only, the use of labels is prohibited. The following additional markings are required: shipment number, lot number, and container number. The container number shall be consecutively numbered from each shipping point for the duration of the contract. For multiple container shipments of C&T items, the packing list shall be placed inside the last container to be loaded for each shipment. The words “PACKING LIST HERE” shall be stenciled on the container.

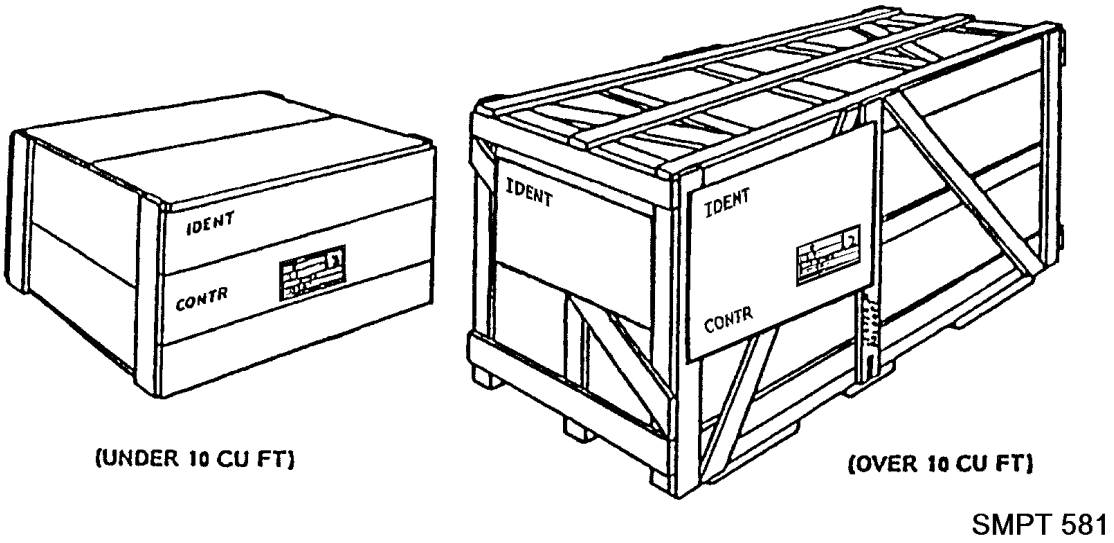


Figure 4-29. Box 10 IDENT over or under 10 cubic feet.

Marking For Assorted Items

Related items. When an assortment of related items which cannot be identified under one stock number, but support a specific weapon system or end item, is packed in a shipping container, the level of protection afforded the pack, the date of pack, the gross weight, cube, and special markings shall be applied, plus a brief description of the contents in lieu of the identification data; e.g., spare parts for NSN XXX, Packing List enclosed. Kit or set components shall be suitably segregated and identified within the unit pack by part number or NSN.

Unrelated items. When containers of unrelated items comprised of mixed NSNs which do not support a specific weapon system or end item are consolidated into a shipping container. The word "MULTIPACK" shall be applied to the shipping container and the gross weight in lieu of the identification markings. Examples of marking are as follows:

MULTIPACK

WT 100

- X When a multipack shipment contains shelf-life material, the following statement will appear immediately below the identification markings: "CONTAINS SHELF-LIFE ITEMS." This is in addition to any shelf-life marking/data which may be placed on the multipack.
- X When a multipack shipment contains items that are covered by a warranty agreement, the following statement shall appear immediately below the identification markings: "WARRANTED ITEMS INSIDE."
- X When a multipack contains HAZMAT, PSNs with applicable ID numbers, and NA or UN identification numbers shall be marked on each applicable container in the multipack. They shall also be listed on the identification-marked side of the multipack.
- X Caution markings will be applied as required (e.g., Fragile, DOT Hazardous Labels, etc.).

Marking of Gross Weight

The capital letters "WT" shall precede gross weight numerals. All weights shall be numerically indicated and shall be expressed in pounds to the nearest pound.

When more than one contract is applicable to a multipack container, contract date is not required on the exterior container but shall be applied to each individual container within the multipack. Contract data is not required when items are repacked for shipment by military installations.

Packing list and DOD Single Line Item Release/Receipt Document, DD Form 1348-1A

Packing list

Sets, kits, or assemblies composed of unlike items but identified by a single stock number or part number, shall have a packing list identifying each item securely attached to the end or side of the container. Sets with two or more exterior shipping containers of different stock numbered or part-numbered items require a master packing list. One copy shall be attached to container No. 1 and one copy placed inside container No. 1. The contents of packages containing installation or assembly hardware such as brackets, connectors, nuts, bolts, and washers shall be listed in detail on the packing list. “Kit contents lists” shall be placed inside the “kit container” and shall not be included with the packing list on the outside of the exterior container. An additional packing list placed inside each container is recommended. For information on exceptions to the use of exterior container documentation, see below. Automated packing lists (APL) shall contain the minimum data listed in DOD 4000.25-1-M.

Exceptions to the use of Exterior Container Documentation, Such as Packing Lists, DD Forms 250, DD Forms 1155, and DD Form 1348-1A.

With the following exceptions, exterior container documentation is required on all contractor and DOD shipments. No exterior documentation is required for containers of like items or single-item packs when the contents are listed on a label attached to the boxes, lithographed or printed on the boxes, or when a manufacturer's part list is provided. For Foreign Military Sales (FMS) shipments, exterior container documentation is always required.

For controlled, sensitive, classified, and pilferable items (except for FMS shipments), the shipping documentation shall be placed inside all containers rather than on the outside. For classified shipments, markings, which indicate the classified nature of the materiel and its security classification, shall not appear on the exterior of each container. If a pilferable shipment is also an FMS shipment, the exception does not apply.

Single Stock Numbered Assembled Sets

Sets consisting of two or more exterior shipping containers consisting of unlike stock numbered items, packed in more than one shipping container, require a packing list for each container. The packing list shall be attached to the exterior of each container. A master packing list shall be prepared for the set and a copy attached to container No. 1.

DD Form 250 (Materiel Inspection and Receiving Report)

The DD Form 250 should be used as a packing list for contractor shipments and shall be applied to exterior containers, as applicable. Packing list copies shall be in addition to the copies required for standard distribution in the DFAR Supplement to the Federal Acquisition Regulation (DFAR Supplement) and shall be marked "Packing List." On multiple container shipments, contractors

shall, when either specified in the contract or requested by the procuring activity/installation, place a packing list inside each container in addition to attaching a packing list to the outside of each container.

DD Form 1155 (Order for Supplies or Services/ Request for Quotation)

DD Form 1155 shall be attached to the commercial packing list used by vendors and shall be applied to exterior containers, as applicable. When specified, the case number and the requisition number shall be included.

Application of Packing Lists

Exterior packing lists shall be sealed in water-resistant envelopes and secured to the exterior of the palletized load or container in the most protected location. An illustration on placement of a packing list is in figure 4-30.

Shipment Units Of Single-Line Items

For single-line item shipments, one legible copy of the DD Form 1348-1A shall be attached to the materiel in shipping container No. 1. In addition, at least one legible copy of the applicable form shall be enclosed in a water-resistant envelope attached to the outside of the shipping container. When the storage container is used as the shipping container, the copy normally placed inside the container shall be enclosed with the copy attached to container No.1

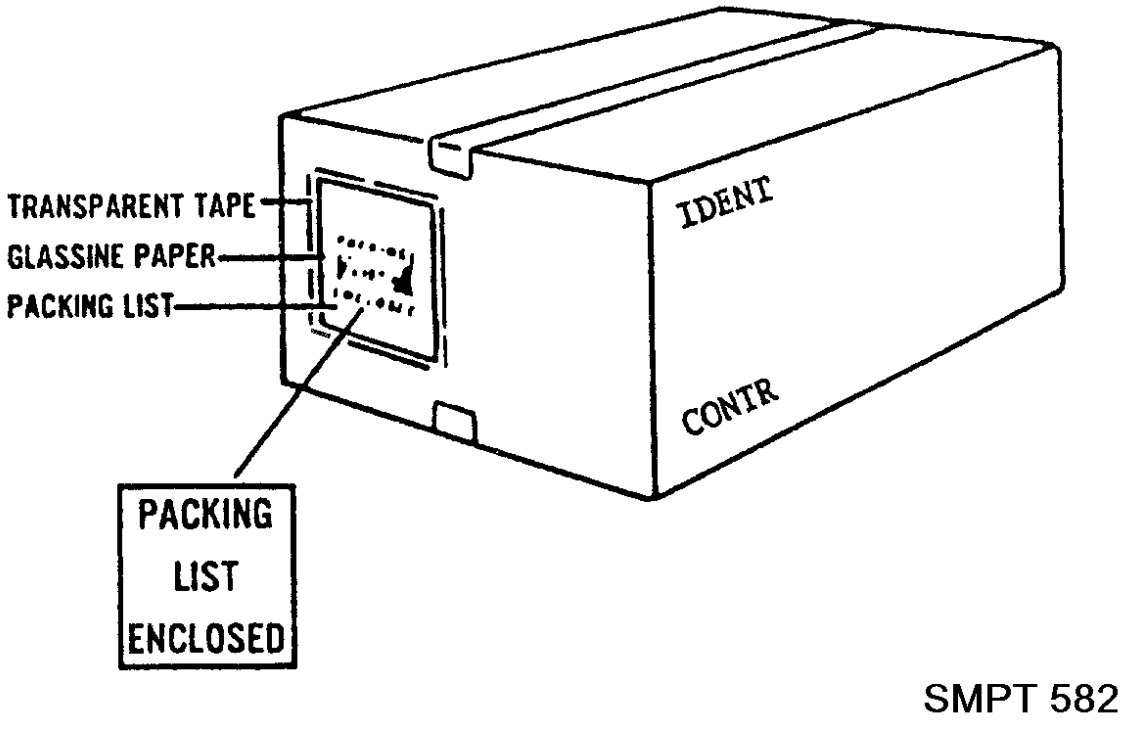


Figure 4-30. Recommended packing list application per MIL-HDBK-129.

Shipment Units of Multiple-Line Items

For multiple-line item shipments, one copy of the DD Form 1348-1A shall be placed in a water-resistant envelope so that the NSN is visible. The envelope shall be attached to the package applicable to each requisition. When a polyethylene bag is used to group single items for packing, the same bag shall contain a DD Form 1348-1A folded so that the identification and requisition information are visible. At least one copy of the form, applicable to each requisition, shall also be placed in a water-resistant envelope attached to the exterior of each multipack container.

Methods of attaching documentation to fiberboard boxes

DD Forms 1348-1A and APLs shall be attached to fiberboard boxes in the following manner. Prior to sealing the fiberboard box, place the appropriate papers in a water-resistant envelope. Then place the envelope under the flaps of the box so that the open end/flap of the envelope extends down the end of the box under the closure tape. Place the words "PAPERS HERE" on the tape in letters at least half an inch high directly over the envelope containing the papers. This is not authorized for FMS shipments, except for those sent by registered mail. When shrink or stretch film is used to consolidate multiple items, one copy of the DD Form 1348-1A shall be attached to the materiel. For single items, two copies of the applicable form shall be placed under the shrink film in such a manner as to be read. This method is not authorized for FMS shipments.

Method of Attaching Accompanying Documentation for Shipments of Vehicles

A minimum of two copies of the DD Form 1348-1A or DD Form 250 shall be provided and shall be securely attached in or on the vehicle as follows:

X Interior. Place one copy of the shipping document and one copy of the preservation/depreservation guide within a sealed bag conforming to Type I, Class B, Style 2 or 3 of MIL-B-117 or within a water-resistant envelope. Attach the bag or envelope to a conspicuous location inside the vehicle.

