Proper Procedures for Loading

PUCO Transportation

Enforcement Division

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General Requirements Applicability

Who Do the Rules Apply To?

- The Federal Motor Carrier Safety Regulations 393.100 - Protection against Shifting and Falling Cargo applies to commercial motor vehicles, including vehicle combinations that are operated on a highway and either;

- *Have a gross vehicle weight rating (GVWR), gross combination weight rating (GCWR), gross vehicle weight (GVW) or gross combination weight (GCW) of 10,001 pounds or more, whichever is greater; OR*

- *Are used in transporting hazardous materials in a quantity requiring placarding.*

General Requirements Applicability

What is the definition of highway?

- A highway is defined as any road, street, or way, whether on public or private property, open to public travel. "Open to public travel" means that the road section is available, except during scheduled periods, extreme weather or emergency conditions, passable by four-wheel standard passenger cars, and open to the general public for use without restrictive gates, prohibitive signs, or regulation other than restrictions based on size, weight, or class of registration.

General Requirements Applicability

Note that pick-up trucks, step vans, and utility-type vehicles may meet the definition of a commercial motor vehicle. The following chart illustrates this point:

	GVWR	Is it a CMV?
Ford T-150 pick-up (1/2 ton)	6,100 lbs.	NO
Ford F-150 + utility trailer	6,100 lbs. + 2,800 lbs.	NO
Ford F-250 pick-up (3/4 ton)	8,500 lbs.	NO
Ford F-250 + utility trailer	**8,500 lbs. + 2,800 lbs.**	**YES**
Workhorse Step Van	10,000 lbs.	NO
Ford F-450 pick-up (1+ton)	**14,000 lbs.**	**YES**
Isuzu NPR HD (Medium Duty)	16,000 lbs.	YES

General Requirements Applicability

- In addition to the general cargo securement requirements, there are also Commodity Specific Requirements that must be met that include:
  - **Logs (393.116)**
  - **Dressed Lumber or Similar Building Products (393.118)**
  - **Metal Coils (393.120)**
  - **Paper Rolls (393.122)**
  - **Concrete Pipe (393.124)**
  - **Intermodal Containers (393.126)**
  - **Automobiles, Light Trucks and Vans (393.128)**
  - **Heavy Vehicles, Equipment and Machinery (393.130)**
  - **Flattened or Crushed Vehicles (393.132)**
  - **Roll-On/Roll-Off or Hook Lift Containers (393.134)**
  - **Large Boulders (393.136)**

General Requirements Applicability

- Before operating a commercial motor vehicle, you must make sure that your vehicle's cargo and equipment is secured properly. This includes:

- Tailgates
- Doors
- Tarps
- Spare tires
- Boards

Why is cargo securement important?

- An improperly secured load can result in:
  - Vehicle Accidents
  - Loss of Life
  - Loss of Load
  - Damage to the Cargo
  - Damage to Vehicles and Other Property

We will be covering:

Roustabout Equipment

Rig Moves

Heavy Equipment

Small Vehicles

And Much More!

General Cargo Inspection Requirements

- Driver must inspect cargo and securing devices within the first 50 miles after beginning a trip.
- Driver must then reexamine when duty status of driver changes
- Driver must reexamine after vehicle has been driven 3 hours or 150 miles
- Drivers, remember that when you are transporting on dirt roads, stop and check straps and chains before hitting the pavement!

General Cargo Securement Requirements

All cargo must be contained, immobilized, or secured so that it does not:

- Leak
- Spill
- Blow off the vehicle
- Fall from the vehicle
- Fall through the vehicle

General Cargo Securement Requirements

Be sure beds are in good shape and swept off before leaving!!

