



Compliance of the Weldcoa Pallet System with 49 CFR 393.102

The Weldcoa Instaload pallet system complies with the requirements of 49 CFR 393.102 for the purpose of transporting compressed gas cylinders.



A detailed stress analysis was performed by a licensed professional engineer on the Weldcoa Instaload pallet system. This system includes Weldcoa 3-rail and 4-rail pallets installed on a Weldcoa truck or trailer body. This was done to address the requirements of 49 CFR 393.102.

Assumptions of the analysis:

1. The pallet is properly loaded on the truck/trailer with the front of the pallet engaged with the body center tube and both locks mechanisms fully extended.
2. The pallet is loaded with 21 DOT cylinders, each weighing 168 pounds.
3. The cylinders are secured upright, nested and bound with two straps.
4. The pallets are in good condition and well maintained.
5. The truck/trailer body is in good condition, well maintained and conforms to the Weldcoa Instaload Truck and Trailer Body Inspection Procedure.

Failure criteria:

There were two cases of acceleration considered in the analysis.

1. Cyclic acceleration that would fatigue the structure over time.
2. One-time acceleration that would yield the structure (cause permanent deformation).

In the case of cyclic acceleration, the number of cycles to failure was selected at 2 million cycles. This was based on 100 cycles per day, 365 days per year for 50 years.

The weakest element of the structure for each of four acceleration vectors was identified and the acceleration necessary to meet the failure criteria was calculated. These four acceleration vectors are:

1. Forward (deceleration of the vehicle)
2. Rearward (acceleration of the vehicle)
3. Inboard (lateral acceleration due to an inside turn)
4. Outboard (lateral acceleration due to an outside turn)



49 CFR states:

§ 393.102 What are the minimum performance criteria for cargo securement devices and systems?

(a) **Performance criteria.** Cargo securement devices and systems must be capable of withstanding the following three forces, applied separately:

(1) **0.8 g deceleration in the forward direction;**

Results of analysis:

- The pallet system exceeds the stated requirement.
- It will withstand a cyclic acceleration of 1.2g for 2 million cycles before fatigue failure. This acceleration is 1.5 times the stated acceleration limit.
- It will withstand a one-time acceleration of 1.4g for the case of permanent deformation. This acceleration is 1.75 times the stated acceleration limit.

(2) **0.5 g acceleration in the rearward direction;**

Results of analysis:

- The pallet system exceeds the stated requirement.
- It will withstand a cyclic acceleration of 1.9g for 2 million cycles before fatigue failure. This acceleration is 3.8 times the stated acceleration limit.
- It will withstand a one-time acceleration of 2.2g for the case of permanent deformation. This acceleration is 4.4 times the stated acceleration limit.

(3) **0.5 g acceleration in a lateral direction.**

Results of analysis:

For the case of inboard acceleration:

- The pallet system exceeds the stated requirement.
- It will withstand a cyclic acceleration of 1.2g for 2 million cycles before fatigue failure. This acceleration is 2.4 times the stated acceleration limit.
- It will withstand a one-time acceleration of 1.4g for the case of permanent deformation. This acceleration is 2.8 times the stated acceleration limit.

For the case of outboard acceleration:

- The pallet system exceeds the stated requirement.
- It will withstand a cyclic acceleration of 1.2g for 2 million cycles before fatigue failure. This acceleration is 2.4 times the stated acceleration limit.
- It will withstand a one-time acceleration of 1.4g for the case of permanent deformation. This acceleration is 2.8 times the stated acceleration limit.

(b) **Performance criteria for devices to prevent vertical movement of loads that are not contained within the structure of the vehicle.** Securement systems must provide a downward force equivalent to at least 20 percent of the weight of the article of cargo if the article is not fully contained within the structure of the vehicle. If the article is fully contained within the structure of the vehicle, it may be secured in accordance with § 393.106(b).

Response:

This paragraph calls out the securement criteria for general cargo. We do not feel that this paragraph applies since 49 CFR 177.840 specifies the means of securement for DOT cylinders.



§ 177.840 Compressed gases, including cryogenic liquids.

- (a) (1) **Cylinders.** To prevent their overturning, cylinders containing compressed gases must be securely lashed in an upright position; loaded into racks securely attached to the motor vehicle; packed in boxes or crates of such dimensions as to prevent their overturning; or loaded in a horizontal position. Specification DOT-4L cylinders must be loaded in an upright position and securely braced.