X Exterior. Place the one remaining copy of the shipping document and the preservation/depreservation guide, unit packed as specified above, on the vehicle adjacent to the shipping address and securely attach the bag to the envelope.

Exceptions to the use of Exterior Container Documentation, Such as Packing Lists, DD Forms 250, DD Forms 1155, and DD Form 1348-1A

With the following exceptions, exterior container documentation is required on all contractor and DOD shipments:

No exterior documentation is required for containers of like items or single-item packs when the contents are listed on a label attached to the boxes, lithographed or printed on the boxes, or when a manufacturer's part list is provided. For FMS shipments, exterior container documentation is always required.

For controlled, sensitive, classified, and pilferable items (except for FMS shipments), the shipping documentation shall be placed inside all containers rather than on the outside. For classified shipment, markings, which indicate the classified nature of the materiel and its security classification, if it will identify the classified nature of the shipment, shall not appear on the exterior of each container. If a pilferable shipment is also an FMS shipment, the exception does not apply.

Address Markings

Application of Address Marking

The domestic and overseas shipment address markings shall be applied by means of stencils, labels, or tags. When the use of labels will interfere with or obscure other required markings on shipping containers, tags shall be used. Separate tags shall be used for identification markings and address markings. Contractors have the option of applying the address markings by means of stenciling or screening provided procurement costs are not increased.

Military Shipment Address Label as Shown in Figure 4-31 (Except Parcel Post)

Transportation Priorities (TPs) 1, 2, and 3 shall be identified by a TP machine printed numeral stenciled stamped, hand lettered or affixed with a stick-on numeral in the TP block of the address Label (DD Form 1387). Minimum height of the TP numeral shall be 3/4 inch. When an automatic (preprinted) marking system is used, TPs 1, 2, and 3 shall be identified by the TP numerals preprinted (printed with the same color ink as other data on the label) in the TP block of the DD Form 1387.

For shipments other than mail, the address label shall be completed as follows:

X TCN: Enter the 17-character (alphanumeric) TCN in both forms (bar coded and in-the-clear).
X Postage data: Leave blank.
X From: Enter DOD activity address code (DODAAC) and in-the-clear address of the shipping activity. (See DOD 4000.25-D, DOD Activity Address Directory.)
X Type service: Enter Air Express, Blue Label, Overnight Delivery, etc., as applicable. If none, leave blank.
X Ship-to/Port of Embarkment (POE): Enter 3-digit air/water port code along with in-the-clear port address, if appropriate.
X Transportation priority: Enter applicable transportation priority.
X Port of Debarkment (POD): Enter 3-digit POD port designator from DOD 4500.32-R (MILSTAMP), if appropriate.
X Project: Enter project code, if applicable.
X Ultimate consignee or Mark for: Enter the DODAAC (bar coded and in-the-clear); also, enter the complete address of consignee.
X WT. (this piece): Enter actual weight.
X Required Delivery Date (RDD): Enter required delivery date, as applicable.
X CUBE (this piece): Enter cube.
X Charges: Entry mandatory for FMS shipments. Enter CONUS inland freight charges on label of number one piece of shipment unit.
X Date shipped: Enter four-position julian date (e.g., 8180) or the in-the-clear date (e.g., 29 Jun 88).
X FMS case number: Enter as appropriate.
X Piece number: Enter bar coded and in-the-clear.
X Total pieces: Enter total pieces in shipment unit.

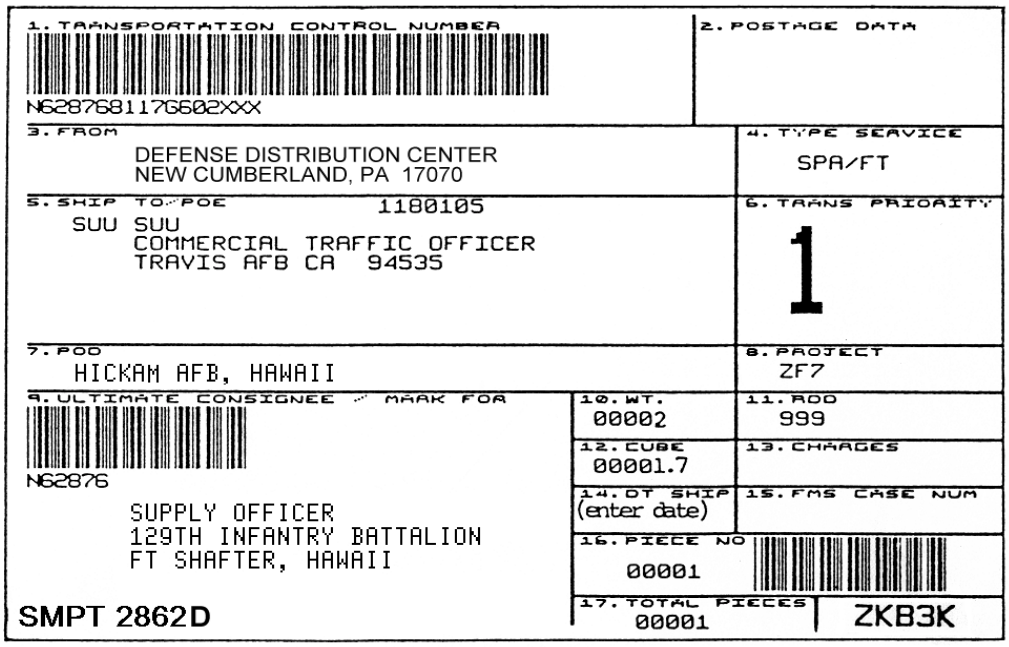


Figure 4-31. DD Form 1387 Military Shipment label.

For mail shipments, the label shall be completed as follows:

X TCN: Enter the 17-character (alphanumeric) TCN in both forms (bar coded and in-the-clear).

X Postage data: Use one of the following:

B For metered mail, leave blank and attach the stick-on metered postage values to or near this block.

B For permit imprint mail, enter the appropriate service/agency mail authorization.

Example: First Class Mail
Postage and Fees Paid
Defense Logistics Agency
Permit No. G-53

B For standard penalty indicia mail, enter the appropriate service/agency name or abbreviation and its sampling number.

Example: Postage and Fees Paid
Department of the Navy
DO-316

From: Enter the in-the-clear address of the shipping activity, including the zip code. The phrase "OFFICIAL BUSINESS, PENALTY FOR PRIVATE USE $300" must be printed on the bottom line of this block.

Type service: Enter First Class-Priority Mail, Express Mail, Military Ordinary Mail, etc., as applicable.

Ship to/POE: For CONUS mail, enter the complete address of the consignee, including the nine-digit zip code. For mail to overseas locations, enter postal concentration at DTS port or MILSTAMP Air/Water Port identifier (APO/FPO).

Transportation priority: Enter appropriate transportation priority.

POD: Leave blank.

Project: Enter project code, if appropriate.

Ultimate consignee or Mark for: Enter DODAAC of consignee (bar coded and in-the-clear). For CONUS, no other data; for overseas shipments, add detailed address.

WT. (this piece): Enter actual weight.

RDD: Enter, if applicable.

Cube (this piece): Enter cube.

Charges: Leave blank.

Date shipped: Enter the four-digit date (day f the year) (e.g., 8181) or the in-the-clear date (e.g., 29 Jan 98).

FMS case number: Enter, if applicable.

Piece number: Enter bar coded and in-the-clear.

Total pieces: Enter total pieces in shipment unit.

For unit moves: The address label should be completed as follows:

X **TCN:** Enter the 17-characters (alphanumeric) TCN for shipments entering the DTS, as applicable, bar coded and in-the-clear.
X **Postage Data:** Leave blank.
X **From:** Enter the DODAAC and in-the-clear address of the shipping activity.
X **Type service:** Leave blank.
X **Ship to POE:** Enter three digit air/water port code and in-the-clear port name.
X **Transportation Priority:** Leave blank. (There is no TP on unit moves.)
X **POD:** enter three digit air/water POD code. (May be coded and/or in-the-clear.) For classified moves, leave blank.
X **Project:** Enter project code, if applicable.
X **Ultimate Consignee/Mark for:**
Enter:
Unit Identifier Code (UIC).
Vehicle bumper number, if applicable.
Vehicle serial number.
Equipment description. (TMCR 56-69, paragraph 21-3, Labels will container descriptive data for ease of matching labels with equipment.)
Vehicle/cargo dimensional data (length (L) width (W), height (H); dimensional data will assist cargo handlers in determining whether a peice can fit in a given area.)
Classified moves: Do not enter POD. (See MILSTAMP, Volume I, appendix G, paragraph a(3))

B **Weight (this piece):** Enter actual weight.
B **RDD:** Enter, if appropriate.
B **CUBE (this piece):** Enter cube.

- **Charges:** Leave blank.
- **Date Shipped:** Leave blank.
- **FMS Case Number:** Leave blank.
- **Piece number:** Enter bar coded and in-the-clear.
- **Total Pieces:** Enter total pieces in shipment unit.

Special Markings

Set or assembly markings refer to figure 4-32. When a set or assembly is placed in two or more containers, all containers with component parts are shipped together.

Each container will have its own number within the set, total number of containers making up the set and the number of the set with each shipment. Set or assembly markings shall be placed in the lower right-hand corner of the identification-marked side of the container.

A 2-inch disc of a high contrast color shall be placed above the numbers on each container.

All component parts of disassembled items will have the serial number of the item on each container of the set. Example: The disc, followed by SET 1 then PK 1 of 5, and under the package numbers, SERIAL 18063.

If the item has no serial number, a date (month, day, year) followed by a capital letter to identify a set or assembly shall be shown on the shipping container in lieu of a serial number. Each set shall bear a different letter. Examples are:

SET 1 PK 1 of 2 4-1-96A	SET 2 PK 1 of 2 4-1-96B	SET 2 PK 1 of 2 4-1-96C
SET 2 PK 2 of 2 4-1-97A	SET 2 PK 2 of 2 4-1-97B	SET 2 PK 2 of 2 4-1-97C

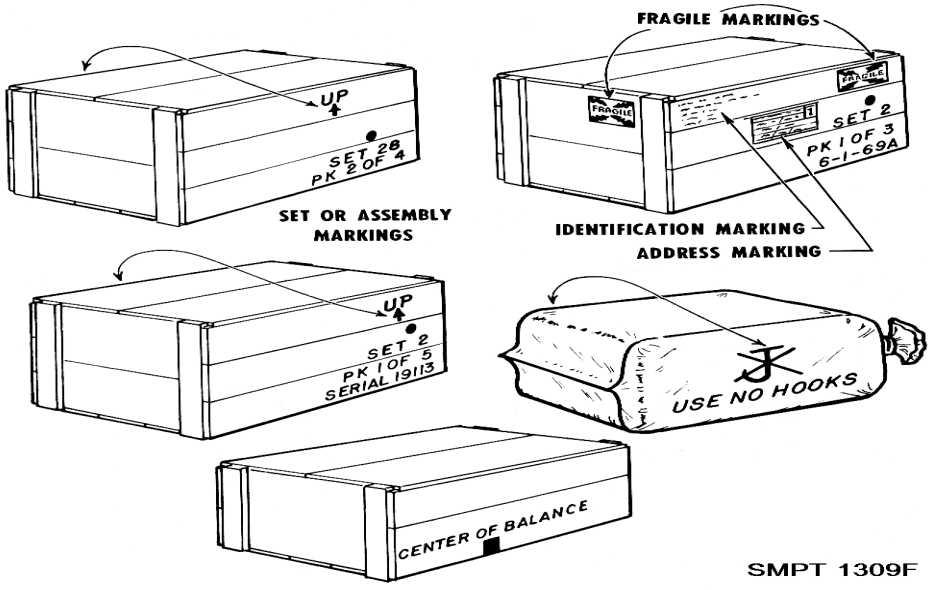


Figure 4-32. Examples of handling markings.

