Supplier Packaging Guidelines

For Locations in North America

Hyster-Yale Group

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1 INTRODUCTION

1.1 SCOPE

This document provides general guidelines on the minimum packaging requirements for production materials shipped to the Hyster-Yale Group (HYG) North American assembly and manufacturing facilities located in Berea, Kentucky; Greenville, North Carolina; Ramos Arizpe, Mexico; and Sulligent, Alabama.

1.2 PURPOSE

The purpose of this document is to provide suppliers with concise guidelines for packaging production materials at the lowest total cost by minimizing product damage, freight costs, ergonomic hazards, material handling labor, and environmental impact.

Due to the wide range of production materials used at the HYG assembly and manufacturing facilities and the condensed nature of these packaging guidelines, there are materials that will exceed the parameters outlined in this document. For these materials, please contact packaging@hyster-yale.com for additional direction.

HYG Packaging is willing to partner with suppliers to establish sound, economical packaging designs that promote efficiency throughout the entire supply chain. However, suppliers retain the responsibility for providing damage free production materials shipped in the lowest total cost package.

2 ACCEPTABLE PACKAGING

Acceptable packaging may be expendable or returnable, but must be of sufficient design and strength to properly protect production materials throughout the entire supply chain. The packaging selected for use must provide the lowest total cost.

2.1 EXPENDABLE PACKAGING

Expendable packaging is used a single time and must place an emphasis on recyclable materials.

2.1.1 BAGS

Bags are an acceptable primary package for smaller components, but will typically require a secondary overpack such as a carton to ensure product protection.

Production materials in bags should be packed in quantities that are equal to the actual line delivery quantity or a common multiple thereof.

The preferred bag material is clear polyethylene for ease of recyclability.

Bag thickness must be a minimum 2 mil. Thicker gauges may be required based on the application.

Bags may be sealed with zip locks, tape, twist ties, zip ties, or heat seals. Staples should not be used.

2.1.2 CORRUGATED CARTONS

Corrugated ("cardboard") cartons are one of the most common forms of packaging, and are a preferred expendable package due to their ease of recyclability.

2.1.2.1 MANUALLY HANDLED CARTONS

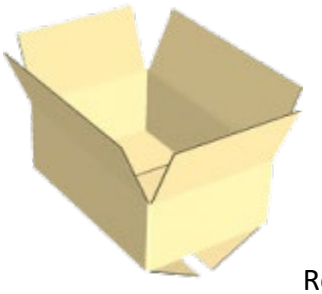
Corrugated cartons that are intended to be manually handled must comply with the following size and weight limits:

- Maximum width of 20 in. (508 mm)
- Maximum gross weight of 35 lbs. (16 kg.)

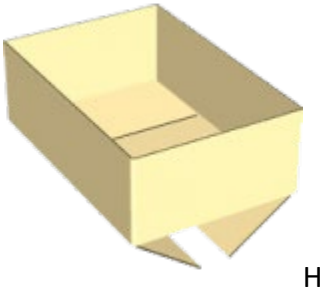
2.1.2.2 CARTON STYLES AND MATERIALS

Corrugated cartons are available in a wide variety of sizes, styles and material strengths.

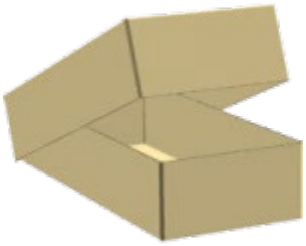
Common styles of corrugated cartons that are most conducive to the HYG assembly and manufacturing operations are regular slotted cartons (RSC), half slotted cartons (HSC), and when additional carton strength is required – full telescoping cartons (FTC).



Regular Slotted Carton (RSC)



Half Slotted Carton (HSC) may also require a lid



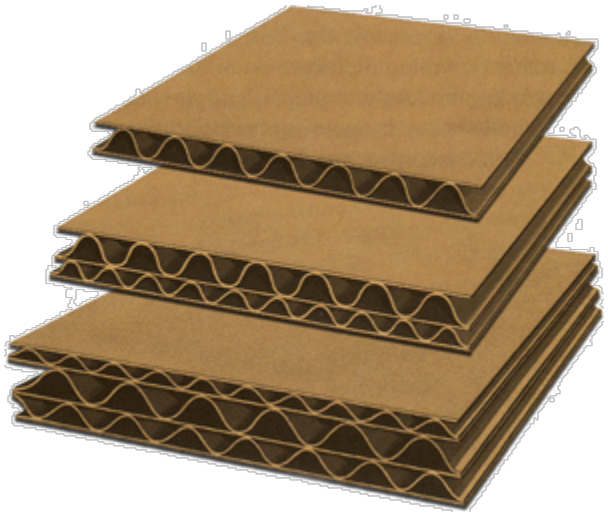
Full Telescoping Carton (FTC)

The table on Page 8 may be used as a guide for selecting the appropriate corrugated material based on the gross weight of the carton being shipped. Referenced within this table are test strengths and wall types. There are two tests used to determine the strength of corrugated cartons – Mullen Burst Test and Edge Crush Test. Cartons are readily available in three different wall types or thicknesses.

