Cushioning Material, Flexible Open Cell Plastic Film (A-A-3129)

This material, available in sheets and rolls, is intended for use within packages. Transparent materials are especially suitable for use in inserts within transparent bags and envelops to permit inspection of the contents. The materials are also used as bags, wraps, dunnage and as filler. Maximum transparency is obtained when use is limited to one thickness. Material may be ordered in two types, two styles, two classes, and three grades. Grade B of this material is static dissipative.

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

This is a resilient cushioning material of expanded polymer of copolymers of styrene for use in cushioning and packaging applications. It is available in two types: type I - sheet form, classed as soft, medium, firm, and extra firm, and type II - roll form, with the same classes as type I. 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, abrasion, and concentrated forces during handling and shipment. It is especially suited to packing problems where a high degree of energy absorption is required in a minimum space and with a minimum weight of cushioning and to packing problems in which the cushioning material must perform at extremely low temperatures. Resilient polystyrene cushioning material may be furnished in special converted forms, sizes, and shapes, such as with paper backing, paperboard backing, cloth backing, pressure-sensitive adhesive surface, die-cut holes or in the form of corner pads of special shapes. This material has a high compression set.

Cushioning Material, Closed Cell Foam Plank (A-A-59136), Polyethylene And Other Poloyolefin Cushioning Materials

This specification establishes requirements for flexible closed cell foam plank material. These materials are intended for use within packages to protect items from damage due to shock, vibration, concentrated forces, contamination and abrasions during transit. The Class 1 Polyethylene plank is inert to most chemical products and stable across a wide variation of temperature ranges. This type (formerly know as PPP-C-1752) has been widely applied to protect many types of military products for worldwide shipment and unknown storage conditions. Reliable and stable in the plank form, it is a very cost-effective selection for a wide range or products. The other classes available are intended to provide the use with options in procurement of other closed cell plank cushioning materials. Refer to MIL-HDBK-304 for specific application guidance.

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

This material, furnished in rolls, sheets, or molded shapes, is available in two types, two classes, and three grades per type as follows:

Type I - Standard Foam	Type III - Anti-static Foam
Class 1 - Rigid	Class 1 - Rigid
Class 2 - Flexible	Class 2 - Flexible
Grade A - Blue	Grade A - Yellow
Grade B - Green	Grade B - Red
Grade C - Charcoal	Grade C - Brown

Materials covered by this specification (see figure 4-11) are intended for use as cushioning and blocking/bracing in packages to protect equipment and items from damage by shocks or impacts incurred during shipment and handling. Unless otherwise specified (when ordering the material), the compression set of class 2 material shall not be more than 10 percent of the original thickness.

Figure 4-11. Polyurethane foam.

Cushioning Material, Packaging (Flexible Closed Cell Plastic Film for Long Shipping Cycle Applications) (PPP-C-795)

This specification establishes requirements for flexible closed cell, heat-sealable, non-corrosive, plastic film for use in cushioning and packaging applications. The cellular materials are intended for use within packages to protect items from damage due to shock, vibration, concentrated forces, contamination, and abrasion during handling and shipment. The transparent class 1 material and class 2 material permit inspection of the contents, without opening the package, for condition of humidity indicators. The flexibility of the material permits it to be used as pads, bags, wrap, dunnage, or filler. When maximum transparency is desired, the use of class 1 or class 2 material should be limited to one thickness. Class 2 materials are used to protect electronic devices which are sensitive to static charges. Class 3 material is used where fire retardant cushioning material is required.

METHODS OF CUSHIONING

Cushioning is usually accomplished by any of four methods or a combination thereof. The methods are known as floated item, floated pack, corner pads and side pads, and shock mounts.

Floated Item (figure 4-12)

The item is floated in cushioning material and placed within a unit container. This is perhaps the method most commonly used for cushioning small, lightweight, fragile items against shock, vibration, and abrasion. Cushioning materials must be secured about the item. Loose cushioning may result in either the displacement of the material when the pack is subjected to shock, its disintegration under repeated vibration, or the production of dust or loose particles which will be entrapped within the pack. Since a container may be dropped on any one of its faces, edges or corners, the cushioning material must be designed to withstand the full impact of the entire weight of the item in any direction.

Figure 4-12. Methods of cushioning - floated item.

Floated Pack (figure 4-13)

The item is packed in an interior container which in turn is floated in cushioning material. This method is generally used in connection with semi-fragile 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. In this method, the noncorrosiveness and moisture content of the cushioning materials are not critical since the materials will not come in contact with the item. The use of absorbent cushioning materials, when used in this method, should be governed as follows:

- X When both the interior and exterior containers are water-resistant, the cushioning material may be simply placed between the two containers.
- X When either container is nonwater-resistant, the cushioning material must be placed in the form of pads wrapped in a water-resistant barrier material. Alternately, provide the interior container with a sealed water-resistant wrap and the exterior container with a sealed liner. The cushioning material is then placed between the two barriers.

Corner Pads and Side Pads

In cases where a full floated item or pack is not justified either because of weight and size or fragility of the item, corner blocks or side pads may be utilized. Corner blocks are used where a minimum amount of material is required to cushion the item. The total surface area of cushioning material for a side is determined, then divided by four. This gives the amount of material for each corner. This is done in turn for all six surfaces. Corner pads are also used where the only requirement of the cushioning is separation of the item from the container.

When the amount of the cushioning material required is too great for proper utilization of corner pads, the use of side pads is indicated. The amount of material per side must be of sufficient quantity as to preclude buckling.

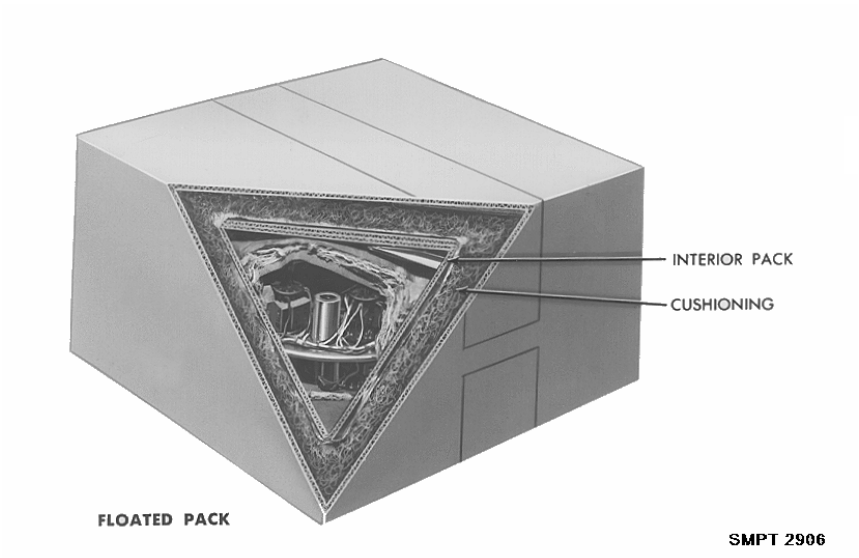

Figure 4-13. Methods of cushioning - floated pack.

Shock Mounts (figure 4-14)

The item is cushioned by means of shock mounts. 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 metal springs with damping, shear mounts, or corner blocks. This method of cushioning may be accomplished in four main ways -

- X The item may be suspended directly by the means of shock mounts.
- X The item may be blocked in a cradle and the cradle suspended by means of shock mounts.
- X The item may be boxed in a unit container and the unit container suspended by means of shock mounts.
- X The item may be boxed in an intermediate container and the intermediate container suspended by means of shock mounts.

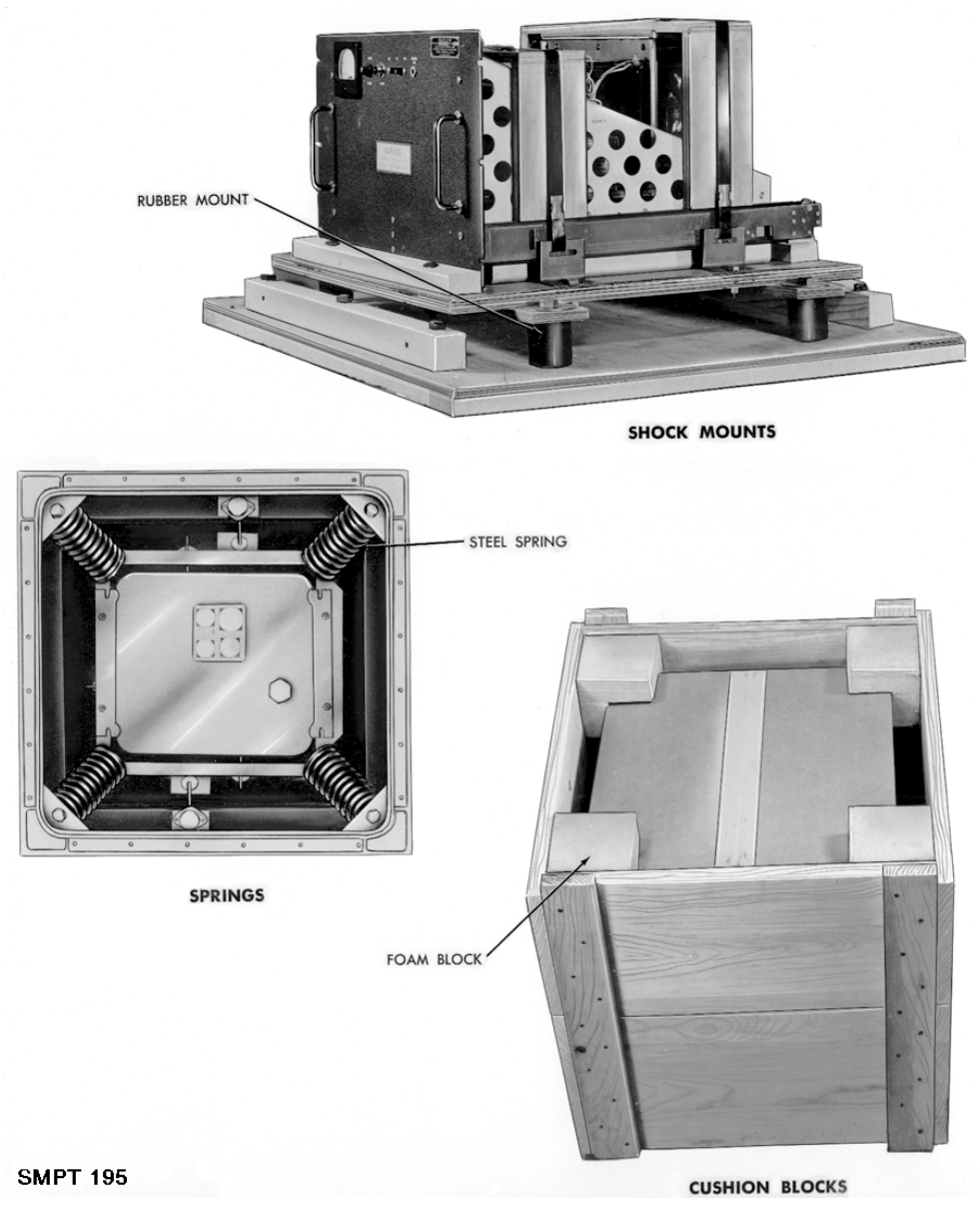

Figure 4-14. Methods of cushioning - shock isolators.