Single Stock Numbered Sets

This marking is used when the components of a single stock numbered item are packed in two or more shipping containers or stored together as a set.

The stock number shown on each shipping container will be that of the complete set and prefixes with P/O (part of).

Method 50 Marking

Method 50 packs which are shipping containers must bear a precautionary label on the identification marked side.

Method 50 markings may be applied by means of labels, or a copy of the label may be printed or stenciled on the container using waterproof red ink.

When there is insufficient space for labeling, the words "METHOD 50 PACKAGE, DO NOT OPEN UNTIL READY FOR USE," in letters as large as space permits must be printed or stenciled on the container. See figure 4-33.

Serial Number

When required, the shipping container will be marked with the assigned serial number. The words "Serial No." will be used to identify the information indicated and located directly below the identification marking. (Example: Serial No. 26481.)

Medical Material

Containers packed with frozen medical material shipments (constant temperature must remain below 32EF) must have completed PERISHABLE--KEEP FROZEN labels (DD Form 1502), figure 4-34, applied to the address side of each container. The applicable icing and time data are to be inserted on the labels at time of shipment. In addition, "ARROW" and "FRAGILE" markings must be applied to containers of frozen medical items. When shipping by military air transportation, a completed DD Form 1387-2 (Special Handling Data/Certification Form) is required and must be applied to the address side of the container. Three copies of the form will also be affixed to the "one end" of the container in a waterproof envelope.

Containers packed with chilled medical material shipments (constant temperatures must be maintained between 35 Eand 46EF) must have completed PERISHABLE--KEEP CHILLED labels (DD Form 1502-1), figure 4-35, applied to the address side of each container. The applicable icing and time data are to be inserted on the labels at time of shipment. In addition, "ARROW" and "FRAGILE" markings must be applied to containers of chilled medical items. A completed DD Form 1387-2 is required and must be applied to the address side of the container when shipment is via military air transportation. Three copies of the form will also be affixed to the "one end" of the container in a waterproof envelope.

Containers packed with limited unrefrigerated medical material shipments out of refrigeration (when receipt of shipment by consignee is assured within a specified number of days) must have PERISHABLE labels (DD Form 1502-2), figure 4-36 applied to the address side of the each container. The data applicable to time of removal from refrigeration are to be inserted on the label at time of shipment. In addition, "ARROW" and "FRAGILE" markings must be applied to containers of perishable medical items. A completed DD Form 1387-2 is required and must be applied to the address side of the container when shipment is via military air transportation. Three copies of the form will also be affixed to the "one end" of the container in a waterproof envelope.



SMPT 583

Figure 4-33. Method 50 Marking.

FROZEN MEDICAL MATERIEL SHIPMENT | *Form Approved OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503. Please DO NOT RETURN your form to either of these addresses.

PERISHABLE - KEEP FROZEN

VACCINE → TEMPERATURE MUST BE MAINTAINED BELOW 32 °F

REQUIRED DELIVERY DATE *(Calendar date)*
9/25/98

THIS PACKAGE PACKED AT ORIGIN

DATE	TIME	POUNDS OF DRY ICE	BY *(Name)*
9/22/98	1030	6	R. SMITH

IMPORTANT

To insure delivery of this vaccine in a satisfactory condition, it is necessary that this container be re-iced with DRY ICE on or before time indicated below.
(Greenwich Meridian Time is used for overseas shipments.)

6 POUND(S) DRY ICE WILL SAFEGUARD CONTENTS FOR _____HOURS WHEN RE-ICING IS DONE. AT FIRST RE-ICING POINT, CROSS OUT PREVIOUS BLOCK *(Left column below)* AND ENTER NEW DATE AND TIME NEXT RE-ICING IS DUE.

MUST BE DRY RE-ICED NOT LATER THAN ↓		DRY ICE ACTUALLY ADDED		
DATE 9/25/98	FIRST DRY RE-ICING →	DATE	POUNDS	DRY ICED BY
HOUR		HOUR		
DATE	SECOND DRY RE-ICING →	DATE	POUNDS	DRY ICED BY
HOUR		HOUR		

INSTRUCTIONS

Break tape on outer container and insert necessary dry ice. IMMEDIATELY re-seal outer container and RECORD this operation on the log above. DO NOT handle this vaccine or permit container to remain open longer than is necessary for DRY re-icing.

NOTE: FAILURE TO COMPLY WITH INSTRUCTIONS MAY ENDANGER LIVES.

If materiel has thawed or if shipment arrives without dry ice, refreeze immediately. Report details by fastest means to Defense Personnel Support Center (DPSC), Directorate of Medical Materiel, 2800 S. 20th Street, Philadelphia, PA 19145-5099. Document discrepancies in accordance with AR 55-38/NAVSUP PUB 459/AFM 75-34/MCOP 4610.19/DLAR 4500.15. DO NOT issue or destroy materiel until disposition instructions are received from DPSC.

DD Form 1502, MAY 96 *(EG)* Previous editions are obsolete.

SMPT 2196B

Figure 4-34. Frozen medical material shipment form.

CHILLED MEDICAL MATERIEL SHIPMENT | *Form Approved OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503. Please DO NOT RETURN your form to either of these addresses.

PERISHABLE - KEEP CHILLED

TEMPERATURE MUST BE MAINTAINED AT 35 °F TO 46 °F

REQUIRED DELIVERY DATE *(Calendar date)*
9/26/98

THIS PACKAGE PACKED AT ORIGIN

DATE	TIME	POUNDS OF WATER ICE	BY *(Name)*
9/22/98	1030	8	R. SMITH

IMPORTANT

To insure delivery of this vaccine in a satisfactory condition, it is necessary that this container be re-iced with water on or before time indicated below.
(Greenwich Meridian Time is used for overseas shipments.)

_____ POUND(S) WATER WILL SAFEGUARD CONTENTS WHEN RE-ICING IS DONE. AT FIRST RE-ICING POINT, CROSS OUT PREVIOUS BLOCK *(Left column below)* AND ENTER NEW DATE AND TIME NEXT RE-ICING IS DUE.

MUST BE WATER RE-ICED NOT LATER THAN ↓		WATER ICE ACTUALLY ADDED		
DATE 9/26/98 HOUR 1030	FIRST WATER RE-ICING →	DATE HOUR	POUNDS	WATER ICED BY
DATE HOUR	SECOND WATER RE-ICING →	DATE HOUR	POUNDS	WATER ICED BY

INSTRUCTIONS

Break tape on outer container and insert necessary water ice. IMMEDIATELY re-seal outer container and RECORD this operation on the log above. DO NOT handle this vaccine or permit container to remain open longer than is necessary for water icing.

NOTE: FAILURE TO COMPLY WITH INSTRUCTIONS MAY ENDANGER LIVES.

If materiel has frozen or if temperature has exceeded 46 °F, refrigerate IMMEDIATELY. Report details by fastest means to Defense Personnel Support Center (DPSC), Directorate of Medical Materiel, 2800 S. 20th Street, Philadelphia, PA 19145-5099. Document discrepancies in accordance with AR 55-38/NAVSUP PUB 459/AFM 75-34/MCOP 4610.19/DLAR 4500.15. DO NOT issue or destroy materiel until disposition instructions are received from DPSC.

DD Form 1502-1, MAY 96 *(EG)* Previous editions are obsolete.

SMPT 2195B

Figure 4-35. Chilled medical material shipment form.

LIMITED UNREFRIGERATED MEDICAL MATERIEL SHIPMENT	*Form Approved OMB No. 0704-0188*

Public reporting burden for this collection of information is estimated to average 5 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, D.C. 20503. Please DO NOT RETURN your form to either of these addresses.

PERISHABLE

REQUIRED DELIVERY DATE *(Calendar date)*

9/26/98

IMPORTANT

This package contains Medical Materiel which may be unrefrigerated during transit provided the cumulative time out of refrigeration does not exceed 96 hours after removal time indicated below. This materiel must be returned to refrigeration upon receipt. If delayed in route, return to refrigeration of 35° F to 46° F temperature.

REMOVED FROM REFRIGERATION			RETURNED TO REFRIGERATION		
DATE	HOUR	PLACE	DATE	HOUR	PLACE
9/22/98		DMT			

NOTE: FAILURE TO COMPLY WITH INSTRUCTION MAY ENDANGER LIVES.

DO NOT FREEZE or allow to be subjected to temperature above 95° F at any time. If material has been frozen or if temperature has exceeded 95° F refrigerate immediately. Report details by fastest means to Defense Personnel Support Center (DPSC), Directorate of Medical Materiel, 2800 S. 20th Street, Philadelphia, PA 19145-5099. Document discrepancies in accordance with AR 55-38/NAVSUP PUB 459/AFM 75-34/MCOP 4610.19/DLAR 4500.15. DO NOT issue or destroy materiel until disposition instructions are received from DPSC.

DD Form 1502-2, MAY 96 ***(EG)*** Previous editions are obsolete.

SMPT 2194C

Figure 4-36. Limited unrefrigerated medical shipment.

Project Code Markings

When required, project code labels shall be applied to exterior containers. The project code shown in the requisition or procurement document (e.g., ARI, ABC, etc.), shall appear in the address and also on a white label having a black bordered disc superimposed on it. If more than one project is required, all project codes may be put on one label. Label sizes shall be 3 by 3 inches with a 2-inch diameter disc or 9 by 9 inches with a 6-inch diameter disc, with both having proportionate black lettering. The project code may also be applied directly on a container. When markings are applied by tags, the project code shall be placed on the identification tag adjacent to the identification markings. The project code markings shall be applied as follows:

- X Rectangular container, consolidation containers, and palletized loads - two discs, one on each side.
- X Cylindrical containers - two discs equally spaced on the circumference.
- X Irregularly shaped containers and loose or unpacked items - stenciled or printed on identification-marked side of a tag.
- X Vehicles or other major unpacked items - one disc on the markings board, or one disc applied directly on a vehicle by a waterproof, pressure-sensitive tape such as ASTM D 5486. The tape shall be placed over the label and extend a minimum half inch from all edges off the label.
- X Postal - one disc adjacent to the address marking.
- X MILVANs/SEAVANs - not marked. However containers or items comprising the load shall be marked.

Handling Markings

Many times people confuse handling markings with special markings. Each one has a different purpose. Earlier, we covered special markings and found that they are used to meet certain marking requirements. Let's discuss handling markings. They are used when special handling instructions, markings, and warnings are required by official regulations.

Special Handling Data/Certification Label (DD Form 1387-2)

The DD Form 1387-2 as shown in figure 4-37 shall be applied to each piece of cargo to be shipped via military/ commercial air when it is necessary to identify the characteristics, precautionary measures and special instructions for the safe and/or proper handling of classified, and other shipments requiring special handling.

Fragile markings

Exterior containers containing delicate or fragile articles shall be marked by means of a fragile label, stenciling or stamping. When space permits, the fragile symbol shall be placed on the identification marked side and either end of a rectangular container. The fragile symbol shall be placed on two equally spaced areas on the circumference of cylindrical containers. Two symbols are required. Fragile labels shall be secured and waterproofed with water-resistant adhesive. When vinyl or plastic coated labels are used, no protective coating is required. Shipping containers imprinted on the top and bottom with GLASS--DO NOT DROP OR THROW, or GLASS-HANDLE WITH CARE, or similar markings do not require fragile labels. The labels, stencils, etc., will be placed so as to be conspicuous but not interfering with other markings. See figure 4-32.