A downward restraining force does exist, however, as a result of the binding of the cylinders to the pallet. The friction between the cylinders, pallet and straps each contribute to this restraining force. It is difficult to estimate this restraining force.

In lieu of an engineering estimate, a test was conducted that demonstrated that the downward restraining force exceeds the stated 20% requirement. A pallet was loaded with 21 cylinders and inverted. None of the cylinders fell out of the restraints. This result means that the restraining force exceeds 100% of the weight of the cylinders and the requirement was exceeded by more than a factor of 5.



The picture at far left was taken during the downward restraining force testing. The nearer picture shows how the system performs in an unfortunate accident in which a truck overturned and slid 50 yards. Not a single pallet or cylinder were ejected.

Continuing with §393.102:

- (b) **Equivalent means of securement.** Cargo that is immobilized, or secured in accordance with the applicable requirements of §§393.104 through 393.136, is considered as meeting the performance criteria of this section.

Referencing §393.104:

§ 393.104 (e) **Manufacturing standards for tie-down assemblies.** Tiedown assemblies (including chains, wire rope, steel strapping, synthetic webbing, and cordage) and other attachment or fastening devices used to secure articles of cargo to, or in, commercial motor vehicles must conform to the following applicable standards:

- (3) **Webbing:** Web Sling and Tiedown Association's Recommended Standard Specification for Synthetic Web Tiedowns, WSTDA-T1, 1998.

According to our supplier, the binder straps that Weldcoa supplies on new SurLoc pallets comply with the referenced standard.

Submitted by:
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Weldcoa Sur-Loc™ Pallets

Comply with new DOT regulations.

Excerpts from the Federal Motor Carrier Safety Administration Regulations Manual

49 CFR § 393.102

What are the minimum performance criteria for cargo securement devices and systems?

- (a) *Performance criteria.* Cargo securement devices and systems must be capable of withstanding the following three forces, applied separately:
- (1) 0.8 g deceleration in the forward direction;
 - (2) 0.5 g acceleration in the rearward direction and;
 - (3) 0.5 g acceleration in a lateral direction.



Weldcoa pallets can withstand up to 3G's of force before being forcibly removed from a pallet vehicle.

49 CFR § 177.840

Paragraph One: "To prevent their overturning, cylinders must be securely lashed in an upright position; loaded into racks securely attached to the motor vehicle;

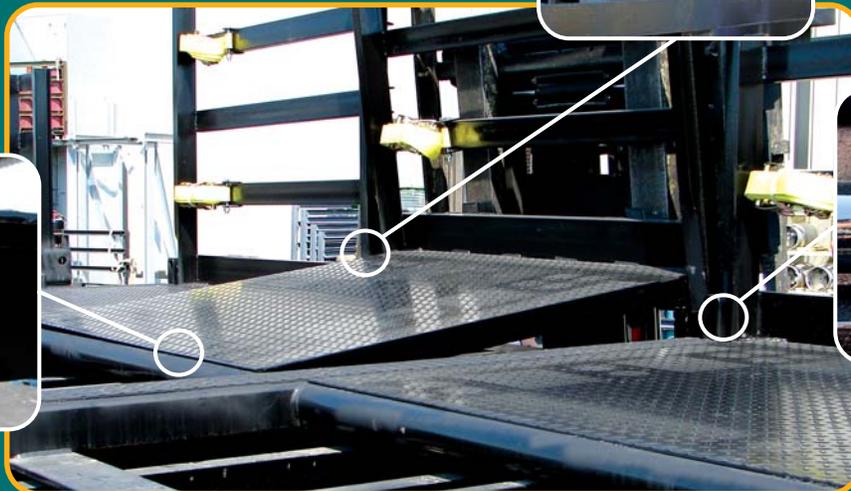


Weldcoa pallets lock automatically and mechanically on to the frame of the vehicle.

Weldcoa's patented locking system does not rely on gravity!



The end of the Weldcoa pallet is shaped like a "C" and cups the center tube of Weldcoa pallet vehicles.



Pallet truck forks automatically engage and disengage the mechanical locks of the patented pallet system. An inverted zerk fitting on the face of the locks makes maintenance easy. Weldcoa pallets lock on to the pallet vehicles. If the vehicle is completely inverted the pallets will remain locked on to the frame.



Once engaged, a quick visual inspection can be performed to assure that the pallets are locked in place.

Pallets that lock



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