Ohio Department
of Transportation

November 2006

Load Securement

Office of Training: Equipment Training Section

Load Securement

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Course Schedule

Day One	Start	Duration	Title
Introduction	8:30 a.m.	5 minutes	Abstract and Learning Objectives
Lesson One	8:35 a.m.	10 minutes	Introduction to Load Securement
Lesson Two	8:45 a.m.	35 minutes	Components of a Securement System
Lesson Three	9:20 a.m.	15 minutes	Requirements for Securement Devices
Lesson Four	9:35 a.m.	15 minutes	Chain Inspection
Break	9:50 a.m.	15 minutes	
Lesson Five	10:05 a.m.	15 minutes	Trailer Hook-up
Lesson Six	10:20 a.m.	30 minutes	Equipment Tie-Down Standards
Lesson Seven	10:50 a.m.	30 minutes	Webbed Slings & Crosby Clips
Lunch	11:20 a.m.	60 minutes	
Video	12:20 p.m.	30 minutes	“Safe Equipment Transport”
Lesson Eight	12:50 p.m.	30 minutes	Securement Requirements by Commodity Type
Lesson Nine	1:20 p.m.	55 minutes	Field Exercises
Break	2:15 p.m.	15 minutes	
Lesson Nine (cont’d)	2:30 p.m.	45 minutes	Field Exercises
Wrap-up & Questions	3:15 p.m.	15 minutes	
Adjourn	3:30 p.m.		

Abstract

During the course of ODOT's core business functions, employees are required to move large pieces of equipment and numerous materials to work sites. In order to safely transport the equipment and materials, employees must be aware of and follow the Federal Regulations governing load and cargo securement.

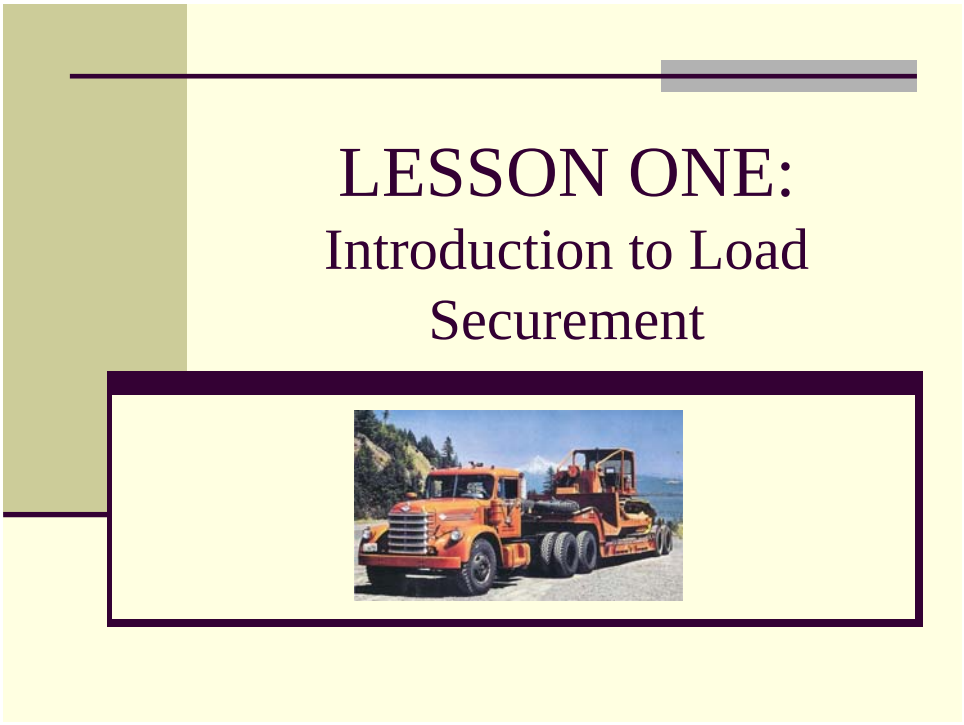
This course is designed to provide an introductory understanding of the load and cargo securement regulations for the United States. Employees will develop a better understanding of the requirements for loading and securing equipment and material for hauling.

Learning Objectives

The learning objectives for this course are as follows:

- Understand the need for load securement
- Knowledge of the laws regarding load securement
- Proper loading and securement of articles against movement during hauling
- How to inspect securement devices

Lesson One: Introduction to Load Securement



A. <u>New Rules and Regulations</u>

1. **In January of 2004 the Federal Motor Carrier Safety Administration (FMCSA) published new cargo securement regulations**

2. **The new regulations are based on the North American Cargo Securement Standard Model Regulations requiring motor carriers to change the way cargo securement devices are used to prevent articles from shifting on or within, or falling from motor vehicles**