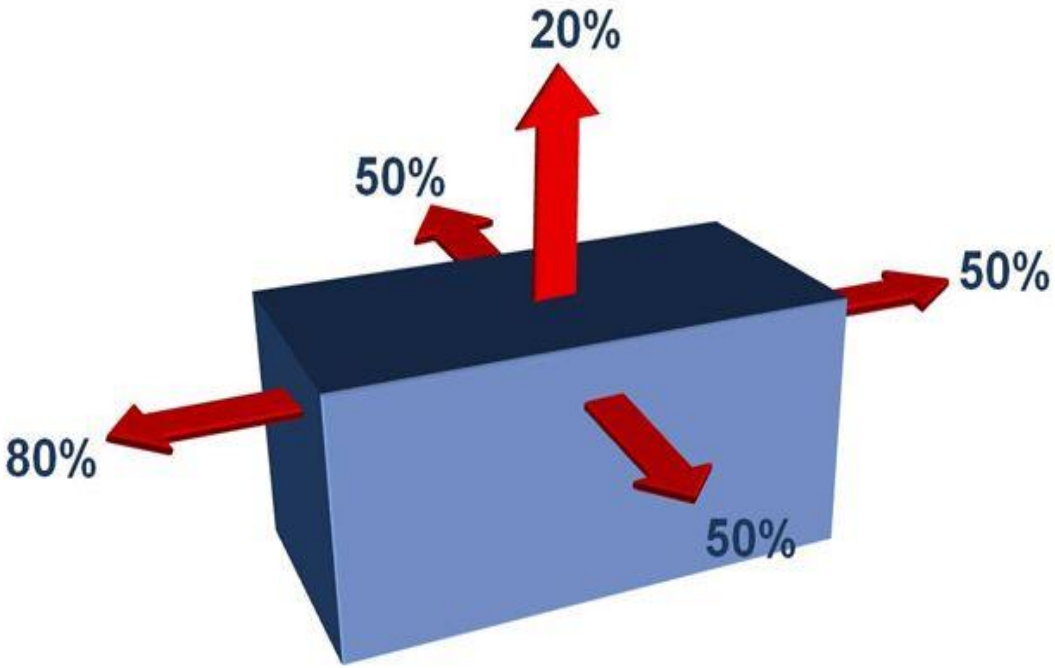
General Cargo Securement Requirements

A properly secured load will remain secured:

- Under all conditions that could reasonably be expected to occur in normal driving
- When you are responding to an emergency situation (except when there is a crash).

General Cargo Inspection Requirements

Each cargo securement system must be able to withstand a minimum amount of force in each direction as follows:



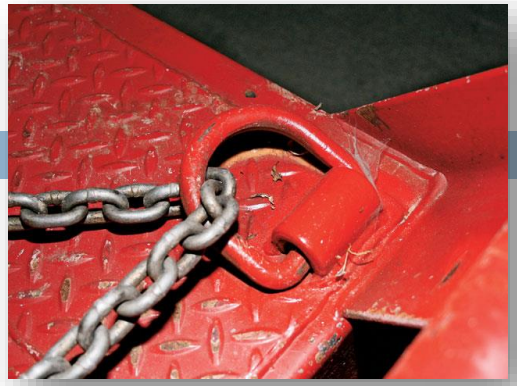
- Forward force: 80% of cargo weight (when braking while driving forward)
- Rearward force: 50% of cargo weight (when accelerating, shifting or climbing hills
- Sideways force: 50% of cargo weight (when turning or changing lanes)
- Upward force: 20% of cargo weight (traveling over bumps, or cresting a hill)

Securement Systems

- A securement system uses one or a combination of the following elements:
  - Vehicle structures: Floors, headerboards, and anchor points
  - Securing devices: Steel straps, wire, chain, rope, and ratchets.
  - Blocking & Bracing: Wood blocks and shoring bars.

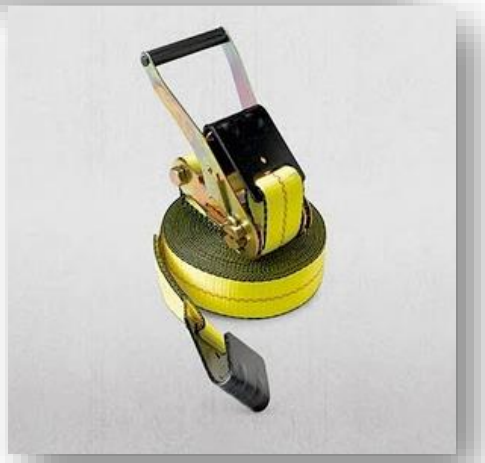
Securing Devices

What is a securing device?



Friction Mats
Chains
Wire Rope
Manila Rope
Synthetic Rope
Steel Strapping
Clamps and latches
Blocking
Front-end structure
Grab Hooks

Binders
Shackles
Winches
Stake Pockets
D-Rings
Pockets
Webbing Ratchets
Bracing
Synthetic Webbing
Binders



What is a tie-down?

A tie down is a combination of securing devices that forms an assembly that:

- Attaches cargo to, or restrains cargo on a vehicle or trailer.
- Is attached to anchor point(s).

Tie down Devices

- All tie downs must be in proper working order.
- No knots, damage, distress, or weakened parts.
- Each tiedown must be attached and secured to prevent it from becoming loose, unfastening or opening while the vehicle is in transit.
- Tiedowns and/or their associated connectors or attachments mechanisms must be designed so that the driver can tighten them.
- Edge protection must be used where tie downs are subject to abrasion or cutting.

