ROLE OF PACKING AND HANDLING IN CARGO SECURITY

PACKING GUIDELINES FOR SAFE, SECURE DELIVERY OF GOODS

Produced Under The Auspices Of The
NATIONAL CARGO SECURITY PROGRAM
City Campaign
in
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FOREWORD

Cargo loss; cargo damage; claims; surveys and their cost; wasteful handling and its cost; all these are financial drains, eroding the profit of the shipping public and transportation carriers. No shipper or carrier should hesitate to take action which would materially reduce avoidable waste of money, time and customer goodwill. The report that follows provides general guidelines on basic packing and environmental factors of transportation necessary to protect cargo from loss and damage.

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INTRODUCTION

Sound packing is a major element in any loss prevention program. Reducing the potential for damage, loss and theft is the key to reducing costs in product distribution.

By putting security planning out in front of product movements, you will profit by reduction in claims, lower levels of employee temptation to theft and higher efficiency, derived from these precautions.

The purpose of this publication is to encourage recognition of the need for sound packing, in the interest of safety, security and theft prevention.

PACKING CONSIDERATIONS

PROPER PACKING IS AN INTEGRAL PART OF CARGO SECURITY

Force is the genesis of most loss and damage to product and shipping container. A primary function of protective packing is to eliminate or inhibit the action of destructive force. Inadequate packing design can result in loss and damage. The ideal package provides proper safety and security, avoiding excesses which do no more than increase cost. The shipper must know the needs of his product, to deliver it securely.

Arriving at the desired level of protection necessitates intelligent evaluation of a product, in relationship to the various hazards of transportation. This manual is intended to assist shippers and carriers by suggesting sound packing guidelines and practices.

Carriers' Requirements

Carriers have rules and regulations on packing and handling, which the shipper should be aware of when preparing his goods for shipping. These rules and regulations are published in the tariffs of the carriers. Terms and conditions, some of which limit the liability of the carrier for loss and damage, appear in the contract of carriage,

TYPE OF LOAD

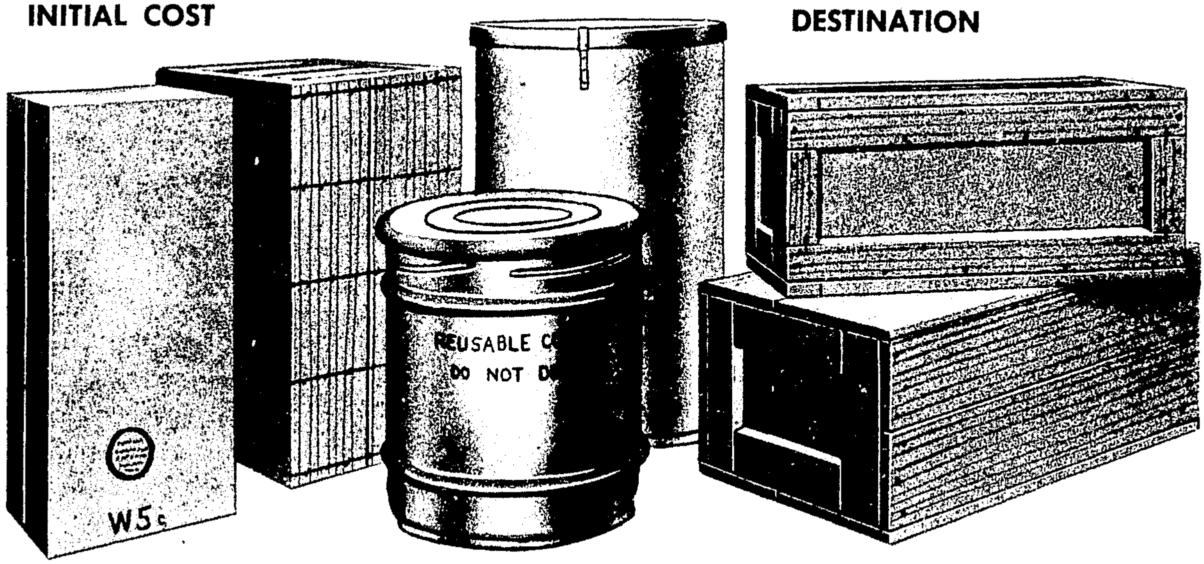
EASE OF ASSEMBLY AND CLOSURE

ITEM CHARACTERISTICS

WEIGHT AND CUBE

INITIAL COST

DESTINATION



LEVEL OF PROTECTION REQUIRED

AVAILABILITY

REUSABILITY

Container Selection Factors

such as the bill of lading. Shippers should also be aware that most carrier packing regulations pertain to the exterior shipping container, not the interior packaging.

Packing

Packing includes the exterior shipping container, closure system, and, when necessary, blocking, bracing, cushioning, waterproofing, strapping and container marking. The container alone cannot be blamed for all losses or damages. Inadequate blocking, bracing and cushioning, or none at all, may also be major causes of losses or damage. Efficient use of available packing aids will improve the shipper's economic posture, through secure delivery of his product.

Know Your Product

By experience, inspection and common sense the shipper should know the more obvious hazards against which the goods require protection. For instance, breakage, which is of major concern for fragile articles, requires only casual consideration in the case of soft goods. If the product is an instrument, machinery, or a special device, specifications of the component materials should be obtained, in order to determine the extent of protection needed.

Method of Distribution

Method of product distribution should be considered in determining the type of packing needed. Packing designed for point of sale frequently imposes criteria different from those applicable for an item intended for additional treatment or multiple movements before point of sale.

Overseas Shipment

Knowledge of port conditions and facilities to be encountered is a primary requisite for overseas shipping. Savings may be gained on export goods by dispatching in a domestic container to a seaport, where the merchandise is then repacked for overseas transportation. Goods exported to undeveloped areas of the world usually need greater protection than goods shipped to industrialized countries.

Style your packing to the modes of transportation to be used and the market you are serving.

Value of Product

Price of product is a determining factor as to amount of funds available for packing. Shippers of readily available goods in common use are most seriously affected by the cost of packing, since competitive pricing is intense. Value in this context is set by appearance and quality of product at point of sale. A penny unwisely saved in packing may reduce product salability.

Energy

The type of energy and forces encountered in transportation which cause most damage are mechanical and chemical in nature.

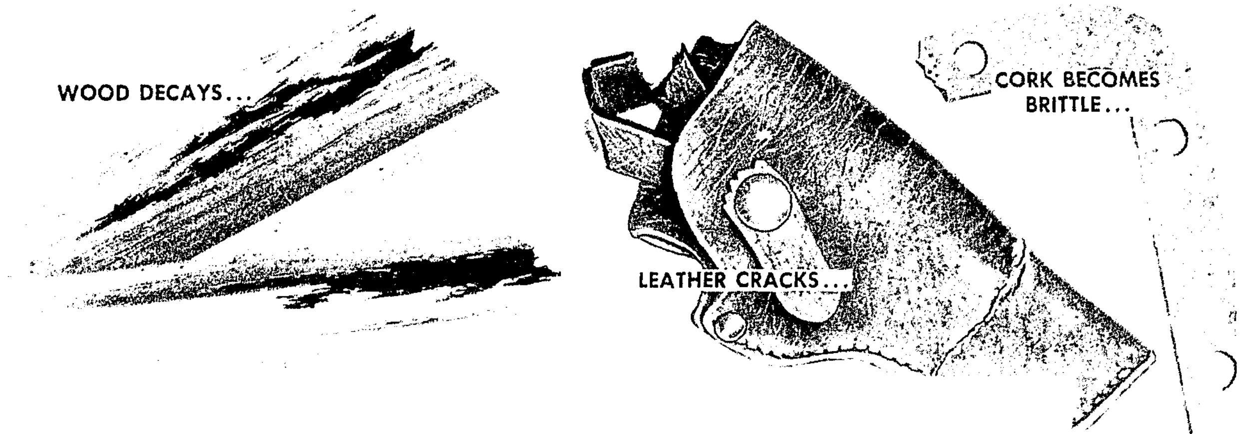
Mechanical energy, arising from movement, exists in all modes of transportation. Abrupt starts and stops, vibrations and jolts of vehicles are potentially destructive forces. Handling forces, those involved in loading and unloading, are significant. Some may be applied accidentally, some maliciously. In any event the affected package may be ripped open, exposing it to damage, theft or loss. Adverse storage forces most commonly experienced are those resulting from the crushing effect of superimposed weights through stacking.

Chemical energy affecting shipments is chiefly the result of contamination by foreign materials or weathering from external conditions, such as humidity, rain, spray, extreme heat and cold. These tend to cause breakdown of the container and deterioration of unprotected contents. Exposure resulting from packing failures can cause goods to be susceptible to damage, theft or loss.

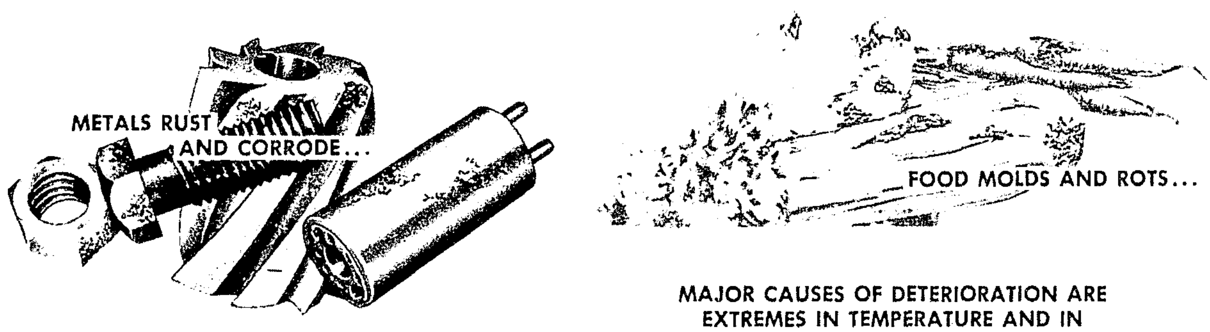
Mechanical forces in movement of product are counteracted by the use of rigid containers and immobilization of the product through blocking, bracing and cushioning. Chemical forces are counteracted by cleaning the product prior to packing and using water-resistant containers and waterproof barrier materials.