HEAT SEALING

IMPORTANCE OF HEAT SEALING

Since World War II, the development of flexible heat sealable barrier materials for military purposes has proceeded at a rapid pace. Scores of barrier materials have been produced for packaging everything from small instruments to jet airplane engines. These barrier materials have been designed to insure long term storage of military supplies under all climatic conditions. They have been constructed to keep preservative oils and greases in contact with metal surfaces and to keep water and water vapor out of the interior of packs. Regardless of how good the barrier material may be, if the pack is not adequately closed and sealed, the contents may arrive at their destination in an unusable condition. One of the problems confronting personnel engaged in military packaging operation is to obtain good heat seals when using heat sealable barrier materials. In the following paragraphs, the basic requirements, methods, and equipment necessary to obtain good heat seals will be discussed.

MILITARY REQUIREMENTS FOR HEAT SEALING

All heat seals performed on heat sealable barrier materials must meet the following three basic requirements:

- X The heat seal must not leak.
- X The heat seal must give the same degree of waterproofness, vaporproofness, or greaseproofness as required of the barrier material itself.
- X The seal must pass the test described later in this chapter.

HEAT SEALABLE BARRIER MATERIALS

Construction (figure 4-15)

To understand the factors essential to proper heat sealing and the equipment needed to produce acceptable heat seals, a general knowledge of the construction of the materials involved is helpful. Most of the heat sealable barrier materials used by the military are composed of several layers or plies of unlike materials laminated together to form a multi-ply or built-up sheet. The general structure of such a built-up sheet or barrier is a heat sealable face, an impervious ply, and a backing ply.

The Heat Sealable Face

This face may be a ply (film) or a coating. This is a thermoplastic material which has the ability to become semi-fluid and flow upon the application of heat. After cooling, the plastic returns to a normal, solid, flexible state. This facing material is made from polyethylene, vinyl chloride, or other plastics. Besides providing a heat sealable face, this material also serves to fill tiny pin holes in the underlying plies to aid in making the barrier resistant to water, grease, or vapor.

The Impervious Ply

This is composed of a metal foil (aluminum) or plastic film (polyethylene, cellulose-acetate, etc.). It gives the whole barrier its greaseproof, waterproof, or watervaporproof properties. This ply may also serve as a heat sealable ply in some types of barrier materials.

The Backing Ply

Usually, this ply is made of cotton cloth (scrim), other fabric, or kraft paper. This ply may be reinforced with glass fibers or other materials. The purpose of this ply is to increase the resistance to abrasion, wear, and puncture, and to improve the tensile strength of the whole sheet.

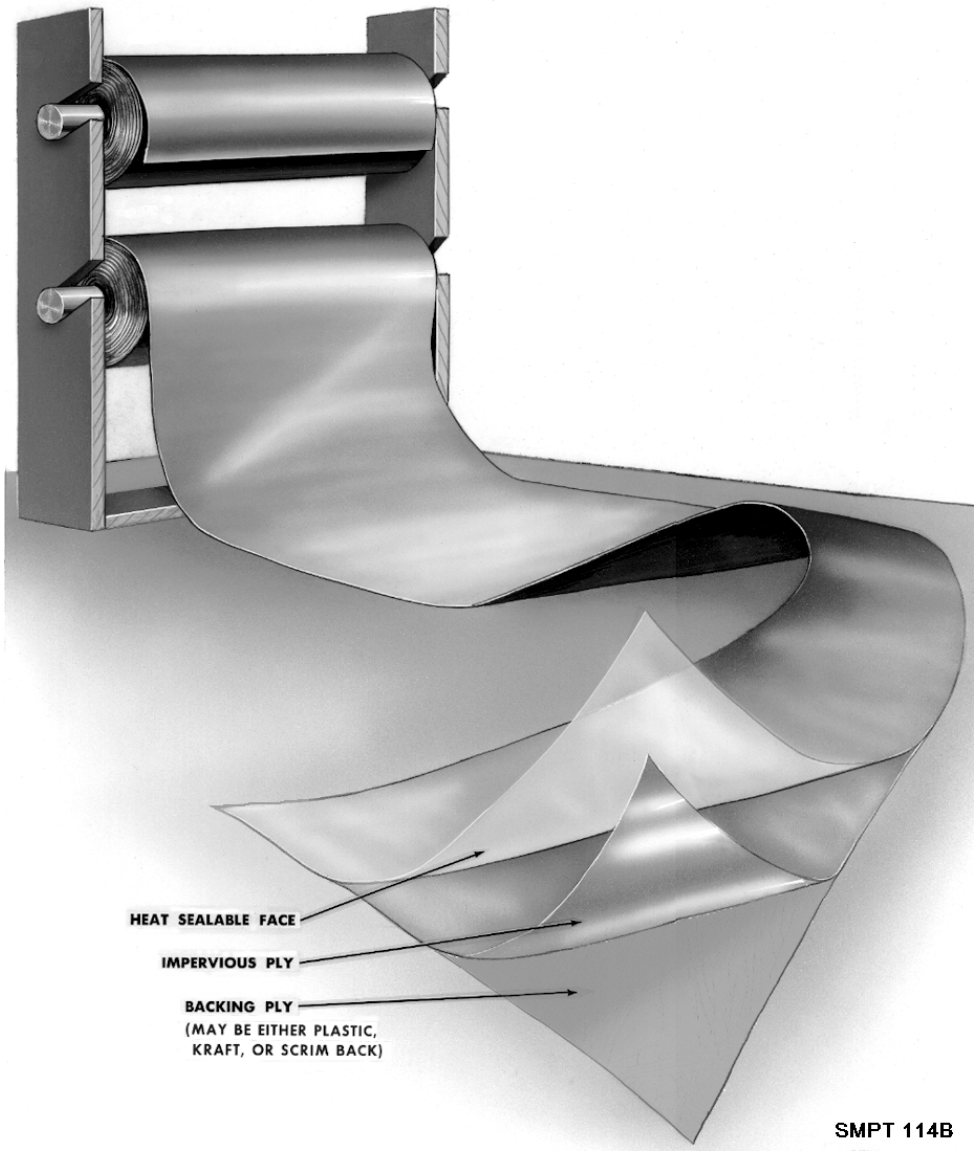

Figure 4-15. General structure of heat sealable barrier materials.

Common Types of Heat Sealable Barrier Materials

Heat sealable barrier materials offer protection from liquid water (waterproof), watervapors (watervaporproof), grease (greaseproof) and electrostatic discharge (electrostatic free). The protection provided, along with specification numbers for the barrier materials are -

- X Waterproof: A-A-3174, Type I or II; and MIL-PRF-22191, Type III.
- X Waterproof-greaseproof: MIL-B-121, Type I or II, and MIL-PRF-22191, Type II.
- X Waterproof-electrostatic free: MIL-PRF-81705, Type II or III.
- X Watervaporproof-greaseproof: MIL-PRF-131 and MIL-PRF-22191, Type I.
- X Watervaporproof-electrostatic free: MIL-PRF-81705, Type I.

FACTORS ESSENTIAL TO PROPER HEAT SEALING

To produce heat seals that can meet the military requirements there are three essential factors that must be considered and fully understood. These are the temperature, the pressure, and the dwell time. These factors are independent but fully interdependent of each other. If one factor varies, the other two must be adjusted for proper correlation.

Temperature

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. Too low a temperature may result in either no seal being made or a weak seal (adhesive tack). Too high a temperature may cause delamination or separation of the backing ply from the other plies and/or decomposition of the thermoplastic. Barrier materials, generally, must be capable of being heat sealed at a temperature not to exceed 525ºF. Manufacturers of heat sealable barrier materials are required to supply recommended temperatures for effective sealing of their materials on the different types of equipment authorized by the Military.

Dwell Time

Dwell Time is the length of time material remains in the heating zone. Enough time must be permitted to raise the temperature of the heat sealable face to 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 the dwell time and vice versa, provided the limits for each factor are not exceeded. As an example, a particular barrier material, when sealed at a temperature of 450ºF., requires a dwell time of 2-1/2 seconds to produce heat seals with maximum strength. The same material, sealed at 400ºF., requires a dwell time of 3 seconds to produce seals with the same strength characteristics. With the exception of special equipment, no dwell time below 1/2 second will produce a good heat seal regardless of the temperature used.

Pressure

Pressure is what brings the surfaces to be sealed into intimate and continuous contact, thereby aiding in the heat flow through the backing material (e.g., scrim or kraft) to the thermoplastic surfaces. Excessive pressure tends to force out the molten thermoplastic material and results in defective seals. Pressure should be maintained at 40 to 80 P.S.I.

HEAT SEALING EQUIPMENT

Heat sealing equipment can be divided into two general classifications, unit or jaw 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. Specification A-A-2963 covers both unit and continuous type heat sealers intended for heat sealing thermoplastic film (unsupported) and barrier (supported) materials. All machines covered by this specification must have adjustable, directly calibrated controls to regulate the temperature, dwell time, and pressure.

The Unit or Jaw Type Sealer (Figure 4-16)

This type of sealer comprises 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 temperature is controlled by means of a thermostat. The dwell time is controlled by the duration of pressure, either manually or by automatic timing devices. The pressure is usually controlled by a spring or by a pressure cylinder actuated by pneumatic or hydraulic power. The jaws of a unit type sealer are sometimes covered or coated with a antistick facing material to prevent adhesion of plastic films to the hot surfaces. 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 Continuous Type Sealer (figure 4-16)

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, the sealers 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. 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 to feed the material into the sealer and a discharge unit to guide the material out of the sealer after it had been sealed. Some sealers employ "preheaters" to precondition the temperature of the thermoplastic prior to sealing.

Band Type Sealers

Band type 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. 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. The temperature is thermostatically controlled. The dwell time is controlled by varying the speed of the bands through the heating zone. The 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 or hydraulic power, or both.

Hot Air Continuous Heat Sealer

The hot air continuous sealer provides a much higher efficiency along with reduced setting up and maintenance time. The unsealed bag is fed into the sealer guides, where it is gripped by two belts and is carried through a heating section. Here, opposing streams of hot air strike the bag sides along a narrow band, causing a heated bond to be formed on the inside surfaces of the bag. After heating, the bag immediately passes through two pressure rollers to complete the weld. The hot air temperature is controlled by a proportional control circuit. The temperature is set on the control panel by the operator.

