

Balance Your Pallet Design

Plastic, wood, paper, or steel? Block or stringer style? Pallet users face a bewildering number of choices today. What's the best pallet for your application? The wrong pallet leads to product damage and inefficient handling.

To optimize a pallet design, five interactive design parameters must be balanced—Strength, Stiffness, Durability, Functionality and Cost. These parameters are interactive, and optimizing just one (i.e. minimizing pallet cost) will significantly impact the others. The proper balance of these five characteristics will vary, depending on your specific product and distribution environments. Each of the five is discussed in more detail below.

Strength is the load carrying capacity of a pallet throughout the shipping and storage environments. We must design pallets that are strong enough to support the required load, because broken pallets are unsafe. To predict pallet strength, we can use laboratory tests or computer aided design procedures. Pallets of any material can be strength tested using standardized pallet test methods (i.e. ASTM D1185, ISO 8611). For wood pallets, the best predictor of strength is the Pallet Design System (PDS), a computer design program developed by the Virginia Tech Pallet Laboratory. PDS is leased by many pallet vendors. Make sure your pallet vendor uses PDS or other standardized tests to ensure that your pal-

lets meet all strength requirements.

Stiffness, the resistance of the pallet to deformation under load, is one of the most overlooked characteristics of pallet design. Many pallets don't break under load but are not stiff enough to protect the product. Many transport packages are oversized to protect against low stiffness pallets. Deck thickness gives us a squared relationship with strength, but a cubic relationship with stiffness. For a typical 48x40 GMA pallet, converting from 5/8" to 3/4" thick decks (adding 1/8") increases deck stiffness by 100% and strength by 40%. In general, deflection that does not exceed 1% of span (i.e. 0.44" in a 44" rack span) will work for most products and handling systems. As with strength, stiffness can be determined from PDS or from standardized pallet tests.

Durability is the ability of the pallet to withstand the rigors of the shipping and handling environments. If we don't intend to recover the pallet, the pallet needs the integrity to withstand one trip. For returnable pallets, we need to design for the number of trips that is economically justified. The ideal life of a reusable pallet is a function of pallet recovery rate and future expected changes to warehouses, product sizes, and distribution channels. We used to recommend a 10 year maximum design life for returnable pallets. Today, as the pace of

change increases, 10 years may be too long. Pallet durability can be estimated through standardized tests and the PDS program.

Functionality is the ability of the pallet to protect a unitized load of product through the material handling environment. Functionality addresses opening heights between the top and bottom decks for handling equipment, deckboard placement, pallet weight, pallet deck friction, etc. If your pallets are handled manually, a 100-pound design is probably not functional. For general-purpose environments, ASME MH1 Part 2 (domestic) or ISO 6780 (international) outline some of the major pallet functionality requirements.

Cost is an important design criterion, but don't confuse this with the initial pallet purchase price. Look at the true cost of using a pallet. For example, in a typical GMA 48x40 wood pallet, nails cost less than 5% of the pallet price (\$0.38 of the overall \$7.50 pallet price). If we increase the pallet cost by 2% (\$0.15), we can double its durability. Even if we don't plan to reuse the pallet, better nails lead to fewer exposed nail heads and loose deckboards. How much does a nail head cost if it causes a beverage "leaker?" What does a loose deckboard cost when it jams the highly automated ASRS system? Unfortunately, these costs are difficult to track, while pallet purchase price is right there in front of us. Also, look at cost per use or cost per pallet trip. The purchase price of reusable pallets is greater than one way pallets, but with a good retrieval program the cost per use may be lower, sometimes much lower.

So don't settle for poor pallet performance. Check the "balance" of your pallet designs. Consider Strength, Stiffness, Durability, Functionality, and Cost as you evaluate the variety of pallet choices and materials in the marketplace. These parameters are interactive, and optimizing just one will significantly impact the others. The better your understanding of this interactive balance, the more likely you are to select the ideal pallet design for your product and material handling environment. ■

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DESIGN PARAMETERS

- 1. **Strength**
- 2. **Stiffness**

- 3. **Durability**
- 4. **Functionality**
- 5. **Cost**