

Positioning Equipment

END4650 – Material Handling Systems

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II. Positioning Equipment

1. Manual (no equipment)

- Max manual weight: 23 kg (51 lbs).
 - Recommendation based on NIOSH (National Institute for Occupational Safety and Health) 1991

II. Positioning Equipment

2. Lift/tilt/turn table

- Used when positioning involves the lifting, tilting, or turning of a load.
- Can be used to reduce or limit a worker's
 - lifting and/or reaching motions.
 - Bending and stooping
- Go to 120. sec



II. Positioning Equipment

3. Dock leveler

- Used at loading docks to compensate for height differences between a truck bed and the dock



4. Ball transfer table

- Used in conveyor systems to permit manual transfer to and from
 - machines and conveyors and
 - between different sections of conveyors



Ball transfer unit for wooden
furniture factory



II. Positioning Equipment

- **5. Rotary index table**
- Used for the synchronous transfer of small parts from station to station in a single workcenter



II. Positioning Equipment

- **6. Parts feeder**
- Used for feeding and orienting small identical parts,
 - particularly in automatic assembly operation
- Motion of parts in a random pile channeled so that each part automatically assumes a *specified orientation*
- Can be used to provide inspection capabilities with respect to the shape and weight of parts
 - e.g., the coin feeder of a vending machine



II. Positioning Equipment

7. Air film device

- Used to enable precision positioning of heavy loads
- Sometimes referred to as “air pallets”
- Can be used in place of cranes and hoists
- Thin film of compressed air used to float loads of up to 130Tons so that a horizontal push of 1 kg. can move 1tons load;



II. Positioning Equipment

8. Hoist

- Used for vertical translation of loads
 - lifting and lowering)
- Frequently attached to cranes
- Can be operated manually, electrically, or pneumatically
- Uses chain or wire rope as its lifting medium



II. Positioning Equipment

9. Balancer

- Mechanism used to support and control loads so that an operator need only guide a balanced (“weightless”) load, thus providing precision positioning