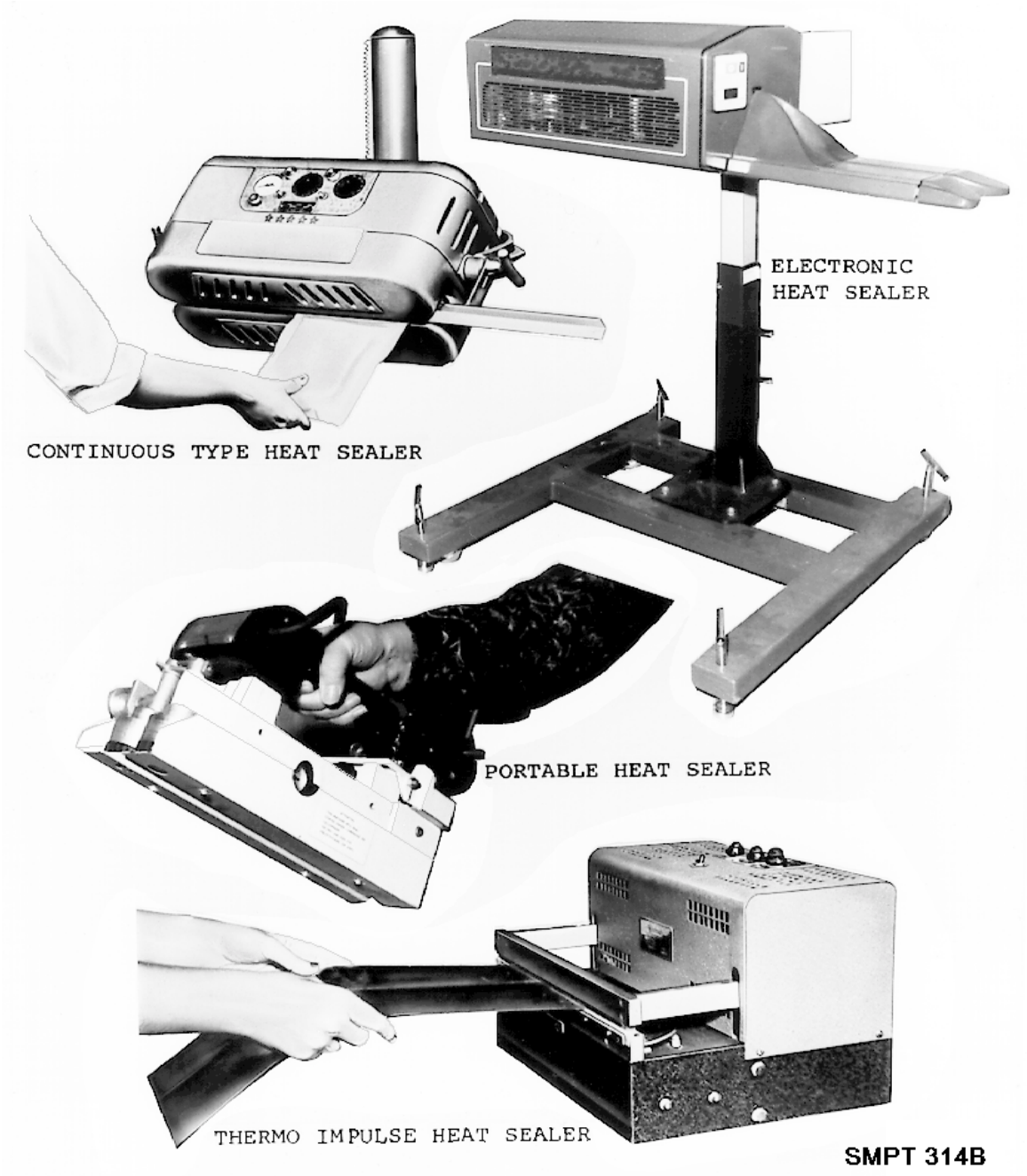

Figure 4-16. Heat sealing equipment.

OTHER TYPES OF HEAT SEALERS

There are other types of heat sealing machines which are used primarily for sealing of unsupported films. A brief description of two of these follows:

Electronic Type

This 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.

Electrical Impulse Type (Figure 4-16)

This machine, which is covered by A-A-2953, looks like a conventional jaw type sealer and operates mechanically the same way, except that an electrical resistance wire is mounted on one of the sealing jaws. The electrical resistance wire, when brought in contact with the material, is heated in a fraction of a second by a heavy current flow and melts and fuses the thermoplastic. The jaws remain closed after the flow of current, thus cooling the seal under pressure. Polyethylene, vinyl, polystyrene and polyester are some of the films commonly sealed with electrical impulse type sealers.

DETERMINATION OF TEMPERATURE, DWELL TIME, AND PRESSURE

Several methods are used to determine starting points for achieving satisfactory heat seals. Two such methods are the manufacturer's recommendations and trial and adjustment.

THE MANUFACTURER'S RECOMMENDATIONS

Manufacturers' recommendations are furnished with each roll of barrier material; these include the recommended temperature, dwell time, and pressure to be used on rotary, band, and jaw type equipment. These recommendations will usually give a good indication as to the settings to be used in the initial attempt to heat seal. The recommended values should be used cautiously because some thermoplastics and adhesives change characteristics upon aging; recommended values for one type of sealing machine do not apply to all machines of the same type; and machines of the same make may vary in temperature, dwell time, and pressure at identical settings.

TRIAL AND ADJUSTMENT

If satisfactory heat seals are not obtained by following the manufacturers' recommendations, or if the recommendations are not available, the temperature, dwell time, and pressure should be determined by the following trial and adjustment method. Set the heat sealing machine controls for dwell time at 250 to 500 increments of temperature starting at about 250ºF for kraft-backed sheets and 300EF for scrimbacked sheets. After cooling the sealed specimens to room temperature, pull each specimen slowly apart by hand and observe the following:

- X Degree of difficulty in separating the sheets of barrier material.
- X Delamination of the heat sealable face from the other plies of the barrier, and the extent of delamination.
- X Color changes on the heat sealed area of the backing material, such as scorching, burning or charring, which indicate too high a temperature.

The correct temperature to use is the lowest temperature at which the heat sealable face completely pulls away from the other plies of the material.

CONSTRUCTION OF METHODS OF PRESERVATION

GENERAL CONSIDERATIONS

Item Protection

The method selected must adequately protect the item from corrosion, deterioration and physical function damage during storage and multiple handlings and shipments associated with the military distribution system. Physical and mechanical function protection is required for all methods of preservation in addition to the specific environment protection provided.

Cushioning and Dunnage

When specific methods require using a bag or container, the preliminary wrapping, cushioning or other dunnage material shall be applied as necessary to protect the item as well as the bag and the container from the item's projections and sharp edges as well as to restrict its movement within the unit pack. All cushioning and dunnage used shall be as clean and dry as practicable to minimize item susceptibility to corrosion and contaminants.

Surfaces Coated with Preservative

Preliminary wrapping materials in contact with the preservation coated item shall be greaseproof and shall conform to the following:

X MIL-B-121, Grade A
X QQ-A-1876.

Preliminary greaseproof wraps applied solely to confine the contact preservative on item surfaces are not necessary when a method requires a bag as the preliminary container and the bag is made of material conforming to MIL-B-121, grade A; MIL-PRF-131; or MIL-PRF-22191, type I or II. However, wraps will not be excluded if necessary to protect the bags from rupture or perforation.

Metal Surfaces not Coated with Preservatives

Only noncorrosive wrapping, cushioning and dunnage materials meeting the test requirements of Test Method 3005 of Federal Test Method Standard No. 101 shall be used in contact with metal surfaces of the item. The following neutral wraps meet this requirement:

X MIL-P-130
X MIL-P-17667.
X A-A-3174.
X A-A-1249

These papers are intended as an initial wrap where a noncorrosive, dust protective wrap is required prior to or as a part of unit packing wherein a greaseproof wrap is not required.

Weight and Cube

Unit packs (methods) shall be designed to minimize weight and volume (cube) to the maximum extent practicable.

Use of Transparent Materials

Where methods allow options in the selection of materials which include both transparent and opaque protection, transparent protection may be furnished at the option of the supplier but is not required unless specifically called for in the contract or order. When a transparent unit pack is specified, the preliminary wrapping, cushioning materials, etc., shall also be transparent.

Critical Surfaces of Metal Items

Do not touch critical surfaces of metallic items with your bare hands during packaging operations as these items are of such a nature that any degree of deterioration will result in premature failure or malfunction of the item or equipment in which installed or to which item is related. Either wear gloves (rubber or canvas) or handle these items with neutral wrapping material so as not to contaminate the item with perspiration, fingerprints, or similar residues.

Electrostatic Discharge Sensitive (ESDS) Items

People handling ESDS items should be trained in ESD precautionary procedures. Untrained personnel should not be allowed to handle ESDS items when the items are outside the ESD protective packaging.

ESDS items should be removed from ESD protective packaging using finger or metal grasping tool only after static charges are neutralized. Neutralize charges of ESD protective packaging containing an ESDS item by placing the packaged item on an ESD grounded workbench.

Alternately, charges can be neutralized by personnel wearing a grounded wrist strap touching the package.

Safety and Health

The Occupational Safety and Health Administration (OSHA) established a Hazard Communication Standard entitled 29 CFR, Parts 1910.1200. This workers-right-to-know standard was written to reduce injuries or illnesses caused by personnel working with or exposed to chemicals. Workers need to know the chemical hazards they are exposed to and the safe practices linked with those chemicals used in the work place.

Many of the cleaning materials and preservatives used with the methods of preservation are chemicals that require Material Safety Data Sheets (MSDS) to let workers know the potential dangers they present if not properly used.

29 CFR tries to make certain that you understand chemical safety. The standard mandates that employers meet the following requirements:

- X Containers of hazardous materials must be properly labeled.
- X Training programs must be established to assist employees in using chemicals safely as well as to enable them to deal with an emergency in containing or neutralizing a spill.
- X A MSDS must be available at all times.

A MSDS identifies chemical substances or mixtures by trade name and chemical name. It also names the hazardous properties of the chemical. A MSDS contains safe conditions for handling hazards of a material plus procedures for dealing with an emergency including first aid procedures. Material Safety Data Sheets are a legal requirement as well as a source of efficient information in a safety program.

MSDS and/or Hazardous Material Information System (HMIS) files must be provided for each chemical/hazardous material that you will be working with during packaging operations.

Review the applicable MSDSs or HMIS files of the chemicals that you work with to insure that you are aware of the following information:

- X The chemicals being used.
- X Protective apparel to be worn while working with each chemical, i.e., aprons and goggles.
- X Health hazards, i.e., symptoms of exposure.
- X Safety procedures that should be followed, i.e., use of ventilation systems and reactions to leakage or materials spills.

X You should report all spills of chemicals to your supervisor or as required by your local standard operating procedures.

METHOD 10 - PHYSICAL PROTECTION

CONCEPT

The unpreserved item(s) shall be tagged, bundled (i.e., tied, taped, strapped, etc.) skin packed, enclosed within wrappings, bags, cartons, boxes or other containers, as applicable to provide protection from physical damage and mechanical malfunction.

As the name of this method implies, it provides physical and mechanical protection only. No protection is afforded the item against the entry of water, watervapor, fumes, atmospheric gases, or the growth of microorganisms. No contact preservatives are authorized for this method of preservation.