Chains

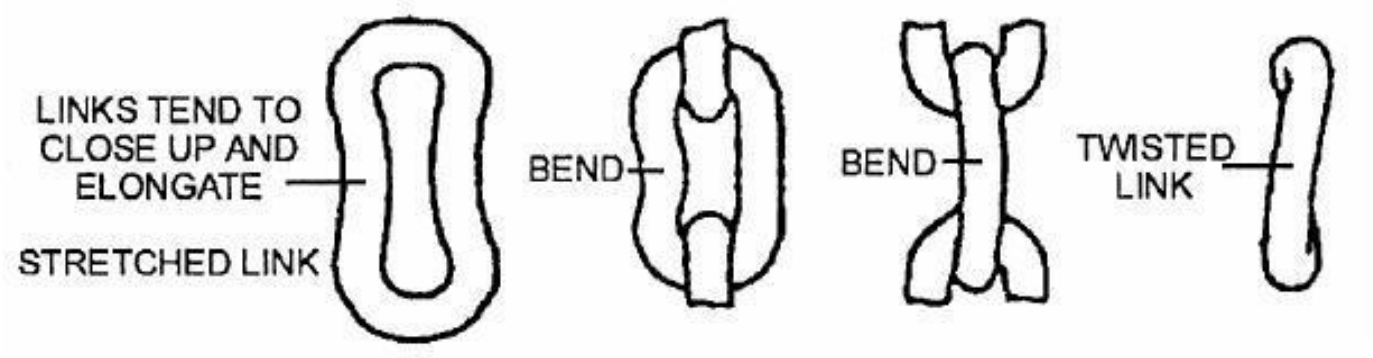
When using chain:

- Make sure your chains, anchor points, and binders have a high enough rating for the weight of the cargo.
- Install chains so that they do not have twists.
- Make sure there are no kinks, snags, or hang-ups in long chain spans
- Use your own strength when using lever-type and ratchet binders. Using a cheater bar can tension the binder beyond its limits. **The use of lever-type binders is not recommended.**
- Remember, **DO NOT** use your Grade 70 Transport chain for lifting.

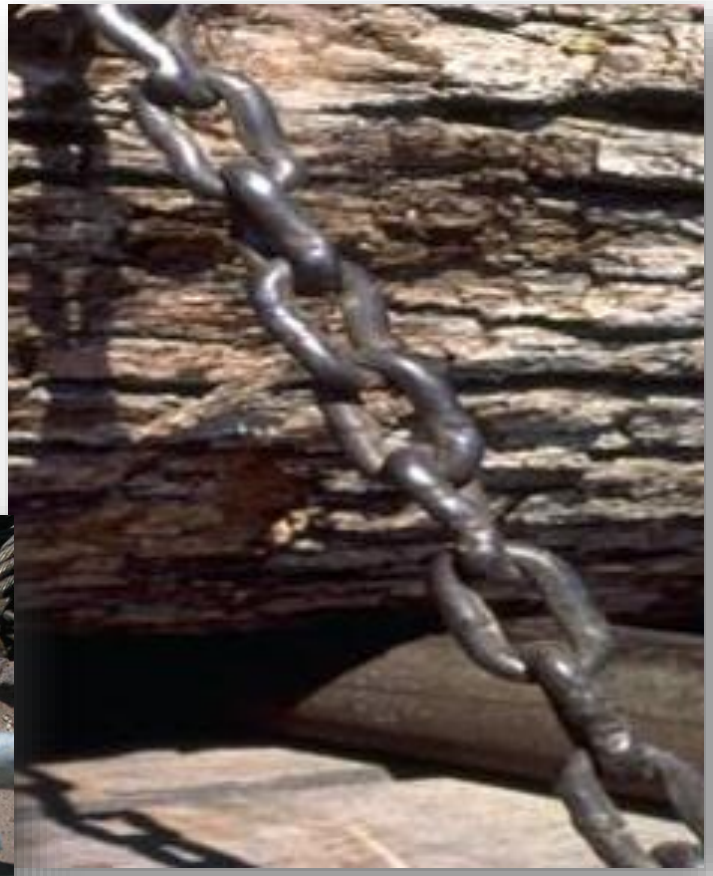
Chain Defects

Chains should not:

- Have broken, cracked, twisted, bent or stretched links.
- Contain nicks, gouges, abrasions, excessive wear, or knots.
- Have any weld on the chain, except the original chain weld in each link.



Examples of Chain Defects



Synthetic Straps

When using straps:

- Make sure the straps, hooks, and tensioning devices are strong enough for the cargo, and not damaged.
- Check for knots, crushed areas, cuts, burns, holes, splices, severe abrasion, and broken load bearing strands.
- Use edge protectors to protect the straps.

Examples of Strap Defects

Using edge protectors to protect straps.

Edge protection must be used if a tiedown could be cut or torn when touching an article of cargo

Without edge protection

With edge protection

Blocking and Bracing

- Material used for blocking or bracing and as chocks and cradles must be strong enough to withstand being split or crushed by the cargo or tie downs.

Blocking and Bracing

- If wood is used:
  - Hardwood is recommended
  - It should be properly seasoned
  - It should be free from rot or decay, knots, knotholes, and splits
  - The grain should run lengthwise

Headerboards

- When cargo is in contact with the front end structure, it must meet the following performance requirements:
  - Height: Al least 4 feet above floor of vehicle or lower as long as it blocks forward movement of any cargo on vehicle
  - Width: As wide as the vehicle or narrower as long as it blocks forward movement of any cargo on the vehicle

Eliminate Movement of Load

- Some articles have a tendency to roll. Prevent rolling by providing more than one point of contact:

- Lift cargo off the deck and/or
- Use chocks, wedges, a cradle, or other equivalent means to prevent rolling.
  - The method used to prevent rolling MUST NOT become unfastened or loose while in transit.