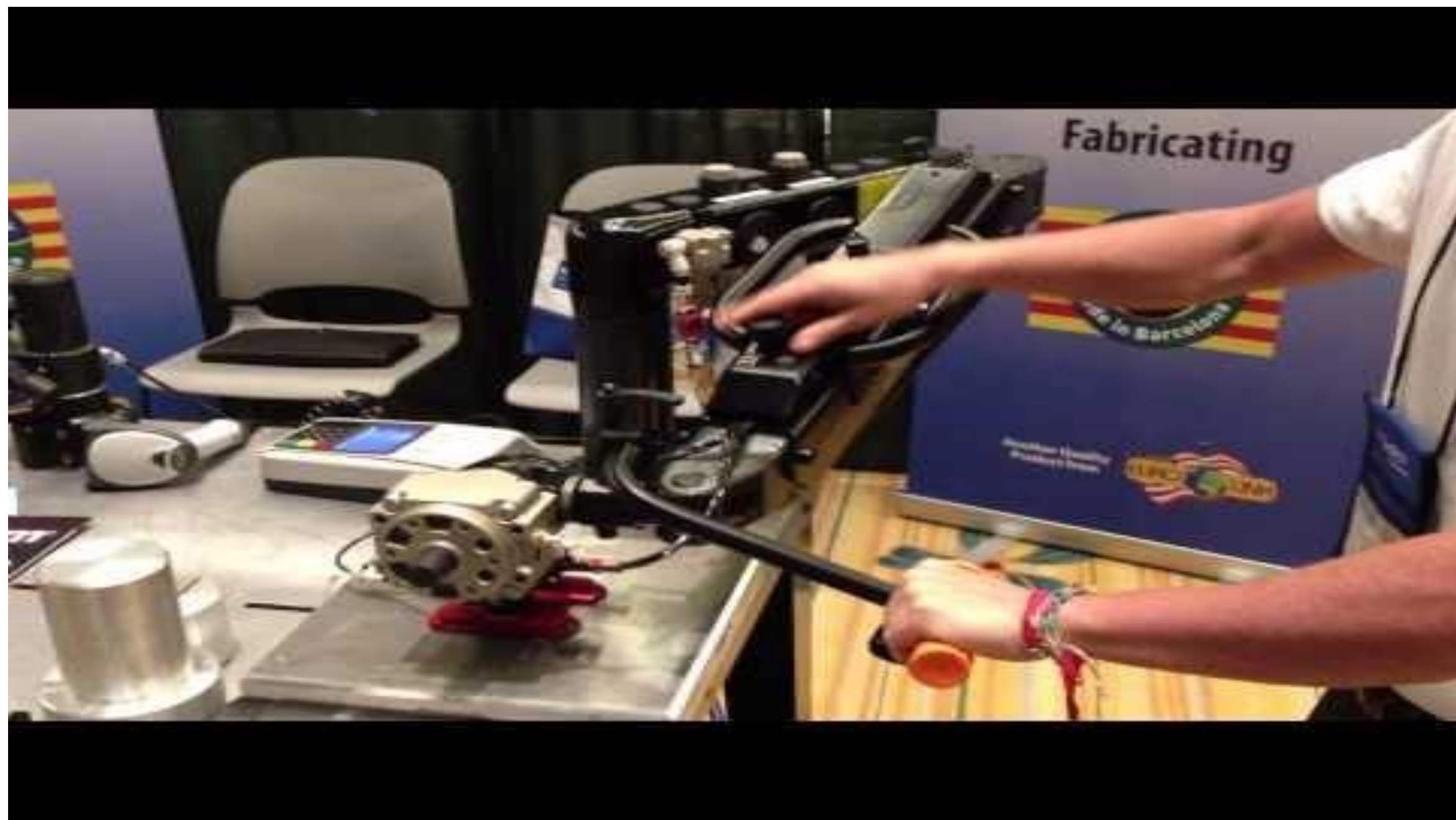


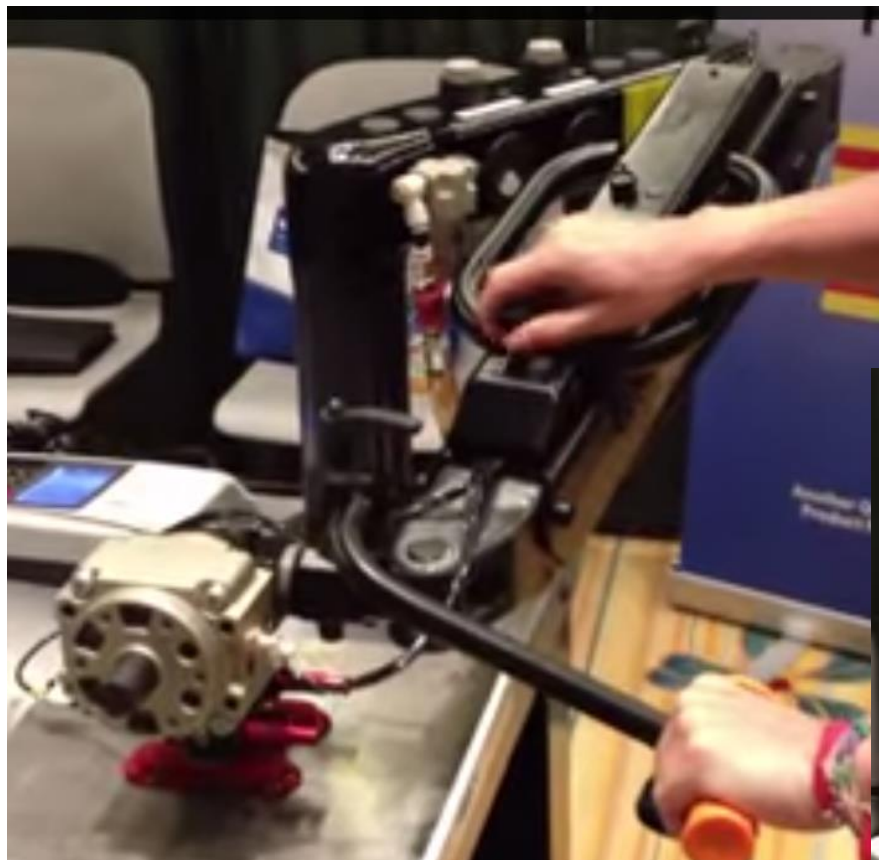


II. Positioning Equipment

10. Manipulator

- Used for vertical and horizontal translation and rotation of loads
- Acting as “muscle multipliers,”
 - operator lifts a small portion (1%) of the load’s weight
- Can be powered manually, electrically, or pneumatically
- Manipulators fill the gap between hoists and industrial robots:
 - Can be used for a wider range of positioning tasks than hoists and
 - More flexible than industrial robots due to their use of manual control