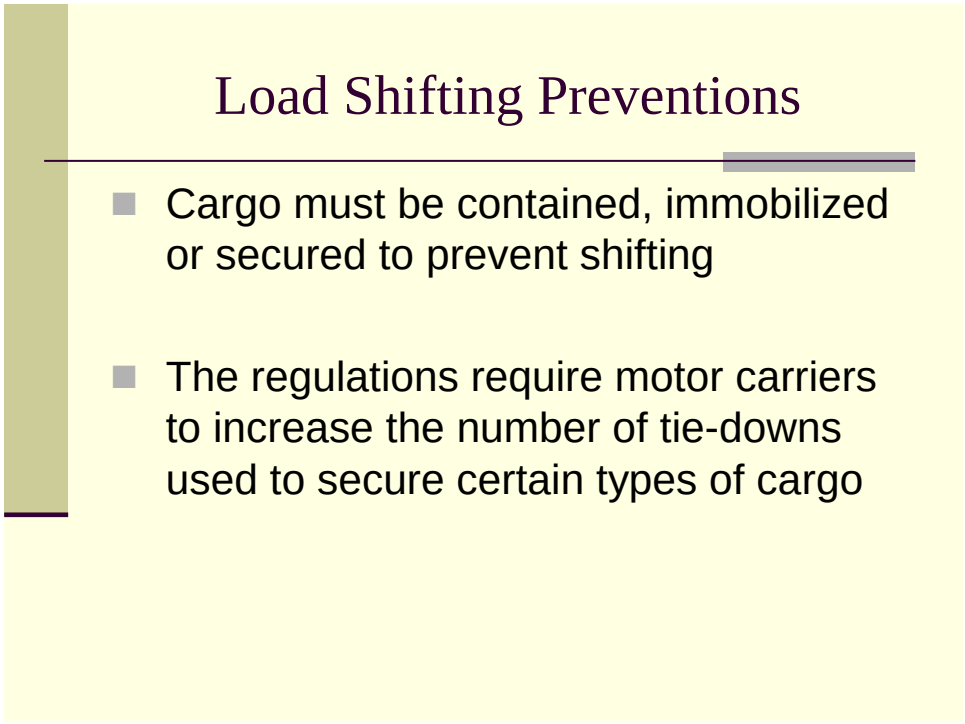
Definition of Load Securement

- Load securement is defined as prevention against loss of load

3. Definition of load securement

a. Load securement is defined as prevention against loss of load

b. Each commercial motor vehicle must, when transporting cargo on public roads, be loaded and equipped, and the cargo secured, to prevent the cargo from leaking, spilling, blowing or falling from the motor vehicle



4. **Prevention against shifting of load**

    - Cargo must be contained, immobilized or secured to prevent shifting upon or within the vehicle to such an extent that the vehicle's stability or maneuverability is adversely affected

5. **The changes in the regulations require motor carriers to increase the number of tie-downs used to secure certain types of cargo**

    a. The regulations do not prohibit the use of tie-downs or cargo securement devices currently in use

    b. Motor carriers are not required to replace current cargo securement equipment or vehicles to comply with the new regulations

6. **The intent of the new requirements is to reduce the number of accidents caused by cargo shifting on or within, or falling from, commercial motor vehicles, and to harmonize to the greatest extent practicable United States, Canadian and Mexican cargo securement regulations**

Figure 1-1

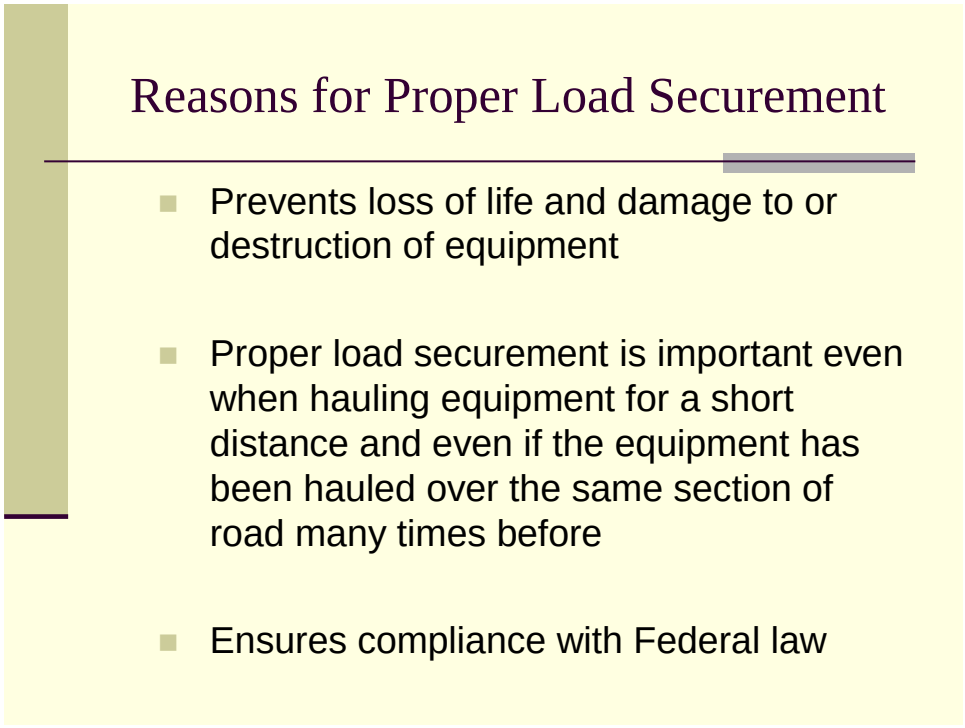
B. <u>Applicability of the New Regulations</u>

1. The new cargo securement regulations apply to the same types of vehicles and cargo as the old regulations, covering all cargo-carrying commercial motor vehicles operated in interstate commerce. This includes all types of cargo articles.

a. Liquids, gases, grain, , sand, gravel, aggregates

b. Cargo transported in a tank, hopper, box, or similar device which forms part of the structure of a commercial motor vehicle