The Mullen Burst Test is a measure of the force required to burst or rupture the side of a corrugated carton. If a carton will be handled individually and exposed to rough handling, use this test for material selection.

The Edge Crush Test (ECT) measures the stacking, or top-to-bottom compression, strength of a corrugated carton. If cartons will be shipped in uniform pallet loads, and/or have the potential for additional loads to be stacked on top use the ECT for material selection.

The three most common corrugated board thicknesses are single wall, double wall, and triple wall. Corrugated board is made from a combination of paper sheets called liners glued to a corrugated inner medium referred to as the flute. Single wall corrugated board correlates to a single fluted medium, double wall has two fluted mediums, and triple wall has three fluted mediums. The three board thicknesses are illustrated below.



Also available, but not listed in the provided table, are multiwall corrugated boards containing four or more fluted mediums. These multiwall boards are used to manufacture heavy duty cartons such as may be required for bulk loads of raw castings or other heavy weight production materials.

Maximum Gross Weight Carton and Contents (lbs.)	Minimum Mullen Burst Test Strength (lbs. per sq. in.)	Minimum Edge Crush Test Strength (ECT) (lbs. per in. width)
Single Wall Corrugated Cartons		
20	125	23
35	150	26
50	175	29
65	200	32
80	250	40
95	275	44
120	350	55
Double Wall Corrugated Cartons		
80	200	42
100	275	48
120	350	51
140	400	61
160	500	71
180	600	82
Triple Wall Corrugated Cartons		
240	700	67
260	900	80
280	1100	90
300	1300	112

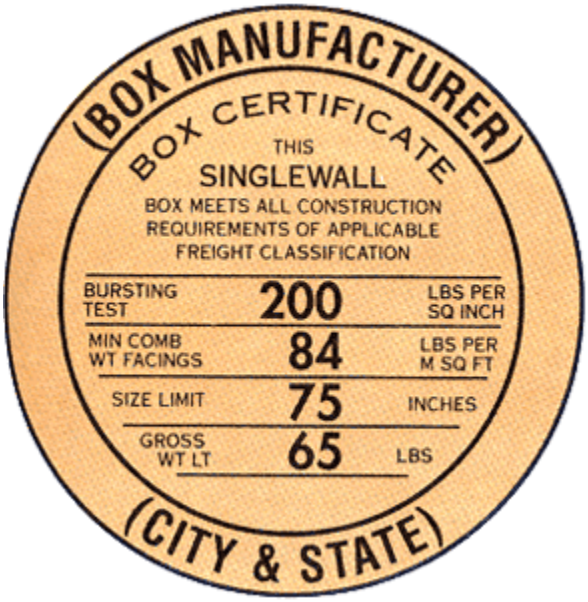
2.1.2.3 CARTON SEALING

Corrugated cartons should be securely sealed with 2” (51 mm) wide pressure sensitive tape or an adhesive specifically designed for carton sealing. Carton sealing must be strong enough to insure that the unsupported bottom of manually handled cartons can hold the net weight of the contents.

Staples should not be used to seal cartons. Staples are only allowed on the stitched manufacturer’s joints and lid flaps of heavy duty, multi-wall (double wall and thicker) cartons where tape or glue is inadequate.