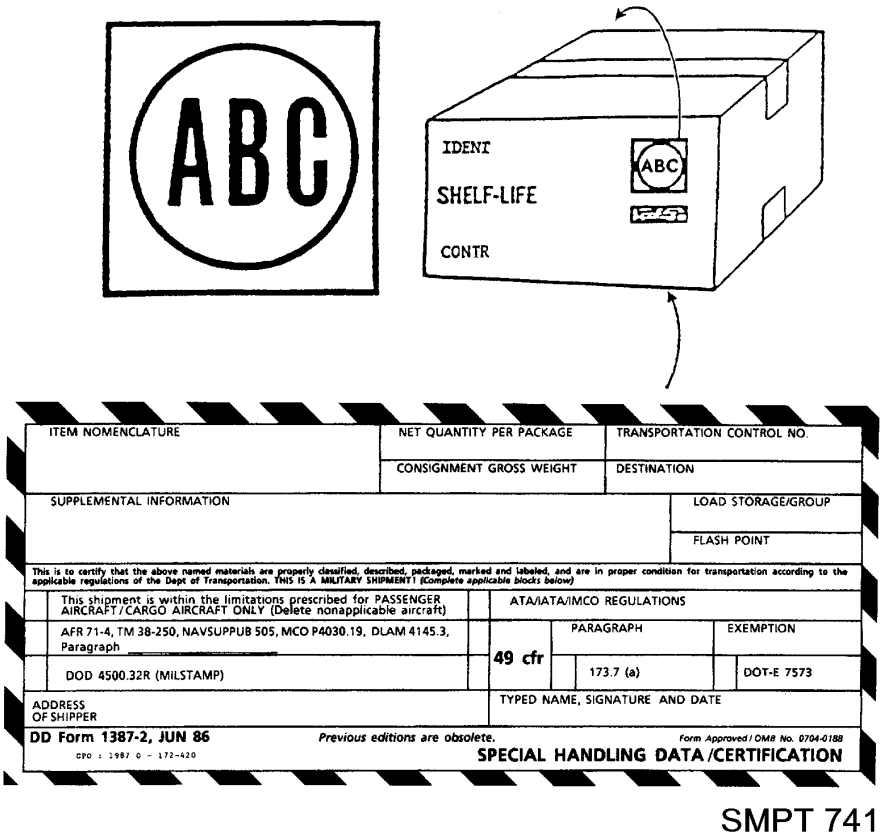


Figure 4-37. Examples of special markings (shelf-life, project code, and transportation special handling/protective services markings.

Arrows

Arrows are used to insure proper stacking of containers when the contents of the container need to be stacked with the top surface up. When placed on containers (rectangular or cylindrical), the word UP will be stenciled on two sides of the container with an arrow towards the top of the container. Length of the arrow will not be less than 1 inch and the stem not less than 1/2 inch and proportioned to the available space. Arrows are intended to indicate or supplement the words "UP" or "TOP." These markings are affixed only when necessary. The word UP may be above, below, or on the stem of the arrow. See figure 4-32.

Center of Balance and Sling Points or Lifting Points

A 1-inch wide vertical line not less than 3 inches long and locating the center of balance must be extended up from the bottom of both sides of containers regardless of its length. The words “CENTER OF BALANCE” will be stenciled or printed in 1-inch letters above or alongside the center of balance mark. Sling points will be marked on unboxed equipment with white letters. Light colored surfaces will be marked in black (example: SLING POINTS). On vehicles which are painted white, yellow or other light colors, the marking shall be black and the words, "LIFT HERE" with arrows pointing to the lifting eyes shall be placed immediately above or alongside of the lifting eyes. See figure 4-32.

Load-Bearing Areas and Lift Points

These markings are required when shipping containers and contents are subject to damage by twisting, bending, or uneven container stresses. The words "LOAD BEARING AREA" will be marked on two opposite panels of the container directly over the load bearing areas. The words "FORKLIFT AREA" will be placed directly over the forklift entry points of the skid and rubbing strip.

Legend "USE NO HOOKS"

When required, the legend "USE NO HOOKS" in letters not less than 1 2 inches in height should be stenciled on both sides of shipping containers in which the contents are susceptible to damage by the use of hooks. In addition, a hook symbol with a superimposed "X" sufficiently heavy to convey the intended prohibitory use of the hooks should be placed directly above the legend. See figure 4-32.

Magnetic Materials Markings as Shown in Figure 4-38

When you are required to pack magnetic material for shipment, you should show whether or not the material is being shipped by military aircraft. It is important to know this, so that the proper magnetic materials label may be used. Boxes, packages, and items containing magnetized material suitable for shipment by military aircraft in conformance with MIL-S-4473, shall be marked in accordance with MIL-STD-129. Magnetized materials suitable for shipment by commercial air shall be marked in conformance with CFR 49. Boxes, packages, and items containing magnetized material not suitable for shipment by military aircraft in conformance with MIL-S-4473, shall be conspicuously marked on two opposite sides with a red caution label having white lettering. Magnetic tapes data shall be conspicuously labeled on both interior and exterior containers.

Structural Markings

When required, structural markings such as "REMOVE TOP FIRST" or "TO OPEN TOP: REMOVE SCREWS", shall be placed on shipping containers on or near the structure described. Containers designated as "reusable" shall include sufficient structural markings to provide instructions for opening and unpacking without causing damage to the container, packing materials, and the container's contents.

As you have just seen, handling markings are very important to our packs. When they are used properly, we are relatively sure our packs will arrive safely at their destination.



Figure 4-38. Labels for magnetic materials.

Expedited Handling Markings as Shown in Figure 4-39

Requisitions and contracts identified as NMCS (Not Mission Capable Supply) shipments shall have an NMCS code shown in the required delivery date block of the address label.

The applicable code is 999 or the letter "N" which may be followed by RDD expressed in the number of days from the requisition dates.

In addition to appearing on the address label, NMCS condition 999 shipments shall be marked with two 999 labels on each container.

For NMCS condition other than 999, containers shall be marked with two NMCS labels.

One label shall be placed adjacent to the address marking, and one shall be placed on the opposite side.

Pictorial Symbols for Marking (see figure 4-40)

Containers should be marked with pictorial symbols to indicate special handling and storage needs, such as “TEMPERATURE LIMITS, DO NOT STACK, DO NOT DROP, DO NOT ROLL, CLAMP HERE, FRAGILE, HANDLE WITH CARE, KEEP AWAY FROM HEAT and KEEP AWAY FROM COLD.” They may appear on a label or be printed directly on the package. Affirmative and negative symbols need not be framed by border lines, but all negative symbols with “DO NOT ...” should have borders with a slash mark across. Additional pictorial marking symbols and their application are illustrated in ASTM D 5445.



Figure 4-39. Expedited.



Figure 4-40. Pictorial symbols.

Marking Procedures for Boxes and Crates

The required markings for boxes and crates must be placed on the location specified and must not be obscured by cleats and strapping. For the purpose of this lesson, each box or crate must have two ends, two sides, a top, and a bottom.

Unless otherwise specified, an end and the top and bottom of containers shall always be free of any markings.

Exterior identification markings shall be applied to the left upper two-thirds of the side of the container having the largest marking surface area.

Additional identification markings are required on the upper left two-thirds of one end of containers 10 cubic feet and over.

The "one end" is defined as the end which is to the left of the identification marked side of the container.

Identification and contract data shall be stenciled or printed directly on the container or applied by use of a stencil or label. Contract data markings must be placed on the side of the container below the identification markings.

The positioning of exterior markings on boxes and crates are shown in figures 4-28 and 4-29.

Marking Procedures for Other Miscellaneous Containers

The proper marking procedures for bales, sacks, cloth-covered bundles, drums, barrels, and other miscellaneous containers are outlined in MIL-HDBK-129. Generally, all containers require the same basic markings; but due to the various shapes of these containers, they differ as to where these markings will be placed on the container. MIL-HDBK-129 outlines the proper location and special markings required on each specific container.

Standard Marking Procedures for Palletized Unit Loads

When a palletized unit load is formed, the individual containers comprising the unit load should already be marked with the appropriate identification and contract data information. Unless otherwise specified, unit loads of box-packed items should have one or more boxes turned to present a blank surface for markings. The palletized unit load should have the exterior container identification, contract data, and address markings applied as specified herein. See figure 4-41 for marking of unit loads having wood collars or frames. For palletized unit loads 10 cubic feet and over, additional identification markings should be placed on the end of the load to the left of the identification-marked side. When a fiberboard container such as a triple-wall fiberboard box is used for unitizing a load in lieu of palletization, all required markings, including the address markings, may be placed directly on the flat fiberboard surface (see figure 4-42). Unitized tires should be stacked on pallets, sidewall to sidewall, to prevent the markings on the individual tires from being seen around the circumference on the load. The gross weight for palletized/containerized unit loads should include the weight of the pallet or container base. Because palletized loads are often stacked two or three high when shipped or stored, the markings must be large enough to be read from a distance. The size of the lettering should be proportionate to the overall size of the unitized load but should be not less than three-fourths of an inch in height.

Exterior container identification and contract data markings should be placed on a marking board/panel by using a label or by direct stenciling. Palletized loads with smooth, flat surfaces may have identification markings stenciled directly on two surfaces, with markings extending from one container to another. Contract data markings should be applied to one surface.

Except for Defense Supply Center Philadelphia (DSCP) Clothing and Textiles (C&T) items, palletized loads of containers of items having different NSNs should be marked as multipacks. Palletized loads of DPCP C&T items having different NSNs should be marked as specified in the contract or order.

When a palletized load is covered with stretch-wrap film, pressure-sensitive labels containing the identification, contract data, and address markings may be placed on the outermost layer of wrap on either side of the load in addition to other markings requirements. Variations are authorized based on local operations and capabilities (e.g., a marking board/panel positioned on the pallet before the last layer of wrap is applied).

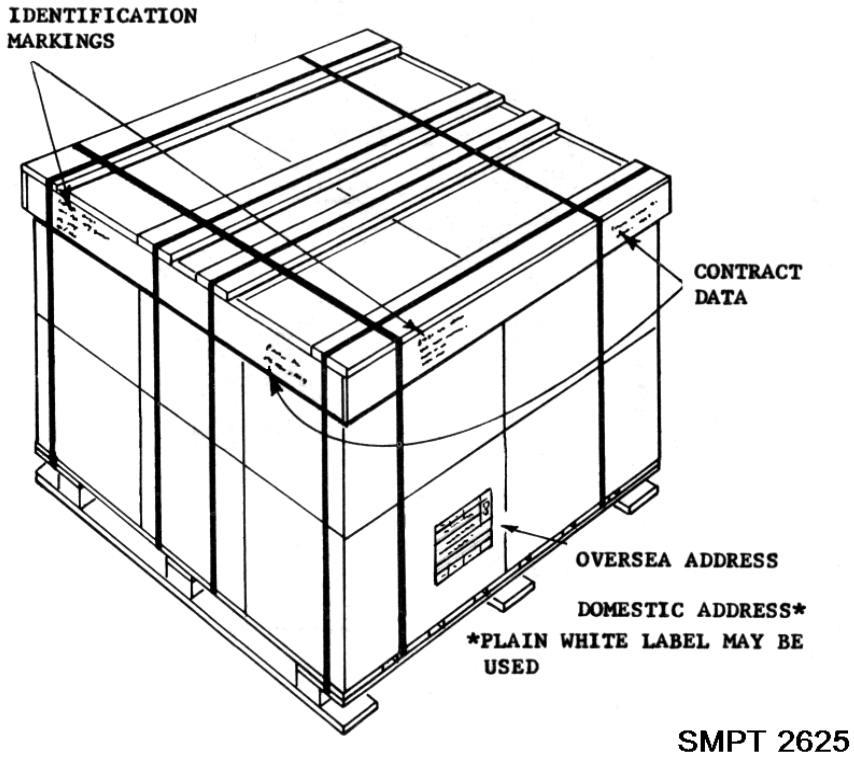


Figure 4-41. Marking of unit loads which have wood collars or frames.