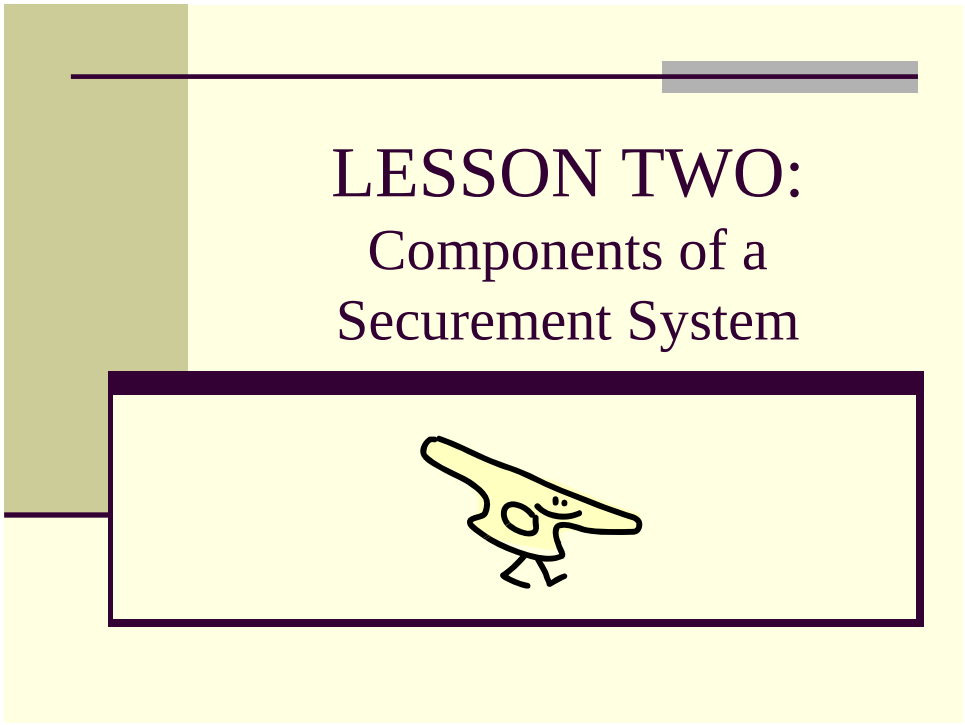
2. **This course will focus on ODOT specific load securement and transportation**

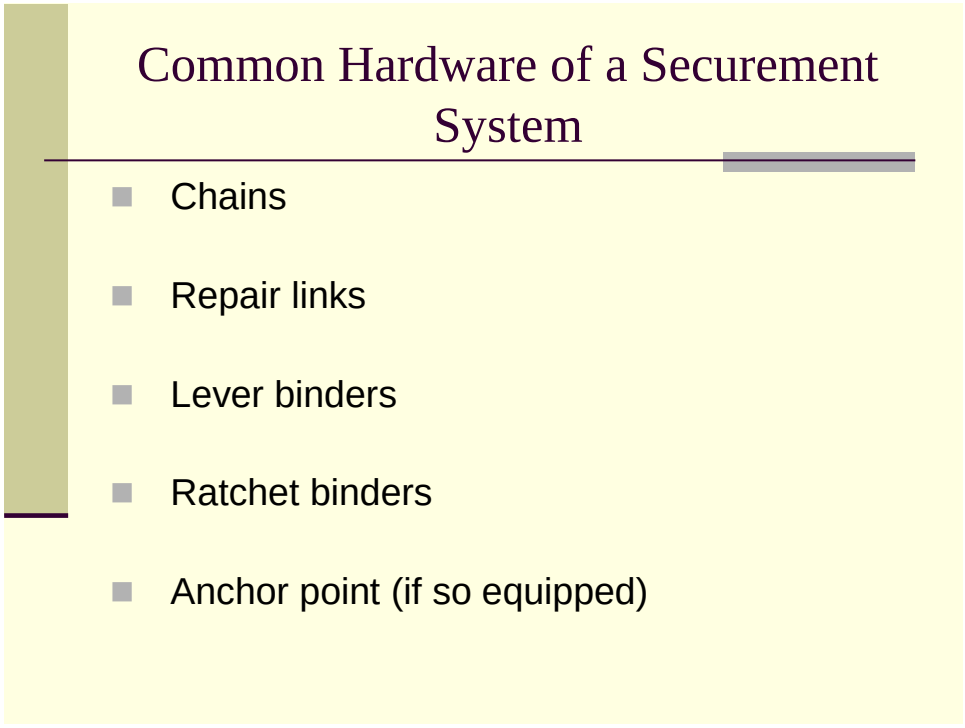


C. <u>Reasons for Proper Load Securement</u>

1. **Prevents loss of life and damage to or destruction of equipment**
2. **Proper load securement is important even when hauling equipment for a short distance and even if the equipment has been hauled over the same section of road many times before**
3. **Ensures compliance with Federal law**

Lesson Two: Components of a Securement System





A. <u>Common Hardware of a Securement System</u>

1. Items which compose the securement system used to secure the load to the trailer

a. Chains

b. Repair links

c. Lever binders

d. Ratchet binders

e. Anchor point (if so equipped)

B. <u>Chain Identification</u>

1. Welded chains come in different grades, stamped with the grade on the links

a. Grade 30 (proof coil chain)

Figure 2-1 Grade 30 Chain

b. Grade 43 (high test chain)