Shape of Product

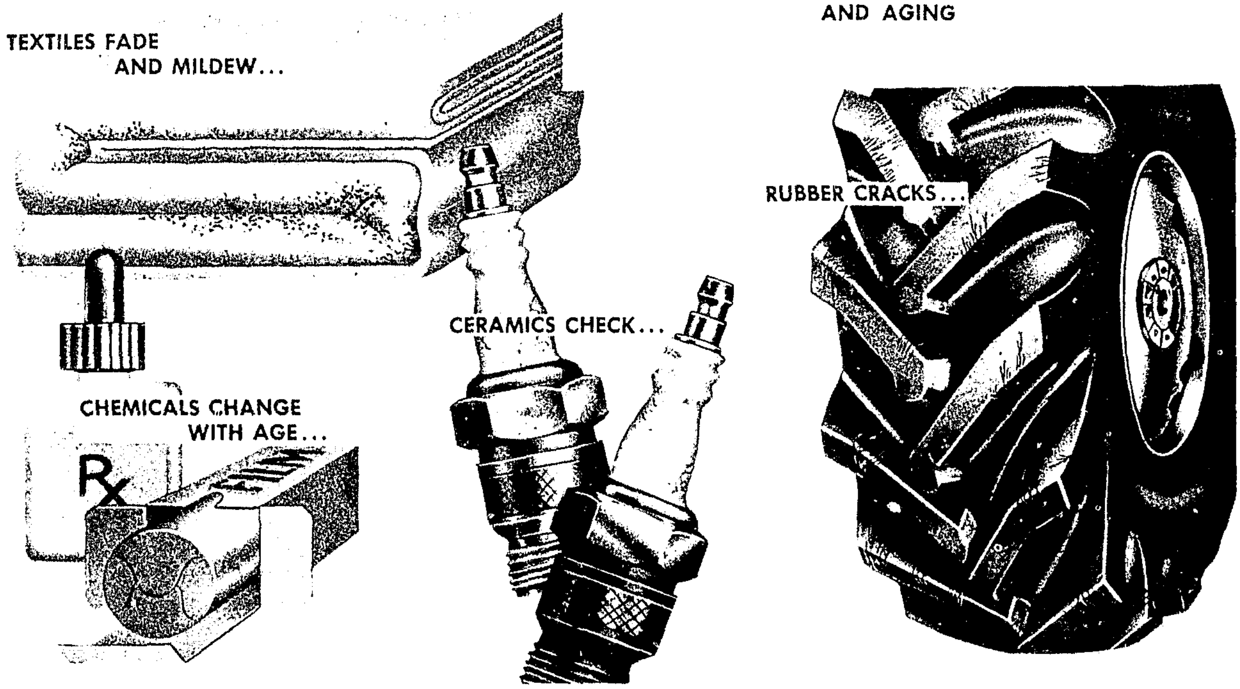
Irregularly shaped items, especially those with projections of any size, generally need more intricate blocking than regularly shaped pieces. Keeping the article immobile is important. So, too, is the distribution of forces affecting it. Long pieces, particularly when heavy, generate great stress on the ends of containers. Problems



DETERIORATION



MAJOR CAUSES OF DETERIORATION ARE EXTREMES IN TEMPERATURE AND IN HUMIDITY, BACTERIA AND FUNGI, AND AGING



are increased when odd-shaped, heavy items must be cushioned as well as blocked. The general solution is to even out the surface with pads and blocking.

Weight and Size

Energy developed by the abrupt stopping of an object in motion is directly proportional to its weight. Therefore the weight of the item is most important in relation to blocking and cushioning requirements. As the item is studied, consider the distribution of the weight in connection with size and bearing areas. Concentrated weight should be distributed, where necessary, over a larger area by transferring it from one container face to the edges or corners of the container by the use of blocks at the ends of the item.

Strength and Fragility

Many items are rugged enough, or of such a nature as to withstand most transportation forces, with the result that packing functions primarily for material handling purposes.

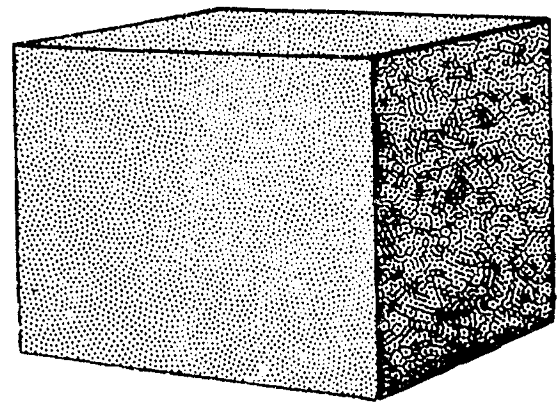
Articles which need some form of cushioning are classified fragile. The amount of cushioning needed is determined by the ability of the piece to withstand shipping and handling forces.

When fragile components of an item cannot be removed from an otherwise rugged article, the entire unit must be treated as fragile, even though this may result in a large, cumbersome pack.

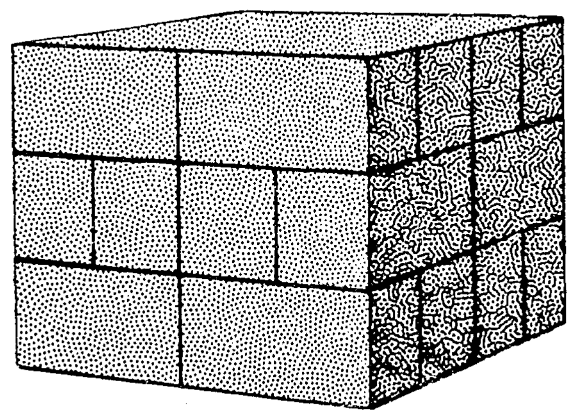
If disassembly is desirable for packing, it should not be done until it is known that reassembly requires no technical skills or special tools.

Types of Loads

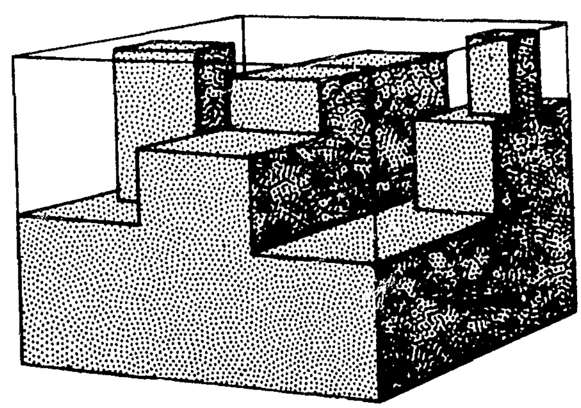
Loads are classified as "easy", "average", and "difficult" in terms of the degree of support they give to the faces of the container. Single items capable of completely supporting all faces of a package are classified as "easy" loads. A shipment of radios, shoes in boxes, packaged hardware—all transmitting vigorous support to the faces of the box—are characterized as "average" loads. Clothes, wigs, bolts of cloth, machine parts of varied and irregular shapes—since they obviously do not uniformly support the faces of the package—are characteristically "difficult" loads. Patently then, a shipper who gives no consideration to the nature of the load in selecting packaging for his shipment, will frequently expose his cargo to unnecessary damage.



EASY LOAD



AVERAGE LOAD



DIFFICULT LOAD

TRANSPORTATION HAZARDS

The laws of motion cause most damage to goods in transit. It can be said, therefore, that, aside from outstanding exceptions, such as sea-water for marine shipments and atmospheric pressure for air, transportation loss and damage hazards are generally common to all modes. Any variations are principally a matter of degree.

Ocean

Forces at work on cargo aboard a vessel are beyond the control of a shipper, but can vary according to such factors as the tightness and security of the load, height of stow, weight distribution of a given stow, as well as the weight distribution of the cargo throughout the vessel. In addition to the forces generated by the method of ship stowage are the external forces of speed and state of the sea. A combination of these forces may cause the ship to roll, dive, pitch, pant and vibrate whenever the propeller comes out of the water. All these, obviously, increase the possibility of cargo damage.

Rail

Changes in the direction of force caused by abrupt starts and stops result in load shifting. The condition of the road-bed will influence the degree of vibration. A poor bed, even at minimal speed, results in considerable car sway and load disruption. It cannot be overly emphasized, in loading rail cars, that the load be tight, adequately blocked and braced. Incomplete layers require support. Dunnage should be used when stacks of containers are of different levels and density. Car doors must also be protected, to prevent cargo falling into the opening.

Motor Carrier

Changes in direction of force, caused by abrupt starts and stops, result in load shifting. Vibration, created by the surface over which vehicles travel, may cause damage. A vehicle will sway and jerk, depending upon the condition of the highway, speed, and the cushion action of the vehicle. Loads should be tight, balanced, blocked and braced to minimize load shifting.

Air

Ground handling of air cargo will experience the forces comparable to those involved in the mode of transportation used to move a shipment to and from an airport. Hazards in the air are primarily the result of changes in atmospheric pressure and temperature.

Handling

The most common cause of damage during handling operations is from dropping of goods. Packages may be manually dropped or fall from material-handling equipment. Contact between a heavy item and a light piece may result in damage to the light article; this would probably occur on a chute, conveyor or when a load shifts in a vehicle. Other handling hazards are caused by forklift trucks, broken pallets and pushing. At some seaports, where nets and slings are used, damage may occur while lifting packages or when dumped. Some handling damage may possibly be malicious.

Storage

Weight of superimposed packages in storage may cause crushing. Failure to keep stacks plumb, or allowing them to hang over edges of racks or pallets, causes similar damage. Long-term storage may also result in container crushing.

Weathering

Any cargo handled during inclement weather may be subjected to water damage. Cargo moving on open-top vehicles will get wet, unless packing is designed for outside storage. Cars and containers should be inspected for leaks prior to loading. Bottom layers of cargo on aircraft unit load devices become wet when not fully covered and/or not supported off the ground during rains.

SOLUTIONS

The function of the exterior shipping container is to protect its contents and to provide ease in handling. With those objectives, container selection is based upon the physical characteristics of the product; whether it is to be a domestic or overseas shipment; type of load; cost of package vs. value of product; plus its criticality, its weight and cube, and ease of assembly and closure.

Blocking and Bracing

Blocking and bracing is intended to prevent the movement of an item within the container and to transfer the impact of concentrated loads to larger areas or other faces of the container. Although the choice of materials used for blocking and bracing varies widely, from heavy lumber to fiberboard, it must be stiff and strong in relation to the size and shape of the areas against which it will be placed, as well as the size and weight of the contents.

Cushioning

The purpose of cushioning is to absorb the energy of shock and vibration, through a gradual but increasing resistance to the movement of the load. The energy is absorbed as the cushion is compressed, resulting in a damping or minimizing of the force on the load.

Cushioning may also be used to prevent rupture of barriers or containers, prevent abrasion, and to absorb liquids, as well as distribute forces.

Waterproofing

Most carriers make every reasonable attempt to protect goods from water damage when handled during bad weather. Where it is known or predictable that equipment and facilities are poor, some weathering seems inevitable. Products susceptible to moisture or "sweating", contemplating this type of exposure, require waterproof barriers. Remember also that certain packing materials absorb and retain moisture. Water, more than any single element, causes fiberboard materials to lose much of their strength, exposing the contents to damage, theft and pilferage.

Waterproof barriers exclude entry of water (not water vapor) or divert water. Barriers also afford protection against dust, dirt, and other foreign matter. Waterproof barriers take the form of case liners, crate liners, shrouds or wraps. The atmosphere within crates lined with waterproof material frequently causes "sweat". Condensation is counteracted by desiccants and providing vents and drainage holes in the crate. Holes should be designed and located so that water runs out of the crate.

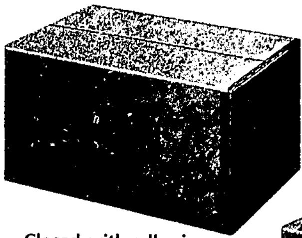
Cargo in open-top vehicles may require shrouds. Cars and containers should be inspected for leaks prior to loading.

