

Alert 15-03: Considerations When Stacking Steel Drums

Steel drums are the most widely used type of industrial packaging in the world and are manufactured with consistent strength and durability. Their standardized design and resistance to extreme temperature and humidity contribute to their overall strength and predictability when packaging various hazardous and non-hazardous materials. These properties also contribute to the excellent stacking strength of steel drums. The shippers and users of these containers have confirmed their capabilities with many years of field experience.

There are many factors that can affect the safe storage and stacking of steel drums. The product packaged in the drum may vary in density which can result in different stack height determinations. For example, some products with a specific gravity of 1.8 are almost twice as heavy after filling than water. In order to provide the proper protection, users should take care to stack and unitize drums properly during both transportation and warehousing.

Industry experience suggests steel drums used to contain hazardous materials can be safely stacked four-high as long as the specific gravity does not exceed 1.5. If the specific gravity of the lading exceeds 1.5 or the ambient temperature is expected to exceed 30°C (86°F) for prolonged periods of time, stacking height should be restricted to three-high. Proper drum handling, palletization and stacking recommendations should be followed. All steel drums used for shipping and warehouse storage of hazardous materials are required to pass a stacking test in accordance with Title 49 of The Code of Federal Regulations (CFR) §178.606. The drums are prepared as for shipment and subjected to a top load force equivalent to a 3-meter high stack (9.842 feet). The test is conducted for 24 hours at ambient temperature. The top load weight used during testing is based on the specific gravity of the intended lading.

Following these general guidelines will help ensure the proper stacking and safe storage of filled steel drums. Your drum supplier can assist in determining the proper stacking array.

Recommended Best Practices

Drum closures should be fully installed and tightened to the prescribed torque as specified in the drum manufacturers' closure instructions as required in Title 49 of the Code of Federal Regulations §178.2(c).

Drums should be palletized on good quality pallets which provide full support and even contact for the bottom of the drum in order to minimize drum sag between pallet boards. Drum overhang over the edge of pallets is not recommended. Pallets should be in good condition and provide uniform surfaces in contact with the ring on the top of the drum. Pallet stringers should be intact, nails should not protrude, and there should be no loose boards or excess space between deck boards. Damaged pallets with broken deck boards should be avoided.

The recommended pallet size is 48" x 48" with 46" x 46" as a minimum to load four drums per pallet. A four-way entry pallet type is recommended. Pallet manufacturers can assist in pallet design and correct sizing.

If drums are stored directly on the floor, the storage area should be flat and in good condition. A concrete floor is preferable.

Drums should be stacked one-high per pallet with a maximum stacking height dependent on the specific gravity and other conditions.

It is important to select the proper steel drum for the lading being packaged; see ISDI alerts [14-06](#), [14-07](#) and [14-08](#) for more information. Drum manufacturers can assist with proper steel drum gauge selection based on the specific gravity and other characteristics of your lading. For solids, the allowed weight should not exceed the actual gross weight tested.

If using a hot filling method, allow the product to cool to ambient temperature before tightening closures to recommended torque values and stacking the drums.

Filled drums should be stored and stacked away from direct sunlight to prevent expansion of the lading due to heating conditions.

Special provisions must be followed to protect palletized drums filled with flammable and combustible materials. NFPA Code 30 prescribes the safety standards for storing flammable and combustible liquids. To take advantage of the steel drum's superior safety and storage capabilities, the drums must be stored in a facility protected by a sprinkler system, palletized and equipped with pressure relieving fittings; see [ISDI Alert 14-14](#) for further details.

The following specific requirements also apply:

- The ceiling or roof height must not exceed 33 feet.
- For three-high, the palletized stack height of the drums must not exceed 10 feet.
- For four-high, the palletized stack height of the drums must not exceed 13 feet, 9 inches.
- Steel drums must be equipped with relieving style plugs in the 2-inch and ¾-inch opening.
- The stack must be protected by a foam-water sprinkler system (also known as AFFF) capable of providing discharge density of .45 gpm/ft² for stacks three-high and .60 gpm/ ft.² for stacks four-high.
- The sprinkler heads should be pendant, extra-large orifice (ELO).

Issued 10/2015; Revised 01/2016

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