How many tiedowns do I need?

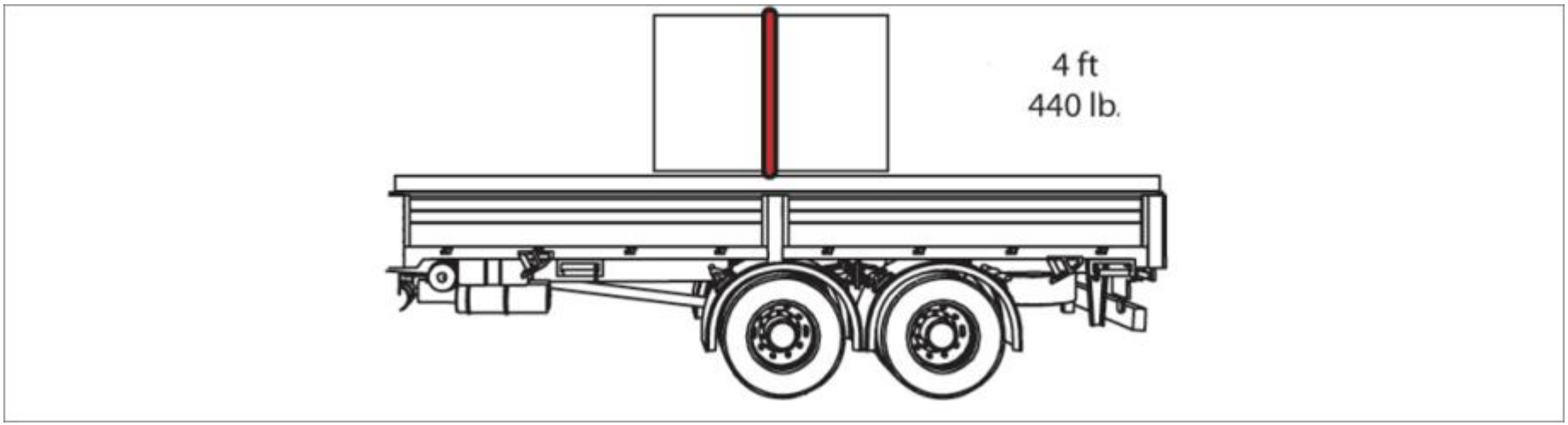
The minimum number of tiedowns needed depends on:

- Whether the cargo is prevented from moving forward,
- The length and weight of the cargo, AND
- The strength of the tiedowns.

If cargo is not prevented from forward movement, secure the cargo according to the following requirements.

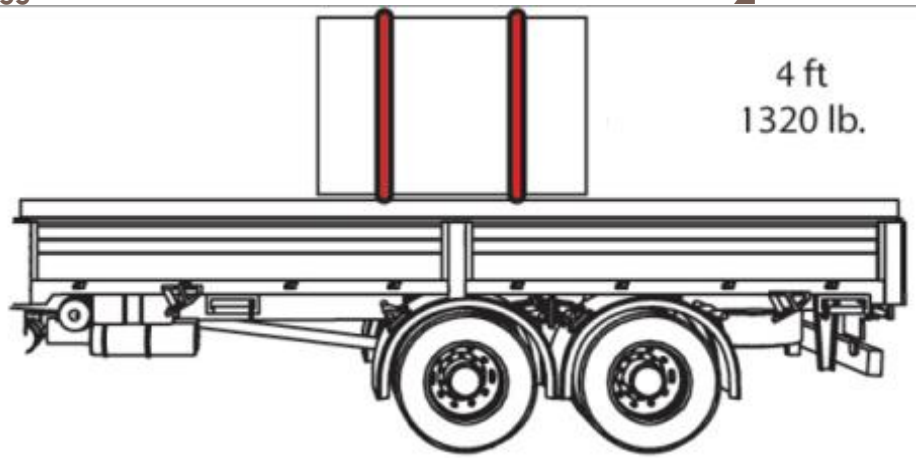
General Cargo Securement Requirements

Article Description	Minimum # of Tie downs
5 ft or shorter	
1,100 lbs. or lighter	**1**