Closure Systems

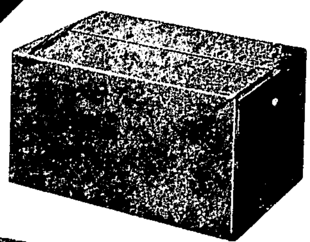
Most materials used in packing are supplied by manufacturers and vendors. The function of the shipper thus becomes one of assembling these materials and proper closure of the finished package. Aside from good workmanship in assembling, the type, quality and skill in performing the closure operation is of paramount importance. The cliche that a shipping container is no stronger than its closure is fundamental to successful packing. This makes it vital that gluing, stitching, taping, stapling, nailing and the like be as good as the packing.

Moreover, a carrier looking for a packing defense, for use in the event of a claim for loss or damage, will examine the closure system of a package to determine its adequacy. Too much stress, therefore, cannot be placed on the need for a proper packing closure system.

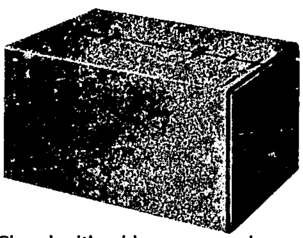
The first requisite for the shipper is to insure that the type of closure used is correct for the



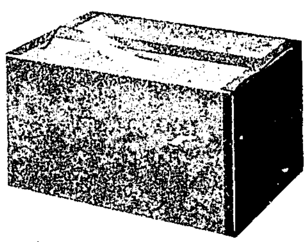
Closed with adhesive



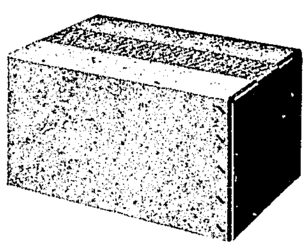
Closed with metal stitches



Closed with wide crown staples



Closed with paper sealing tape



Closed with reinforced tape

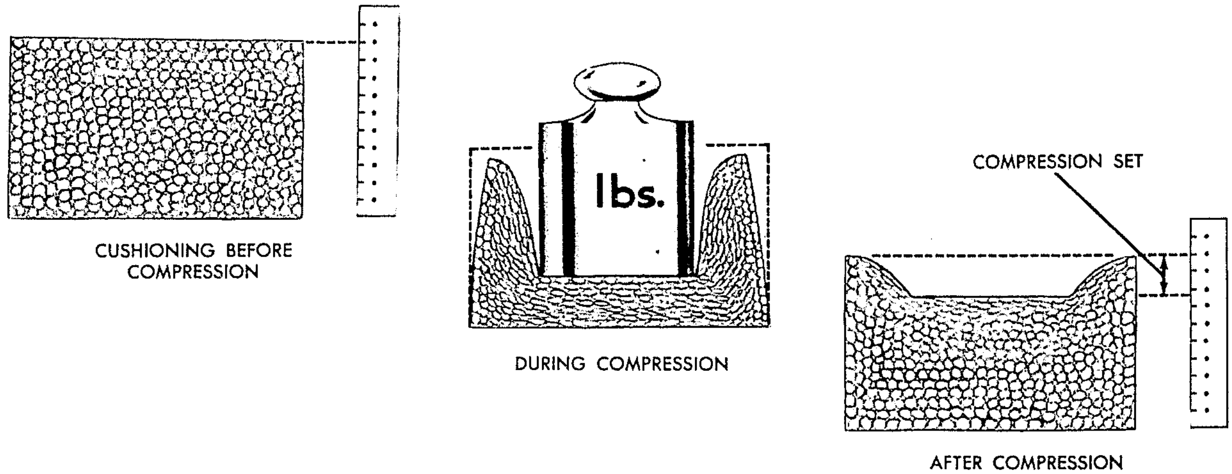
package; that is, that it meets the needs of the container and contents. The employees performing the closure must be properly trained and provided with correct equipment, kept in good order. Establish a quality-control procedure, which will monitor the output and insure that closures are being performed properly. Finally, it is in the shipper's interest to analyze his own claims experience, to see if he is contributing to losses by reason of failures of his own closure operation.

Strapping

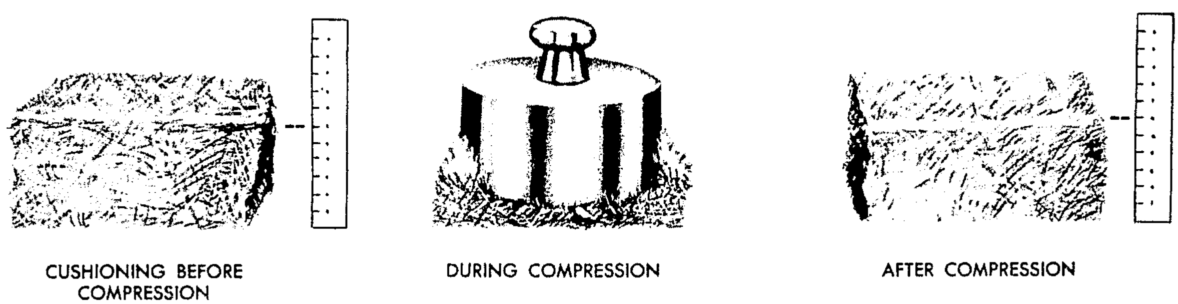
Although strapping is used as a reinforcement for blocking and bracing, its widest use is for reinforcing the exterior shipping container. The principal strapping materials are metal or plastic. Strapping is particularly useful in strengthening wooden boxes and crates and in minimizing nail pull. Strapping adds about 10% to the strength of a fiberboard box, particularly along the score lines. With an overloaded carton (obviously something to be avoided), the strap is often the difference between failure of the box and successful delivery.

Care in Stacking

As indicated, superimposed weights may result in container crushing. Exercise care, therefore, in stacking tiers squarely, limiting weight of tiers to the stacking strength of packages. Prevent containers from overhanging edges of shelves and pallets. Provide adequate aisle space to prevent damage by material handling equipment.



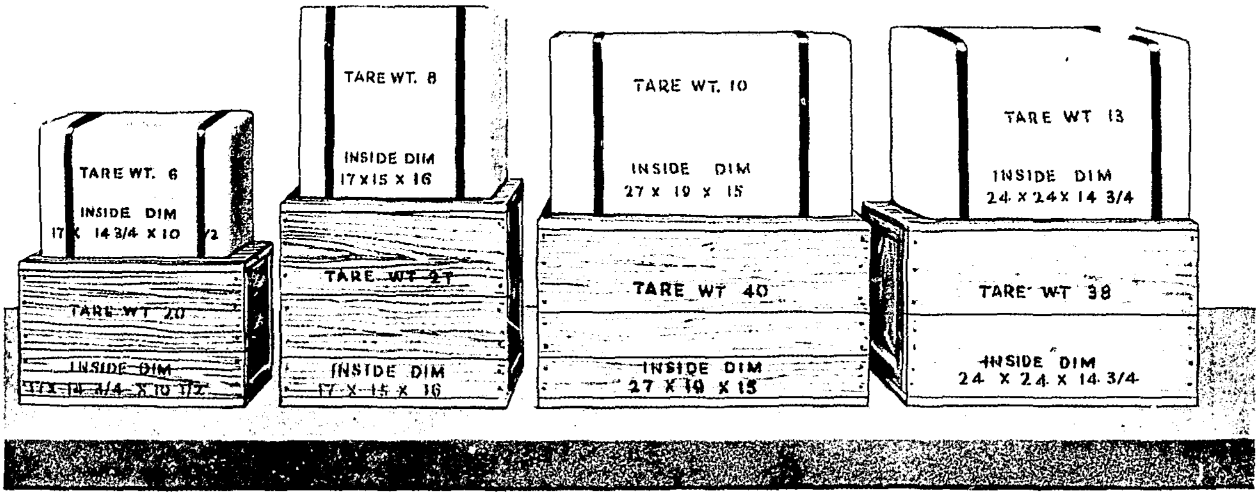
COMPRESSION SET



RESILIENCE

RATE OF RECOVERY

Cushioning Characteristics



Weight Savings Possible Through Proper Container Selection

Fiberboard Containers

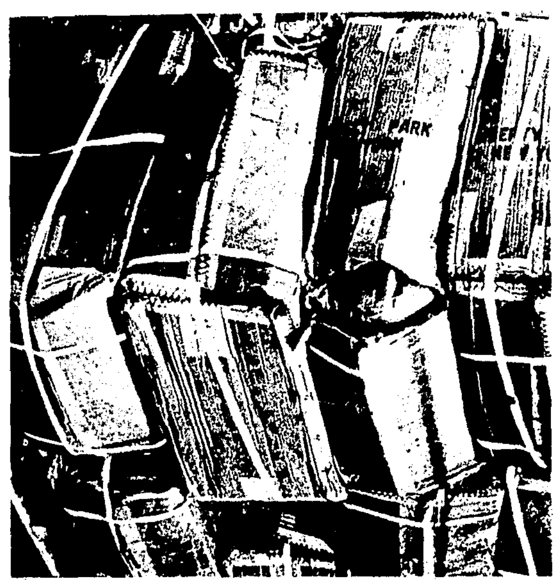
Advanced technology in transportation contributes significantly to reduction of hazards of loss and damage. It has made possible the development and utilization of light-weight, low-cost, and easily handled packing, which is exemplified in the fiberboard box or carton.

Although fiberboard is adaptable to a great variety of packaging and packing conditions, five principal factors affect its capabilities:

1. Resistance to compression;
2. Strength of score lines (creased edges);
3. Resistance to puncture;
4. Ability of the fiberboard to resist the weakening effects of moisture.
5. Weight of product to be packed.

Resistance to Compression

A carton's capacity to resist compression is, in general terms, inversely proportionate to the length of its corrugations. This principle holds, however, only when the carton is stacked with the corrugations vertical to the base upon which it rests. If the carton selected has corrugations too long to sustain the weight of the merchandise, or if the carton is placed on its side, crushing



Side areas of cartons are twice those of ends; therefore, the tendency is to stow such boxes on their sides, resulting in crushing, forcing closures open. Fragile items in crushed containers may be damaged, and exposed goods are vulnerable to theft.

and the consequent opening of closure is inevitable. (See photograph). (The relative humidity is also a factor in determining resistance to compression: See photograph).

Score Lines (Creased Edges)

If the closures of the carton remain secure, most pressure and breakage will occur along the score lines. Score line joints vary considerably in their capacity to withstand pressure; however, it has been observed that foreign-made cartons, particularly those boxes in which the body joint is lapped and stitched (See photograph), are the most likely to fail. Handlers should be most pointedly made aware of this fact.

Resistance to Puncture

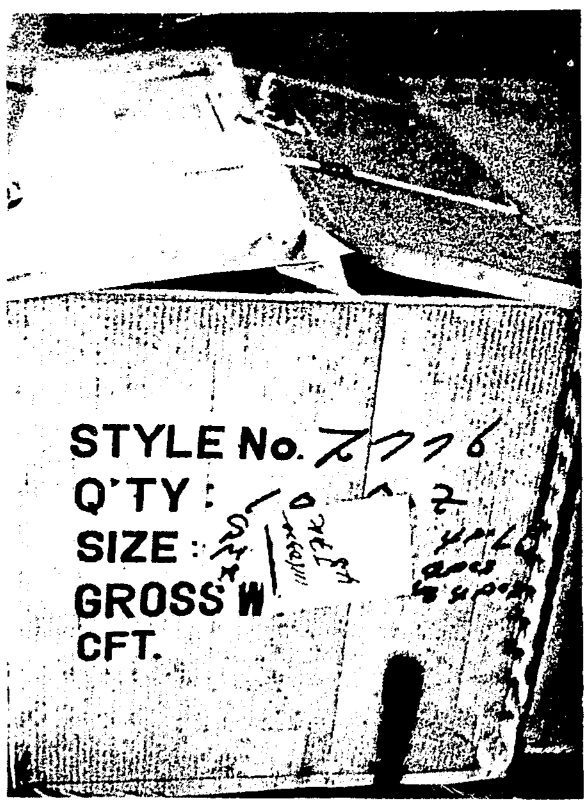
Resistance to puncture varies with materials and workmanship of the finished box.