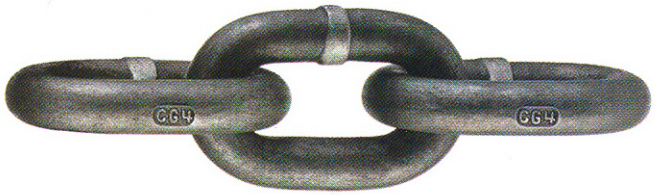


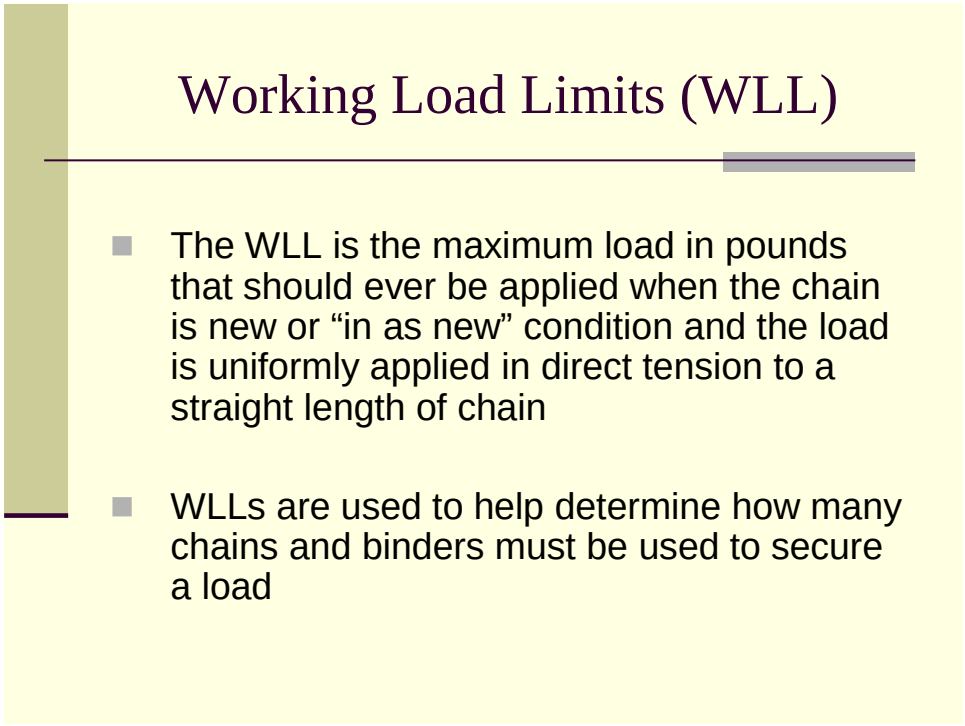
Figure 2-2 Grade 43 Chain

c. Grade 70 (transport chain)

Figure 2-3 Grade 70 Chain

d. Grade 80 (alloy chain – only chain approved for overhead lifting)

Figure 2-4 Grade 80 Chain



e. Working Load Limit (WWL)

i. The WLL is the maximum load in pounds which should ever be applied to the chain when the chain is new or "in as new" condition and the load is uniformly applied in direct tension to a straight length of chain

ii. WLLs are used to help determine how many chains and binders must be used to secure a load

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

iv. The WLLs of tie-downs may be determined by using either the tie-down manufacturer's markings or by using the tables in this lesson. The WLLs listed in the tables are to be used when the tie-down material is not marked by the manufacturer with the WLL. Tie-down materials which are marked by the manufacturer with WLLs different from the tables, shall be considered to have a WLL equal to the value for which they are marked.

v. The WLL of any securement system used to secure an article or group of articles against movement must be at

least one half times the weight of the article or group of articles

vi. The grade and size of chain, the grade of the binder and the grade of any replacement links must be known to determine the WLL

vii. Welded steel chain which is not marked or labeled to enable identification of its grade and WLL shall be considered to have a WLL equal to that of grade 30 proof coil chain

2. Chain ratings

Engineering Specifications

Proof Coil — Grade 30 Chain						
Trade Size (in.)	**Size Material (in.)**	**WLL (lbs)**	**Maximum Inside Length (in.)**	**Minimum Inside Width (in.)**	**Maximum Length 100 links (in.)**	**Weight Per 100 Ft (lbs.)**
3/16	.217	800	.98	.30	98	39
1/4	.276	1300	1.24	.38	124	65
5/16	.315	1900	1.29	.44	129	100
3/8	.394	2650	1.38	.55	138	144
1/2	.512	4500	1.79	.72	179	250
5/8	.630	6900	2.20	.79	220	421
3/4	.787	10600	2.75	.98	275	649

Table 2-1

High Test — Grade 43 Chain						
Trade Size (in.)	**Size Material (in.)**	**WLL (lbs.)**	**Maximum Inside Length (in.)**	**Minimum Inside Width (in.)**	**Maximum Length 100 links (in.)**	**Weight Per 100 Ft (lbs.)**
1/4	.276	2600	1.24	.38	124	70
5/16	.315	3900	1.29	.44	129	106
3/8	.394	5400	1.38	.55	138	154
7/16	.468	7200	1.40	.65	129	205
1/2	.512	9200	1.79	.72	179	267
5/8	.630	13000	2.20	.79	220	402
3/4	.787	20200	2.76	.98	276	567

Table 2-2

Transport — Grade 70 Chain						
Trade Size (in.)	**Size Material (in.)**	**WLL (lbs.)**	**Maximum Inside Length (in.)**	**Minimum Inside Width (in.)**	**Maximum Length 100 links (in.)**	**Weight Per 100 Ft (lbs.)**
1/4	.276	3150	1.24	.38	124	81
5/16	.343	4700	1.32	.48	132	98
3/8	.394	6600	1.38	.55	138	141
7/16	.468	8750	1.64	.65	164	216
1/2	.512	11300	1.79	.72	179	246

Table 2-3

Alloy — Grade 80 Chain						
Trade Size (in.)	**Size Material (in.)**	**WLL (lbs.)**	**Maximum Inside Length (in.)**	**Minimum Inside Width (in.)**	**Maximum Length 100 links (in.)**	**Weight Per 100 Ft (lbs.)**
9/32 (1/4)	.276	3500	.90	.34	90	72
5/16	.343	4500	1.00	.48	100	108
3/8	.394	7100	1.25	.49	125	148
1/2	.512	12000	1.64	.64	164	243
5/8	.630	18100	2.02	.79	202	351
3/4	.787	28300	2.52	.98	252	584
7/8	.866	34200	2.77	1.08	277	705