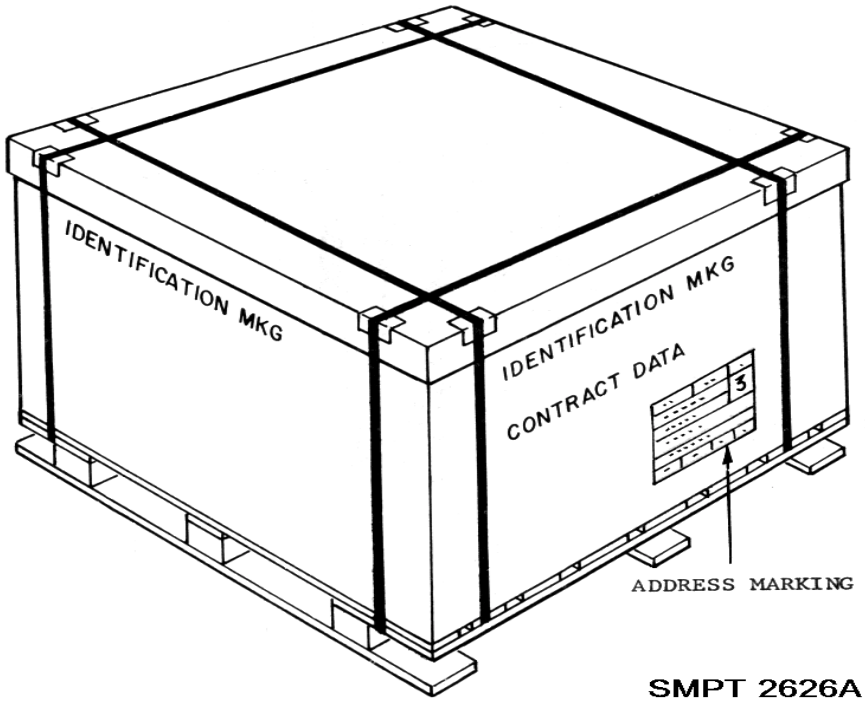


Figure 4-42. Marking of box type pallets.

Bar Code Markings

The bar coded (NSN/NATO) stock number will consist of the basic 13 data characters. Prefixes and suffixes to the stock number as well as spaces and dashes will not be bar coded. In addition, the MFR/PN will not be bar coded.

The human readable interpretation (HRI) will be an exact interpretation of the bar code data and will not contain spaces or dashes. The HRI will be located preferably below the bar code markings or optionally above the bar code markings.

On other than wood containers, bar code markings will be applied either by labels or by direct printing on the container. Unless otherwise specified by the cognizant activity, labels used for bar coding shall meet the following minimum requirements.

Preprinted labels shall have a clear, transparent laminate coating. Non-preprinted labels shall have a protective coating.

Labels shall be made of polyester or equal material.

On wood containers (intermediate or exterior shipping), bar code markings will be applied only by means of labels. The labeling area will be given a smooth coat of sand-colored paint, lacquer, or varnish prior to application. A clear/transparent overcoating must be placed over the bar code labels. In addition to the adhesive, it may be necessary at times to also use staples. Any commercial-type staple may be used as long as it is not placed within the bar code or the quiet zone.

When the unit pack and exterior shipping container are one and the same, only the exterior shipping container bar code markings need to be applied.

When bar code labels are used on exterior shipping containers, a waterproof, clear/transparent, plastic, protective overcoating such as ASTM D 5486, type III, class 2 tape, shall be applied to or inherent to the label. Bar code quality shall be in conformance with AIM BC1, Uniform Symbology Specification Code 39, after the protective coating has been applied.

There are two bar code configurations. Vertical (ladder) and horizontal (picket fence). All bar codes will be in a horizontal configuration unless otherwise specified in the contract or order.

Recommended Placement of Bar Code Markings, **MIL-HDBK-129, Military Marking**

Unit Packs and Intermediate Containers

The NSN/NATO stock number will be bar coded and applied above the identification markings. When space does not permit placing all of the required markings, including bar code markings, on one surface of the package, bar code labels/markings will be placed on an adjacent or opposite side of the package. As an alternative, the procuring activity may request that the package size be increased to accommodate bar code markings. Bar code markings placed inside a transparent container must be machine readable from the outside of the container. Similarly, bar code markings on containers which are shrink/ stretch wrapped into a load must be machine readable from the outside of the load in at least one location. In addition to the HRI section of the bar code markings, the NSN/NATO stock number, including spaces or dashes and prefixes or suffixes, when applicable, shall be marked in-the-clear as the first line of identification markings.

Exterior Shipping Container Under 10 Cubic Feet

For exterior containers, the NSN/NATO stock number and contract number will be bar coded and will be applied on the identification side of the container. The bar code symbol will be located in an area adjacent to the identification markings and will be in a horizontal, or "picket fence," configuration. The bar code will be applied at minimum distances of 2.0 inches (50.8mm) from the top and bottom edges, 1.0 inch (25.4mm) from the side edges, and a minimum distance (quiet zone) of 0.25 inch (6.35mm) from the nearest identification marking will be maintained. Bar codes may be applied in either one of the following formats, listed in order of preference, unless otherwise specified:

X Stacked on two separate lines with the NSN/NATO stock number immediately above the contract number. When a stacked configuration is used, the bar codes shall be left-justified (left-hand (start) characters vertically aligned).

X Horizontal (in line) with the NSN/NATO stock number preceding the contract number and with a minimum space of 0.5 inch (12.7mm) separating the two bar codes. Other data, when specified, will follow the contract number with a minimum separation of 0.5 inch (12.7mm). See figure 4-43.

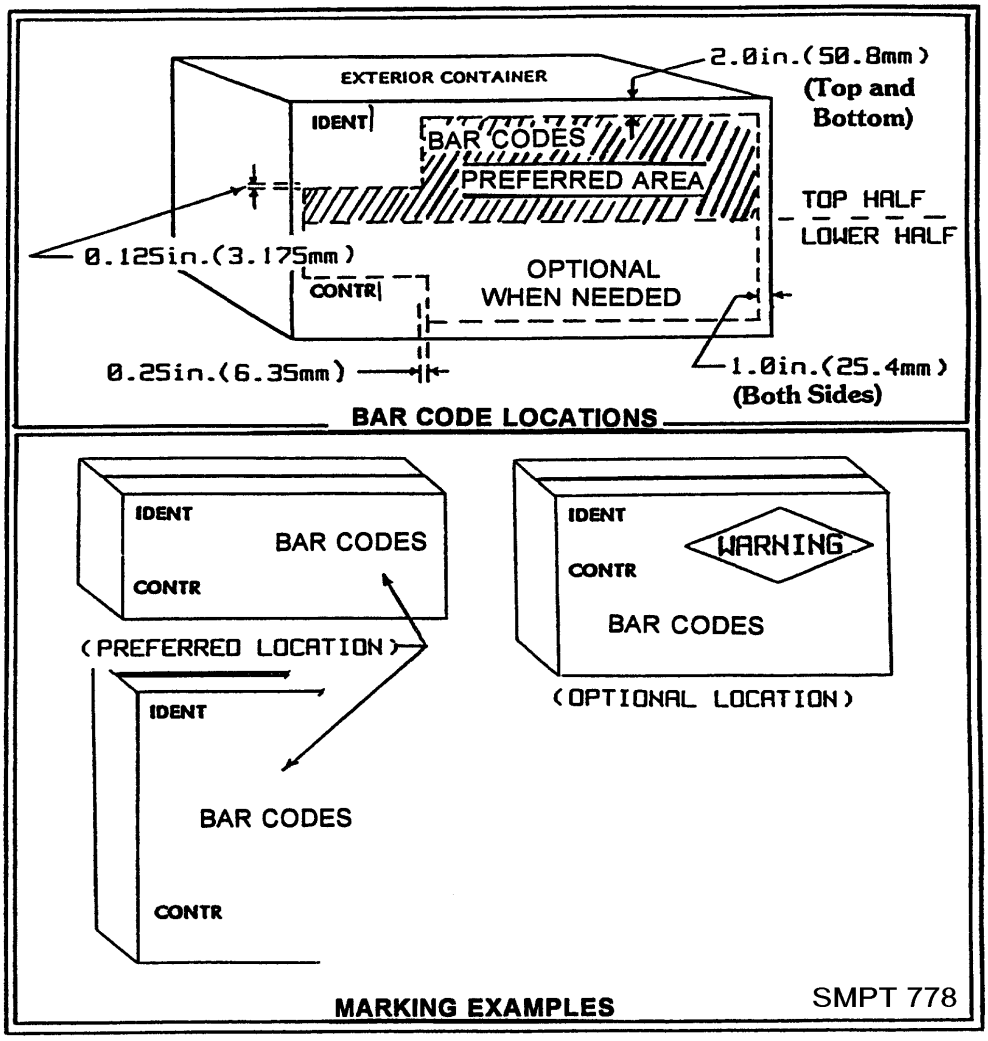


Figure 4-43. Bar Code Markings on Boxes Under 10 Cubic Feet.

Exterior Shipping Containers 10 Cubic Feet and Over

Bar code markings are required on one end and one side of the container and will be applied as shown. The positioning of the bar code markings will be as specified in figure 4-44. When a marking board is used for unsheathed crates, the bar code markings shall be applied immediately to the right of or beneath the contractor markings and shall be in line with them.

Bar coded tags

If space permits on the identification tag, the bar code label/marking may be applied to the right of the identification markings or beneath the contract data markings. If space does not permit, the bar code markings may be applied on the reverse side of the tag.

Multipacks

Item identification markings will not be bar coded on the exterior shipping container of multipack shipments. However, unit packs and intermediate containers require bar coding. The contract number will be bar coded on the exterior shipping container of the multipack if the number applies to all unit and intermediate containers in the multipack. If mixed contract numbers are contained in the multipack, then each unit or intermediate container will have the contract data bar coded, and the exterior container will not be bar coded.