II. Positioning Equipment

11. Industrial robot

- Used in positioning to provide variable programmed motions of loads
- “Intelligent” industrial robots utilize sensory information for complex control actions,
 - as opposed to simple repetitive “pick-and-place” motions
- Industrial robots also used for
 - parts fabrication,
 - inspection,
 - assembly tasks







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III. Unit Load Formulation

III. Unit Load Formulation

1. Self-restraining (no equipment)

- One or more items that can maintain their integrity when handled as a single item (e.g., a single part or interlocking parts)

III. Unit Load Formulation

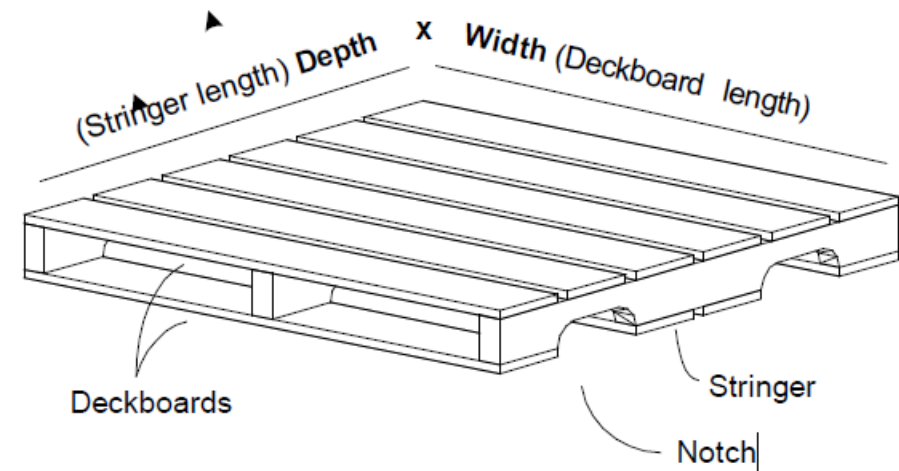
2. Pallets

- Platform with enough clearance beneath its top surface (or face) to enable the insertion of forks for subsequent lifting purposes
- Materials: Wood (most common), paper, plastic, rubber, and metal
- Size of pallet is specified by
 - its depth (i.e., length of its stringers or stringer boards)
 - its width (i.e., length its deckboards)—
 - pallet height (typically 5 in.) is usually not specified



III. Unit Load Formulation

- Orientation of stringers relative to deckboards of pallet is specified by always listing its depth first and width last:
 - *Depth* (stringer length) × *Width* (deckboard length)



III. Unit Load Formulation

- 48×40 (1222 x 1016) in. pallet is most popular in the US (27% of all)
 - because its compatibility with railcar and truck trailer dimensions
- 1200 × 800 mm “Euro-Pallet” is the standard pallet in Europe

III. Unit Load Formulation

- **Pallet Characteristics**

- Paper

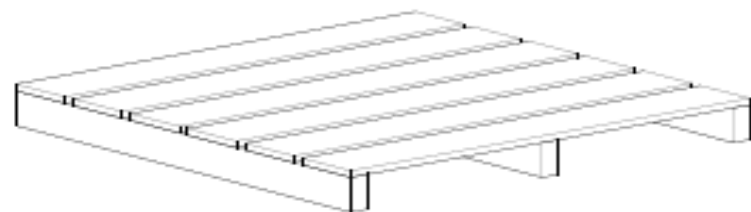
- \$3–10;
- expendable, low cost, and lighter and smaller than wooden pallets
- usually used in shipping;
- furniture retailer Ikea switched from wooden to paper pallets to save...
 - **\$193 million** per year.

III. Unit Load Formulation

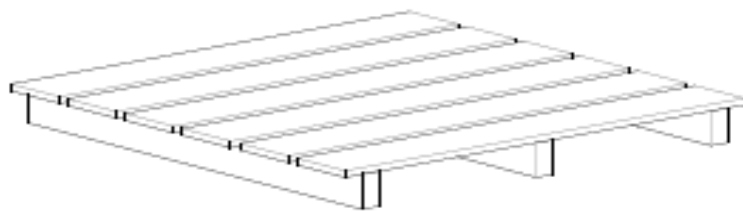
- Wood
 - \$5–25;
 - most common type of pallet;
 - economical, reusable pallet;
 - low initial cost; repair cost typically two-thirds the cost of a new pallet;
 - estimated life of 5 trips.