Resistance to Moisture

The effects of moisture on the strength of a box at different relative humidities are shown in the Table on Page 12.

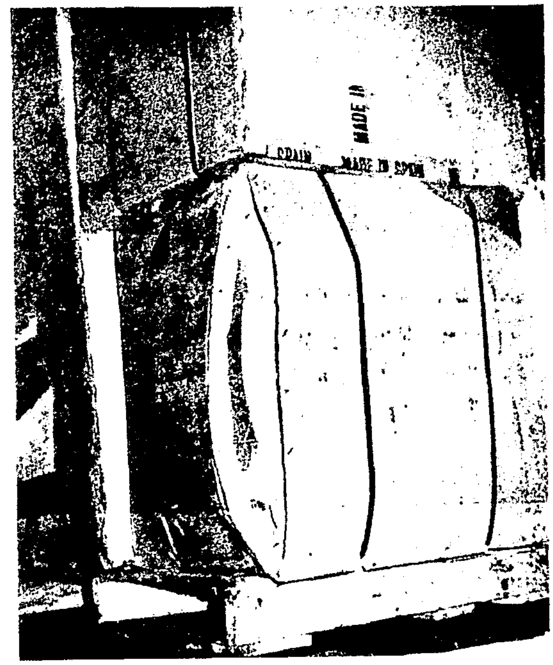
Weight of Product to be Packed

The weight of the product to be packed is a major factor in the selection of the proper carton to be used in transportation. Avoid loading cartons beyond their rated capacity.



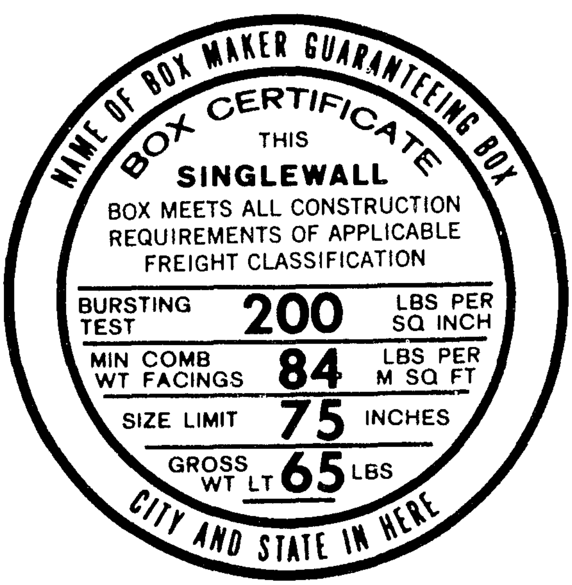
A corrugated carton is upright when the corrugations are vertical to the floor or base they rest upon. Where it is not possible to see the direction of the corrugations, this is usually determined by the location of the box openings; that is, when the flaps or box openings are top up and bottom down, the corrugations are running in a vertical plane. Had the above cartons been properly manufactured, the corrugations would not be as visible. Carton on left is overloaded, as indicated by bulge of top flaps. Carton on right failed as result of poor taping of closure.

Carton oversize for umbrellas, allowing them to shift inside box. Shifting resulted in failure of score line of carton, which in turn caused box to collapse and exposure of contents to pilferage. Collapsed carton prevents proper stacking of other cargo in a load.



Typical body joint failure. The stitching tore loose from the lap used to form joint. Although not shown, joint also fails when stitching holds, but score line, forming lap for stitching, tears.

American-made cartons usually show the gross weight limit in the Manufacturers Certificate on the bottom of the carton. Weighing the carton, and comparing its weight with that of the certificate, will show if the container is overweight and therefore, improperly packed.



Load Bulge

A supplemental problem, associated with load type and general carton quality, is load bulge, of which there are three groupings: filling, compression, and settling. Briefly (since the matter is rather obvious) an overloaded carton of loose wearing apparel bulges by overstuffing; a carton with side bulges caused by over-tightening of straps bulges by compression; settling is self-evident. But while bulging weakens a carton, its greatest detriment is to handling and to loose unit loading in particular.

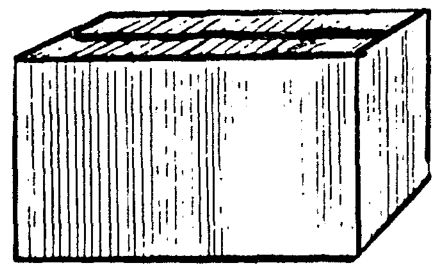
Load Collapse

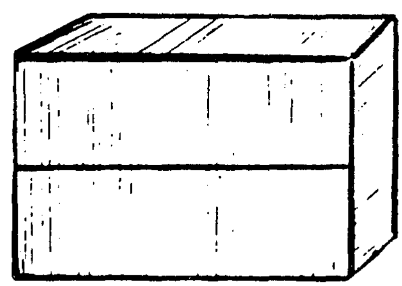
The opposite of load bulge is the caved-in or collapsed load, which reveals itself in a crease or crush inward of at least one of the faces of the carton. While container cave-in, like bulge, causes loose loads, its greater significance is that it evidences an oversized box for the load, inadequate interior packing, compression or the container being hit. Care in the selection of the carton to be used reduces the risk of such failures.

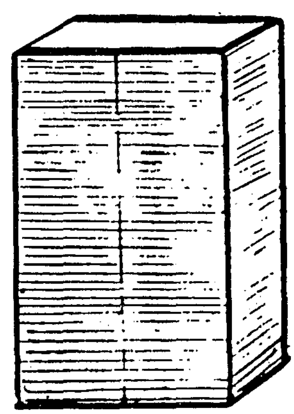
COMPRESSION STRENGTH

Regular Slotted Fiberboard Box (Carton)
Single Wall, 200 lbs. per square inch
Bursting Strength
Size 17½" x 11½" x 10"

Direction of Force	Relative Humidity	Compression Pounds Per Square Inch
Top To Bottom	50%	1900
Top To Bottom	90%	1000
Side To Side	50%	730
Side To Side	90%	430
End To End	50%	510
End To End	90%	350







Compression strength of a carton varies according to dimensions and relative humidity. Under the same humidity conditions, a given corrugated box stood upright on its top or bottom withstands approximately two-thirds more compression force than the same box when stood on its end or side.

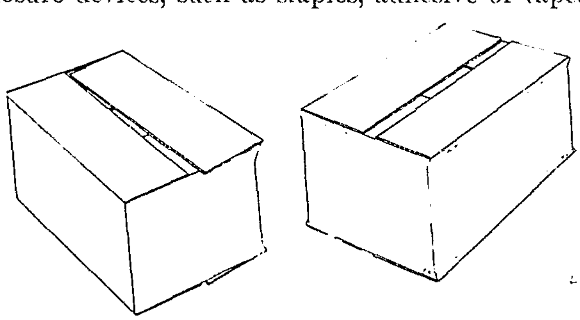
The contents settled in transit, resulting in the cartons either bulging or collapsing.

Inadequate Interior Packing

There are no published commercial specifications as to what constitutes adequate interior packing. How goods are blocked, braced and cushioned within the carton is a judgmental responsibility of the shipper. They should be packed so that they cannot move. Any item which can move within a container invariably damages itself, the container or both.

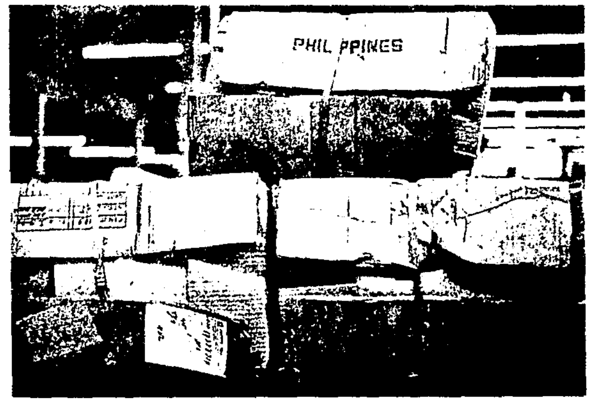
Improper Closure

Improper closure occurs when the top and bottom flaps are not tight together and square. This results from poor or inadequate application of closure devices, such as staples, adhesive or tape.



When cartons are oversize and/or improperly sealed, the contents shift, resulting in possible damage to the item and/or box. Flaps must be tight and square.

This failure brings about an oversized box, allowing the contents to shift within the carton.



These cartons should have been refused, as inadequately packed for transportation. The single strap around the girth of the carton is all that prevents the flaps from opening.

Indicators of Weakness

It is to be observed, from the above photograph and others in the text showing container failures, that weaknesses in packing will be common to more than one package. Shippers should evaluate their packing, through experience tests, to assure that their goods in movement are bearing up as well as expected.

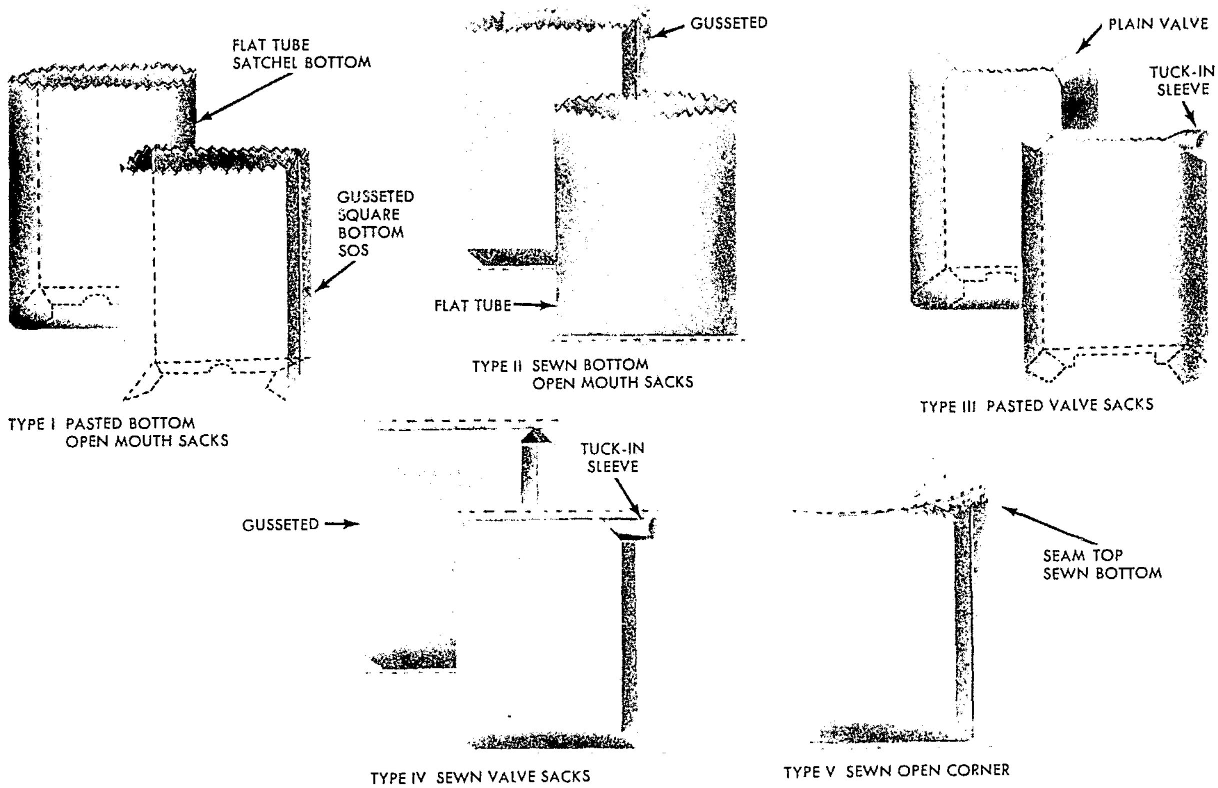
Bags and Sacks

Many bulk products are economically shipped in flexible containers, such as bags and sacks. The chief advantages of these are the relatively light weight in relation to the weight of the contents they carry, plus flexibility, filling and handling ease, minimum storage space required, and low cost of manufacture.