Protection against climatic and atmospheric conditions is not provided because the items packed by Method 10 are, by the characteristics of their construction and composition, immune to such conditions.

If the item to be packed needs a contact preservative or a barrier such as a waterproof material to protect it, then Method 10 is not an appropriate method of preservation for the item.

Intended Use

Method 10 is a method of preservation for items of a chemically noncritical nature made of corrosive-resistant metals or inert nonmetals such as crockery, ceramics or nonoptical glass or items rendered deterioration-resistant by the application of metal platings, paint, prime coatings, plastic coatings, or similar treatments or finishes. Items appropriate for Method 10 preservation include motor vehicle bumpers, tires, and windshields; tent pegs and poles; wire fencing; and many other items designed to be used in an unprotected environment.

CONSTRUCTION STEPS AND TECHNIQUES

A variety of techniques used in the construction of Method 10 unit packs is provided below. These techniques include forming unit packs that are bundled (i.e., tied, taped, strapped, etc.), skin packed, or enclosed within wrappings, bags, cartons, boxes or other containers, as applicable, to provide protection from physical damage and mechanical malfunction. It is neither practicable nor possible to present detailed information on all of the Method 10 applications. Several of the most common applications are given below. Figure 4-17 illustrates some of these techniques.

Method 10 (bundling)

Bundling is appropriate for items of military supply such as lumber, tent-poles and stakes, rods, metal and nonmetal pipe, tubes, automobile bumpers, and rolls of material such as wire or roofing. The following steps should be followed:

Step 1

Clean and dry the item as required.

Step 2

Apply cushioning or dunnage or wrap (or blocking and bracing) to individual item(s) that are damageable. Materials will be clean and as dry as practicable.

Note: Also apply protective pads (i.e., cushioning or fiberboard) between the item and the bundling material as required to prevent the strapping, wire or twine from inflicting damage to the item(s).

Step 3

Tie or strap or tape the item(s), as applicable to form the unit pack. Bundling materials available include (but are not limited to) the following:

- X A-A-1451 (twine, cotton, up to 48 lbs breaking strength).
- X A-A-228 (twine, jute, up to 370 lbs breaking strength).
- X T-R-650 (rope, up to 18,600 lbs breaking strength).
- X T-R-605 (rope, up to 95,000 lbs breaking strength).
- X ASTM D 3953 (steel strapping, up to 47,150 lbs, depending on width and thickness).
- X ASTM D 5330 (filament reinforced tape, up to 400 lbs per inch of width breaking strength).

Note: Refer to specific specification (or ASTM) for use and limitations of bundling materials.

Step 4

Apply markings according to MIL-STD-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see the example of unit pack markings in figure 4-46.

Method 10 (Cartonizing or Boxing)

This technique involves enclosing the item cleaned, dried, cushioned, blocked and braced, as required, in a carton or box. Contact preservatives are prohibited as well as barriers that afford protection from the environment. Remember that any and all techniques used in Method 10 preservation protects the item from physical and mechanical damage only.

Step 1

Clean and dry the item as required.

Step 2

Apply cushioning materials, dunnage, blocking and bracing as required to protect the item(s) and the enclosing box or carton and to restrict the movement of the item within the container. (Note: See "METHODS OF CUSHIONING" presented earlier in this chapter).

Note: When the unit pack quantity is greater than one, individual items that are damageable should be wrapped, e.g., MIL-B-130, for protection.

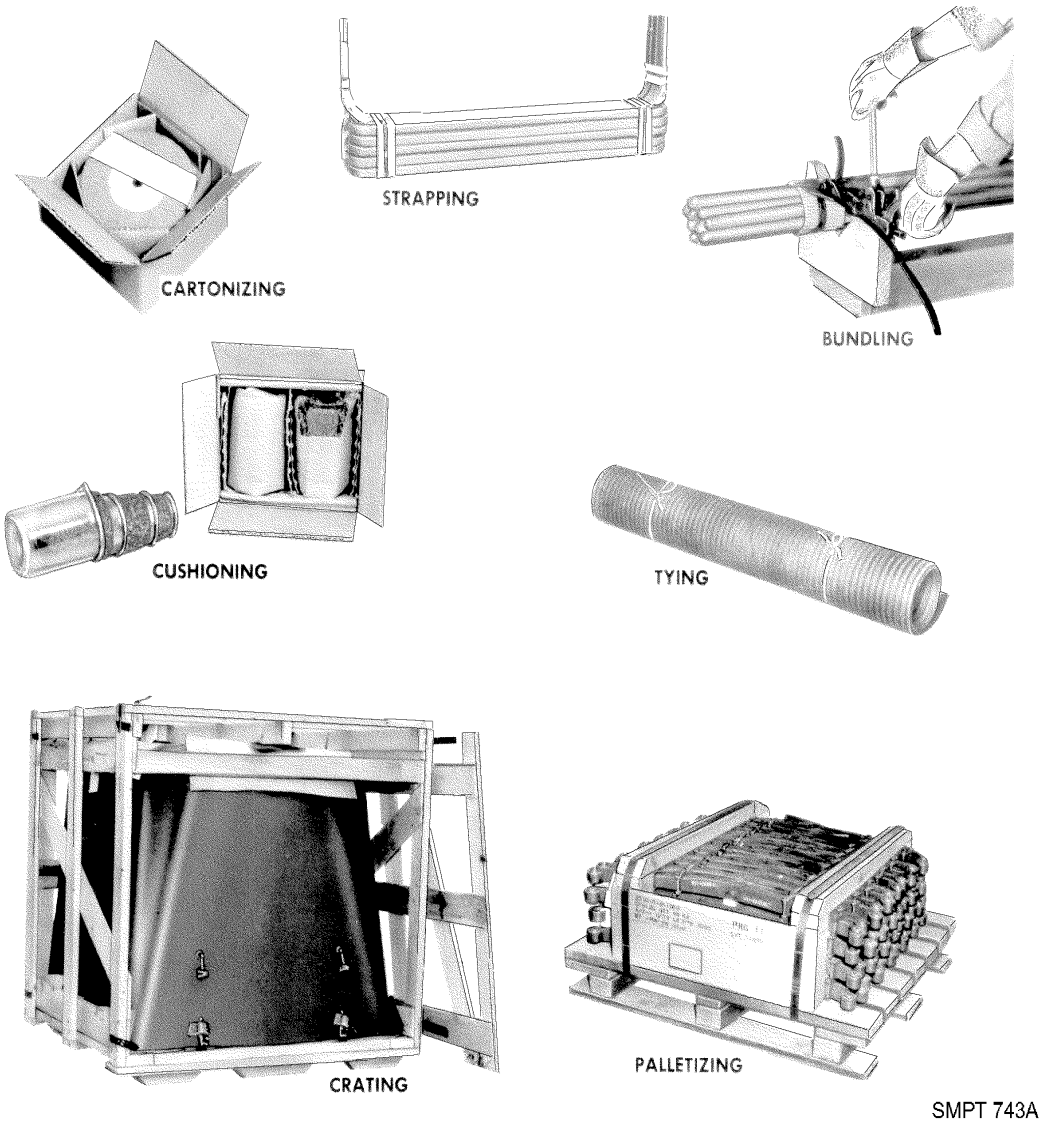

Figure 4-17. Application of Method 10.

Step 3

Enclose the item (cushioned as required) into a carton or box selected from MIL-STD-2073-1C, as appropriate (containers given in chapters 6 and 7 are examples). The following cartons and boxes (see chapter 6) are commonly used:

X Fiberboard Boxes.
X Folding Boxes.
X Set-up Boxes.
X Metal-edged Paperboard Boxes.

Note: Information of the use and closure of these boxes is given in chapter 6 of this manual.

The following types of reusable cushioned boxes (Fast Packs) are designed for items of various shapes and sizes and are also authorized for Method 10.

- X Type I - Vertical star packs.
- X Type II - Folding Convoluted packs.
- X Type III - Telescoping Encapsulated packs.
- X Type IV - Horizontal Star Packs.

Note: See the different styles and available sizes as well as box closure information concerning Fast Packs in chapter 8.

Step 4

Apply markings according to MIL-STD-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see the example of unit pack markings in figure 4-46.

Method 10 (Other Techniques)

There are several other techniques that may be used to accomplish Method 10. These include skin packing, bagging, and wrapping. Skin packing will be covered in detail next in this chapter under the paragraph entitled "THERMOFORMED PACKING" as a separate entity, although you must remember that thermoformed packing is authorized as a technique used in Method 10. If skin packing (an example of thermoformed packing), bagging or wrapping is used, you must remember to mark the pack in accordance with MIL-STD-129 as you would any other method of preservation presented in detail earlier in this chapter.

THERMOFORMED PACKING

Thermoformed packaging is packaging which employs thermoplastics which may be drawn tightly against the item, as in skin packaging, or molded to the approximate configuration of the item, as in bubble packing, by heating the plastic to its softening point and draping it about the item or mold. Examples of the films used are flexible vinyls, acetates, butyrates, styrene, polyester films, and polyethylene.

THERMOFORMING

The most common method of thermoformed packing is known as vacuum forming. This method employs a machine capable of performing two functions basic to the method, i.e., the creating of a vacuum and the application of heat to transparent material used for the packing. In addition to the transparent film, there is usually employed a backing or mounting board. Figure 4-18 is an example of a typical machine used for developing vacuum formed packs.

VARIATIONS OF THERMOFORMING

There are three variations of the thermoformed pack, the "skin" pack, the "blister" pack, and the "shrink" pack.

Skin Pack

The skin pack is so named because, as a result of the process, the transparent film is drawn tightly around the item being packed, forming a skintight protective covering. In forming this pack normally a backing board is used on which to mount the item and to which to heat seal the transparent film. This backing board extends from within a few inches of the heating unit in its forward position to an immediate proximity to the platen. In the uppermost position, heat is applied to the transparent film by drawing the heating unit over it. When the transparent film has been adequately heated, the clamping frame with the softened film is dropped to the lower position, bringing the film in direct contact with the item being packed. Simultaneously, a valve is opened allowing the air beneath the transparent film and surrounding the item to surge into the vacuum tank, thus permitting the atmospheric air pressure to force the film down tightly to the backing board and tightly around the item. When the film cools, it forms a sealed covering over the item.

Figure 4-18. Vacuum forming machine.

Blister Pack

The blister pack, sometimes known as the "bubble" pack, varies from the skin pack in that the transparent film is performed around a mold, resulting in a configuration being imparted to the transparent film which approximates the general contours of the item to be packed. This performed, rigid blister or bubble is usually formed with a flange either 1/4 or 1/2 inch in width. This flange permits the stapling, gluing, or sealing of the blister over the item to the backing. Figure 4-19 illustrates the basic components of the blister pack.

Shrink Pack

The shrink pack, unlike the two previous methods of packing, employs no vacuum but instead uses a heat tunnel and transparent films with a built-in memory. The item to be packed is wrapped in the film and then passed through the heat tunnel, where the heat shrinks the film (memory effect) to form a contour-fit pack.