III. Unit Load Formulation

- Plastic
 - \$45–90;
 - becoming more common (as lumber and repair *costs* of wood pallets increase);
 - provide uniform “tare weight” (i.e., gross weight of the load less the weight of the product);
 - can be steam cleaned for hygienic applications;
 - durable;
 - estimated life of 2–3 years.
- Rubber—used in spark-free environments.
- Metal—used for heavy loads.



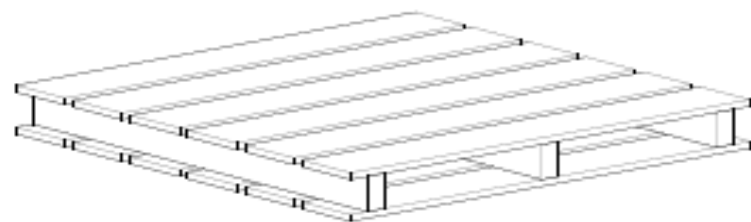
Two way
Single face
Nonreversible
Flush stringer



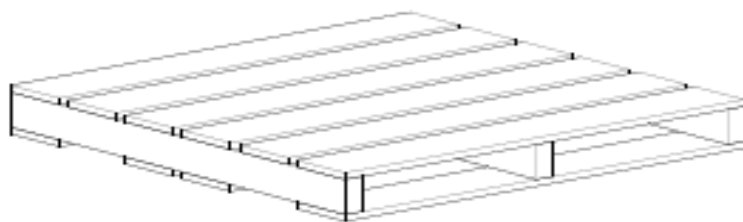
Two way
Single face
Nonreversible
Single wing



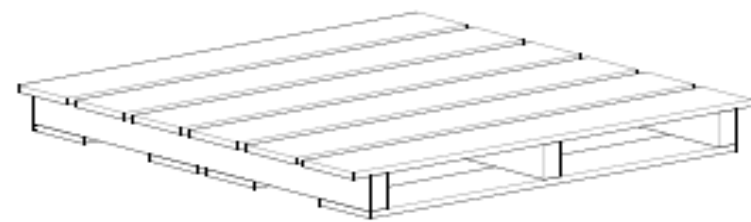
Two way
Double face
Reversible
Flush stringer



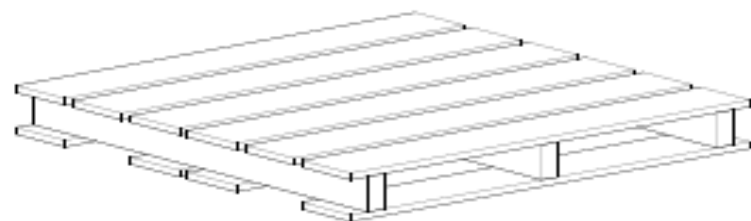
Two way
Double face
Reversible
Double wing



Two way
Double face
Nonreversible
Flush stringer



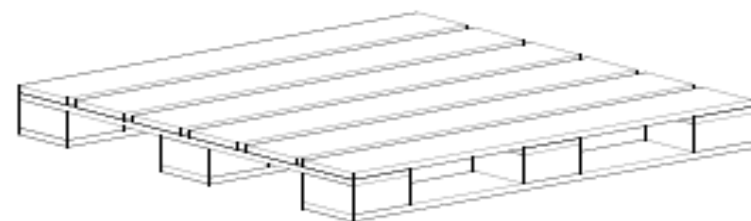
Two way
Double face
Nonreversible
Single wing



Two way
Double face
Nonreversible
Double wing



Four-way notched
Double face
Nonreversible
Flush stringer



Four-way block leg
Double face
Nonreversible
Flush stringer

III. Unit Load Formulation

The Pallet Loading Problem

- The pallet loading (or packing) problem refers to determining the “optimal” patterns (or layouts) of the items to be loaded onto pallets.
- There are, at least, *two* different problems that can be identified as “the Pallet Loading Problem”
 - The Manufacturer’s Pallet Loading Problem
 - The Distributor’s Pallet Loading Problem

III. Unit Load Formulation

- The *Manufacturer's Pallet Loading Problem*
 - loading **identical** items onto a pallet
 - the number of **items per pallet is maximized**.
- The *Distributor's Pallet Loading Problem(s)*
 - single pallet
 - loading various size items onto a pallet
 - the **volume of items** loaded onto the pallet is maximized;
 - multiple pallets
 - loading **various size items** onto identical pallets so that the number of pallets required to load all of the items is minimized