There are five basic types of bags and sacks—cotton mailing bags; cushioned paper sacks; burlap, cotton and waterproof textile bags; polyethylene or other plastic materials; and the paper shipping sack. This latter sack is the most common and can be manufactured to suit a wide range of bulk products.

Aside from selection of the appropriate shipping sack, proper storage, filling and handling strongly influence the serviceability of these containers.

Brittleness of paper sacks causes ruptures and usually results from storing bags in too dry an atmosphere. Paper sacks should be stored in areas of high humidity.



Types of Paper Shipping Sacks.

The wrong filling equipment can damage paper shipping sacks. Care must equally be exercised in properly closing the mouth of the bag. Common problems involving closures are poor stitching, not allowing sufficient gathering for good application of wire ties, and failure to tuck valves in their correct position. Regardless of how well the bag construction and filling are performed, sacks cannot withstand certain mishandling practices.

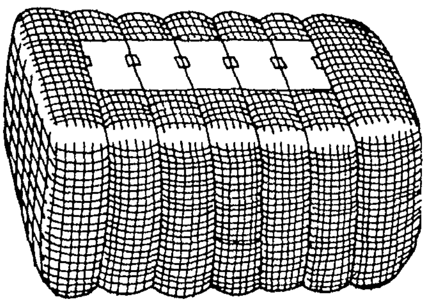
Things one should do or should not do in handling sacks include:

1. Sacks should be lifted with hands under both ends and carried at waist height or on shoulder.
2. When stacking on platforms, skids or two-wheeled hand trucks, sacks should be laid on flat sides. Use only trucks with wide and extended noseblades.
3. Examine every sack in bottom tier before lifting. Carry damaged sacks with torn side up.
4. Maintain plenty of aisle space to prevent "snagging".
5. Avoid dragging sacks on floor or over other cargo.
6. Drop sacks only on the flat.
7. Don't jab bags with truck blades.
8. Avoid bags overhanging on pallets.
9. Don't walk over or dig heels into sacks.

Bales

Bales are either compressed, such as those used for raw cotton, wool and scrap paper, or loose, for the shipment of soft goods including textiles, clothing, furs, rugs and so forth.

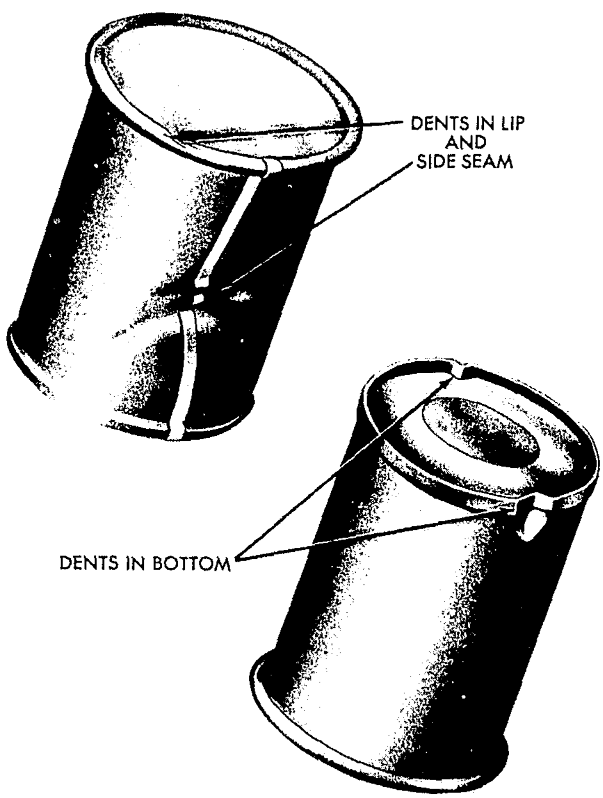
Products susceptible to dirt, water, chafing, cutting, and hook damage require interior protection, usually in the form of waterproof barrier material, fiberboard wrap and, to minimize hook damage, "ears" at the corners of the bales. Handling and cautionary markings should be stenciled legibly and large on the bales.



Cans, Pails and Drums

Cans, pails and drums are adaptable to many uses. For instance, they can handle liquids, semi-liquids, powder, and flaked and granular chemicals. They provide considerable protection for fragile and precision instruments. They are common for the handling of dangerous, flammable, corrosive and acid materials.

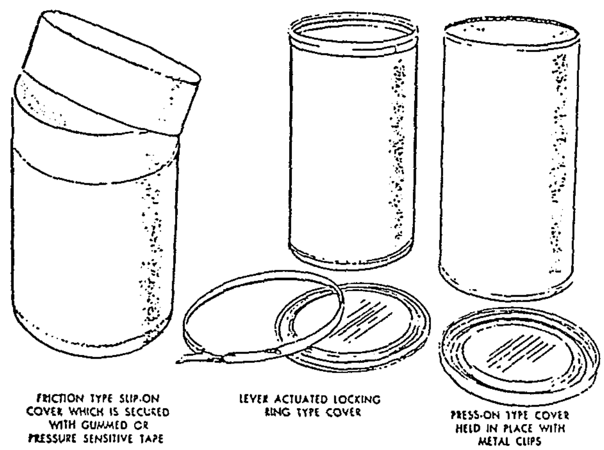
These containers are dustproof, waterproof and may be made vaporproof. They likewise serve as a deterrent to pilferage. Construction may be of fiberboard, paperboard, paper composite, plywood, steel, aluminum, or plastic. A number of possible closure techniques are available.



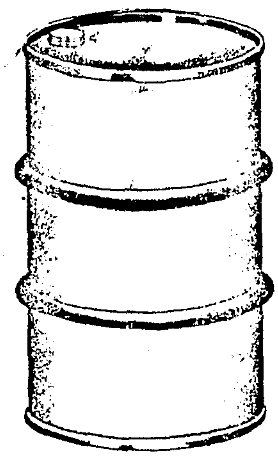
Cans, pails and drums are broadly classified as exterior or interior containers, and reusable or non-reusable.

The propensity of the consumer is to reject dented cans, whether or not they are ruptured. The principal causes for can denting are oversized shipping containers and poor closures. In the case of a carton, the fault is the result of not tightly butting and squaring the top flaps, or too large a box.

Dented pails and drums are usually less vulnerable to consumer resistance, unless the container is ruptured. Here, too, the cause is container shifting, resulting in body, seam or lip dents. Tight loading and adequate dunnage minimizes load movement.