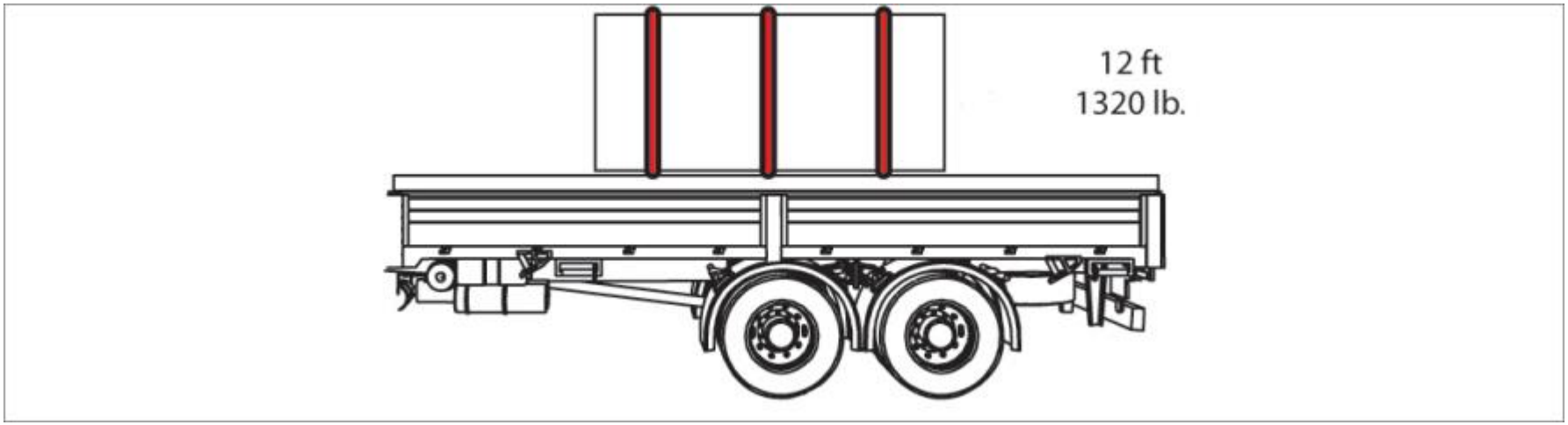
General Cargo Securement Requirements

Article Description	Minimum # of Tie downs
5 ft or shorter And weighs over 1,100 lbs.	**2**
OR	
More than 5 ft but 10 ft or less	**2**



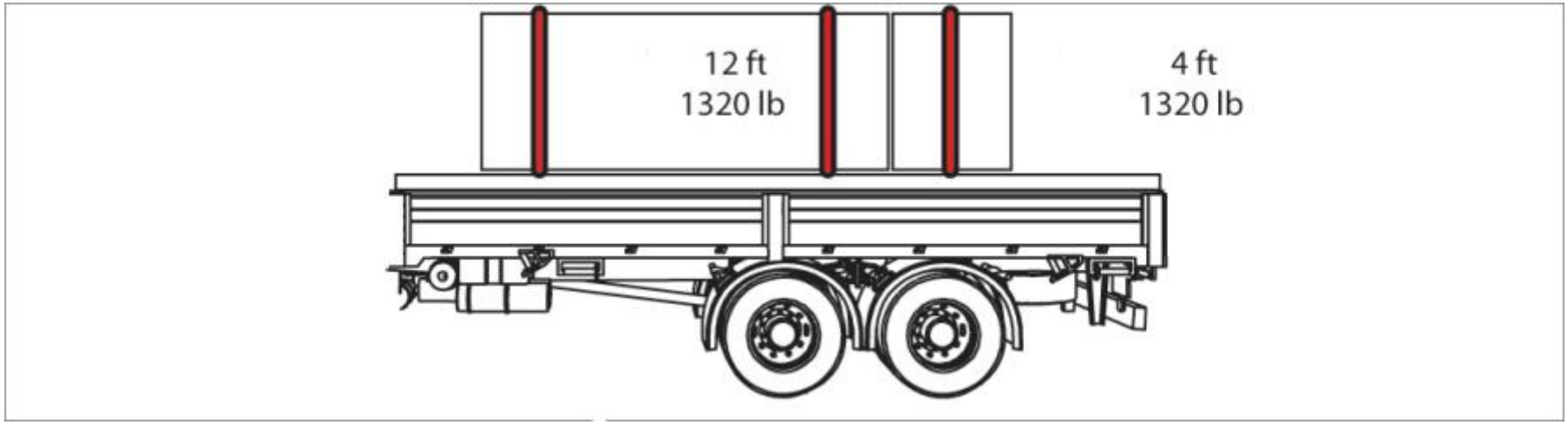
General Cargo Securement Requirements

Article Description	Minimum # of Tiedowns
More than 10 ft	**2 + 1 tie down for every additional 10 ft, or part thereof**



General Cargo Securement Requirements

Article Description	Minimum # of Tiedowns
Prevented from moving forward	**1 tiedown for every 10 ft, or part thereof**



How should tiedowns be attached?

Tiedowns can be attached in two ways:

- Attached to the cargo or pull the cargo in only one direction (**Direct tie downs)-** Tiedowns are attached directly to the cargo and an anchor point or the tiedowns pass over, through, or around the cargo and attached back to the same side of the vehicle.

- Passed over the cargo (**Indirect tie downs**)- Tiedowns are attached to the vehicle, passed over, through, or around the cargo, and then attached to the vehicle again on the other side.