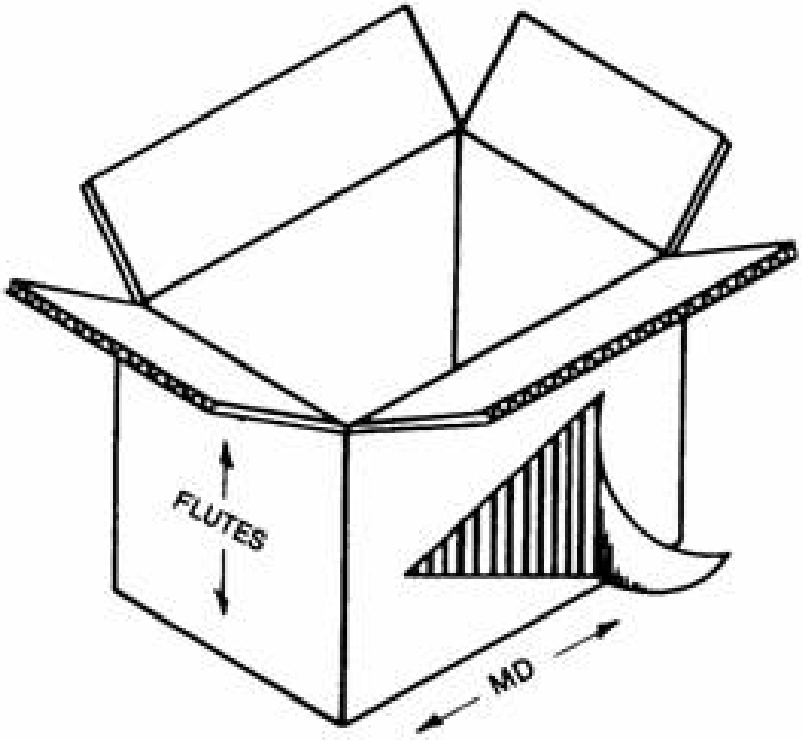
2.1.2.4 BOX MAKER CERTIFICATE

All cartons should be printed with the box maker's certificate identifying test strength and wall type as illustrated below.



2.1.2.5 FLUTE DIRECTION

The corrugated flutes should run vertically for maximum carton stacking strength.



Vertical flute box.

2.1.2.6 CARTON STACKING

Two-thirds of the stacking strength of a corrugated carton is concentrated at the corners. Stack cartons on a pallet with the corners aligned, and the cartons within the perimeter of the pallet for maximum stacking strength.

Misaligned carton corners can reduce stacking strength by up to 30%.

Interlocked stacking patterns can reduce stacking strength by up to 50%.

Carton overhang off the pallet can reduce stacking strength by up 32%.

2.1.3 INTERNAL PACKAGING

Internal packaging consists of a wide range of materials and components that protect production materials from shock, vibration, and abrasion. As with all expendable packaging, it is important to focus on recyclable materials. Corrugated or other paper based inserts and separators are acceptable; as well as, polyethylene based sheeting and air-filled cushioning.

2.1.4 PALLETS

All pallets larger than 32” X 30” (813 mm X 762 mm) must be four-way entry to allow fork access on all sides for maximum material handling efficiency.

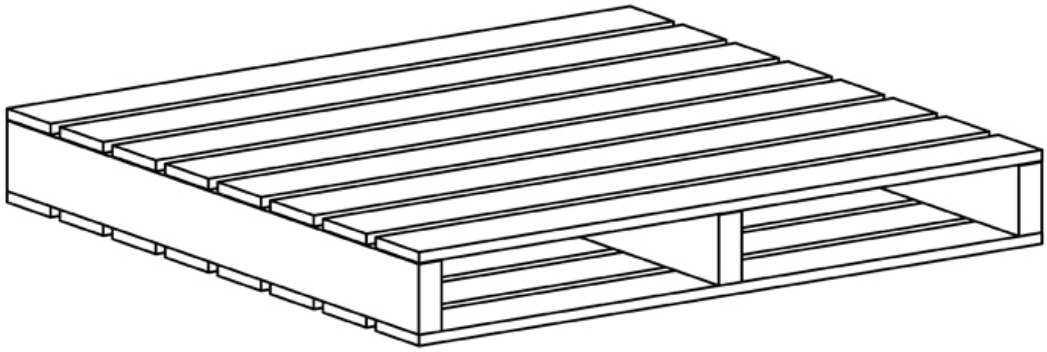
Expendable pallets may be made of wood or paper based materials. Wood pallets may be made of lumber or plywood. Acceptable paper based materials for pallet constructions include corrugated boards, convolute tubes, and Kraft honeycomb.