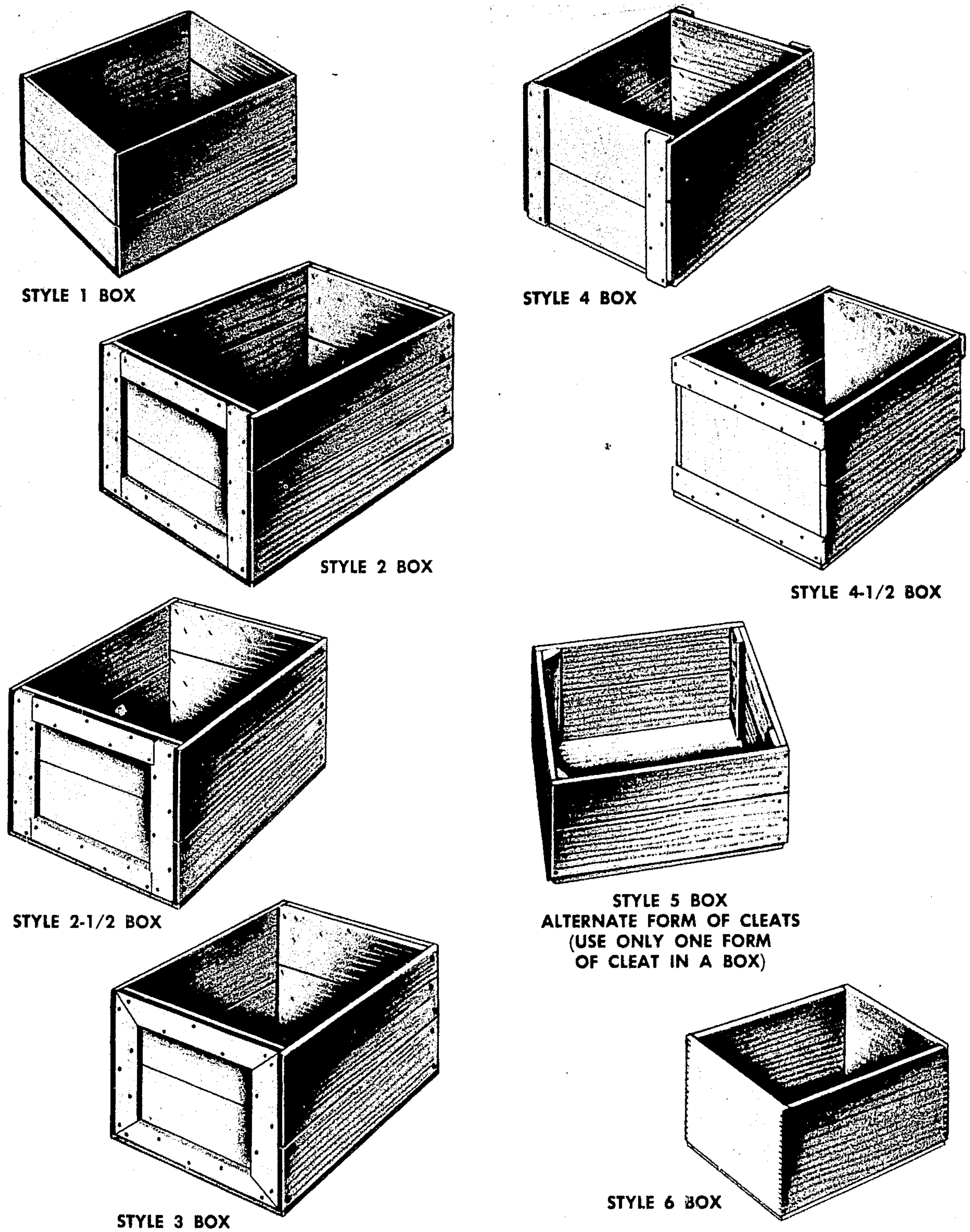
Types of fibre drum closures



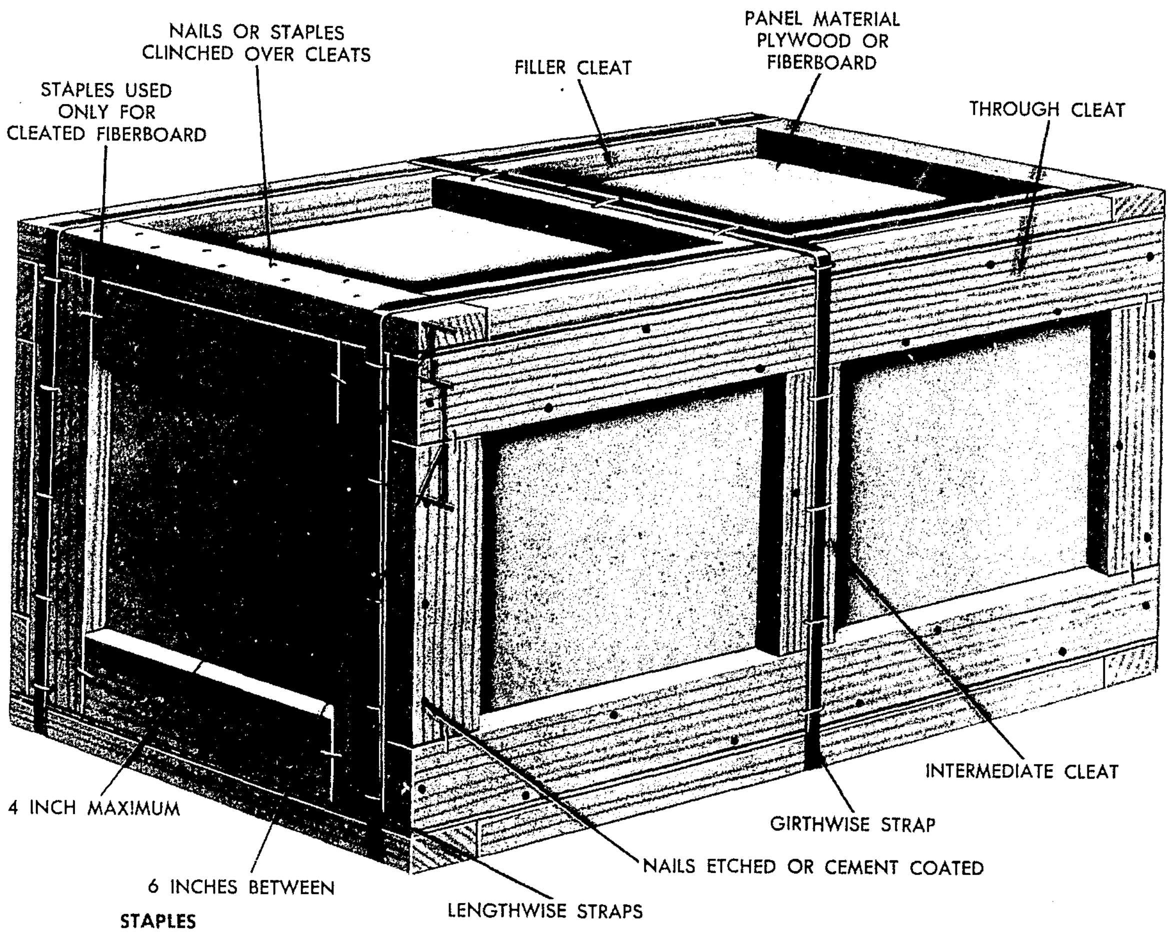
TIGHT HEAD

Wood Boxes

The durability of wood, and its ability to withstand shock and impact stresses, are significant reasons for selecting wood containers.



Styles of Nailed Wood Boxes



Woods used in container construction are either soft or hard. The characteristics of the soft woods are that they do not split easily, have moderate nail-holding power, and moderate strength and shock resistance. The hard woods have a greater tendency to split. Wood grain often deflects nails, but hard woods have greater nail-holding power, strength and shock resistance.

Nailed Wood Boxes

There are seven basic styles of nailed wood boxes, which are distinguishable by their cleats or lack of cleats.

The chief advantage of these containers include:

1. Maximum protection to contents against damage due to puncture, distortion and breakage.
2. Ability to support loads during transit and storage.
3. They contain difficult loads without undue distortion.
4. Adaptability to complex wood blocking and bracing.
5. Adaptability to varying strengths by adjusting the style of box, thickness of material and group of wood.
6. They are easily workable and of simple construction.

Disadvantages include:

1. High tare weight to cube.
2. Not water-tight.
3. Tendency to wrack.

Tables describing board thicknesses for the different wood groups, box styles, load types, and weight of contents are available. In general, when the weight of the contents is less than 100 pounds, ½″ thick boards are used for the sides, tops and bottoms. Board thicknesses increase to ¾″ when the weight of the load is 400 to 600 pounds. End boards are ¼″ thicker than those of the girth. For heavier loads cleats should be about ¾″ x 2⅝″. These boxes should be reinforced with strapping.

Cleated Panel Boxes

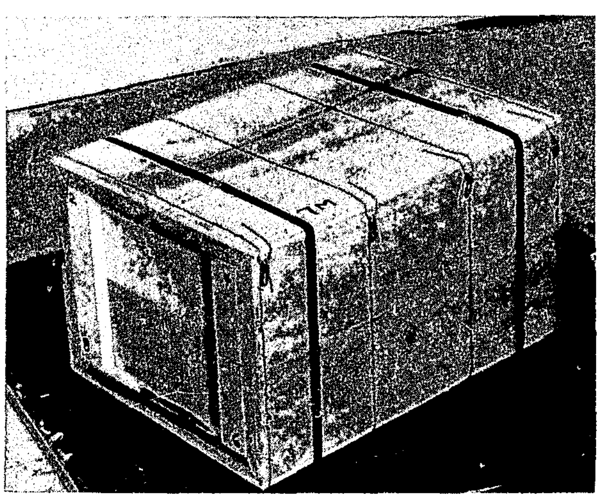
Cleated boxes have an assortment of uses. They may be utilized as complete containers or for paneling items secured to a load-bearing base. The panels may be of plywood, fiberboard or paper overlaid veneer.

These containers may fail when overloaded, installed with insufficient intermediate cleats, or split or broken cleats, or if assembled panels are improperly nailed. Avoid re-used boxes.

Apply strapping over cleats and hold straps in position with staples.

Wirebound Containers

Wirebound boxes are resilient engineered containers, deriving both strength and economy from the substitution of steel wire for a considerable portion of wood. The sides, top and bottom are stapled to several binding wires and are fastened to a framework of cleats at each end by staples driven astride the end binding wires. The ends are nailed, stapled or wired to the framework to form the container.



In using these boxes, care should be exercised to select the box designed for the type of load to be shipped.

Line boxes with waterproof barrier material, when necessary. Apply strapping when pilferage is a factor, or load weighs over 150 pounds.

Pallet boxes and crates are containers having an attached base designed to carry substantial loads and to be easily and efficiently handled by mechanical handling equipment.

The sidewalls and base of this container may be of tight or open construction and may or may not have tops of tight or open construction.

This type of packing has grown remarkably since the end of World War II, simultaneously with the development of mechanical handling equipment and the design of high-ceiling warehouses to accommodate heavy floor loading.

The use of lightweight wirebound pallet containers has resulted in substantial economies to the users:

(a) By reducing the tare weight and thus transportation costs;

(b) By the reduction of cube, permitting the loading of more containers in a given conveyance, thus further reducing transportation costs;

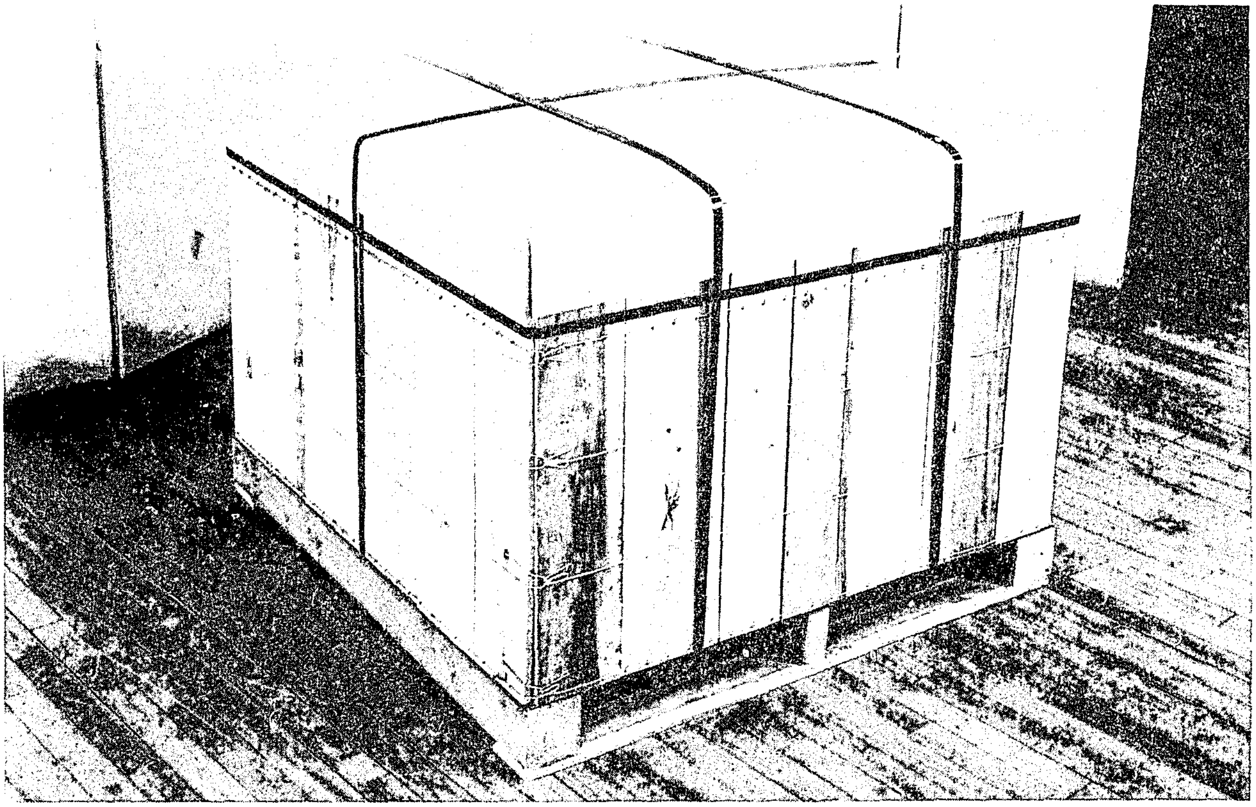
(c) By permitting maximum cube utilization in warehousing at origin, as well as at destination and in transportation vehicles.