PROTECTION AFFORDED

The packs resulting from the application of the above techniques can generally be considered to provide, as a minimum, Method 10 protection. Methods 30, 40, and 50 protection may be afforded by making such provisions as will insure the impermeability of the package to water or water vapor.

DEVELOPMENT AND APPLICATION

The above description of thermoformed packing serves mainly as an introduction to this type of packing. Further research of technical manuals, pamphlets, and texts, is necessary in developing a particular type of pack or in establishing thermoformed packing at a facility. See figure 4-20 for variations of plastic packages.

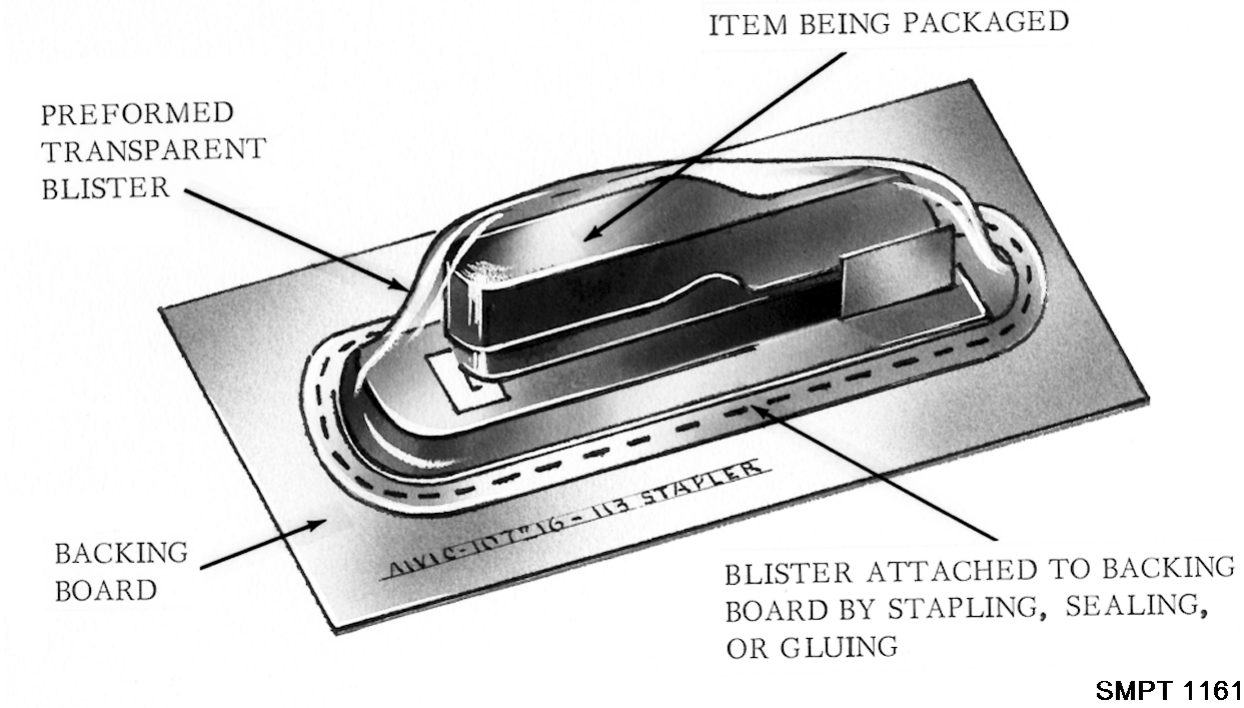

Figure 4-19. Blister pack.

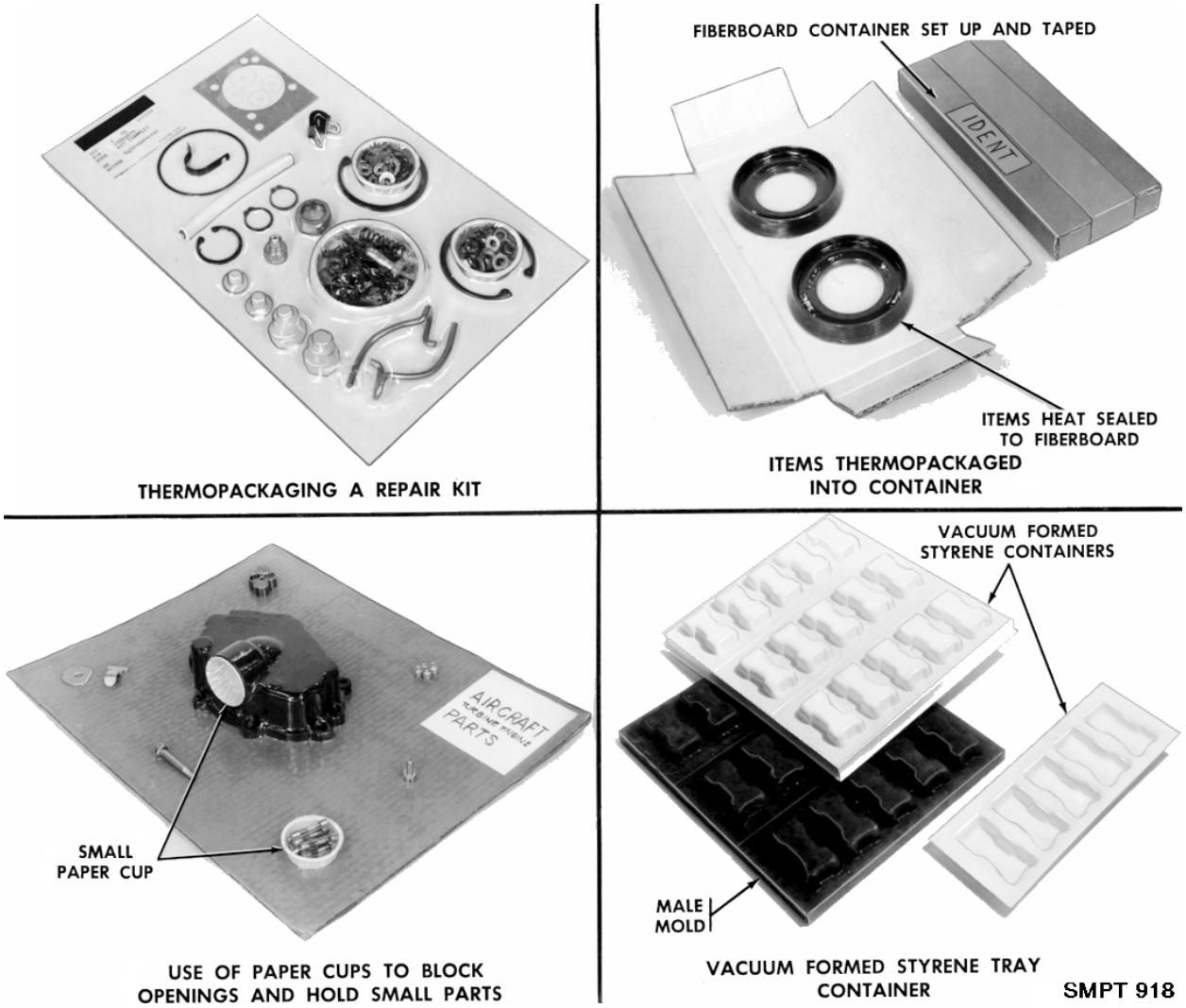

Figure 4-20. Variations of plastic packages.

THERMOFORMED PACKING EQUIPMENT

There are many machines on the market that are designed to accomplish thermoformed packing. These machines vary in size, configuration, productive capacity, and price range, but they are all of the same basic design. Figure 4-18 points out the basic design features of the vacuum forming machine. The simplest design includes the following components:

- X A rod-type heater, controlled to about 400ºF output, mounted on the underside of a hood.
- X Two actuator switches, one for the heating unit and the other for the vacuum pump.
- X A master clamp frame and seal with spring-loaded lock grips.
- X A drape mechanism.
- X A machine platen, slightly smaller than the opening in the master clamp frame.
- X A vacuum unit and parts.

X A timer for controlling the heating and vacuum cycles.
X A mount for the roll of plastic film.

THERMOFORMED PROCESS

To perform the thermoformed process, the manufacturer's instructions should be followed for operation of the equipment. Figure 4-21 shows how the plastic sheet is draped over the item and then sealed to the backing board.

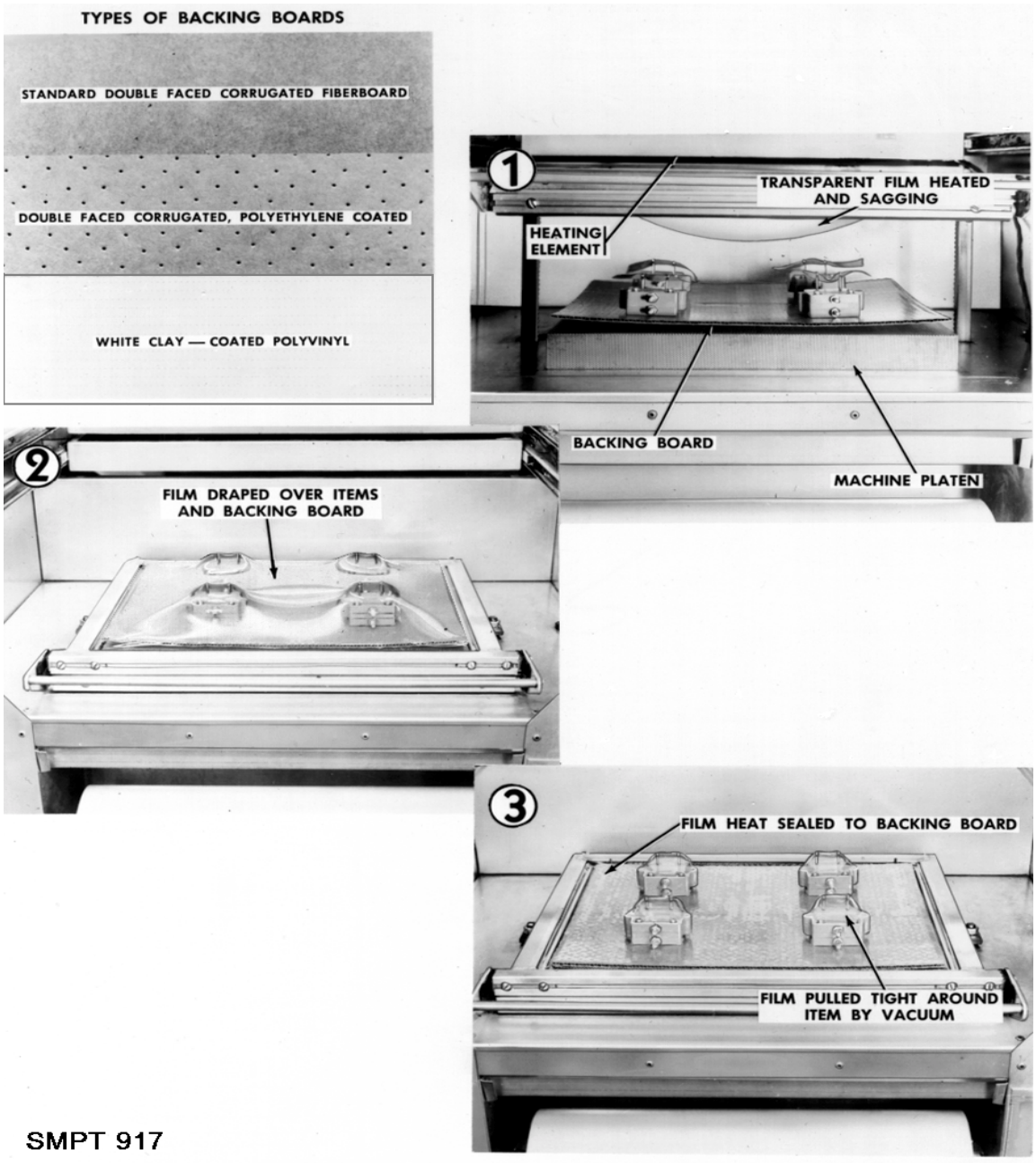

Figure 4-21. Basic steps in the thermoformed process.