Table 2-4

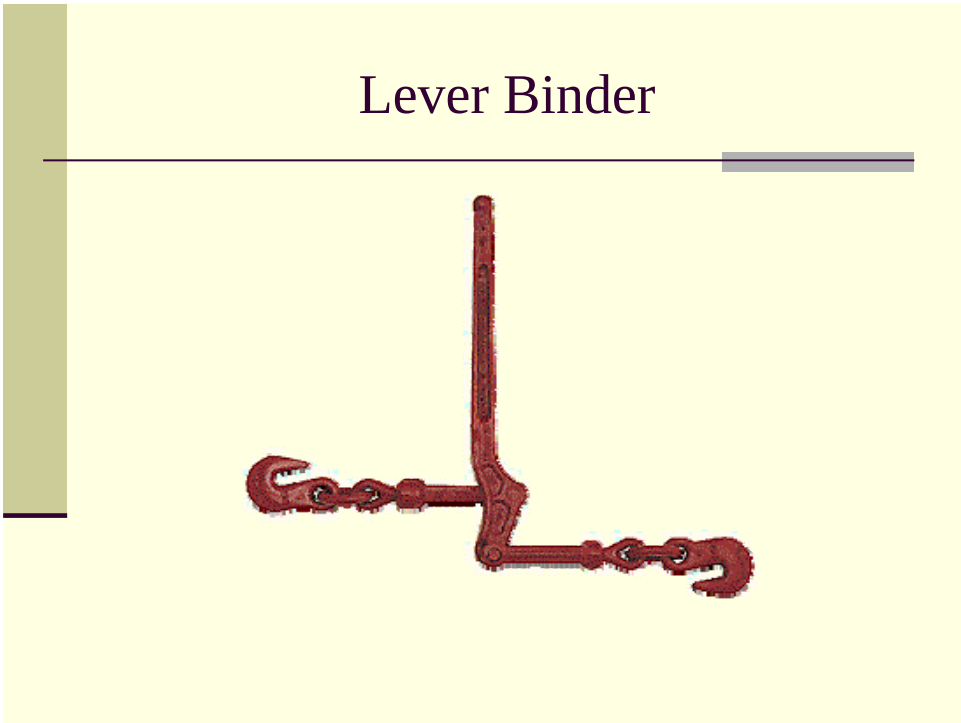
Repair Links

- **Used to complete a securement system or to repair a broken chain**
- **The Loc-A-Loy link is used at ODOT and has the same strength as a grade 80, 3/8 inch chain**

3. Repair links

a. Used to complete a securement system or to repair a broken chain

b. The Loc-A-Loy link is used at ODOT and has the same strength as a grade 80, 3/8 inch chain



4. Binders

a. Two types of binders are used at ODOT - lever and ratchet

i. Lever type

a) The lever type binder is designed to fold over itself when closing

b) The mechanical advantage of a lever type binder is 25:1. For every 100 pounds of force applied to the handle, 2500 pounds of force is applied to the chain.

c) Instructions for using a lever type binder

1) Hook the binder so one can operate it while standing on the ground. Position the load binder so its handle can be pulled downward to tighten the chain. Be aware of ice, snow, rain, oil, etc., which can affect one's footing; make certain one's footing is secure.

2) Whenever possible, hook the binder(s) to the right side (passenger's side) of the trailer. The mirrors on the right side of

the vehicle must also be readjusted so the operator may have a clear view of the binders and chains while transporting the load.

(a) Placement on the passenger side will enable the binder to fall into the ditch if it comes loose, instead of falling into a lane of traffic

(b) Securing to the right side of the trailer also permits the operator to stay out of the line of traffic if the binder must be readjusted at a stop during transit

3) The manufacturer specifically recommends against the use of a handle extender (cheater pipe). If sufficient leverage cannot be obtained using the lever type load binder by itself, a ratchet type binder should be used.

- Cheater pipe accidents are caused by using pipes which do not closely fit the handle and do not slide down the handle until the handle projections are contacted. Another cause of accidents with cheater pipes is the failure to secure the pipe in place with a pin so the pipe cannot fly off the handle if the operator loses control and releases the pipe. Additionally, the use of a cheater pipe can cause deformation and failure of the chain and load binder by exceeding the WLL of the securement system.

4) During and after tightening the chain, check the load binder handle position. Be sure the load binder handle is in the locked position and the bottom side touches the chain link.

5) Chain tension may decrease due to load shifting during transport. To be sure the load binder remains in position:

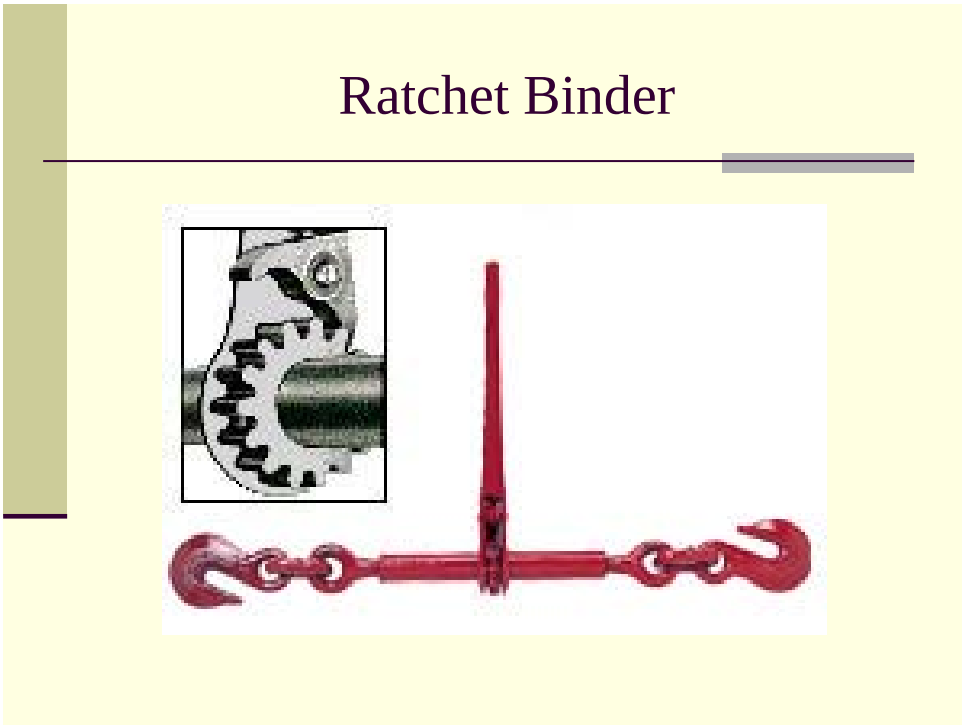
   (a) Secure the handle to the chain by wrapping the loose end of chain around the handle or