Direct Tie downs

½ working load limit (x2)

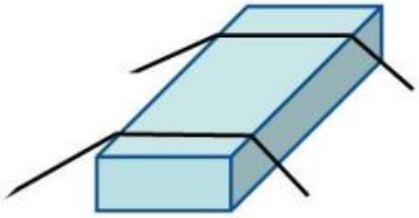
½ working load limit

Indirect Tie downs

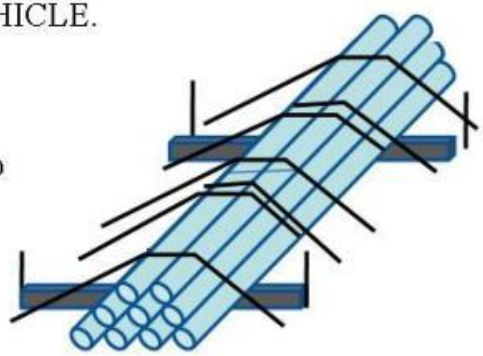
(full working load limit)

Working Load Limits

THE WORKING LOAD LIMIT (WWL) OF A TIE DOWN IS 100% WHEN IT IS ANCHORED FROM A POINT ON THE VEHICLE,THROUGH, OVER, OR AROUND THE LOAD AND IS THEN ATTACHED TO ANOTHER ANCHOR POINT ON THE OTHER SIDE OF THE VEHICLE.

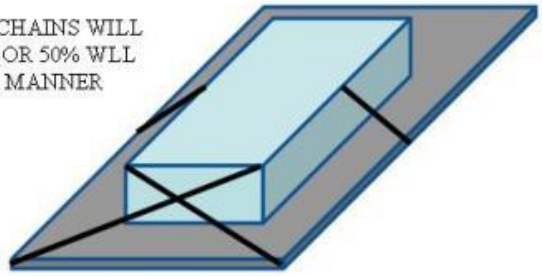


GRADE 70 TRANSPORT CHAINS ARE RATED FOR 6600 LBS OR 100% WLL IF SECURED IN THIS MANNER



THE WORKING LOAD LIMIT OF A TIE DOWN IS REDUCED BY 50% IF THE TIE DOWN IS ATTACHED TO AN ANCHOR POINT ON THE VEHICLE TO AN ATTACHMENT ON A LOAD OR PASS THROUGH, OVER, OR AROUND THE LOAD THEN ATTACH TO AN ANCHOR POINT ON THE SAME SIDE OF THE VEHICLE.

GRADE 70 TRANSPORT CHAINS WILL BE RATED AT 3300LBS OR 50% WLL IF SECURED IN THIS MANNER



Working Load Limits

Tie down strength and working load limits.

- The working load limit (WLL) is the maximum load that may be applied to a component of a cargo securement system during normal service.
- The WLL is usually assigned by the manufacturer, and may not always be marked on the component.

Working Load Limits

How is the Working Load Limit Determined?

- The working load limit (WLL) of a tiedown, associated connector or attachment mechanism is the lowest WLL of any of its components (including tensioner), or the working load limit of the anchor points to which it is attached, whichever is less.

- Example: if a lever binder with a WLL marked 5400 lbs is used with a chain that is rated at 8750 lbs. The WLL of this assembly is 5400 lbs.

Remember… a chain is only as strong as its weakest link!

Working Load Limits

How Do I determine The Working Load Limit Of My Tiedown?

- When determining the WLL of your tie down, you should use the manufacturers marking on the tie down. If the tie down is not marked, use one of the following tables to determine your WLL.
- These and other WLL Tables can be found in the Federal Motor Carrier Safety Regulations Part 393.108.

Default Working Load Limits For Chain

Working Load Limit of CHAIN

Size	Grade 30 proof coil	Grade 43 High test	Grade 70 Transport	Grade 80 Alloy	Grade 100 Alloy
1/4 in.	1300 lb.	2600 lb.	3150 lb.	3500 lb.	4300 lb.
5/16 in.	1900 lb.	3900 lb.	4700 lb.	4500 lb.	5700 lb.
3/8 in.	2650 lb.	5400 lb.	6600 lb.	7100 lb.	8600 lb.
7/16 in.	3700 lb.	7200 lb.	8750 lb.	-	-
1/2 in.	4500 lb.	9200 lb.	11300 lb.	12000 lb.	15000 lb.
5/8 in.	6900 lb.	13000 lb.	15800 lb.	18100 lb.	22600 lb.
Chain Marks					
Example 1	3	4	7	8	10
Example 2	30	40	70	80	100
Example 3	300	400	700	800	100

Default Working Load Limits For Steel Strapping and Synthetic Webbing

Steel Strapping	
Width / Thickness Inch	Working Load Limit
1-1/4 x .029	1190 lb.
1- 1/4 x .031	1190 lb.
1- 1/4 x .035	1190 lb.
1- 1/4 x .044	1690 lb.
1- 1/4 x .05	1690 lb.
1- 1/4 x .057	1925 lb.
2 x .044	2650 lb.
2 x .050	2650 lb.