THERMOPLASTIC MATERIALS

The materials vary depending on the thermoformed process utilized. The materials used in skin packing include the flexible vinyls, acetates, butyrates, and polythylene. Each of these materials, excluding polyethylene, may be obtained with a polyethylene coating or as a polyethylene laminate.

Polyethylene

This material requires slightly less heat than other coating materials, and will adhere just as readily to the backing board. Polyethylene is widely used because of its lower cost. Some specially processed polyethylene films will adhere to a noncoated backing of ordinary paperboard or fiberboard, thus reducing the cost of the pack. Some packages prefer to use polyethylene coated butyrate or acetate because it is very clear. The most commonly used thicknesses is a 4-mil film. Polyethylene coated vinyl chloride may react with certain preservative oils, and metal items coated with oil and packed with this film will become discolored as a result of this chemical action.

Backing Board

The backing board is as important a factor as the thermoplastic material itself. Figure 4-21 shows three commonly used backing boards. The following identifies and provides information concerning the use and limitations of these boards:

White, Clay-Coated Polyvinyl

This board is coated with a layer of white clay and with a layer of polyvinyl chloride. It is to be used when the packaging film is uncoated polyvinyl chloride, or in the case of a polyvinyl-polyethylene laminate, the polyvinyl side of the film must face the board. The board is perforated through the polyvinyl coating only. This is because the polyvinyl coating is impervious to the flow of air, whereas the board stock is porous and will allow the air trapped between it and the film to be drawn out of the pack by the vacuum unit.

Double-Faced, Corrugated Fiberboard, Polyethylene Coated

This board is to be used when good adhesion to the polyethylene packing film is desired. This board is perforated through the polyethylene coating only, for the same reason as above.

*D**ouble-Faced Corrugated Fiberboard, Noncoated***

For good adhesion, a specially processed polyethylene film must be used. This board is not perforated, nor is it finished with a glossy finish. This board cannot be used to pack metal parts intended for long-term storage. This is due to the sulfur content of the board, which, with the absorption of moisture from the air, will chemically attack and corrode the metal surfaces.

Marking on Backing Boards

Backing board are very often used for advertising purposes or as a surface on which to apply markings required by MIL-STD-129. Caution must be taken not to print with inks containing linseed oil, glycol, or varnish, as these substances will cause poor adhesion. Water-base and solvent-type inks are recommended.

SAFETY PRECAUTIONS

Before attempting to operate any thermoformed packing machine, read the safety precautions. On some machines, the top of the hood gets very hot after the heating coils are on. So make sure you keep your hands and elbows off of the hood. Also when the master clamp frame is raised to insert the plastic film, it may fall forward,

injuring your fingers, meaning that you should provide support to the frame when it is open.

METHOD 20 - PRESERVATIVE COATING ONLY (WITH GREASEPROOF WRAP, AS REQUIRED)

Method 20 is one of the five basic methods of preservation. Method 20 always requires the application of a preservative.

CONCEPT

Method 20 is accomplished by applying a preservative coating to the item. The coating protects the item against free water, salt spray, gases, and fumes which may be encountered during handling, shipping, and storage. The entire chemical protection afforded to the item is through the contact preservative. Figures 4-22 and 4-23 illustrate the basic steps used in forming the Method 20 unit pack.

INTENDED USE

Method 20 is used primarily on metal items whose characteristics allow ready application of a corrosion preventive compound by dipping, flow coating, slushing, spraying, flushing, brushing, or fogging.

Items preserved by Method 20 must be such that depreservation by means of solvents, vapor degreasers, or alkali metal-cleaning compounds will not damage the item nor impair its operation. The determining factor in the selection of this method is whether or not the nature and design of the items permit application and removal, when necessary, of the compound without damage to the items.

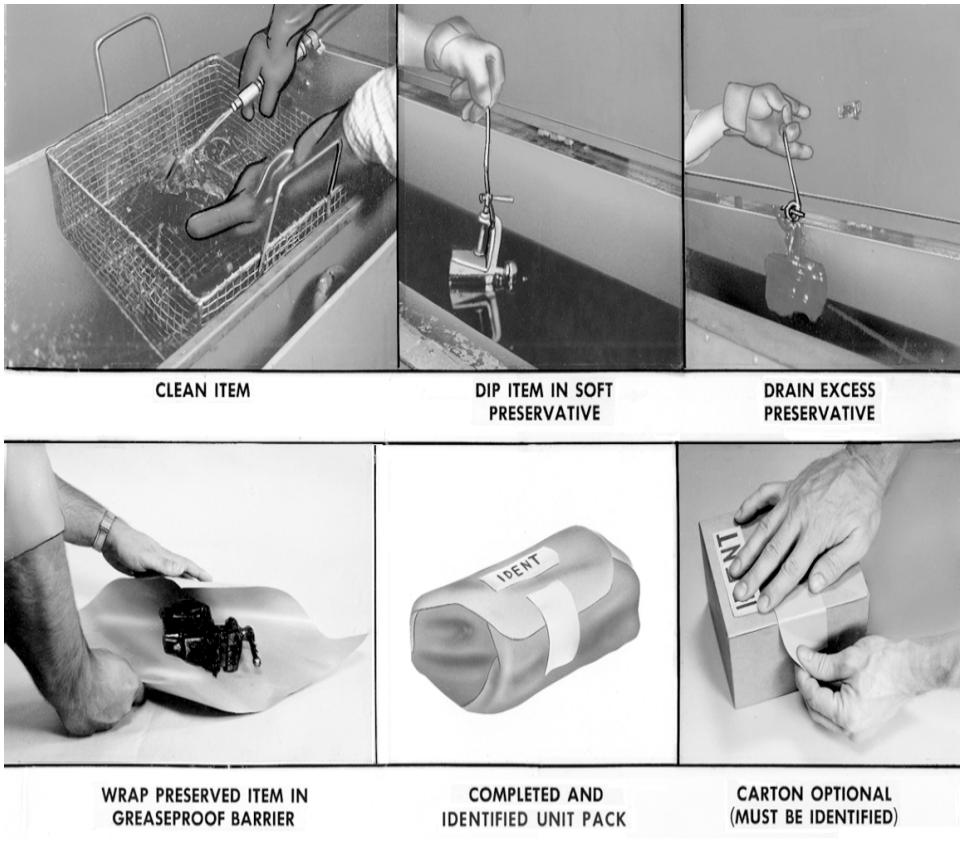

Figure 4-22. Application of Method 20 using a soft film preservative.

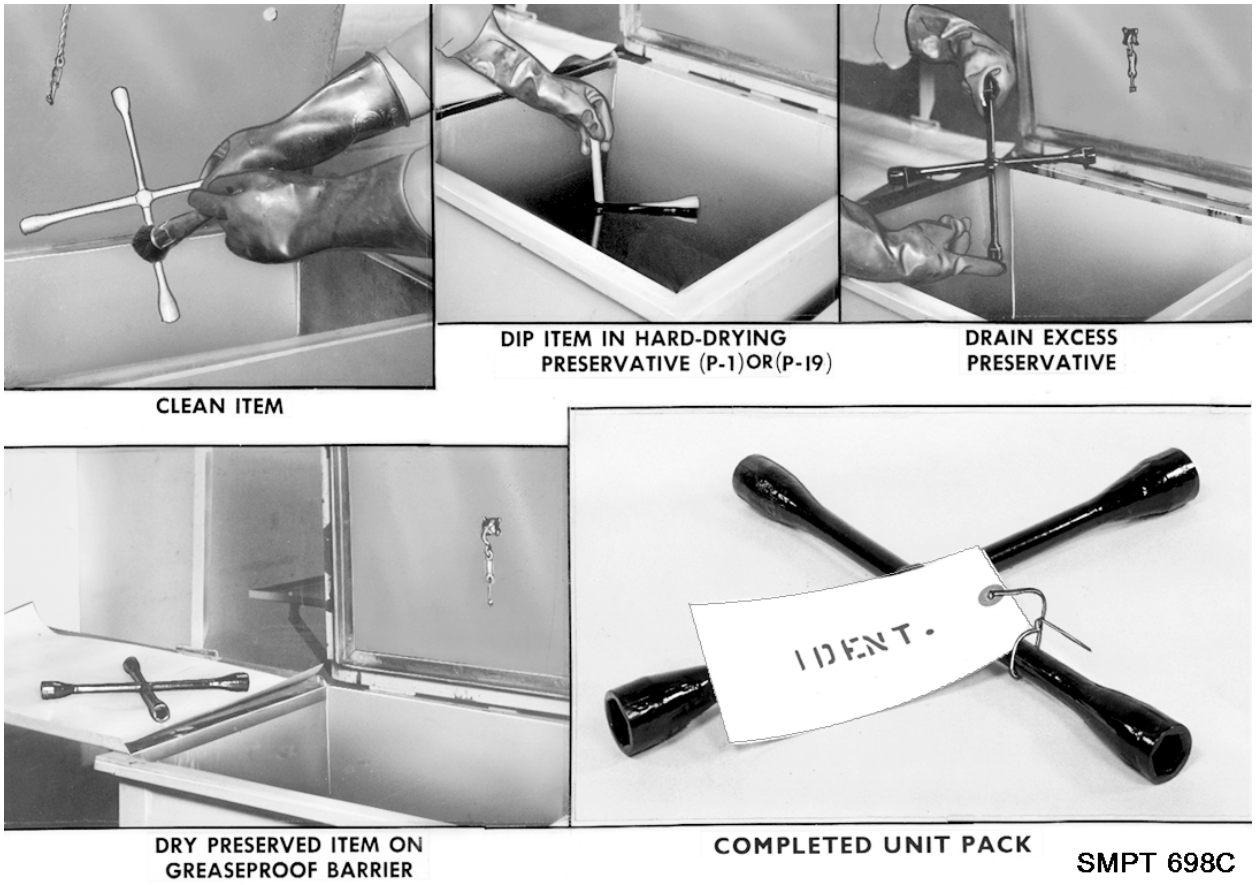

Figure 4-23. Application of Method 20 using a hard-drying preservative.