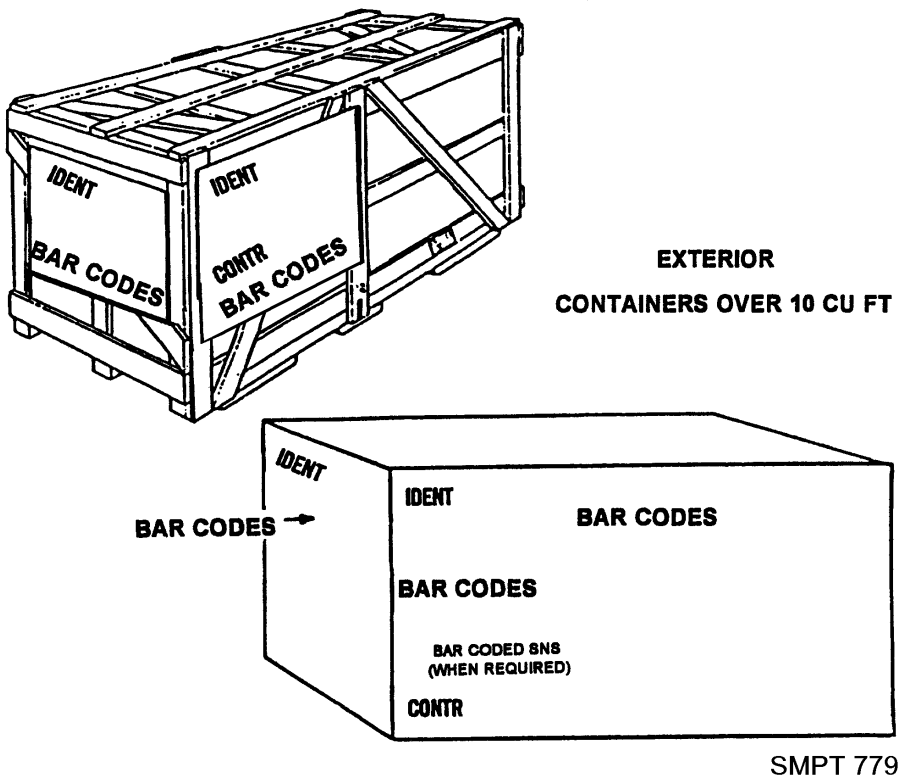


Figure 4-44. Exterior container bar code markings on boxes 10 cubic feet and over.

Checkup

X What is the purpose of marking?
X What documents cover marking for shipment and storage?
X What are the required interior unit pack identification markings?
X How many oversea address labels are required on a box over 10 cubic feet?
X Where are the identification markings and contract data markings located on a palletized load of fiberboard boxes?
X Where is the domestic or overseas shipment address label located on the exterior shipping container?

MARKING AND LABELING APPLICATION PRACTICAL EXERCISE

Objective

As a result of this practical exercise, the student will be able to apply the appropriate marking and labels to containers being prepared for shipment.

General Instructions

This exercise will take approximately one class period.

This exercise will be conducted in the classroom.

A critique will be conducted at the end of the exercise.

Conduct of Exercise

Situation

As a packer you are responsible for marking and labeling containers for shipment. You are going to pack items which will be sent as a multipack to a break bulk point where the individual packs will be transshipped.

Requirement No. 1. Answer the following questions.

X What materials may be used for stencil marking?
X List at least 4 waterproofing materials used as protective coatings.
X What special materials are used to obliterate CARC painted markings on metal reusable containers?
X Describe the requirements for pressure sensitive, water-resistant paper labels.
X What are the general requirements for the condition of surfaces to be marked?
X What materials may be used for stencil marking?
X List weatherproofing materials that may be used as protective coatings.
X What special materials are used to obliterate CARC painted markings on metal reusable containers?
X What are the general requirements for the condition of surfaces to be marked?
X How many expedited shipment labels are required on each box and where are they placed?
X A 2-inch black ball on the lower half of the right hand end of the marked side means the box is what?
X What should you do with old or unrequired markings?
X On a box over 10 cubic ft., where is the address label placed?
X Where are the identification markings placed on a 12 cu. ft. crate?
X Under what circumstances are you required to put center of balance

markings on a container?

X Describe the two types of shelf-life markings.

X What markings must be placed on an exterior shipping container of unrelated items?

X How would you protect the packing list for a military overseas shipment?

X What labels would you put on a container of frozen medical material which will be shipped by military air?

X List the proper exterior identification markings in the proper order for the shipment described below.

PN: 3456
NSN: 1234-56-789-1234
Method and level of pads: M41-4/97
Gross weight: 8 lbs. Gross weight should be rounded up to the nearest pound.
Quantity and Issue: 2 ea.

Critique

The instructor will hold an oral critique of the exercise when the students have finished answering the questions.

Care of Area, Training Aids & Equipment

Not applicable.

HAZARDOUS MATERIALS

GENERAL

Because of the special nature of hazardous materials and the associated dangers, the public and the government are taking greater interest in their shipment and storage. Everyday more and more items are being placed under hazardous materials regulation. As the number of regulated hazardous materials increases, the greater the chance that they will enter the inventory of items with which you are associated. It is important, therefore, that you be able to readily identify hazardous materials through their labels and special markings.

HAZARDOUS MATERIAL REGULATION

The proper classification of hazardous materials influences the packaging, hazard markings, shipping paper entries, emergency response, and any other instruction governing the material. It is, therefore, essential that the appropriate classification is made, because improper classification can be extremely dangerous.

CLASSIFICATION

Department of Transportation hazardous material class (classification) definitions. (Also used by DOD).

Class 1 (Explosive)

An "explosive" means any substance or article, including a device, which is designed to function by explosion (i.e., an extremely rapid releases of gas and heat) or which, by chemical reaction within itself, is able to function in a similar manner even if not designed to function by explosion, unless the substance or article is otherwise classed under the provision of CFR 49. Explosives in Class 1 are divided as follows:

- X Division 1.1 consists of explosives that have a mass explosion hazard. A mass explosion is one which affects almost the entire load instantaneously.
- X Division 1.2 consists of explosives that have a projection hazard, but not a mass explosion hazard.
- X Division 1.3 consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.
- X Division 1.4 consists of explosive devices that present a minor explosion hazard. No device in this division may contain more than 25 g (0.9 ounce) of a detonating material.
- X Division 1.5 consists of very insensitive explosives. This division is comprised of substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.
- X Division 1.6 consists of extremely insensitive articles which do not have a mass explosive hazard.

Class 2 (Gases)

Gases in Class 2 are divided as follows:

X Division 2.1 (Flammable gas) "Flammable gas" means any material which is a gas at 20EC (68EF) or less and 101.3 kPa (14.7 psi) of pressure (a material which has a boiling point of 20EC (68EF) or less at 101.3 kPa (14.7 psi) which is ignitable at 101.3 kPa (14.7 psi) when in a mixture of 13 percent or less by volume with air; or has a flammable range 101.3 kPa (14.7) with air of at least 12 percent regardless of the lower limit.

X Division 2.2 (non-flammable, non-poisonous compressed gas). A "non-flammable, non poisonous compressed gas" means any material (or mixture) which exerts in the packaging an absolute pressure of 280 kPa (41 psia) at 20EC (68EF), and does not meet the definition of Division 2.1 or 2.3.

X Division 2.3 (Poisonous or toxic gas). "Poisonous gas" means a material which is a gas at 20EC (68EF) or less and a pressure of 101.3 kPa (14.7 psi) (a material which has a boiling point of 20EC (68EF) or less at 101.3 kPa (14.7 psi) and which is known to be so toxic to humans as to pose a hazard to health during transportation, or in the absence of adequate data on human toxicity, is presumed to be toxic to humans based on tests.

Class 3 (Flammable liquids)

A "flammable liquid" means any liquid having a flashpoint of not more than 60.5EC (141EF) with certain exceptions listed in CFR 49.

Flammable Solids

Class 4 flammable solids are as follows:

X Division 4.1 (Flammable Solid). A "flammable solid" means any of the following three types of material:

B Certain wetted explosives
B Self reactive materials
B Readily combustible materials

X Division 4.2 (Spontaneously Combustible Material). "Spontaneously combustible material" is either pyrophoric or self-heating.

B A pyrophoric material is a liquid or solid that, even in small quantities and without an external ignition source, can ignite after coming in contact with air.
B A self-heating material is a material that, when in contact with air and with an energy supply, is liable to self-heat.

X Division 4.3 (Dangerous when wet material). "Dangerous when wet material" means a material that is spontaneously flammable or gives off flammable or toxic gases when in contact with water.

Class 5

Class 5 is made up of the following divisions:

X Division 5.1 (Oxidizer). "Oxidizer" means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials.

X Division 5.2, (Organic Peroxide). "Organic peroxide" means any organic compound containing oxygen (O_2) in the bivalent -0-0-structure and which may be considered a derivative of hydrogen peroxide, where one or more of the hydrogen atoms have been replaced by organic radicals, with certain exceptions.

Class 6

Class 6 is made up of the following divisions:

X Division 6.1 (Poisonous or Toxic Material). A “poisonous material" means a material, other than a gas, which is known to be so toxic to humans as to afford a hazard to health during transportation, or which, in the absence of adequate data on human toxicity is presumed to be toxic to humans.

X Division 6.2 (Infectious Substance). An "infectious substance" means a viable microorganism, or its toxin, which causes or may cause disease in humans or animals, and includes those agents listed in 42 CFR 72.3 of the regulations of the Department of Health and Human Services or any other agent that has the potential to cause severe, disabling or fatal disease.

Class 7 (Radioactive Material)

"Radioactive material" means any materials having a specific activity greater than 0.002 microcurie per gram (Φci/g).

Class 8 (Corrosive Material)

A "corrosive material" is a liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of contact, or a liquid that has a severe corrosion rate on steel or aluminum.

Miscellaneous Hazardous Materials

"Miscellaneous hazardous materials" means a material which presents a hazard during transport, but which is not included in any other hazard class. This class includes:

X Any material which has an anesthetic, noxious or other similar property which could cause extreme annoyance or discomfort to a flight crew member so as to prevent the correct performance of assigned duties.

X Any material that is not included in any other hazard class, but is subject to the requirements CFR 49 because it meets the definition of an elevated temperature material, a hazardous substance or a hazardous waste.

Other Regulated Materials (ORM)

"ORM-D material" means a material such as a consumer commodity, which, although otherwise subject to the regulations presents a limited hazard during transportation due to its form, quantity and packaging.

Hazardous Material Identification Numbers

Most hazardous materials have been given identification numbers. These numbers are preceded by the letters UN for proper shipping names considered appropriate for international transportation as well as domestic transportation and NA associated with proper shipping names not recognized for international transportation, except to and from Canada. Identification numbers may be found on shipping papers, individual packages, placards, and/or panels. These numbers are also a key to a guide published by the Department of Transportation (DOT P5800.5, Emergency Response Guidebook) that outlines initial action to be taken by emergency response personnel handling incidents involving hazardous material. Each guide lists potential hazards and emergency actions that should be taken.

Labels

Since each class of hazardous materials has its own characteristic, it is important to be able to identify the contents of the individual packages. This is accomplished by special markings and labels. Let us look at the labels first.

- X All hazardous materials class labels are diamond shaped. Each side of the diamond is at least 4 inches long.
- X Each label is distinctive color and contains both a representative symbol plus the class designation.
- X Labels are generally required to be placed on the surface of the package bearing the proper shipping name.
- X When more than one hazardous material is packaged in a container, more than one label or kind of labels may be needed.
- X In some cases more than one hazard class warning label(s) is required. The first label shown for an entry indicates the primary hazard of the material and additional labels indicate subsidiary or secondary hazards.
- X Subsidiary/secondary labels will not bear a hazard class identification number. This is to help emergency responders identify the primary hazard to which they must respond. Rationale: It is essential that readers understand there is a difference in primary and subsidiary labels.
- X No label will be used on a package if the material is not hazardous, and no label that looks like a hazardous label should be used.

Markings

Containers of hazardous materials must be marked per MIL-STD-129, Standard Practice for Military Marking. That is, the container must have the normal markings found on all the material in the Defense Transportation System, such as the identification, contract, and shipping markings.

In addition, the container must have the proper shipping name and the identification number assigned to the material by CFR 49 applied below the identification markings. For hazardous materials classified as an ORM, the appropriate designation must be placed after the proper shipping name.