III. Unit Load Formulation

- Unlike the Manufacturer's Problem, the Distributor's Problem is not repetitive
 - it requires a unique solution for each pallet loaded)
 - one should be willing to spend more time and effort to find a good solution to the Manufacturer's Problem as compared to the Distributor's Problem.
- Manufacturer's Problem
 - use of automatic palletizer possible
- Distributor's Problem
 - manual or robotic (pick and place) palletization

III. Unit Load Formulation

3. Skids

- Platform (typically metal) with enough clearance beneath its top surface to enable a **platform truck** to move underneath for subsequent lifting purposes
- Compared to a pallet, a skid is usually used for **heavier loads** and when stacking is not required

III. Unit Load Formulation

4. Slipsheets

- Thick piece of paper, corrugated fiber, or plastic upon which a load is placed
- Handling method: tabs on the sheet are grabbed by a special push/pull lift truck attachment

III. Unit Load Formulation

- Advantages:
 - long-distance shipping instead of pallet
 - cost is 10–30% of pallet
 - weight and volume is 1–5% of a pallet
- Disadvantages:
 - slower handling as compared to pallets;
 - greater load damage within the facility;
 - special lift truck attachment reduces the vehicle's load capacity
- <https://www.youtube.com/watch?v=VSqVpBjS9ZM>

Designed for Durability

Reilly  Company



III. Unit Load Formulation

- **5. Tote pans**
- **6. Pallet/skid boxes**
- Both used for loose items



III. Unit Load Formulation

8. Cartons

- Disposable container used to unitize and protect **loose discrete items**
- Typically used for distribution

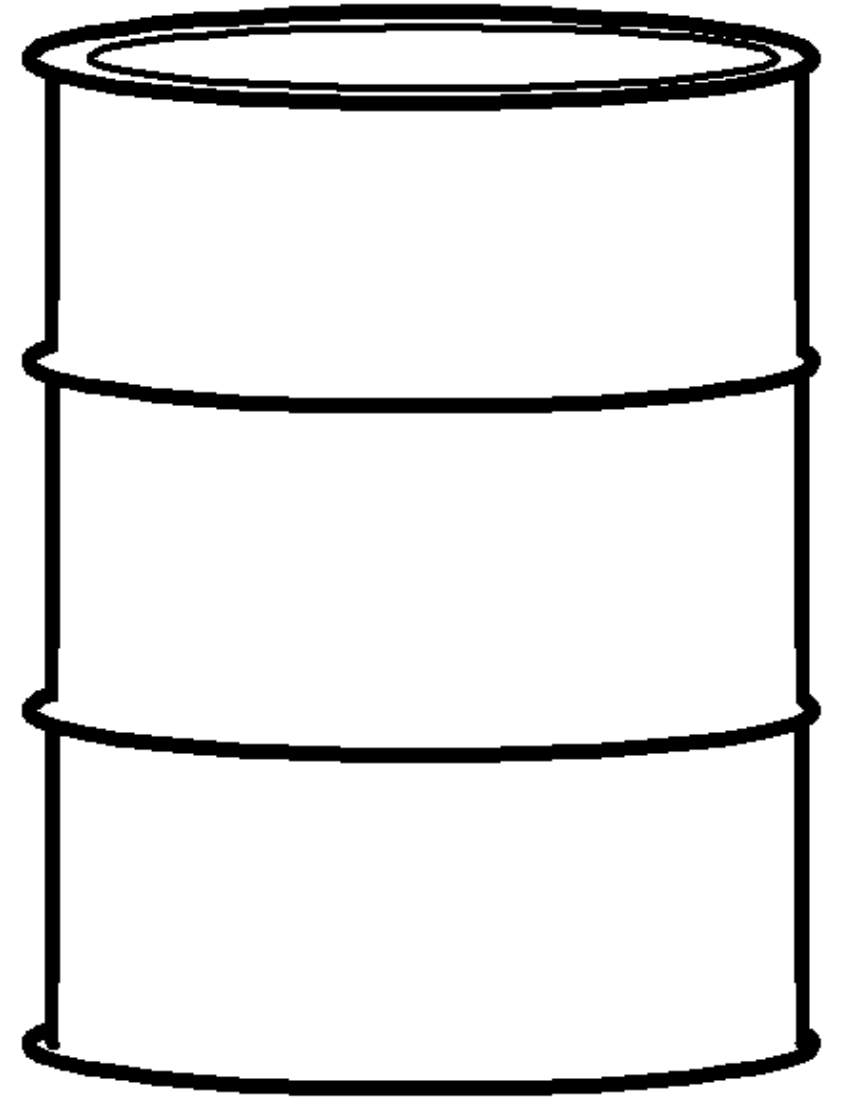
9. Bags

- Disposable container used to unitize and protect **bulk** materials
- Typically used for distribution