Method 20, with a hard-drying, thin-film preservative Code 01 or Code 19 is particularly adapted to items whose function or operation is not impaired by the presence of a hard-surface coating. Such items include hammers, chisels, mounting brackets, and turnbuckles.

The protection of an item preserved by Method 20 depends upon a clean and moisture-free surface. After the cleaning operation, items must be protected, particularly, against moisture and deposits from fingerprints.

CONSTRUCTION STEPS AND TECHNIQUES

Method 20 is accomplished by applying a preservative coating to the item and using greaseproof wrap as required. The preservative coating protects the item against free water, salt spray, gases, and fumes which may be encountered during handling, shipping and storage. The entire chemical protection afforded to the item is through the contact preservative.

Use the following steps along with the illustrations depicted in figures 4-22 through 4-26 to accomplish Method 20.

Step 1

Clean and dry the item, as required, using one or more of the processes and procedures given in chapter 2.

Step 2

Select and apply a preservative coating to the item (or parts of the item), using selection criteria and application procedures given in chapter 3.

Note the following before proceeding to step 3:

- X Parts coated with Code 01 or Code 19 preservatives and allowed to dry do not require the wrap specified in step 3 unless called for in the contract or order.
- X Items treated with Code JL, VCI treated barrier material, MIL-PRF-22019, or bag, MIL-B-22020, and securely taped to make an airtight enclosure, shall be exempted from the wrap specified in step 3.

Step 3

Enclose the coated item, cushioned as required, in a wrap conforming to one of the following:

- X MIL-B-121, Grade A or C.
- X MIL-PRF-22191, Type II.
- X QQ-A-1876.

Step 4

Apply markings according to MIL-STD-129 and MIL-HDBK-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see figure 4-46 for an example of unit pack markings.

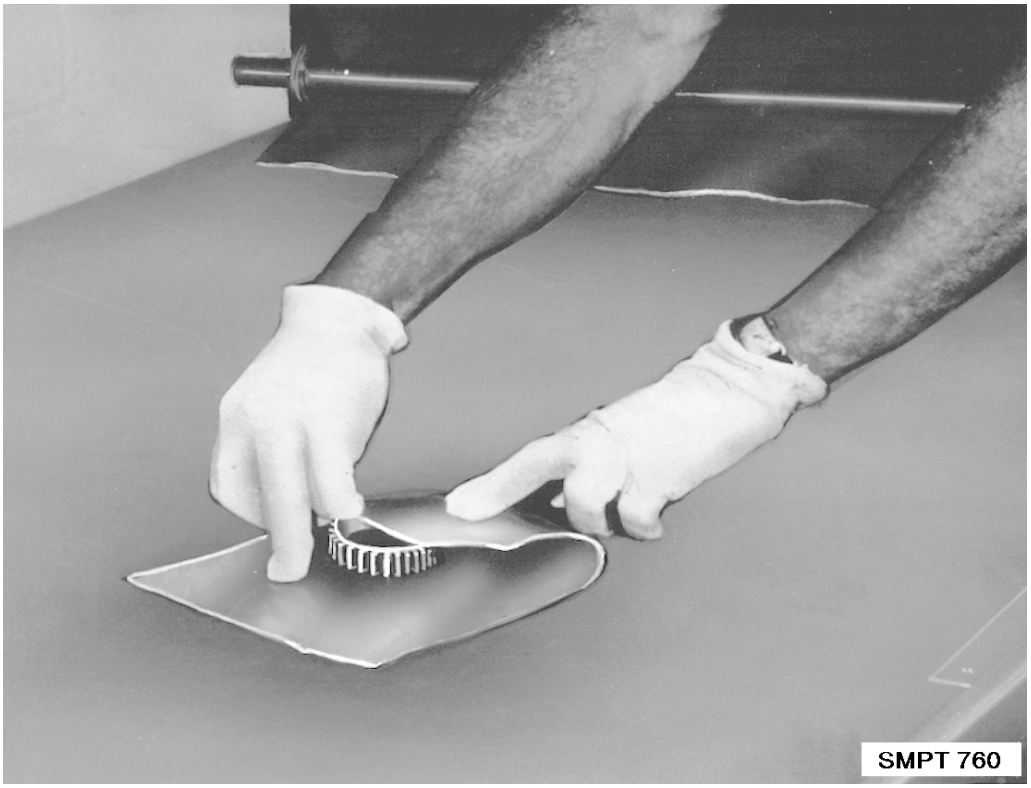

Figure 4-24. Method 20 - use large enough wrap to cover item completely.

Figure 4-25. Method 20 - conform wrap to shape of item.

Figure 4-26. Method 20 - include minimum of air volume.

METHOD 30 - WATERPROOF OR WATERPROOF-GREASEPROOF PROTECTION WITH PRESERVATIVE AS REQUIRED

CONCEPT

Items protected in accordance with this method must be sealed within a waterproof or waterproof-greaseproof enclosure required by the specific method. Method 30 itself is only a concept or description. Method 30 packs can only be accomplished in the form of one of the three methods discussed herein.

INTENDED USE

Methods 30 packs are appropriate for almost any item that will fit into a bag; a rigid container other than all metal; or as long as only waterproof or waterproof-greaseproof protection is needed. If watervaporproofness is a requirement, then you must choose one of the Method 40 or Method 50 methods.

METHODS UNDER METHOD 30 CONCEPT

Three applications of Method 30 are used, all of which involve the item being sealed within a waterproof or waterproof-greaseproof enclosure. The three methods of Method 30 are -

- X Method 31 - Waterproof bag, sealed.
- X Method 32 - Container, waterproof bag, sealed.
- X Method 33 - Greaseproof-waterproof bag, sealed.

METHOD 31 WATERPROOF BAG, SEALED

This method is accomplished by inserting the item, wrapped and cushioned as necessary, into a waterproof bag, exhausting the excess air, and closing the bag. Normally, Method 31 is used for items that do not require a contact preservative. For items requiring a preservative, a Method 33 would be more appropriate. To construct this method, perform the following steps while also observing the construction techniques shown in figure 4-27.

Step 1

Clean and dry the item, as required, using one or more of the processes and procedures given in chapter 2.

Step 2

Apply a neutral wrap where a noncorrosive, dust protective wrap is required prior to or as a part of unit packing. The following neutral wraps meet the compatibility requirements of MIL-STD-2073-1C:

- X MIL-B-130
- X MIL-B-17667
- X A-A-3174

Note: MIL-P-130 and A-A-3174, when used as an initial wrap, also provide a cushioning effect that helps protect the item as well as the bag from the item's projections and sharp edges as well as to restrict its movement within the bag.

Step 3

Select a barrier (bag) made from material conforming to MIL-B-117, Type I, Class B or MIL-B-22020 as limited by MIL-I-8574. You may use one of the following materials for the bag since they meet the MIL-B-117 requirements:

X A-A-3174, Type I or II, Grade A, Class 1 (See note).
X MIL-PRF-22191, Type III

Note: Unless otherwise specified, nominal thickness shall be 0.004 inch and finish shall be No. 2(treated).

Step 4

Enclose the item (wrapped, and/or cushioned as required) within the close-fitting bag that you selected in step 3.

Step 5

Heat seal the bag making sure excess air is kept to a minimum by compressing the bag or by a mechanical evacuation process before the final seal is effected.

Step 6

Apply markings to the bag according to MIL-STD-129 and MIL-HDBK-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see figure 4-46.

Note: When specified in the contract or order, a carton or box shall be required to be used with unit container, and the primary cushioning specified in the contract or order shall be placed between the outside of the bag and the inside of the carton or box. In this case, the carton or box will be marked the same as the bag.

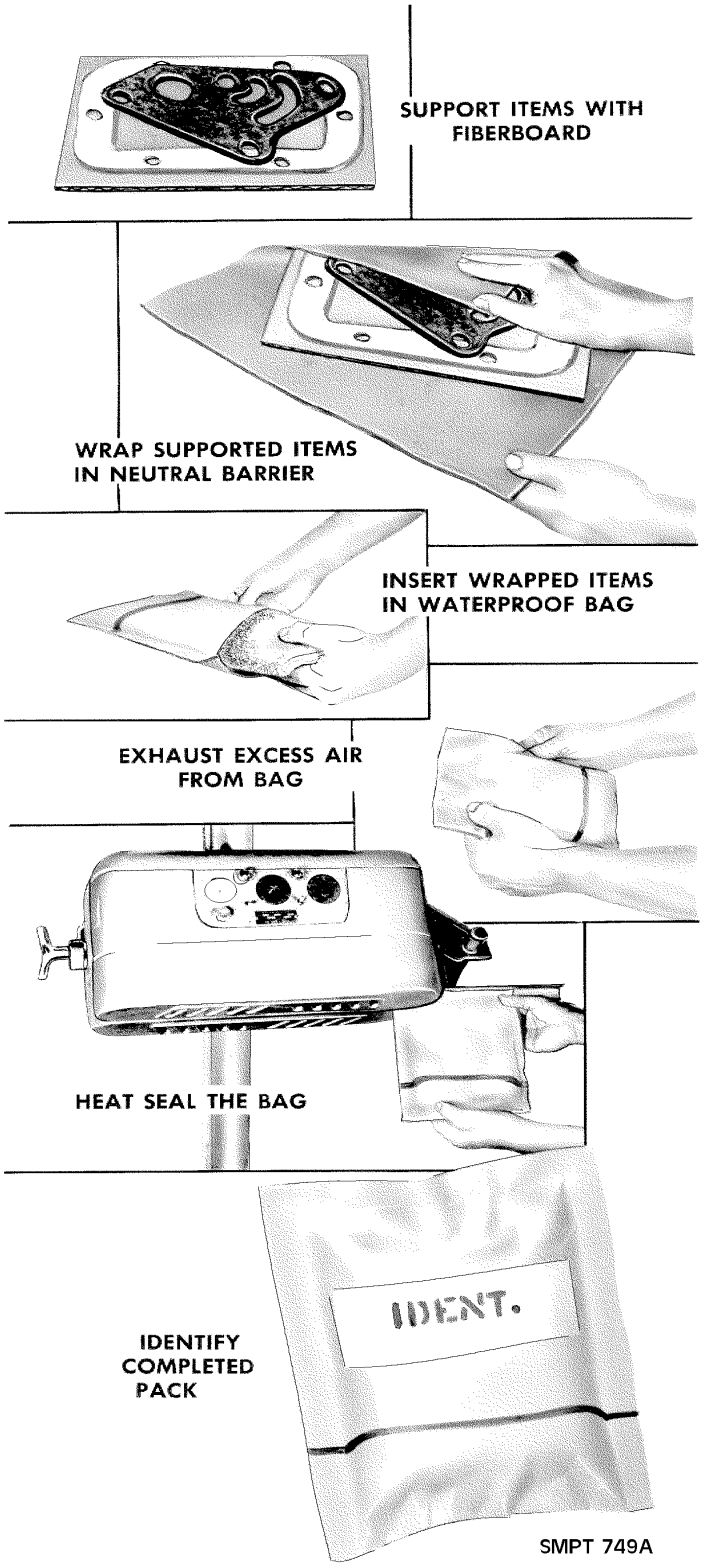

Figure 4-27. Application of Method 31.