Synthetic Webbing	
1- 3/4 in.	1750 lb.
2 in.	2000 lb.
3 in.	3000 lb.
4 in.	4000 lb.

Default Working Load Limits for Wire Rope

Wire Rope (6x37, Fiber Core)	
Diameter	Working Load Limit
1/4 in.	1400 lb.
5/16 in.	2100 lb.
3/8 in.	3000 lb.
7/16 in.	4100 lb.
1/2 in.	5300 lb.
5/8 in.	8300 lb.
3/4 in.	10900 lb.
7/8 in.	16100 lb.
1 in.	20900 lb.

Aggregate Working Load Limit

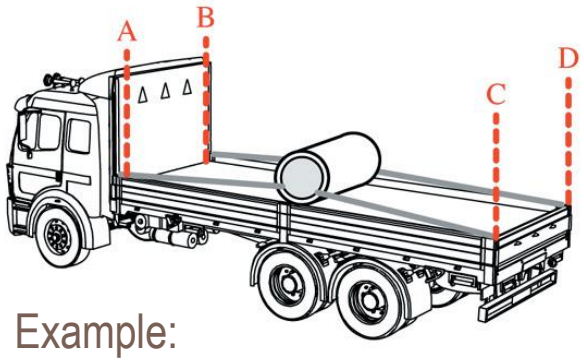
- Aggregate Working Load Limit is: The sum of the working load limits of each device used to secure an article on a vehicle.

- Knowing the aggregate working load limit will allow you to determine the minimum number of tie downs required for your cargo, based on the weight of the cargo.

How do you calculate the aggregate Working Load Limit?

To calculate the aggregate WLL, add together :

- 50% of the WLL of each direct tiedown
- 100% of the WLL of each indirect tiedown.



Example:
50% of A
+ 50% of B
+ 50% of C
+ 50% of D
= Aggregate Working Load Limit

Aggregate Working Load Limit

- *If the aggregate working load limit of your securement devices is less than ½ the weight of the cargo being hauled, you can be placed* out of service *on a roadside inspection!*

Anchor Points

- Some loads we face in our industry have little or no anchor points manufactured on them to secure the load.

Is this a sufficient anchor point?

Anchor Points

This trailer has several anchor points but where to anchor to the cargo can present a problem for a driver.

Anchor Points

- All elements of the vehicle structure and anchor points must be strong enough to withstand:
  - 80% forward force
  - 50% rearward force
  - 50% sideways force
  - 20% Upward force, and
  - Have no obvious damage that would affect performance or reduce the working load limit.
  - Have no distress
  - Have no weakened parts or sections.

Pick-ups and small vehicle securement

- Vehicles should never exceed the Manufacturer's Gross Vehicle Weight rating.

Roustabout Load Securement

- Loads, equipment and other items shall be tied-down or secured before commencing motion. This includes items in the possum belly.

Which of the cargo shown are properly secured?

Roustabout Load Securement

- All Palletized equipment must be secured to prevent the load from coming off during transit.

Equipment Baskets

- All equipment should be loaded so that the load can be secured.

If you can not secure the load, STOP the job!!

Stopping the Job

- Ultimately, it is the drivers' responsibility to secure the load properly before transport. If you are dispatched to pick up a load and you are unable to secure it, you must **STOP THE JOB**, and have the equipment reloaded properly.

IF YOU PICK IT UP, YOU OWN IT.

Mud Products

- Proper cargo securement prevents cargo from leaking, spilling, blowing, or falling from a vehicle.

Which one of these loads would you haul?

Mud Products

- If you are transporting mud trailers like this, all pallets must be properly secured to prevent them from shifting during transport. No opened bags should be transported unless they have been properly contained in an approved container.

Bobtailing Loads

- Proper route planning is essential in identifying situations that may require oil and gas equipment to be bobtailed.
  - **When road conditions discovered during a route survey dictate that bobtailing may be required, attempts should be made to take an alternate route or have the roads fixed so that the loads can be hauled in compliance of the cargo securement guidelines.**
  - **If bobtailing is the least hazardous means of transport, attempts should be made to minimize the distance the load is bobtailed as much as possible.**

Multiple Piece Loads

Each piece must be secured.

Tubulars

Tubulars

- Tubulars must be secured in a manner that prevents the load from moving forward or backward while in transit.

No one wants to see this happen to you.

Tubulars

Are these trailer stakes sufficient cargo securement for this tubular cargo in transit?

Tubulars

Make sure that tubulars loaded inside pipe tubs are loaded well below the top of the tub so the pipe can't come out during transit. Could this pipe come out on the sides?

Heavy Haul

Heavy Haul

Transporting Heavy Equipment

- Heavy equipment or machinery with crawler tracks or wheels must be restrained against movement in the lateral, forward, rearward, and vertical direction using a minimum of four tie downs.
- Each of the tie downs must be affixed as close as practicable to the front and rear of the vehicle, or mounting points on the vehicle that have been specifically designed for that purpose.

Heavy Haul

- Lower and secure all accessory equipment to the vehicle (hydraulic shovels, booms, etc.).