When requirements are for extreme stacking, pallet containers with corner posts can be designed. Such designs have sustained maximum compression tests of 27,000 lbs. to over 30,000 lbs.

Crates—Open and Closed

When an item is too large to be shipped in a box, crating is used. To select the proper crate, it is necessary to consider certain basic factors that may influence the selection.

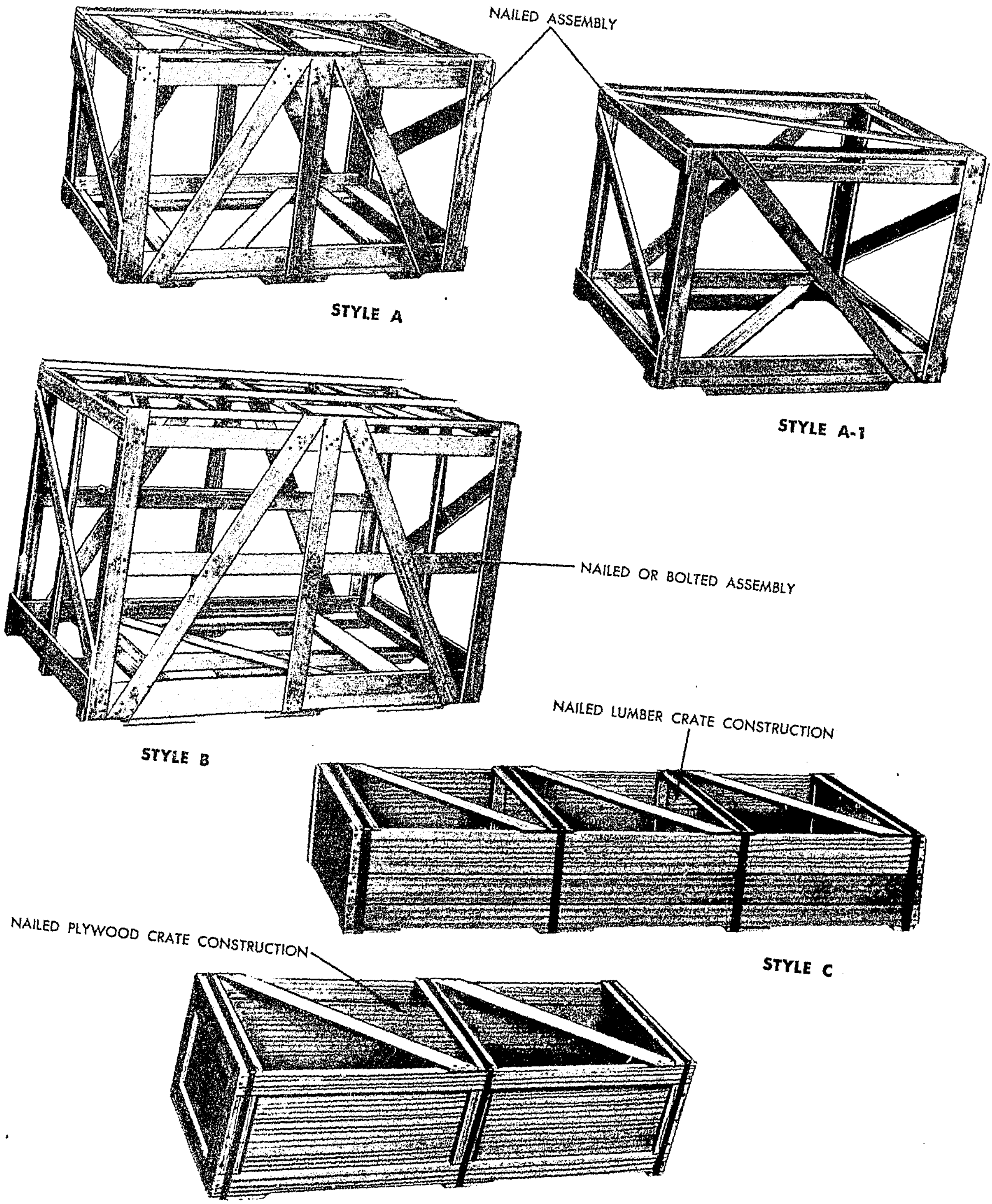
1. To manipulate a crate without excessive tilting, the size and weight should be limited to 30′ x 9′ and 11,200 pounds. These weights and measurements permit the crate to be handled by standard material handling equipment. Larger and heavier pieces



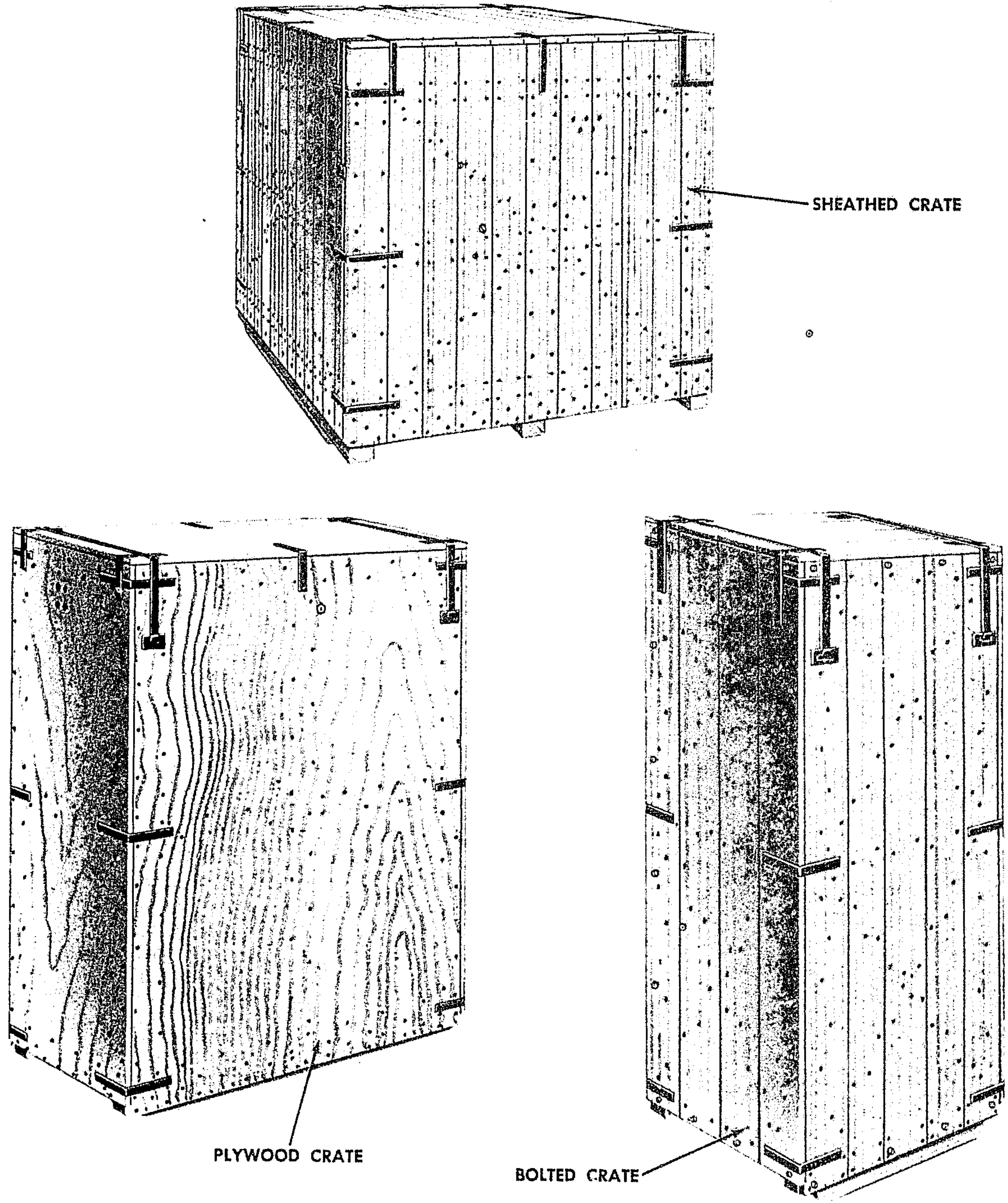
usually require special handling arrangements with the carrier.

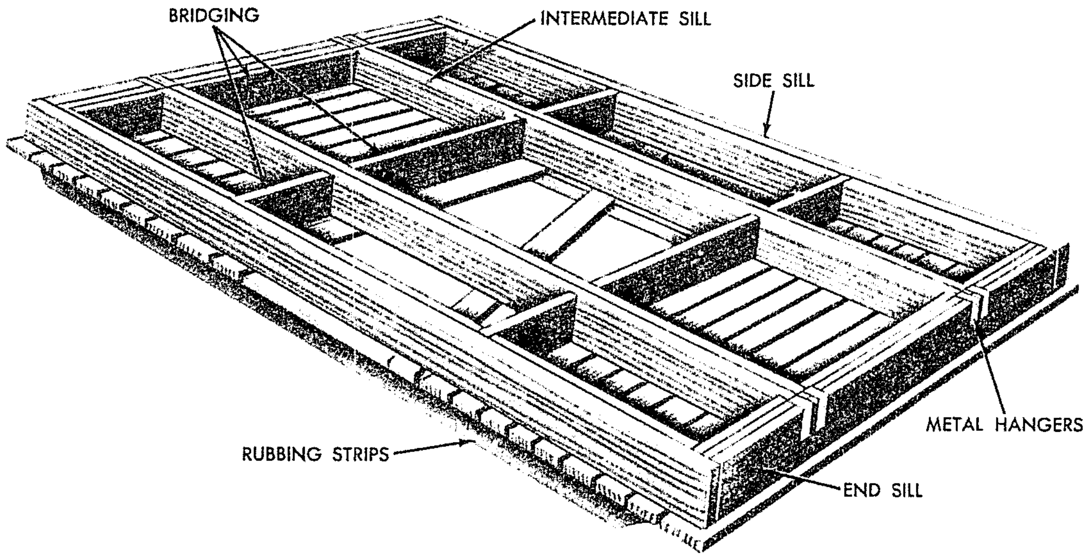
2. Protection requirements depend upon the nature of the contents, handling and shipping hazards. If no protection is required against weathering, use an open crate.
3. Disassembly of item permits a reduction in container cube. However, do not disassemble the item to the point where special tools or personnel are needed to reassemble it.
4. Weight distribution should be such that the center of gravity coincides with the geometric center of the crate. When this is not possible, mark exterior of crate where the points of balance are located.
5. Anchor the load securely to the base of the crate. All loose parts must also be secured within the crate.
6. Clearance of at least 1 inch should be allowed between the item and the interior faces of the crate to allow for container distortion.
7. Bases of crates are designed to support the contents. The two types of bases are the sill base, frequently used to save cube, and the skid base.

Crate design basically conforms to building construction. For instance: studs are vertical frame members; horizontal members are the lower edge pieces of the side and end panels; joists support the top and prevent crushing; sheathing is the shell; floor boards together with load-bearing boards form the flooring; diagonals provide rigidity; and headers are cross members attached to the ends of the skids which hold the skid together.