   (b) Tie the handle to the chain with a soft wire

6) When releasing the load binder, remember there is a great deal of stored energy in the stretched chain. This will cause the load binder to move very quickly with great force when it is unlatched. **Move the handle with caution, as it may whip; keep body clear.**

7) **Never use a cheater pipe or handle extender to release the handle.** Use a steel bar and pry under the handle and **stay out of the handle's path** as it moves upward.

8) If one releases the handle by hand, use an open hand under the handle and push upward. **Do not close one's hand around the handle. Always stay out of a moving handle's path.**



ii. Ratchet type

a) The ratchet type binder pulls from both sides with threaded ends

b) The mechanical advantage of a ratchet type binder is 50:1. That means for every 100 pounds of force applied to the handle, 5000 pounds of force is applied to the chain.

c) Instructions for a ratchet type binder

1) Hook the binder so one can operate it while standing on the ground**. Be aware of ice, snow, rain, oil, etc., which can affect footing. Make certain footing is secure.**

2) Screw out both ends of the ratchet type binder

3) Hook the chains to the hooks

4) Using the handle, crank (ratchet) the binder to tighten the chains

5) Loosen the chains by reversing the locking lever under the handle and crank (ratchet) the binder to loosen the chains

5. Anchor points

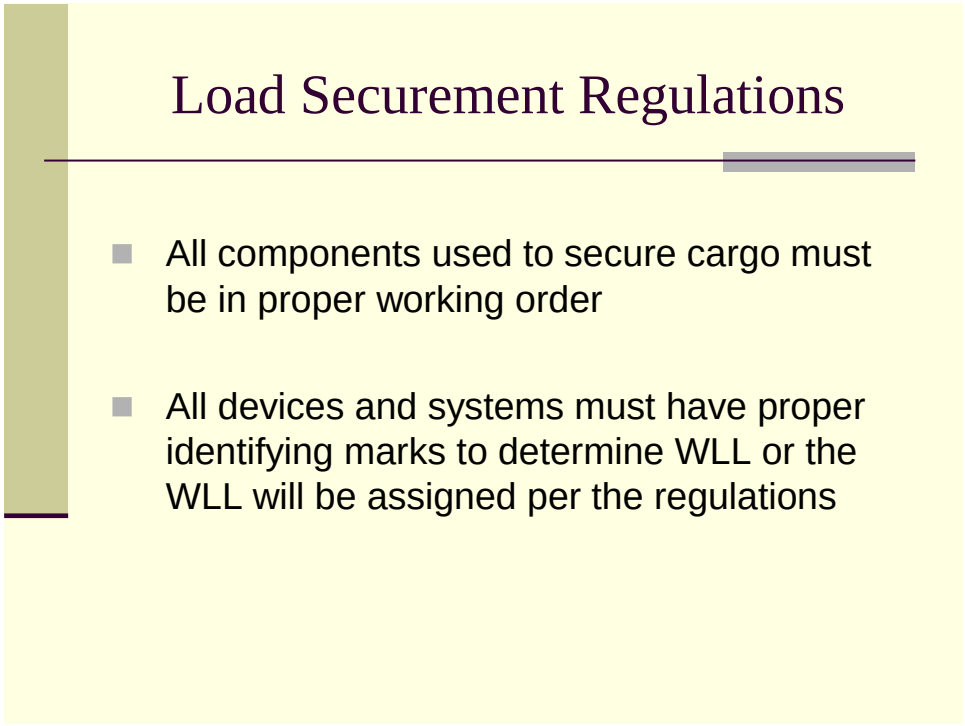
a. Manufacturer's specific securement system attachment point

b. Equipment may or may not contain anchor points

Lesson Three: Requirements for Securement Devices

A. Load Securement Regulations

A. The regulations require all devices and systems used to secure cargo to or within a vehicle be capable of meeting the following performance criteria



a. All vehicle structures, systems, parts and components used to secure cargo must be in proper working order when used to perform the function

   - Watch for damaged or weakened components which could adversely affect their performance

b. All devices and systems must have proper identifying marks to determine WLL or the WLL will be assigned per the regulations

Figure 3-1

B. How Well Must a Cargo Securement System Work?

1. Each cargo securement system must be able to withstand a minimum amount of force in each direction

a. Forward Force = 80% of cargo weight when braking while driving straight ahead

b. Rearward Force = 50% of cargo weight when accelerating, shifting gears while climbing a hill, or braking in reverse

c. Sideways Force = 50% of cargo weight when turning, changing lanes, or braking while turning

d. Upward Force = 20% of cargo weight when traveling over bumps in the road or cresting a hill