2.1.4.1 PALLET SIZES AND STYLES

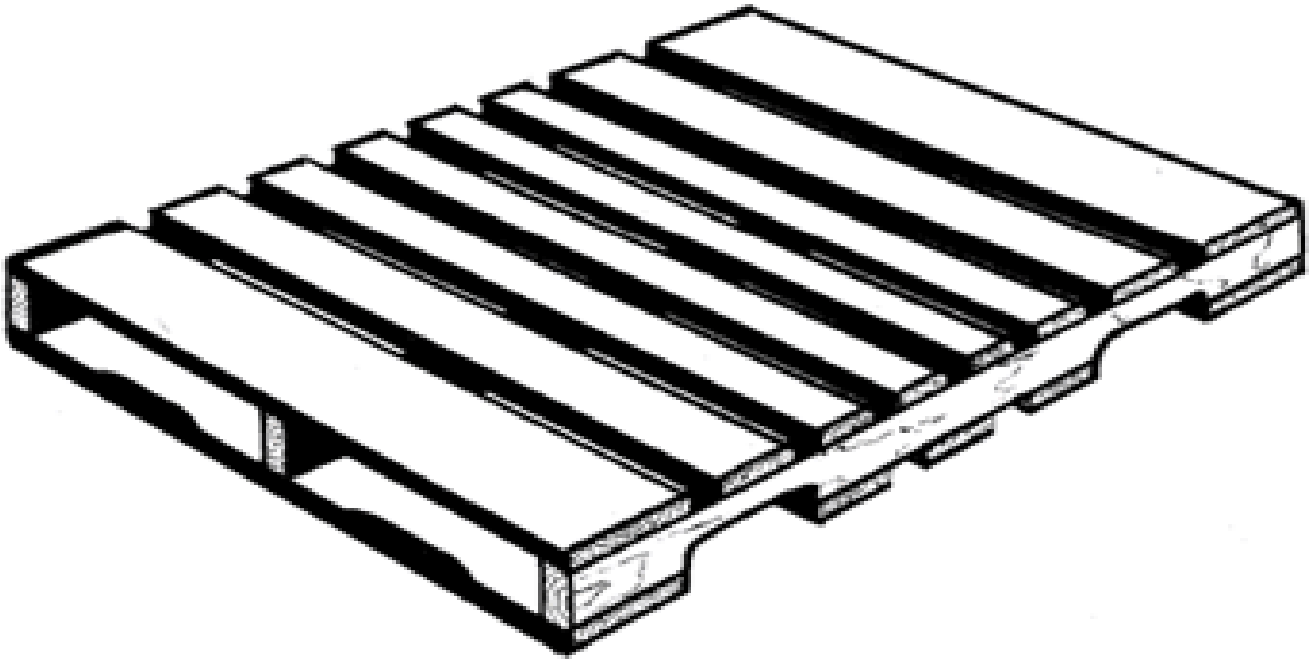
Acceptable pallet sizes and payloads are listed in the following table.

Pallet Size	Maximum Load Height Including Pallet	Maximum Gross Payload
32” X 30” (813 mm X 762 mm) (32” X 32” is allowable)	**15” (381 mm)**	**2500 lbs. (1136 kg)**
42” X 32” (1067 mm X 813 mm)	**24” (610 mm)**	**3250 lbs. (1477 kg)**
48” X 40” (1219 mm X 1016 mm)	**48” (1219 mm)**	**4875 lbs. (2216 kg)**
48” X 45” (1219 mm X 1143 mm)	**54” (1371 mm)**	**4875 lbs. (2216 kg)**

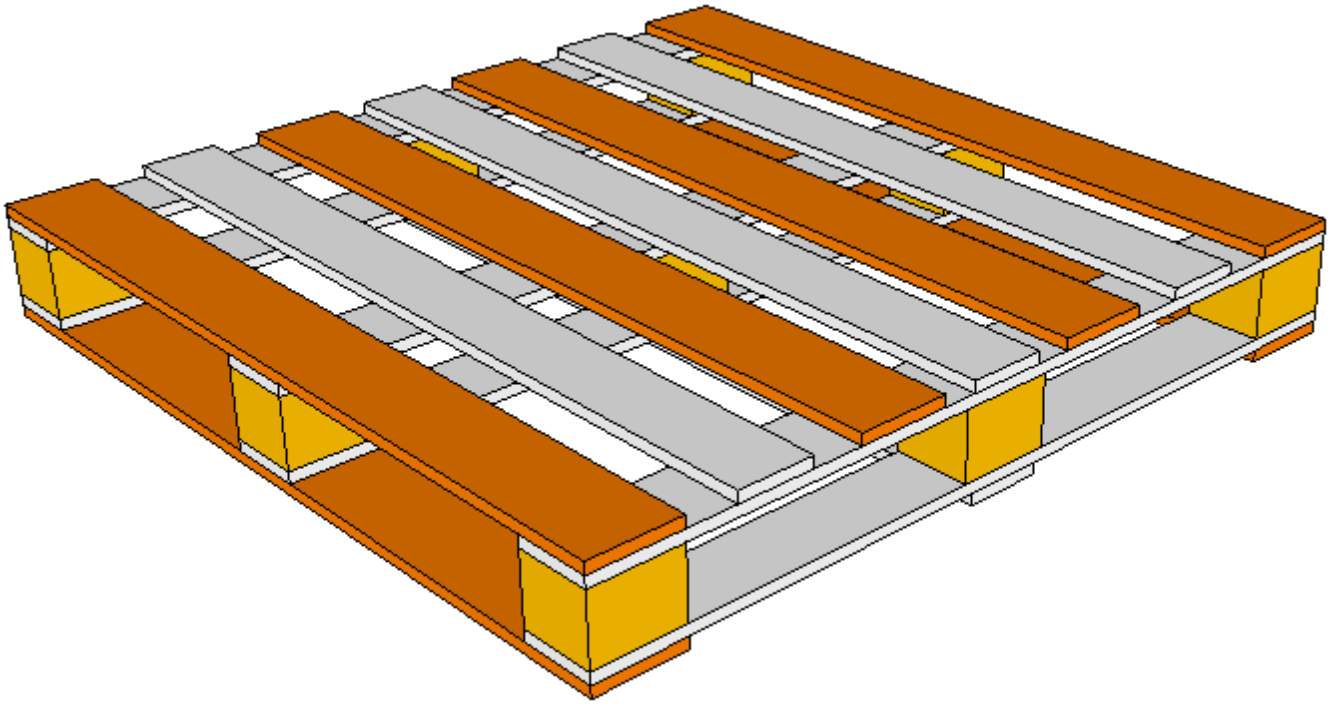
The 32” X 30” pallet style must be double face reversible as shown below to allow use on roller conveyors.



Acceptable styles for the other pallet sizes are flush stringer style (double face, nonreversible)



and block style with full overlap base.



2.1.4.2 PALLET CONSTRUCTION

Wood pallets should be fabricated in general accordance with the current Good Manufacturing Practices outlined in the latest version of the Uniform Standard for Wood Pallets published by the National Wooden Pallet and Container Association (www.palletcentral.com).

Wood pallets should be assembled with minimum 2.25” (57 mm) helically or annularly threaded nails for maximum holding power.

Top and bottom deck boards should be a minimum 3.5” (89 mm) wide and 0.5” (13 mm) thick. Deck board spacing must provide full support to the production material. There should be no missing or broken top or bottom deck boards.

Stringer style pallets must have a minimum of three stringers. Each stringer must be a minimum of 1.5” (38 mm) wide X 3.5” (89 mm) tall (nominal 2”X 4” (51 mm X 102 mm) lumber) in order to maintain a minimum 3.5” (89 mm) high fork entry opening. For four-way entry, each stringer must have two notches 2” (51 mm) to 2.5” (64 mm) high and 9” (229 mm) long on 24” (610 mm) centers to allow side fork entry. There should be no missing or broken stringers.

Block style pallets must be fabricated with a minimum of nine blocks. Each block must have the minimum block dimensions of 3.5” X 3.5” X 3.5” (89 mm X 89 mm X 89 mm) in order to maintain a minimum 3.5” (89 mm) high fork entry opening. There should be no missing or broken blocks.

As indicated, the above dimensions are the minimums. Larger deck boards, stringers, or blocks may be required depending upon the load configuration and/or payload.

Paper based pallets should be constructed with water resistant adhesives versus staples or other mechanical fasteners that may adversely affect recycling efforts.

2.1.4.3 EXPORT PALLETS

Wood pallets that will be shipped internationally must comply with the latest version of the International Standards for Phytosanitary Measures, ISPM No. 15, Regulation of Wood Packaging Material in International Trade (www.ispm15.com).

2.2 RETURNABLE PACKAGING

Returnable packaging is acceptable when it provides the lowest total cost. Returnable packaging proposals must undergo a thorough financial feasibility analysis by HYG Packaging to confirm that all associated expenses are accounted for.

Returnable packaging is used repeatedly over multiple years and must place an emphasis on durability in material selection and design.

Back up expendable packaging of like dimensions and net quantity of contents must always be readily available to cover potential disruptions in the flow of returnable packaging.

2.2.1 INVESTMENT POLICY

HYG's investment policy on returnable packaging is that the packaging will be purchased by the supplier with reimbursement provided through a piece price amortization process. The supplier purchase policy applies to initial returnable packaging purchases and associated maintenance expenses, as well as, supplemental purchases to cover attrition, volume increases, etc. HYG will be responsible for freight expenses.

2.2.2 ACCEPTABLE RETURNABLE PACKAGING STYLES

A wide variety of returnable packaging styles are in use at the HYG assembly and manufacturing facilities including, but not limited to the following.

- Custom steel shipping racks
- Bulk bins
- Bulk tubs
- Layer packs
- Dedicated pallets
- Spools
- Custom thermoformed tray packs
- Sleeve packs
- Hand totes

2.2.3 DESIGN CONSIDERATIONS

The following features should be taken into consideration when designing returnable packaging.