III. Unit Load Formulation

10. Bulk load containers

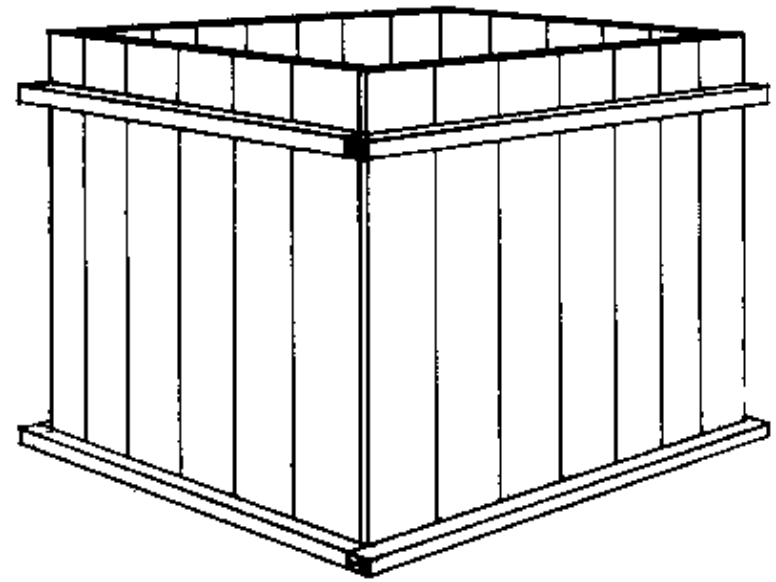
- Reusable container used to unitize and protect bulk materials
- Includes barrels, cylinders, etc.



III. Unit Load Formulation

11. Crates

- Disposable container used to protect discrete items
- Typically used for distribution



III. Unit Load Formulation

12. Intermodal containers

- Reusable container used to unitize and protect *loose discrete items*
- Enables a load to be handled as a single unit when it is transferred between ***road, rail, and sea*** modes of transport;
 - e.g., the container can be unloaded from a cargo ship and loaded onto a truck as a single unit
- It is ***not*** as common to use intermodal containers for ***airfreight*** transport because of aircraft shape and weight restrictions



III. Unit Load Formulation

13. Strapping/tape/glue

- Used for load stabilization
- Straps are either steel or plastic
- Plastic strapping that shrinks is used to keep loads from becoming loose during shipment



III. Unit Load Formulation

14. Shrink-wrap/stretch-wrap

- Used for load stabilization
- Allows irregular loads to be stabilized
- Shrink-wrapping,
 - a film or bag is placed over the load
 - heat is applied to shrink the film or bag;



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III. Unit Load Formulation

- Stretch-wrapping,
 - film is wound around the load while the film is stretched;
 - has lower material, labor, and energy costs as compared to shrink-wrapping
 - most shrink-wrap applications are being replaced by stretch-wrapping



III. Unit Load Formulation

15. Palletizers

- Used for load formation
- Three general methods of building (or “palletizing”) unit loads
- **(a) Manual palletizing**
- *Operators* arrange items into the desired pattern used to form the UL
- Since the ergonomics of loading and unloading are important lift and turn tables are often used

III. Unit Load Formulation

- **(b) Robotic pick and place palletizers**
- Fully automated device to build unit loads
- Used when flexibility is required (e.g., the “Distributor’s Pallet Loading Problem”)
- Greatest limitation is capacity,
 - typically 6 cycles per minute;
 - capacity is determined by the number of items handled with each pick operation



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III. Unit Load Formulation

- **(c) Conventional stripper plate palletizers**
- Fully automated device to build ULs
- Used when *high throughput of identical loads* is required (e.g., the “Manufacturer’s Pallet Loading Problem”)
- Capacity is typically greater (30–180 items per minute) than pick and place because an entire layer is placed on the load at one time;
- not as flexible as pick and place (the previous one)



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