METHOD 32 CONTAINER, WATERPROOF BAG, SEALED

This application involves placing the item (preserved, wrapped and cushioned as required) into a close-fitting box or carton which in turn shall be enclosed in a sealed waterproof bag. To construct this method, perform the following steps while also observing the construction techniques shown in figure 4-28.

Construction Steps

Note: The steps direct the item to be coated with a preservative. If this is not the case, then a noncorrosive wrap, as applicable, would be applied instead of the greaseproof wrap cited in step 3.

Step 1

Clean and dry the item, as required, using one or more of the processes and procedures given in chapter 2.

Step 2

Select and apply a preservative coating to the item (or parts of the item), unless otherwise specified, using selection criteria and application procedures given in chapter 3.

Step 3

Apply a greaseproof wrap conforming to one of the following:

X MIL-B-121, Grade A.
X QQ-A-1876.

Container

Step 4

Select a close-fitting inner container from MIL-STD-2073-1C (or a container specified by the contract or order). The following are examples of inner containers appropriate for this method.

X Fiberboard Boxes.
X Folding Boxes.
X Set-up Boxes.
X Metal-edged Paperboard Boxes.

Note: Information of the use and closure of these boxes is given in chapter 6 of this manual.

Step 5

Insert the item into the container along with the application of cushioning and dunnage, as necessary, to protect the item as well as the container from the item's projections and sharp edges and also to restrict its movement within the container.

Step 6

Blunt the sharp edges and corners of the box to protect the bag selected in step 7.

Step 7

Enclose the box in a bag conforming to MIL-B-117, Type I, Class B. The following are examples of barrier (bag) material meeting the MIL-B-117 requirement:

X A-A-3174, Type I or II, Grade A, Class 1 (see note).
X MIL-PRF-22191, Type III.

Note: Unless otherwise specified, nominal thickness shall be 0.004 inch and finish shall be number 2 (treated) for A-A-3174 material.

Note: When specified, a protective wrap of heavy duty kraft paper or equivalent (tape sealed) shall be used to protect the barrier material.

Step 8

Heat seal the bag.

Note: The trapped air between the box and the bag shall be kept to a minimum by compressing the bag or by a mechanical evacuation process (i.e., vacuum cleaner attachment). Caution shall be taken to prevent rupture of the bag.

Step 9

Apply markings to the bag according to MIL-STD-129 and MIL-HDBK-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see figure 4-46.

Figure 4-28. Application of Method 32.

METHOD 33 GREASEPROOF-WATERPROOF BAG, SEALED

As the title suggests, this method is accomplished by enclosing the item (preserved, wrapped and cushioned, as required) in a close-fitting sealed bag. See the construction steps that follow along with the techniques shown in figure 4-29 to accomplish Method 33:

Construction Steps

Step 1

Clean and dry the item, as required, using one or more of the processes and procedures given in chapter 2.

Step 2

Select and apply a preservative coating to the item (or parts of the item), unless otherwise specified, using selection criteria and application procedures given in chapter 3.

Step 3

Apply a greaseproof wrap conforming to one of the following:

X MIL-B-121, Grade A.
X QQ-A-1876.

Note: Preliminary greaseproof wraps applied solely to confine the contact preservative on item surfaces are not necessary for this method if the bag is made of material conforming to MIL-B-121, Grade A or MIL-PRF-22191, Type II. However, wraps shall not be excluded if necessary to protect the bags from rupture or perforation.

Step 4

Apply cushioning as required to projections, sharp edges or other physical characteristics of the item which may damage the waterproof-greaseproof bag and also as required to mitigate shock, thereby preventing physical and functional damage to the item.

Step 5

Select a barrier (bag) made from material conforming to MIL-B-117, Type I, Class C, Style l, 2 or 3, or Type II, Class C, Style l or bags conforming to MIL-B-22020 as limited by MIL-I-8574. Bags made from the following material meet the MIL-B-117 requirements:

X MIL-B-121, Type I or II, Grade A, Class l.
X MIL-PRF-22191, Type II.

Step 6

Enclose the item (preserved, wrapped, and cushioned as required) within the close fitting bag, that you selected in step 5.

Step 7

Apply markings to the bag according to MIL-STD-129 and MIL-HDBK-129. See the paragraphs under "MARKING OF UNIT AND INTERMEDIATE PACKS" near the end of this chapter. Also see figure 4-46.

Note: When specified in the contract or order (or when the weight of the item exceeds 20 pounds), a carton or box shall be required to be used on the unit container, and the primary cushioning specified in the contract or order shall be placed between the outside of the bag and the inside of the carton or box. The carton or box must be marked the same as the bag.

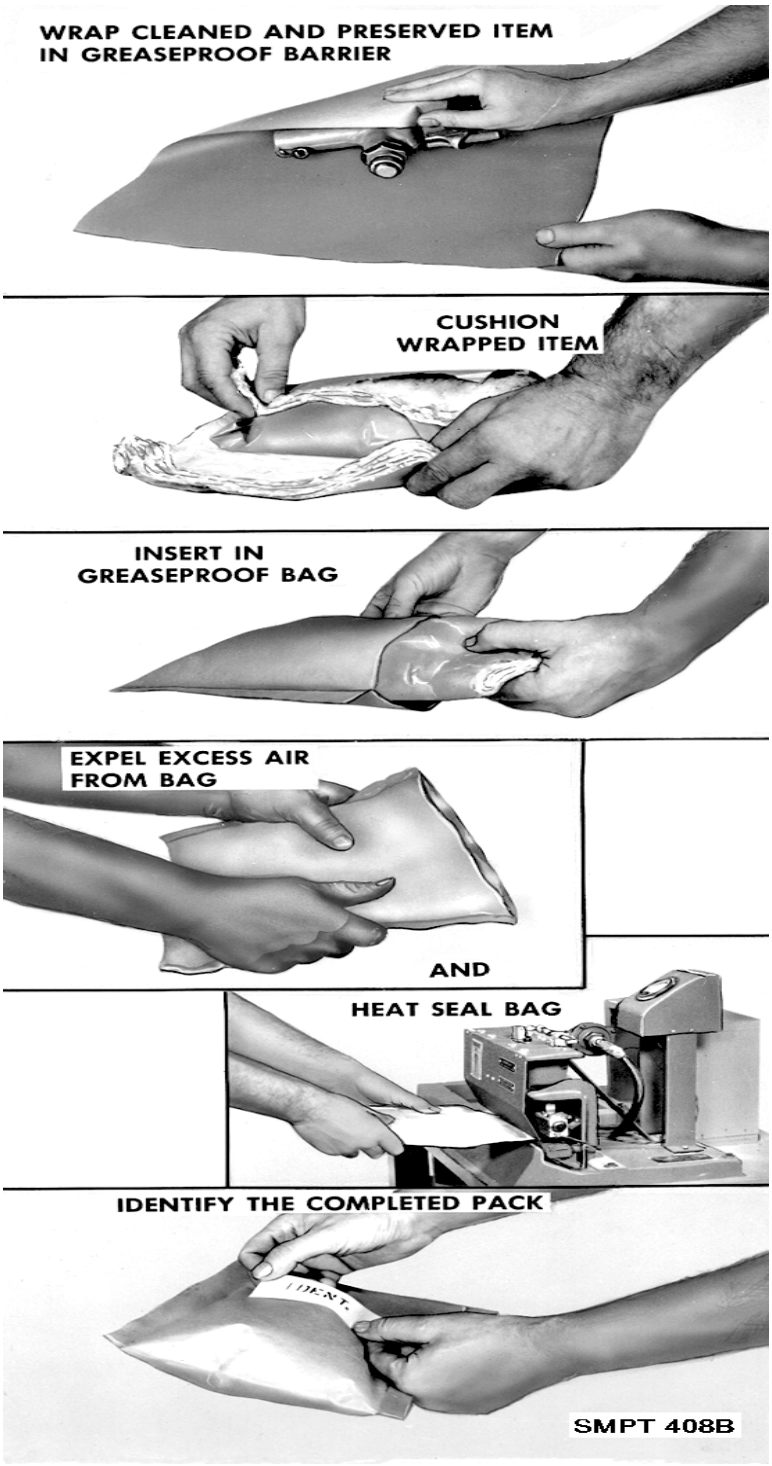

Figure 4-29. Application of Method 33.

METHOD 40 - WATERVAPORPROOF PROTECTION WITH PRESERVATIVE AS REQUIRED

CONCEPT

Method 40 is a watervaporproof enclosure in which the items, with or without a preservative coating, are placed. The enclosure may be a rigid container or a watervaporproof barrier, depending on the method being developed.

INTENDED USE

This method of unit packing is intended to afford protection to metallic and nonmetallic items against deterioration caused by water or water vapor and by natural or industrial contaminates and pollutants.

Method 40, supplemented by contact preservatives, is applied to parts and equipment where critical functioning metal surfaces, held to close tolerances, are involved. When contact preservatives are used in Method 40, they should be selected from those preservatives which can be easily removed, if removal will be necessary before putting the item into use. While Method 40 was originally intended to prevent corrosion on metal parts, it can also be used without a contact preservative to keep fabric, paper, plastic , and other nonmetallic items clean and dry during shipment and storage.

METHODS UNDER METHOD 40 CONCEPT

There are five military preservative applications under the Method 40 concept. They are made with or without contact preservatives, as required. Before fabricating any method or applying a preservative, all items must be properly cleaned and dried according to the instructions in chapter 2. When the application of a contact preservative is required, it shall be done as explained in chapter 3. The five methods of Method 40 are -

- X Method 41 - Watervaporproof bag, sealed.
- X Method 42 - Container, watervaporproof bag, sealed, container.
- X Method 43 - Floating watervaporproof bag, sealed.
- X Method 44 - Rigid container (other than metal), sealed.
- X Method 45 - Rigid metal container, sealed.

It is suggested that detailed steps involved in the application of all methods be followed carefully for consistent, satisfactory results.

METHOD 41 - WATERVAPORPROOF BAG, SEALED

This method is accomplished by inserting the item, wrapped and cushioned as necessary, into a watervaporproof bag, exhausting the excess air, and closing the bag. Items packed by Method 41 are generally light in weight and flat in shape, so as to lend themselves to easy insertion into the flat or envelope-type bag. In the steps that follow, notice that this method is also used for items (such as circuit cards) which are sensitive to damage caused by electrostatic discharge (ESD). Make sure that only the correct electrostatic protective materials, as indicated in the steps that follow, are used for the wrap and the bag when packaging items sensitive to ESD. Refer to figure 4-30 and the following steps and techniques when constructing Method 41: