SUSTAINABLE PACKAGING GUIDELINES FOR SUPPLIERS

Lockheed Martin Corporation
Table of Contents

1.0 Introduction .......................................................................................................................... 1
2.0 Definitions ............................................................................................................................ 2
3.0 Benefits of Improved Packaging ............................................................................................ 5
4.0 Packaging System Redesign Considerations ......................................................................... 6
5.0 Reducing Packaging Waste ................................................................................................... 7
6.0 Preferred and Non-Preferred Packaging Materials ............................................................... 9
7.0 Helpful Links ........................................................................................................................ 13

Disclaimer: Use of these Guidelines does not constitute a substitute for transportation requirements and program specifications.
1.0 Introduction

Product transportation and protection (“packaging”) is integral to the success of any business. Improper packaging can lead to costly problems, both for the shipper and the customer. The primary objectives of the Sustainable Packaging Guidelines for Suppliers (“the Guidelines”) are to reduce packaging waste that is disposed in landfills and to encourage the use of proper packaging techniques that prevent asset damage.

Packaging has been identified as a large component of Lockheed Martin’s waste stream going to landfill. As part of Lockheed Martin’s corporate-wide environmental program known as Go Green, we are encouraging our suppliers to use these Guidelines to improve their packaging solutions. This supports Lockheed Martin’s goal to reduce waste to landfill by 25% by 2012.

Being cognizant of what potential impact packaging has on waste generation and product protection is necessary to understand what can be reduced or eliminated. While product integrity cannot be compromised due to logistical, legal, and safety reasons, using the latest technologies coupled with the required amount of material necessary to safely package and transport the product will reduce the overall impact on the environment. Following these Guidelines and using sound judgment will help to achieve the goals of sustainable packaging, and reduced waste to landfill.

Suppliers to Lockheed Martin should consider working with their Design Engineers, Planners, Packaging, and other groups to develop packaging that, to the maximum extent possible, eliminates unnecessary packaging and/or allows for packaging that can be re-used, recycled or composted.
2.0 Definitions

Terminology used in packaging and packing:

**Package and Packing**

A "package" refers to the interior product protection including the cushioning materials and the exterior shipping container, respectively.

Interior packaging includes the following items:

- **Primary Package**: An interior container or bag which is in contact with the contents. It is also known as the unit package. It may be used as the shipping container if it meets transportation requirements.

- **Secondary Package**: A container which encloses one or more primary containers. It is also known as an intermediate package. It may be used as the shipping container if it meets transportation requirements.

Exterior packing includes:

- **Transport Package**: An exterior package used to protect goods during the process of distribution, handling, storage and transportation. It includes shipping containers and pallets with shrink wrapping or banding, for example.

**Military Levels of Packing**

There are different levels of packaging depending on the environmental conditions, the storage duration, and degree of protection required. Contractual packaging requirements will also determine the level of packaging.

- **Level A** – Military (MIL-STD-2073) Level of Preservation—Indeterminate storage preservation and packaging which will protect against corrosion, deterioration and physical damage during the most severe world-wide shipment, handling, and storage conditions. A Level A Pack must be capable of protecting material from the effects of direct exposure to extremes of climate, terrain, and operational and transportation environments.

- **Level B** – Military (MIL-STD-2073) Level of Packing—Indeterminate storage preservation and packaging which will protect against corrosion, deterioration, and physical damage during the most moderate world-wide shipment, handling, and storage conditions. A Level B Pack must be capable of protecting material not directly exposed to the extremes of climate, terrain, and operational and transportation environments.

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1 ASTM D996, Standard Terminology of Packaging and Distribution Environments
**Commercial (ASTM-D3951) Packaging**

Commercial packaging provides requirements for commercial preservation, packaging, unitization, and marking. Such packaging affords adequate protection against mechanical and physical damage during shipment, intended for a minimum storage period of one year.

**Shock**

Shock refers to the blunt forces encountered in distribution environments. Shocks can be mild or severe and, for example, can be the result of cartons dropping off conveyor belts, drivers tossing cartons into trucks, or forklifts banging into palletized loads. Typically, this blunt force - the shock - causes the most product damage.

**Vibration**

Vibration is the mild, but continuous, forces encountered in distribution environments. Vibration is experienced when cartons are moving down conveyor belts or when packages are riding down highways in trucks. Typically, damage from vibration occurs when an item can shift to the side of a carton and it rides there through distribution.

**Sustainable Packaging**

While there are many ideas and definitions of sustainable packaging, it can be defined as follows:\(^2\):

- Is beneficial, safe and healthy for individuals and communities throughout its life cycle;
- Meets market criteria for performance and cost;
- Is sourced, manufactured, transported, and recycled using renewable energy;
- Maximizes the use of renewable or recycled source materials;
- Is manufactured using clean production technologies and best practices;
- Is made from materials that have no adverse environmental impacts in all probable end-of-life scenarios;
- Is physically designed to optimize materials and energy;
- Is effectively recovered and utilized in biological and/or industrial cradle-to-cradle cycles.

The criteria presented here blend broad sustainability objectives with business considerations and strategies that address environmental concerns related to the life cycle of packaging.

Suppliers to Lockheed Martin will initially focus on the following elements of sustainable packaging:

- Reducing packaging volumes so as to reduce the amount of packaging that must be disposed of by Lockheed Martin;

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\(^2\)`http://www.sustainablepackaging.org/pdf/Definition%20First%20Page.pdf`
- Using packaging materials that are more easily recycled or reused; and
- Using returnable containers wherever feasible and economical.
3.0 Benefits of Improved Packaging

From Lockheed Martin’s perspective, the direct benefits of improved packaging from our suppliers are to 1) reduce the quantity of packaging waste we have to send to landfill (which benefits the environment and helps us reach our goal of reducing waste to landfill); and 2) reduce product damage due to improper packaging.

There are also indirect benefits from improved packaging that help fulfill broader sustainability objectives. These include, among others:

- **Higher Cube Utilization** – In warehousing and logistics, cube utilization refers to the use of space within a storage area, trailer, or container. Cube utilization is generally calculated as a percentage of total space or of total “usable” space. Higher cube utilization is desired.

- **More Efficient Transportation** – Items that can be sourced locally and do not have to be transported longer distances are preferable because the shorter transportation routes lead to reduced fuel use / greenhouse gas emissions.

- **Increased Use of Renewable Materials** – Use of renewable materials encourages the conservation of resources and reduces dependence on finite resources. Using renewable materials, including renewable energy, encourages the sustainable management of resources.

In addition, improved packaging encourages:

- Increased safety

- Reduced cost and waste associated with multiple handling of materials

- Providing material in a “ready to use” presentation to Lockheed Martin
4.0 Packaging System Redesign Considerations

Changes to supplier packaging systems must be compliant with existing contractual and technical (i.e., engineering) requirements and must protect the part(s) to prevent damage. Suppliers must consider the following before changes are implemented:

- Review contract provisions before changing existing packaging systems, as these have precedence when making decisions on the packaging used for certain products.

- Federal Department of Transportation and state agency shipping requirements must be followed.

- Damage prevention must be a primary consideration when packaging products. One of the most important principles of proper packaging protection is complete encapsulation, the “float,” to eliminate movement and to keep the item away from the sides of the container. The “fragility factor,” or how sensitive the part is to damage, also helps determine the cushioning type and required thickness. Delicate cargo/products may require more float.

- Ensure product integrity when Electro-static Discharge (ESD) requirements exist. In addition to cushioning protection, Electrostatic Sensitive Devices (ESD) must also be protected from electrical discharges (like static electricity in a low humidity environment) by placing the ESD part in shielding or barrier materials to prevent charges from passing to the part and damaging the components. An ESD label must placed on the protective bag and container.

- The surface/area size of a skid or pallet should always be greater than the size of the cartons stacked on it. This will prevent damage from pallets banging into other pallets with loads overhanging and will help evenly distribute the weight across a flat surface to increase stacking strength. Void space in cartons should be eliminated by use of adequate cushioning. A combination of cushioning materials can be used to achieve proper protection.
5.0 Reducing Packaging Waste

The logical way to reduce waste is not to generate it. Since generation of a nominal amount of waste is inevitable, it is imperative to re-use, recycle, and reduce as much as possible.

Suppliers should explore the following options when determining how to approach packaging of its products.

The options of Reuse, Recycle and Reduce are presented below in order of feasibility, not in order of preference. The most preferred option is to eliminate or reduce the amount of waste generated; the second preferred option is to change the packaging materials so they are more easily reused, recycled or composted.

**Reuse**

Suppliers should provide reusable packaging whenever possible. Consider a “cradle-to-grave” concept when choosing packaging. Consider the following:

- What type of product does the packing material hold and how could it be reused?
- How many times can the packing materials be reused and still maintain the quality and the integrity of the product being shipped? The higher the number of re-uses, the better.

**Recycle**

Suppliers should use recyclable packaging as much as possible. Consider:

- Do I know what the numbers and symbols on each of these containers or packing items mean? By knowing the number codes on the packaging, this can provide a greater understanding of how much packaging can be recycled.
- Can recyclable packaging be used without impacting the packaging quality?

**Note:** A list of preferred packaging materials and materials to be avoided is provided in Section 6. This list will facilitate the substitution of packaging materials that are not easily recycled to those that are recyclable.

**Reduce**

Suppliers should reduce packaging when practical and viable for an end item. Consider the following:

- Do the packing materials need to be this heavy or dense, or can they be lighter while still serving the same purpose?
- Maximize the product-to-package ratio:

Ensure containers are right-sized and as full as possible. Increasing the product-to-package ratio means using less material to package a product. Suppliers can achieve a higher product-to-package ratio by making sure containers are mostly full.

An example of an improved product-to-package ratio is the multipacks used by a Lockheed Martin computer supplier. Instead of providing one laptop per box, in many cases this supplier is now providing Lockheed
Martin with shipments of six laptops per box to decrease the amount of packaging it takes to send the same number of products.
6.0 Preferred and Non-Preferred Packaging Materials

This section provides a list of preferred packaging materials that Lockheed Martin suppliers should evaluate for use wherever practical. Packaging materials whose use should be restricted are also listed. The items listed should be viewed as recommendations; the list is not all-inclusive. When considering how best to improve packaging, both pre-usage (production costs/ energy usage/ transport costs) as well as post-usage (compostable materials need to be properly composted, not simply thrown out with general trash) criteria should be taken into account. Product protection must be maintained and contractual packaging requirements met.

Reusing and recycling packaging and packing materials is encouraged. Suppliers reusing packaging reduces spending, prevents or reduces sending non-biodegradable materials to landfill, and supports Lockheed Martin’s Go Green initiatives. However, good judgment must be used when deciding what to use and how to use it. Reused materials must be clean, free of FOD (foreign object debris) and must still have the original cushioning or container properties.

*Note that the use of glue to attach cushioning material to other packaging should be avoided where possible in all types of packaging, because it makes packaging difficult (if not impossible) to recycle.*

**PREFERRED PACKAGING AND PACKING MATERIALS**

**Preferred Interior Packaging Materials – Cushioning**

Cushioning is the protection from physical and mechanical damage for an item by means of resilient or elastic materials designed to absorb energy caused by shock and vibration from external forces and to prevent movement. Typically consists of a part being “floated” or encapsulated in materials on all sides. The following are preferred interior cushioning materials that should be used by suppliers where practical:

- **Air Cushioning Bags** – Use less weight and fewer materials to fill voids (Check the bags for #2 or #4 plastics, which can be recycled).

- **Biodegradable Bubble Wrap** – Plastic material consisting of air filled bubble cells, in large and small size cells, with anti-static properties available. Used to provide cushioning and protection for items up to a weight of 20 to 25 lbs. Note that biodegradable bubble wrap must offer the same level of protection as non-biodegradable bubble wrap. This material is only recommended for commercial shipments involving short-term (< 6 months) storage.

- **Cellulosic Paper** – Commonly known as Kimpac or Creped Wadding. This paper is less expensive and is used for the protection of durable metal or plastic parts (heavy or light). It can be recycled or reused, and biodegrades relatively quickly compared to other materials such as foam.

- **Fiberboard or Molded Paperboard** – This material can be recycled and biodegrades relatively quickly compared to other materials such as foam. However, energy usage during production of recycled paper products tends to be higher than that of foam products.
• **Polyethylene (PE)** – A dense, strong, lightweight material used to float or block items that come in a variety of densities and thicknesses. This material is often placed along the sides of a carton to prevent the movement of an item or under large, heavy items to absorb shock. PE can be recycled if foreign materials (e.g., glue, tape, etc) are not adhered to edges of container, and if a recycling vendor is readily identifiable.

**Preferred Interior Packaging Materials – Bagging**

Most items to be packaged are bagged at some point in the packaging process – either just before the outer box or before the inner cushioning is added. Similarly to interior packaging, some bagging materials are preferred over other, less sustainable choices. The following interior bagging types are preferred, and should be used by suppliers where practical:

- Bioplastics that are derived from renewable biomass sources and can be composted.
- Paper that can be recycled.
- Plastics that are typically recyclable in most every location.
- Bagging that can be reused by Lockheed Martin.

**Preferred Exterior Packing Materials – Shipping Containers**

When selecting the exterior packing, choose sustainable materials whenever possible. Cartons, reusable boxes and crates are preferred exterior packing materials, and should be used by suppliers whenever possible. Exterior packing options include:

- **Banding** – Straps used to secure groups of cartons or a single large carton onto pallets. It can also provide additional strength and security to wood boxes and crates.
- **Corrugated Cartons** – The outer container protection used to contain the asset being shipped. Cartons are available in various sizes and thicknesses, and can be single-, double-, or even triple-walled to increase strength depending on the item being packaged. All cartons contain a BMC (Box Manufacturer’s Certificate) that states pertinent information on the carton’s characteristics such as bursting or edge crush strength and the maximum weight it can hold. Lockheed Martin recommends packing a carton up to 75% of the maximum weight indicated on the BMC.
- **Pallet or Skid** – A flat transport structure (often made of wood but there is increased use of plastic pallets made from recycled and recyclable plastics) used as a stable foundation that provides for material handling, often for a stack of cartons. Pallets that can be reused or recycled, or are otherwise considered environmentally preferable, should be used whenever possible.
- **Stretch Wrap** – A plastic film that is wrapped tightly around containers and mainly used to keep cartons stable on skids. It provides some water protection and helps prevent tampering.
- **Wood Boxes** – Can be used for packing items that are over 90 pounds, but do not exceed 1,000 pounds.
- **Wood Crates** – Can be used for packing items that exceed 1,000 pounds. Depending on the lumber used, crates can be designed to hold up to 30,000 pounds.
NON-PREFERRED PACKAGING AND PACKING MATERIALS

Non-Preferred Interior Packaging Materials – Cushioning

The following are non-preferred interior cushioning materials, the use of which should be restricted by suppliers when practical:

- **Biodegradable Loose Fill (Peanuts)** – Made from items such as grain sorghum and corn starch which can be composted. However, these materials may attract pests and insects. If these are exposed to moisture, they can degrade. Products cushioned with peanuts are often damaged.

- **Bubble Wrap** – Plastic material consisting of air-filled bubble cells, in large and small size cells, with anti-static properties available. Used to provide cushioning and protection for items up to a weight of 20 to 25 pounds. Not manufactured to be environmentally friendly and takes hundreds of years to break down.

- **Edible Food Items** – Such as popcorn as a cushion. These materials should be avoided as they can lead to pest infestations.

- **Foam-in-Place** – A combination of liquid polymers used to create a foam cushion that expands when activated and will conform to the shape of an item. Polyurethane foam-in-place is not recyclable or reusable, and all of these materials are directed to landfill. Foam-in-place should be avoided when possible.

- **Polystyrene (PS)** – A widely used type of plastic that is manufactured into a loose fill “peanut” form, in a sheet, or into specially molded forms. Sheets and molded end caps are typically used for items weighing approximately 20 pounds or less. PS is made from crude oil, leaches toxic chemicals, and is specifically manufactured for one-time usage. Once used, this goes to a landfill and will not biodegrade. Recycling is limited and costly, and it is difficult to find companies to recycle this material.

- **Polyurethane** – A foam material in various densities and thicknesses, used to cushion medium-weight items from shock and vibration damage. Polyurethane is a superior packaging material for extremely fragile products. Suitable substitutes are slowly making their way to the marketplace, including a plant-based foam material (called Earth-Cell Foam) that is comparable in cushioning properties to traditional petroleum-based polyurethane foam.
  - Traditional Flexible Foam Sheeting – Uses several hazardous intermediates and creates numerous hazardous by-products. These include phosgene, isocyanates, toluene, diamines, and the ozone-depleting gases methylene chloride and CFCs, as well as halogenated flame retardants and pigments. The burning of PU releases numerous hazardous chemicals such as isocyanates, carbon dioxide, hydrogen cyanide, PAHs and dioxins. Polyurethane provides superior protection to extremely fragile products; make sure there are no technical requirements for its use before changing to another material.

- **Starch-based Flexible Foam Sheeting** – While this material can be composted, it may attract pests and insects. Also, when exposed to high humidity, this material can be significantly compressed or it can “melt away” before the product is delivered.
Non-Preferred Interior Packaging Materials - Bagging

Suppliers should restrict the use of these bagging materials when practical:

- **Non-recyclable Petroleum Plastics** – These materials are not recyclable and take many years to break down in a landfill. These include plastics imprinted with the number 7 or nothing at all.

Non-Preferred Exterior Packing Materials – Shipping Containers:

Suppliers should restrict the use of the following exterior shipping containers when practical:

- **Non-recyclable and Non-compostable Packing** – If the packing cannot be reused or recycled, it should be avoided.

- **Packing Not Easily Separated from Non-recyclable Components** – Nails, tape, glue, and adhesives that may prevent materials from being recycled must be removed.
7.0 Helpful Links

Lockheed Martin Greening the Supply Chain Website
www.lockheedmartin.com/suppliers/green_supply_chain

Lockheed Martin Go Green Website
www.lockheedmartin.com/aboutus/energy_environment/going-green.html

Lockheed Martin Suppliers Website
www.lockheedmartin.com/suppliers

Lockheed Martin EESH Sustainability Report
www.lockheedmartin.com/aboutus/energy_environment/performance_report.html