Non-bulk packages having inner packagings containing liquid hazardous material must be packed with the closure up and legibly marked with "arrows" pointing in the correct upright direction of the package.

Radioactive material packs will be marked either Type A or Type B indicating the type of package. When in excess of 110 pounds (50 kilograms), must have its gross weight marked on the outside of the package.

With a few exceptions, packages containing hazardous materials must be marked with the "proper shipping name" as determined from the applicable modal regulations. The proper shipping name is used to provide universal understanding of the contents of the package, since the proper shipping name may be different from the item nomenclature. The four digit identifications number is also applied for this reason.

Markings must be clear and durable, and on a contrasting background.

Most hazardous material packages must be marked with the name and address of the consignee or consignor.

Only authorized abbreviations, such as "w" for with, "wo" for without, and ORM for Other Regulated Materials may be used.

Performance Oriented Packaging (POP) markings shall be located opposite the identification marked side of the package (see figure 4-45).

Compatibility

Compatibility of hazardous materials is a key factor that needs to be considered during every phase of packaging, shipping, storage and transportation. Packages containing hazardous material which react dangerously with another are incompatible and must be segregated and/or in some cases separated during shipment and storage.

Compatibility and other safety considerations are also crucial during loading and movement of hazardous materials. Compatibility must be determined through the proper use of the Segregation and Separation charts in the CFR 49. Additionally, for movement on military aircraft, the pilot must be notified when and where hazardous materials are positioned on the aircraft in case of an incident.

Placards

The final means of identifying shipments of hazardous materials is placarding.

Placards are similar to the labels, but they are placed on the outside of the vehicle.

They are also diamond-shaped, but 10-3/4 inches on each side.

They contain a symbol and description of the contents of the vehicle (not necessarily the class). Placards for tank cars will have the identification number of the material in place of the descriptive wording.

The shipper is responsible for furnishing the required placards to the carrier.

The placards are needed on all ends and sides of the transporting vehicle and some freight containers and portable tanks.

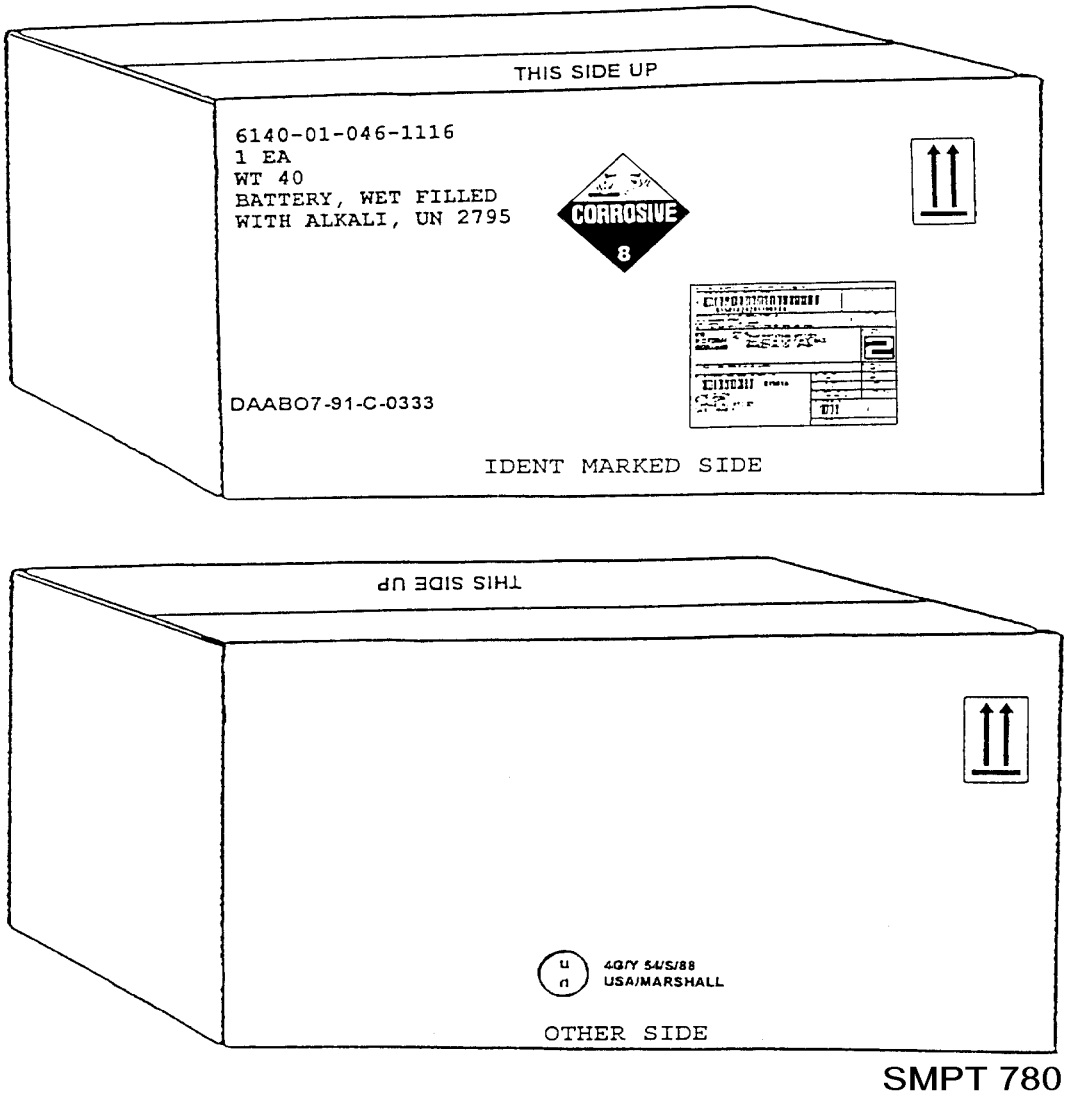


Figure 4-45. An example of exterior container HAZMAT marking and labeling requirements.

General Packaging Requirements

Containers are to be so designed and constructed that there will be no significant release of the hazardous material into the environment.

There must be no mixture of gases that could increase heat or pressure that would reduce the effectiveness of the package.

Containers labeled with the "Empty" label must be entirely free of any hazardous material.

Many containers will be marked with the Department of Transportation (DOT) specification number for the container, e.g., DOT-1A, DOT23G40, etc.

Containers should be made of materials that do not react with the hazardous material inside.

Containers with screw cap closures should be sealed with a secondary closure to prevent loosening by vibration.

Containers being reused must have the old markings removed or obliterated.

Containers should be marked with the proper shipping name.

For our purpose, it is sufficient to understand that DOD shipments of hazardous materials may be made in either DOT, UN or federal/military specification containers if they have successfully passed the performance oriented packaging testing requirements with the material being shipped.

We should always concentrate our efforts to insure that containers of hazardous materials are sound, properly sealed and not leaking. Any indication that the container is not doing its job should be reported and the discrepancy corrected prior to shipment or storage.

General Handling Requirements

Explosives

To be eligible for transportation, explosives, explosive devices, and munitions, including commercial and foreign, must be tested, approved, and assigned a DOD classification according to TB 700-2/NAVORDINST 8023.3/DLAR 8220.1, DOD Explosive Hazard Classification Procedures. The services and DLA must comply with AFI 91-201/TM 9-1300-206/NAVSEA OP 5 for safety precautions, standards, and rules when operating in an environment with explosives.

Flammable Liquids

These materials should be stored in cool, well-ventilated areas. They must be stored away from sources of heat, flames, sparks, combustible materials or oxidizing agents. Containers must be kept tightly closed. In the event of leakage or spillage, rubber gloves, goggles, aprons and respirators must be used.

Flammable Solids and Oxidizing Materials

These materials must be stored in cool, well-ventilated areas away from moisture. They must not be stored near corrosives. All containers must be tightly and securely closed.

Corrosive Materials

Corrosives must be stored in a cool ventilated area away from sources of heat and oxidizing agents. Gas masks, respirators, rubber gloves, goggles, and other protective clothing should be available for use in the event of leakage.

Compressed Gases

These materials, in general, must be stored in a cool, well-ventilated area away from fire hazards, sources of heat, ignition, or sparks. Do not drop jar, or slide containers.

Poisonous Materials

Keep cool and away from direct sunlight and high temperatures. Store away from sources of ignition oxidizing materials, and acids. Avoid direct contact with the materials. Wear a gas mask or breathing apparatus as instructed by safety personnel during exposure.

Radioactive Materials

Handling requirements for these materials can be complex and involved. At least, it should be emphasized that personnel handling these materials take precautions to minimize exposure. Containers should not be opened except for good reason under supervision of radiological protection personnel.

Handling Markings

Always be sure to comply with all handling markings, e.g., THIS SIDE UP, FRAGILE, etc.

Training

No person will accept the responsibility of handling HAZMAT, including but not limited to packing, marking, labeling, etc., without first meeting the training requirements found in DOD 4500.9-R, Defense Transportation Regulation, Part II, Cargo Movement, Chapter 204, Hazardous Material.

Checkup

X Hazard class labels signify what when placed on a package?
X What markings are placed on the exterior of a package of hazardous material to identify the material?
X May oxidizing materials be packed in the same outside container with corrosive liquids?

SMALL PARCEL SHIPMENT

DEFINITION

The primary factors to keep in mind when defining small parcels are that weight, cube, and quantity play the big roles in establishing the requirements for shipment. A parcel may be described as a small wrapped package, box, bundle, or container.

Parcel Shipment Policy

The DOD supports the use of parcel carriers. Contractors are authorized to employ carriers for movement of small packages within the scope of guidance provided by DLA. Just as in the selection freight carriers, they must weigh all factors and choose mode and carrier according to dominant consideration. Their decision must accommodate these rules:

X In general, choice of mode and carrier depends upon a number of variables; weight, size, cost, urgency destination, and carrier service. This sequence does not necessarily imply order of importance. Any one factor or combination can determine choice.
X Consolidate parcels to common destinations if priority, delivery schedule, contract provisions, or other factors permit. The mechanics, of course, would consist of holding parcels for a reasonable length of time and combining them on a pallet or in a container for freight movement. Conversely, do not break up legitimate freight shipments to ship through small package channels.
X Each package must contain or have attached four copies of DD Form 250.
X Under no circumstances should items or materials be tendered to USPS or UPS that could be dangerous to life or health of their employees, the general public, or compromise the safety and security of mail/parcels. USPS Publication 52, entitled "Acceptance of Hazardous or Perishable Articles," identifies nonmailable materials and establishes requirements which must be met prior to placing other authorized hazardous items in the mail. *A publication by UPS, entitled "Guide for Handling Hazardous Material," contains packaging and labeling requirements as well as a long list of prohibited chemical products not necessarily reflected in 49 CFR.* UPS has designated as hazardous some items not so identified by DOT.

Parcel Carriers

There are several services which provide for small parcel shipment.

Parcel Post

Defined narrowly, parcel post should be viewed as any material or items tendered to USPS for delivery through USPS channels. There are many rules surrounding use of parcel post. The Congress of the United States sets forth conditions under which postal services are available to the public.

The availability of postal services

The Code of Federal Regulations, Title 39, sets forth service available, prescribes rates, fees, and conditions under which postal services are available. The Postal Service Manual contains regulations and procedures for both public and internal use. Chapter 1 covers procedures for use by the postal department, public, and authorized departments and agencies of the Federal Government.

Postal Services for Military Use

The postal services for military use are outlined in DOD Instruction 4525.8, Official Mail. The military post offices are designated as APO's and FPO's for OCONUS and by military activity for CONUS. Both follow the regulations and procedures set forth in the Postal Service Manual. Chapter 1 of the Postal Service Manual covers the parcel post procedure.