- Orientation of the production material within the package to insure part protection and ergonomic

access during loading and unloading.

- Secure containment of the production material with minimal internal packaging and labor requirements.
- Package dimensions compatible with applicable freight conveyances, storage racks, and production line stations.
- Collapsible features to maximize empty package return ratios, and minimize freight costs and storage space requirements.
- The use of lanyards to secure removable components such as lock pins and stacking posts to the package to prevent loss.
- Generic designs to best accommodate potential production material design revisions, and maximize the opportunities to reallocate the package for use with other production materials.
- Plan for exterior storage under harsh weather conditions – UV resistant materials, drain holes, etc.
- Bar code identification label locations with reusable placards.
- Returnable packaging used for export must include the markings “CONTAINER MADE IN (COUNTRY)”. These markings must be permanent, legible, and located in a conspicuous place.
- Material recyclability at end of package life cycle.

2.3 LOAD CONTAINMENT

All production materials shipped on pallets must be securely contained on the pallet to withstand the rigors of transport and material handling and arrive intact at the HYG assembly and manufacturing facilities.

Acceptable methods of load containment include stretch wrap, polyester (PE) strapping, heat shrink wrap, and cord strapping. The load containment method selected must take into consideration the characteristics of the load; i.e., crush resistance, sharp edges, irregular shapes, gross weights, transport modes, etc. In some instances, more than one method will be required to insure safe load containment.

2.3.1 STRETCH WRAP

Stretch wrap should be made from clear (non-tinted) linear low density polyethylene (LLDPE) to maximize recyclability. Adequate clarity to allow bar code scanning is also required.

The appropriate thickness of stretch wrap will be determined by the load weight. At a minimum, an 80 gauge thickness should be used. If the load weight exceeds 2,200 lbs. (1,000 kg), a thicker gauge film may be required.

Machine wrapping is preferred for the consistent tension maintained during application. Suppliers limited to manual wrapping should use pre-stretch film to insure adequate tension is applied to the load.

A minimum of three layers of stretch wrap must encompass the entire load from bottom to top. The stretch wrap must overlap the full height of the pallet and extend half of the stretch wrap width above the top of the load. Additional layers may be required depending upon the stretch wrap gauge, wrapping tension, and load weight.

2.3.2 POLYESTER (PE) STRAPPING

Polyester (PE) strapping is suitable for use on non-compressible loads with gross weights of up to 3,000 lbs. (1,364 kg).

Corner or edge protectors may be used in conjunction with polyester strapping. Paper-based protectors should be used for ease of recycling.

Polyester strapping should be translucent green and secured with friction weld seals. Crimp seals will be accepted from suppliers that do not have access to a friction weld tensioner.

A minimum of four polyester straps should be used for load containment – two lengthwise and two widthwise applied vertically around the load. Production materials loaded in rows or column stacks should have strapping vertically aligned with each row or column stack. Strapping must be positioned to prevent damage to the strapping during forklift entry into the pallet.

To determine the correct polyester strapping tensile (breaking) strength to use, apply the following formula as a general guideline.

(LOAD WEIGHT X 1.5)/NUMBER OF STRAPS = TENSILE (BREAKING) STRENGTH REQUIREMENT

EXAMPLE:
Load Weight: 2,400 lbs. (1,091 kg)
Four Straps Applied

(2,400 X 1.5)/4 = Minimum 900 lbs. (409 kg) Tensile (Breaking) Strength Required

2.3.3 SHRINK WRAP

Shrink wrap is useful for containing heavy, odd shaped loads and is often recommended for ocean and air transport due to its strength characteristics.

Shrink wrap comes in film, tube and bag form. All forms should be made from transparent polyethylene due to its stretchability and ease of recycling. Minimum polyethylene thickness should be 480 gauge for shrink film, and 500 gauge for tubes and bags.

The load must be fully encapsulated by the shrink wrap with an emphasis on extending the wrap beyond the base of the pallet to accommodate for shrinkage. With the shrink wrap in place, heat is applied by a shrink gun to shrink the wrap and securely contain the load.

2.3.4 CORD STRAPPING

Cord strapping is the preferred choice for securing non-compressible loads with gross weights exceeding 3,000 lbs. (1,364 kg), and provides a safe alternative to steel strapping.

Cord strapping is made from industrial high tenacity polyester filament yarn, and is typically available in composite corded, bonded corded or woven forms. The best form to use will be determined by the specific load characteristics such as weight and mode of transport.