- This requirement is satisfied when the cargo is "Fully Contained"

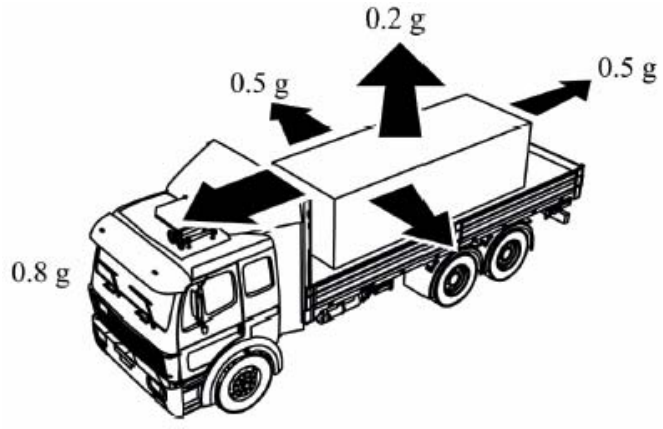


Figure 3-2 0.5 g is 50% of force of gravity or 50% of cargo weight

Proper Use of Tie-Downs

- Each tie-down to be attached securely
- All tie-downs must be located inboard of the rub rails whenever practicable
- Edge protection must be used whenever a tie-down touches an article of cargo

C. <u>Proper Use of Tie-downs</u>

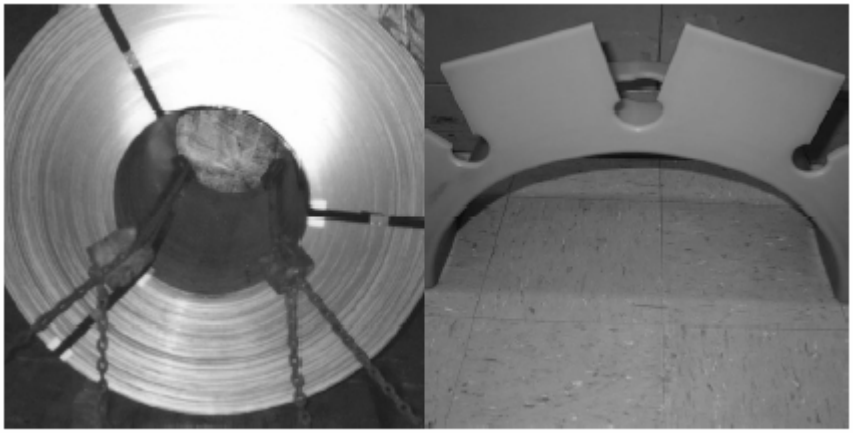
1. **The regulations require each tie-down to be attached and secured in a manner preventing it from becoming loose, unfastening, opening or releasing while the vehicle is in transit**

2. **All tie-downs and other components of a cargo securement system used to secure loads on a trailer equipped with rub rails must be located inboard of the rub rails whenever practicable**

Figure 3-3 Rub rails

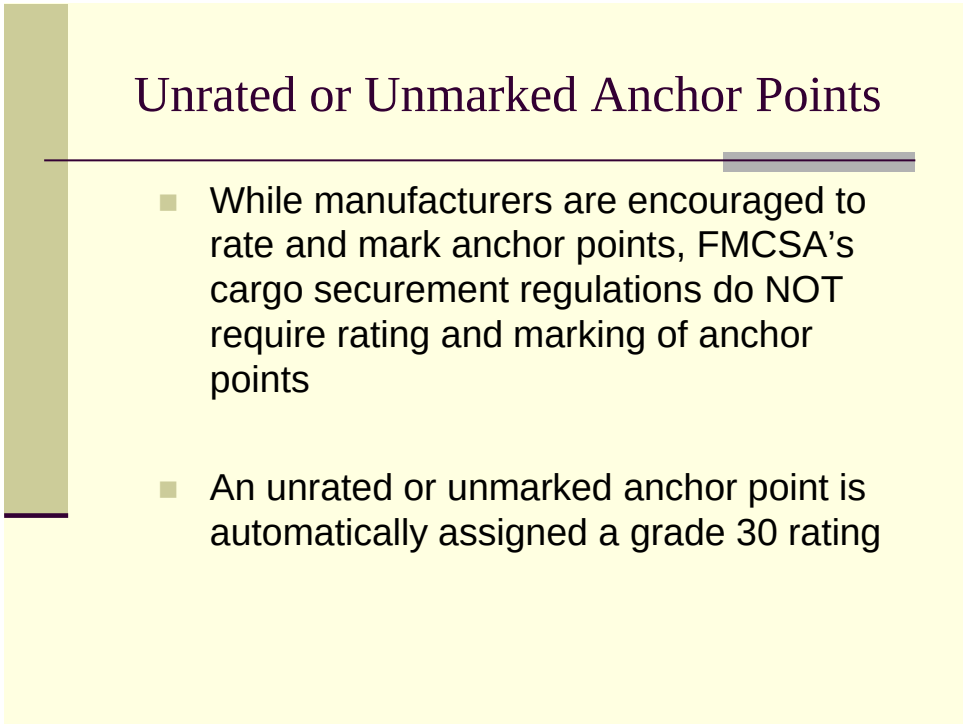
3. **Edge protection must be used whenever a tie-down would be subject to abrasion or cutting at the point where it touches an article of cargo**