Heavy Haul

- Restrain articulated vehicles to prevent articulation while in transit.

Heavy Haul

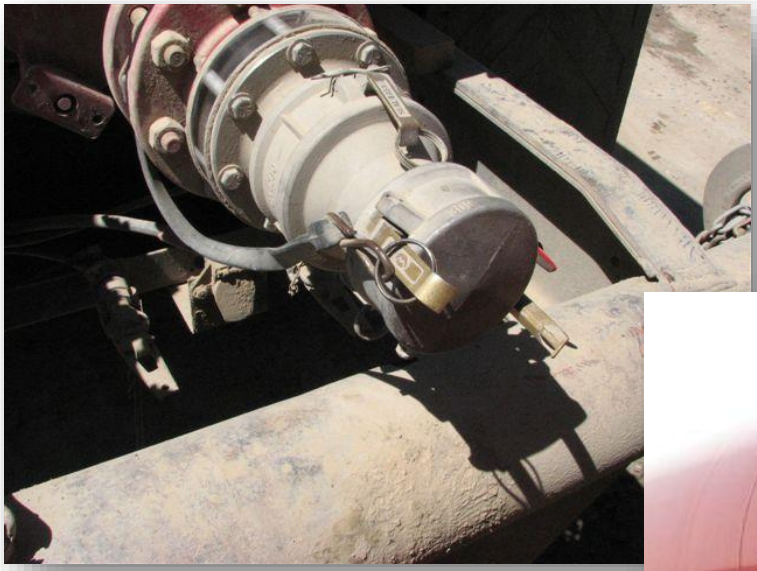
- Secure tie downs as close as practicable to the front and rear of the vehicle.

Was this piece of equipment secured?

Heavy Haul - Dump Trucks

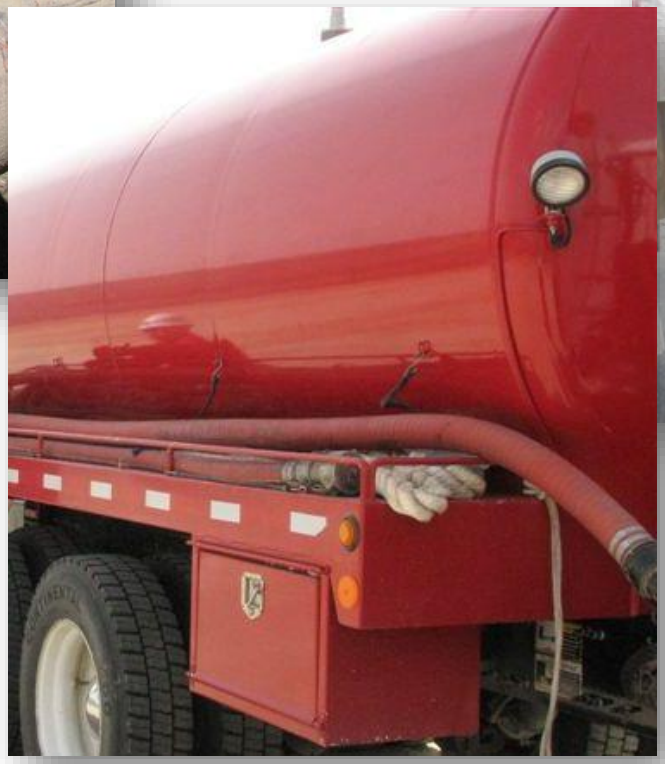
- Loads need to be secured to prevent material from falling or blowing onto roadways.

Heavy Haul - Water Trucks



Secure all valve caps

Secure all items on possum belly



Secure all hoses

Special Purpose Vehicles

- The basic rules concerning the minimum number of tiedowns do not apply to a vehicle transporting one or more articles of cargo such as, but not limited to:

- Machinery or fabricated structural items (e.g., steel or concrete beams, crane booms, girders, and trusses, etc.) which, because of their design, size, shape or weight, must be fastened by special methods.

However, any article of cargo carried on that vehicle must be secured adequately to the vehicle by devices that are capable of meeting the performance requirements and the working load limit requirements.

So, why should we secure our loads?

- An improperly secured load can hurt you or someone else when you least expect it. You might get away with it once, or twice, or a hundred times, but sooner or later it's going to bite you. Load it right and tie it down every time so this doesn't happen to you or someone else.

For More Information:

- *www.fmcsa.dot.gov*
- www.csa2010.fmcsa.dot.gov
- www.cvsa.org
- www.practicalcargosecurement.com
- www.jjkeller.com

FOUR CORNERS SAFETY NETWORK

EQUIPMENT MOVE TASK FORCE

Cargo Securement

Reliable Resource: NPCA

Cargo Securement Regulations for the Precast Concrete Industry

The information in this pamphlet is taken from the Regulatory Guidance for the Federal Motor Carrier Safety Regulation's Part 393 - Protection Against Shifting or Falling Cargo.

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