As a baseline material reference, Cordstrap (www.cordstrap.net), or equivalent, cord strapping materials should be used for shipments to the HYG assembly and manufacturing facilities.

2.4 LABELING

2.4.1 BAR CODE LABELS

Bar code labels must be used on all packages shipped to the HYG assembly and manufacturing facilities.

Bar code labels must conform to standard Code 39 symbology, and the AIAG B-10 Trading Partner Label Guideline.

Full details on bar code labeling can be found at https://www.hyster-yale.com/about-hyster-yale-group/suppliers/supplier-resources/ under Bar Code Label Requirements.

2.4.2 TEST PACKAGE LABELS

All new or revised packages being shipped for the first time must be identified with TEST PACKAGE HOLD labels as shown on the next page.

Print off TEST PACKAGE HOLD labels, fill out notification data, and adhere labels to all sides of the shipment.

TEST PACKAGE

HOLD

IN RECEIVING AREA

NOTIFY: _____

AT EXT.: _____

UPON ARRIVAL

2.5 PACKING SLIPS

All production materials shipped to HYG assembly and manufacturing facilities must have a packing slip contained in a weather proof "PACKING LIST ENCLOSED" envelope and securely attached to the exterior of the package in a conspicuous location.

Full details on packing slip requirements can be found at http://www.hyster-yale.com/Business-Partners/Suppliers/srm-training-materials/ under General Documentation, "Supplier Expectation Manual".

2.6 CONSISTENCY

All package dimensions and quantity of parts per package must be consistent for each shipment of the same production material part number.

The consistent package size and quantity applies to all package types – expendable, returnable, and back up expendable packages for returnable programs.

Consistency is required to insure that packaged production materials fit their assigned storage locations.

All packaging changes must receive written approval from HYG Packaging (packaging@hyster-yale.com) prior to implementation.

2.7 MIXED LOADS

Each package should contain only one production material part number.

Packages containing the same part number should be consolidated on the same pallet.

The mixing of different packaged part numbers on the same pallet is discouraged. However; in support of lowest total cost objectives, part numbers with order quantities less than a full pallet quantity may be combined on the same pallet with the following restrictions.

- The mixed pallet load must be clearly identified with "MIXED LOAD" labels attached on two adjacent sides. The "MIXED LOAD" labels must conform to the AIAG B-10 Trading Partners Label Guideline.
- Packages containing the same part number must be consolidated on one mixed load pallet and not spread over different pallets.
- All packages on the mixed load pallet must be individually identified with bar code labels. Package size permitting, the individual package labels should be positioned so that they are visible from the outside perimeter of the pallet.
- On mixed load pallets, packages containing the same part number must be consolidated on the same

layer as much as possible. Position the production material with the highest quantity or heaviest weight in the bottom layer(s). Continue to layer the production materials by quantity or weight until the lowest quantity or weight production material is in the top layer(s). Load height and payload must be within the limits specified in Section 2.1.4.1, PALLET SIZES AND STYLES.

3 RESTRICTED PACKAGING

The following packaging items negatively impact safety, quality, delivery, cost, and/or material recycling at the HYG assembly and manufacturing facilities, and should only be used with prior written approval from HYG Packaging (packaging@hyster-yale.com).

- Manually handled packages exceeding 35 lbs. (16 kg) gross weight.
- Manually handled packages exceeding 20 in. (508 mm) width.
- Steel strapping.
- Staples.
- Wood crates.
- Styrofoam (expanded polystyrene/EPS).
- Fiber drums.
- Tinted plastics.
- Two way entry pallets.
- Loose (unpackaged) production material.
- Individual or aftermarket packages.
- Inconsistent package sizes/styles used for the same part number.
- Oversized packages requiring excessive internal packaging.
- More than one part number in the same package.
- Mixed pallet loads.
- Foam in place internal packaging.
- Free flowing internal packaging (“peanuts”).
- Dissimilar materials bonded together in expendable packages (e.g., foam pads to corrugated).

4 PRESERVATION OF PRODUCTION MATERIALS

Supplier packaging must preserve the quality of the production material to the level specified by HYG Supplier Quality Engineering during the request for quotation and part approval process.

4.1 CLEANLINESS

Production materials with cleanliness specifications must be protected from degradation by the use of proper packaging materials. The packaging materials must not release contaminants when in direct contact with the production materials. The use of individual part wraps or bags should be avoided unless absolutely necessary to maintain cleanliness.

4.2 CORROSION

Production materials that are required to be corrosion free must be adequately packaged to prevent corrosion for a minimum of 12 months.

4.2.1 OIL AND WAX BASED PRESERVATIVE OILS

Oil and wax based preservative oils should not be used without prior written approval.