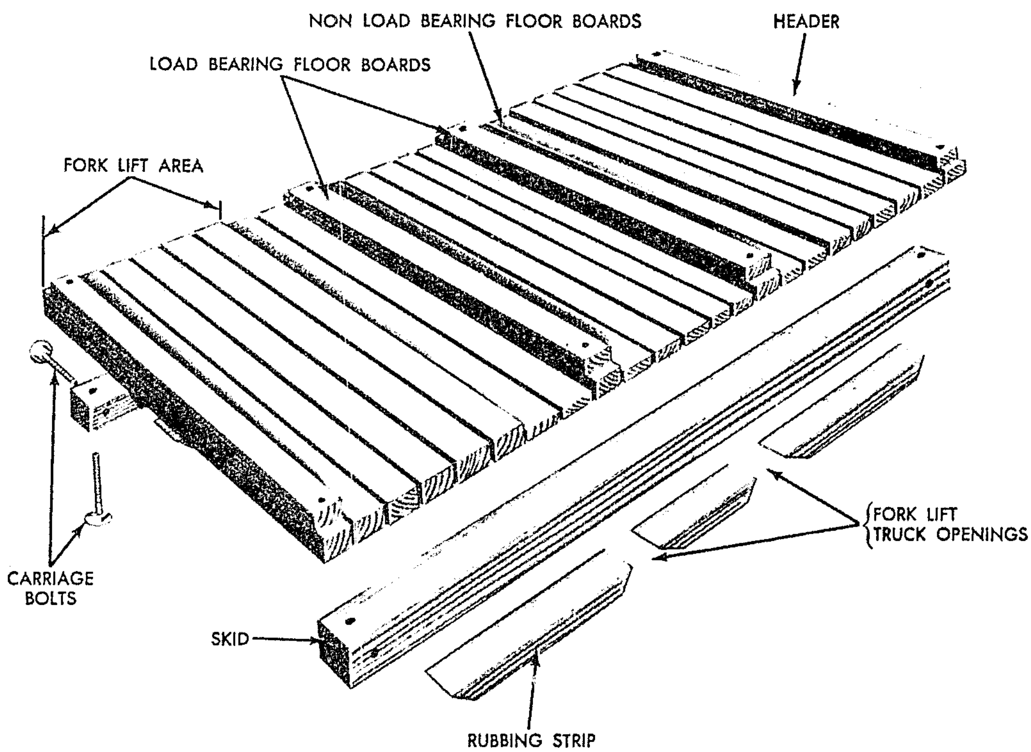


Styles of Open Crates


SHEATHED CRATE
PLYWOOD CRATE
BOLTED CRATE



Sill Base



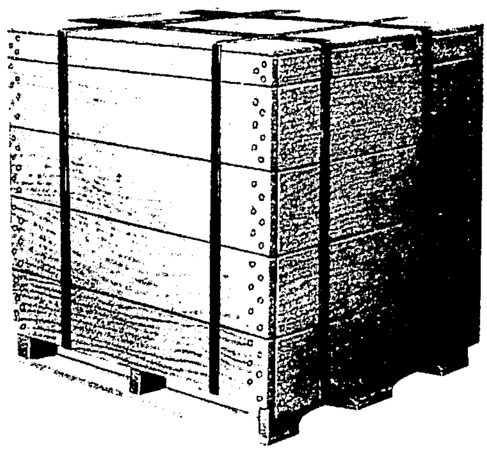
Skid Base

Unit Loads

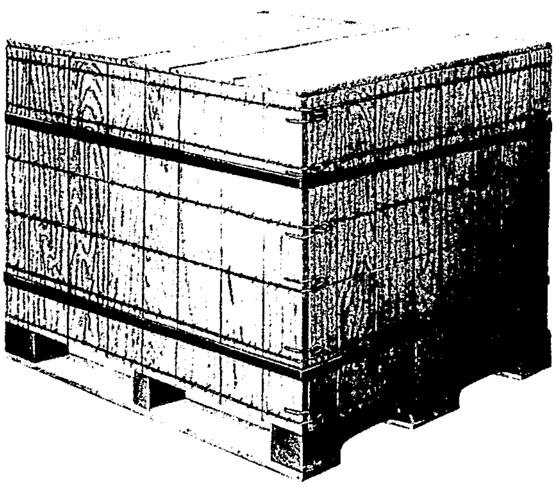
Although the unit load is basically designed to reduce packing and material handling cost, it does provide significant benefits in reducing cargo loss and damage when handled properly.

The greatest advantage accrues when the unit load is assembled as early in the transportation cycle as possible and disassembled as late as possible.

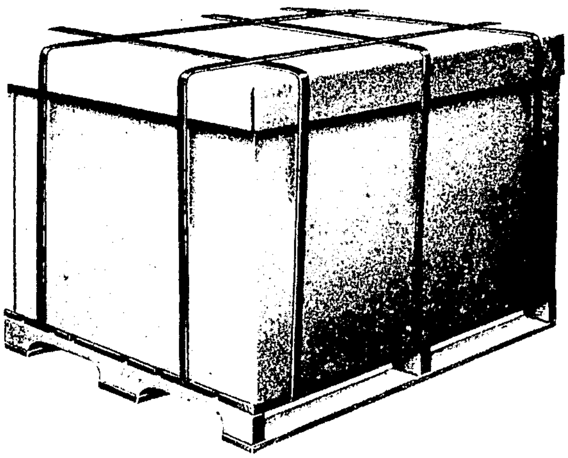
In addition to the typical application of the unit load depicted by the illustration, some units are designed for special purposes such as being reusable and providing pilfer-proof protection. Also many carriers make available to shippers containers and pallets which are either captive or intermodal.



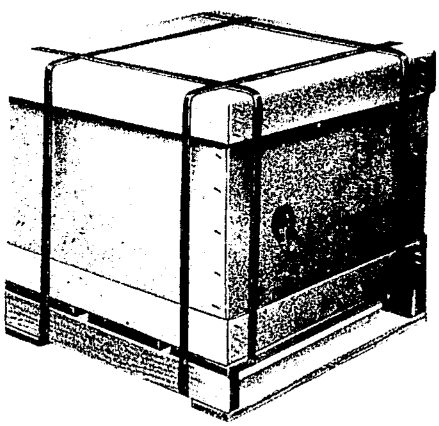
WOOD



WIREBOUND

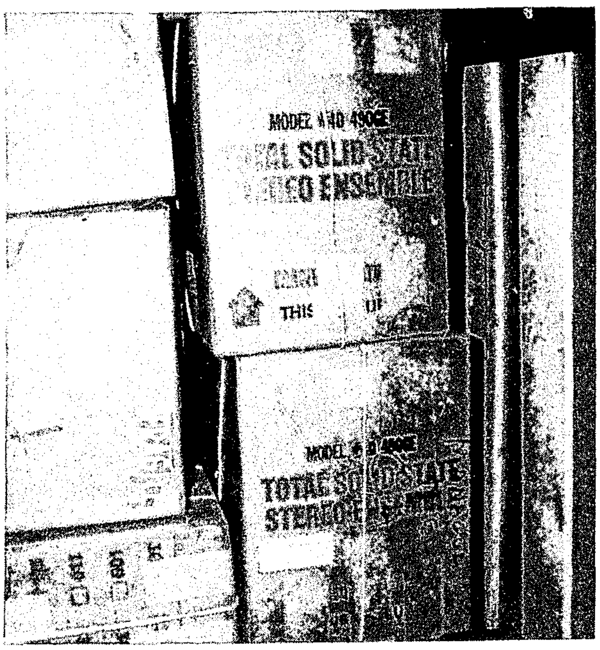


TRIPLE-WALL FIBERBOARD



FIBERBOARD

MARKINGS



Marks identifying the shipment are required on all packages. Distinct, legible, complete and accurate marks minimize handling errors. If an error occurs, clear markings assist in locating and correcting the mishandling.

Obliterate ALL old markings, except shipper's and manufacturer's marks.

In addition to identifying the shipment, all restricted articles must be specifically labeled. When necessary, apply appropriate cautionary symbols, locating them where they will do the most good. Warning marks for international cargo should be in the language of the countries of transit.

Marks revealing the contents are to be discouraged, especially if the item is valuable, desirable and readily portable. A box that does not "advertise" its tempting contents is less likely to catch the eye of a potential thief.

SEALING

Where practical, vehicles and containers should be sealed. There are two basic classes of seals—those mainly providing evidence of tampering, and high-security seals.

Proper application of seals to containers and vehicle doors protects shipper and carrier against loss due to theft or error. Record seal numbers on shipping documents, for purposes of verification.

The value of the seal was demonstrated during a test of 873 rail cars provided with high-security seals. The program reported shortages in 43 cars, of which 39 had undisturbed seals. This demonstrates that the security seal protects the goods while in transit, and that all shortages are not attributable to the carrier.

CONCLUSION

Exclusive of damage resulting from poor packing design or a weakness of the product, most damage attributable to packing results from poor closures, overloading, voids, inadequate blocking, bracing and cushioning.

When a shipper performs the loading and unloading function of a rail car, a trailer or a container, he may cause the identical damage a carrier can cause, if he permits rough handling, loose load, or fails to properly block and brace load.

A shipper should trace his cargo movements, to determine consistent patterns of damage. Consistent patterns, clearly indicating faults in the strength of the product or packing, must be corrected before further shipping, to avoid unnecessary shipping costs.

Clearly these matters are mutual problems of shippers and transportation companies.

Damage to goods in transit means financial loss. Theft or pilferage resulting from damage or package weakness compounds that loss. The nature of a product's packing may be a major factor in transportation loss through theft and/or damage.

Reduction of such losses can be accomplished through recognition and implementation of practical packing guidelines and principles.

This report has been prepared as a guide to packing and handling of goods in transit, to assure them safe, secure delivery. It is not meant to cover the technical aspects of packing, but to illustrate packing principles.

For further information on the subject, shippers are strongly urged to obtain the services of a recognized package testing laboratory or a reputable packaging consultant.

The references which follow are excellent sources for further guidance in packing and handling.

PUBLICATIONS

Distribution Packaging—Freidman and Kipness
Robert E. Krieger Publishing Co., 645 New York Avenue
Huntington, New York 11743

Fibre Box Handbook—Fibre Box Association
Obtain from your supplier of corrugated materials or Request from SPHE

Packaging For The Small Parcel Environment
United Parcel Service, or
Order from SPHE Office

Principles of Package Development—Griffin and Sacharow
Avi Technical Books, Inc.
P.O. Box 831—Westport, Conn. 06880

AMCO 706-121 Engineering Design Handbook —Packaging and Pack Engineering—3/72
Order from Technical Information Service, Department of Commerce, Springfield, Va. 22151

Packaging Production Management—Raphael and Ollson
Rochester Institute of Technology, College of Continuing Education
One Lomb Memorial Drive, Rochester, N.Y. 14623

Mil. St. 726
Government Printing Office

Mil. St. P116
Government Printing Office

Uniform Freight Classification

National Motor Freight Classification

Functional Plant Planning Layout and Materials Handling—Merle C. Nutt
Exposition Press, Inc., 50 Jericho Turnpike
Jericho, N.Y. 10016

Materials Handling Systems Design—
James M. Apple
The Ronald Press Co., 79 Madison Avenue
New York, New York 10016

SOCIETIES AND ASSOCIATIONS

American Management Association

International Material Management Society

Packaging Institute U.S.A.

Society of Packaging and Handling Engineers (SPHE)

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