Shipment of Military Items

The shipment of military items by parcel post requires the same type of blocking, bracing, container selection, closure, and marking as previously covered in this document. Shipment of material by parcel post is desirable whenever shipments meet the requirements of the Postal Service. Material will be cleaned, dried, and preserved (as required), neutral or greaseproof wrap applied, and cushioning, blocking and/or bracing furnished as needed. Additionally, parcels addressed to overseas military post offices must be packed in boxes or containers constructed from metal, wood, plastic, or class weather-resistant, class waterproof, or water-vapor resistant fiberboard. Parcels containing mailable (nontoxic and nonflammable) gases, liquids, oils, paint, and substances which easily liquefy, must have sufficient absorbent cushioning material within the containers to absorb the contents in case of breakage.

Restricted and Nonmailable

The following items as shown in figure 4-46 are restricted and nonmailable to, from, or between overseas military post offices:

X Matches of all kinds, lighter fluid, or lighters containing fluid.

X Air shipments of magnetic material capable of producing sufficient magnetic fields to cause appreciable deviation to compass sensing device of an aircraft at fifteen feet or more (does no apply to surface shipments).

X Any package of radioactive matter which contains in excess of the quantities listed in the Code of Federal Regulations, Title 49 and United States Postal Services Publication No. 6., Explosives or ammunition.

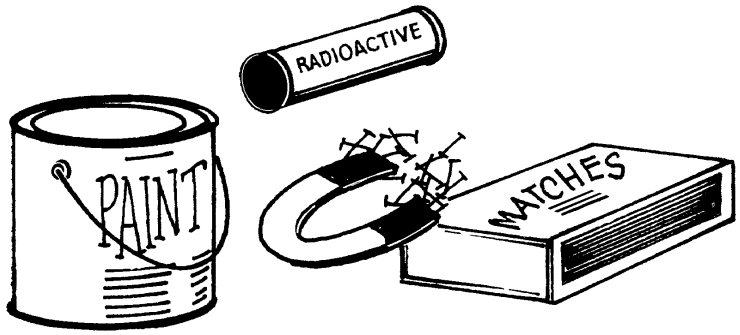


Figure 4-46. Restricted and nonmailable items.

Mailings Within the United States

Priority or first-class mail shall be used only for high-priority logistic shipments, such as 999 shipments, and Weapon System Pouches (WSP's). Priority or first-class mail shall also be used for Uniform Material Movement and Issue Priority System (UMMIPS) priority designators 01-08 shipments that are consigned to a location more than 300 miles from the shipper. UMMIPS priority designator 01-08 shipments consigned to location 300 miles or less shall be sent as third or fourth-class mail. All UMMIPS priority designators 09-15 shipments shall be sent third or fouth-class mail or held for consolidation as freight, whichever is less costly.

Mailing Overseas

Mailings to, from, and between overseas are via the MPS. Priority or first-class mail shall be used only for high-priority logistics shipments, such as, 999, WSPS and UMMIPS priority designators 01-08 shipments. All UMMIPS priority designators 09-15 shipments shall be sent by third or fourth-class mail or held for consolidation as freight, whichever is less costly.

Addressing and Marking

MIL-STD-129, Standard Practice for Military Marking, governs addressing and marking. Except for precautionary labels, packing list, or other markings required by regulation or statute, no other markings need appear on an outer wrap or container provided it is a supplemental container used for shipping purposes only and the enclosed container has the required identification markings. If a USPS mail pouch is used as the outer container for mailing of more than one package as a direct pouch to the addressee, each package in the pouch must have a parcel post label attached. Parcel post shipments to Army Post Office/Air Post Office (APO)/Fleet Post Office (FPO). APO/FPO parcel post shipment address shall be composed as follows. The DD Form 1387 shall be used as a parcel post address label and shall be completed as follows:

X TCN: Enter the 17-character (alphanumeric) TCN in both forms (bar coded and in-the-clear).
X Postage data: Use one of the following:

B For metered mail, leave blank and attach the stick-on metered postage values to or near this block.
B For permit imprint mail, enter the appropriate service/agency mail authorization.

Example: First Class Mail
Postage and Fees Paid
Defense Logistics Agency
Permit No. G-53

B For standard penalty indicia mail, enter the appropriate service/agency name or abbreviation and its sampling number.

Example: Postage and Fees Paid
Department of the Navy
DOD-316

X From: Enter the in-the-clear address of the shipping activity, including the zip code. The phrase "OFFICIAL BUSINESS, PENALTY FOR PRIVATE USE $300" must be printed on the bottom line of this block.
X Type service: Enter First Class- Priority Mail, Express Mail, Military Ordinary Mail, etc., as applicable.
X Ship to/POE: For CONUS mail, enter the complete address of the consignee, including the nine-digit zip code. For mail to overseas locations, enter postal concentration at DTS port or MILSTAMP Air/Water Port identifier (APO/FPO).
X Transportation priority: Enter appropriate transportation priority.
X POD: Leave blank.
X Project: Enter project code, if applicable.
X Ultimate consignee or Mark for: Enter DODAAC of consignee (bar coded and in-the-clear). For CONUS, no other data; for overseas shipments, add detailed address.
X WT. (this piece): Enter actual weight.
X RDD: Enter, if applicable.
X CUBE (this piece): Enter cube.
X Charges: Leave blank.
X Date shipped: Enter four-digit julian date (e.g., 8180) or the in-the-clear date (e.g., 29 Jun 88).
X FMS case number: Enter, if applicable.
X Piece number: Enter bar coded and in-the-clear.
X Total pieces: Enter number of pieces in the shipment unit.

Hazardous Materials

It is absolutely imperative that shipments do not violate the Postal Service Manual Part 124. This part defines material and substances which may not be transmitted through the USPS.

Weight and size limits

Packages are limited to not more than 70 pounds and 108 inches in length and girth combined. The minimum weight for a package to qualify for parcel post is 16 ounces. Two or more packages may be mailed as a single parcel, if they are about the same size or shape or if they are parts of one article. They must be securely wrapped or fastened together and must not, together, exceed the weight or size limit. To compute the size of a parcel as shown in figure 4-47. Measure the longest side to get the length. Measure distance around the parcel at its thickest part to get the girth. Add the length and the girth together.

United Parcel Service

UPS is an acceptable carrier which offers parcel delivery service. For some weight categories, UPS rates may be lower than USPS. In addition, UPS provides routine tracing capability and proof of delivery. The shipper may use UPS if the following conditions have been satisfied:

- X The package meets all shipping criteria of the carrier-including weight and size limitations as shown in table 4-1
- X The company is willing to absorb the UPS service charge since the DOD will not reimburse that expense.

Less Truckload (LTL) Shipments

This mode is available for surface movement when USPS or UPS cannot handle the shipment configuration. Due to its high minimum rate, however, LTL, as a carrier of small packages, should not be used unless absolutely necessary.

Federal Express Corporation

Federal Express is an acceptable carrier which offers small parcel delivery service. For size and weight limitations, see table 4-1.

Commercial Air

Choice of commercial air in connection with small parcels is governed by a number of factors.

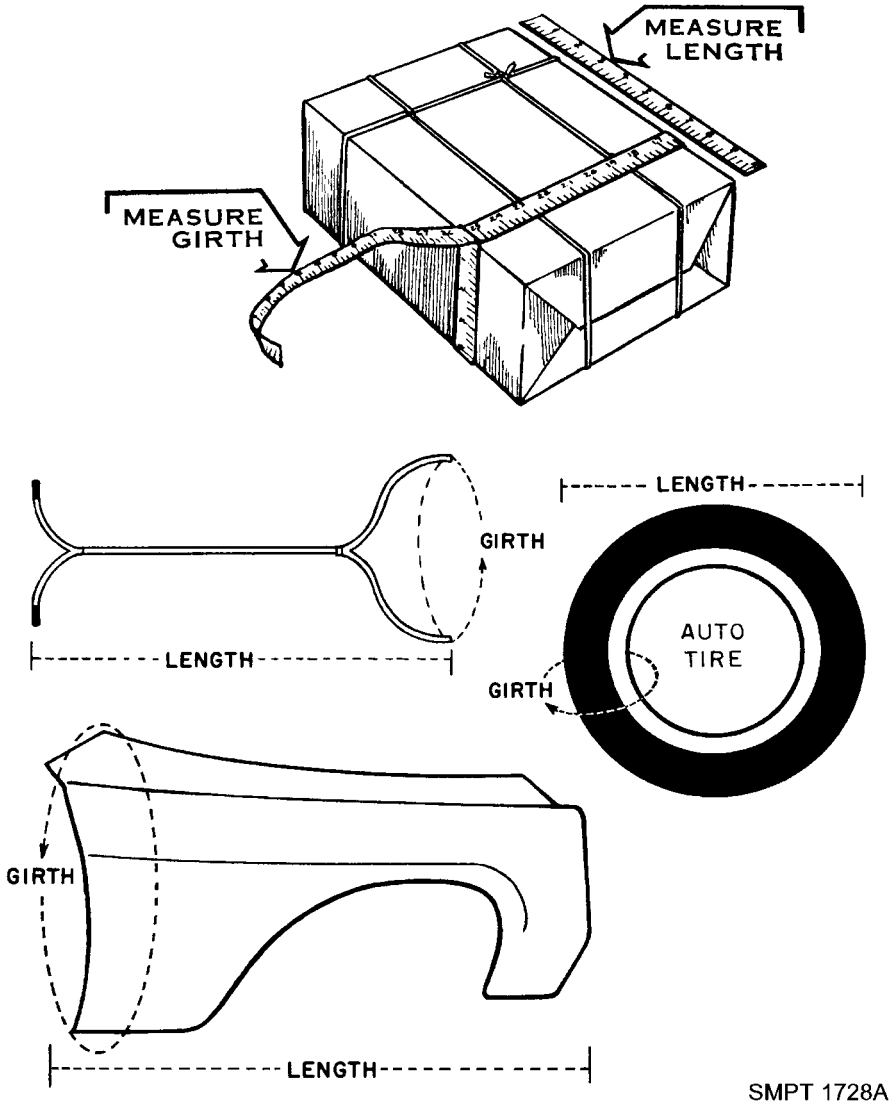


Figure 4-47. Post office measurement requirements.

Justification

Air shipments must be fully justified. TP 1 or 2 in the contract or specific instructions from the PCO or ACO is sufficient provided that surface transportation will not meet the time standard.

Distance

At no time should you use commercial air if the delivery point lies within 300 miles of the origin point. As in routing generally, selection of air carriers depends upon such factors as service, cost, weight per day. Scheduled airlines have larger size and weight criteria. Do not attempt to route hazardous, classified, or sensitive material without contacting the Transportation Office for a routing. This is important for applicability of DOT requirements.

Table 4-1. Parcel Carriers size and weight limitations

Carrier	Weight (16 ounces or more but not exceeding)	Size (Length and Girth may not exceed)
U.S. Postal Service	70 lbs*	108 in*
United Parcel Service	150 lbs.	130 in.
Federal Express Corporation	150 lbs.	165 in. (length may not exceed 119 in.)

* Maximum weight and size limits between First Class Post Offices are 40 lbs and 84 in.
Note: Shipments by air are limited to $25,000 value in merchandise.

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By Order of the Secretary of the Army, the Navy, the Air Force, the Marine Corps, and the Director, Defense Logistics Agency:

Official:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff



JOEL B. HUDSON
Administrative Assistant to the
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