4.2.2 VOLATILE CORROSION INHIBITORS (VCI)

Volatile corrosion inhibitors (VCI) are preferred over oil and wax based preservative oils in that they eliminate the need for cleaning production materials prior to use.

VCI materials are available in many forms – poly films, Kraft papers, bags, sheets, tubes, additives, emitters, etc. VCI material selection will be based upon the minimum total cost application.

Select VCI films and papers that can be easily recycled with ordinary films and papers. Clear versus tinted films further aids the ease of recycling.

Depending upon the application, the best practice is typically to line the package with a VCI poly bag prior to loading production materials to prevent direct contact between production materials and the package. The VCI bag must be completely intact with no holes. Acceptable methods for sealing the bag after loading include zip lock, tape, twist tie, zip tie or heat seal. Staples must not be used.

The use of VCI film or paper to separate parts or layers of parts is preferred over individually wrapping or bagging production materials.

VCI products provide the best protection when the production material is free of all contaminants – dust, dirt, residue, etc.

Production materials must be completely dry after washing operations, etc. prior to packing with VCI products.

Wear clean and dry rubber gloves when handling clean production materials during the VCI packaging process.

VCI products prevent corrosion, but cannot reverse corrosion that has already begun. Make sure that all production materials are corrosion free prior to packing.

4.2.3 DESICCANT

Depending upon the transit and storage requirements, desiccant may be required to keep production materials corrosion free. Calculate the proper amount of desiccant required for the application and enclose the desiccant within the VCI poly bag, or other water vapor barrier material, to absorb excess moisture.

4.3 HYDRAULIC CLEANLINESS

Production materials that come in contact with hydraulic fluid, brake fluid, or fuel must be protected from corrosion and contamination.

All open points on these materials must be sealed with a securely fitting plug. Use of threaded plugs is preferred to seal open threaded holes. The cleanliness of all sealing plugs must be consistent with the cleanliness expectations of the production materials.

Depending on the production material design, sealed bags or other protective packaging may also be required.

4.4 CLASS A SURFACE

Production materials having finished surfaces designated Class A must be adequately packaged to protect against surface finish damage such as scratching or abrasion.

Protective packaging applied to Class A surfaces must not leave any residue or require sharp tools for removal.

4.5 CRITICAL MACHINED SURFACE

Production materials that have critical machined surfaces that are susceptible to damage must be adequately packaged to protect these surfaces from nicks, dings, or scratches which could lead to mechanical failures.

Protective packaging applied to critical machined surfaces must not leave any residue or require sharp tools for removal.

4.6 ELECTROSTATIC DISCHARGE (ESD)

All ESD sensitive production materials must be packaged to the appropriate level of ESD protection in compliance with ANSI/ESD S541.

All ESD protective packages must be identified with an ESD caution label. The caution label must be legible at a minimum distance of three feet (0.9 m). The label must clearly indicate by words and symbol that ESD sensitive materials are contained in the package, and that the package must not be opened except at an ESD protected work station. An example of an ESD caution label is shown below.

4.7 GENERAL PRESERVATION REQUIREMENTS

General preservation requirements support packaging designs that minimize total costs.

4.7.1 RIGHT SIZE PACKAGING

Production materials must be secured within a right size package that appropriately fits the material with minimum excess space to avoid damaging movement during transport and material handling. Right size packages support the lowest total cost in materials, freight, etc.

4.7.2 PART SEPARATION

Production materials that are susceptible to damage from part-to-part contact must be separated by appropriate internal packaging. Partition assemblies, layer pads, etc. are preferred over individual part bags or wraps.

4.7.3 PART ORIENTATION

Production materials must be oriented within the package to allow loading and unloading with no threat of damage to the material or injury to personnel. This requires a wide consideration of all potential damages and injuries; e.g., material damage from box cutter blades during carton opening, load shift during removal of load containment materials, etc.

5 ERGONOMICS

All packaging must incorporate good ergonomic designs to avoid injury to personnel.

In addition to the size and weight restrictions on manually handled packages (Section 2.1.2.1), avoidance of staples (Sections 2.1.2.3, 3), palletized load height restrictions (Section 2.1.4.1), restriction on steel strapping (Section 3), and part orientation requirements (Section 4.7.3); consideration must also be given to the disassembly of packaging, limiting reach distances into packages to 24 inches or less, and any other design features and materials that may compromise personnel safety.

6 CONTACT INFORMATION FOR QUESTIONS

For questions related to these guidelines, or questions on packaging details not found herein; please contact packaging@hyster-yale.com for assistance.