    - The edge protection must resist abrasion, cutting or crushing



Use of edge protection *Edge protector*

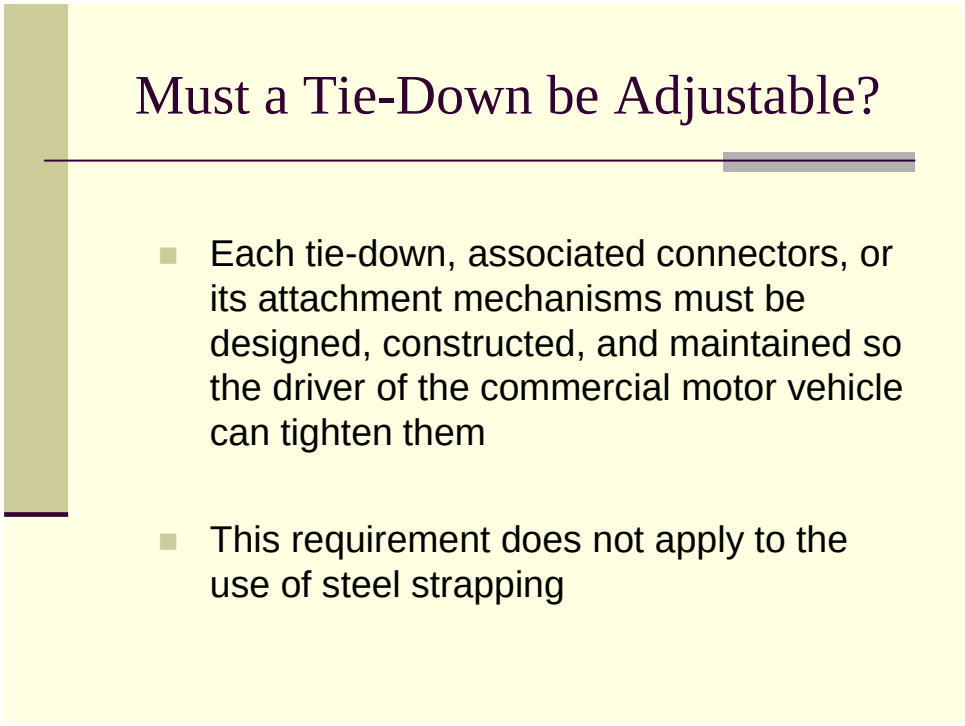
Figure 3-4 Edge protectors



D. <u>Unrated and Unmarked Anchor Points</u>

1. **While manufacturers are encouraged to rate and mark anchor points, FMCSA's cargo securement regulations do NOT require rating and marking of anchor points**

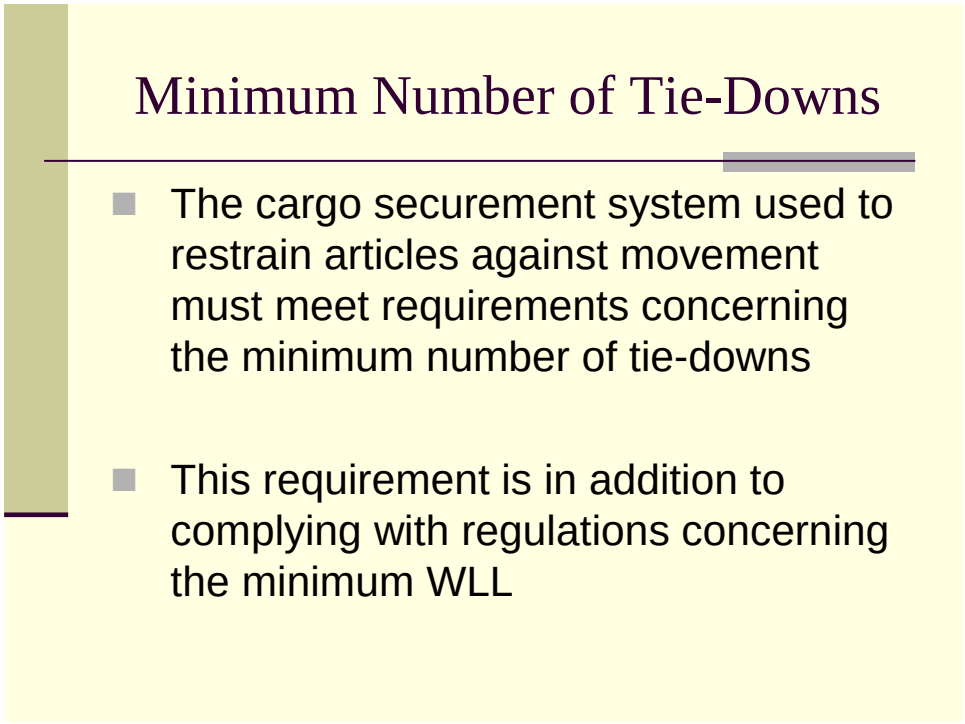
2. **An unrated or unmarked anchor point is automatically assigned a grade 30 rating**



E. <u>Must a Tie-down be Adjustable?</u>

1. **Each tie-down, associated connectors, or its attachment mechanisms must be designed, constructed, and maintained so the driver of the commercial motor vehicle can tighten them**

2. **This requirement does not apply to the use of steel strapping**



F. <u>Minimum Number of Tie-downs</u>

1. **The cargo securement system used to restrain articles against movement must meet requirements concerning the minimum number of tie-downs. This requirement is in addition to complying with regulations concerning the minimum WLL.**

    a. When an article of cargo is not blocked or positioned to prevent movement in the forward direction, the number of tie-downs needed depends on the length and weight of the articles. There must be

        i. One tie-down

            - For articles 5 ft. or less in length, and 1,100 lbs. or less in weight

        ii. Two tie-downs

            a) If the article is 5 ft. or less in length and more than 1,100 lbs. in weight

            b) Greater than 5 ft. but less than 10 ft., regardless of weight

            c) Items beyond 10 ft. in length require additional tie-downs as noted below

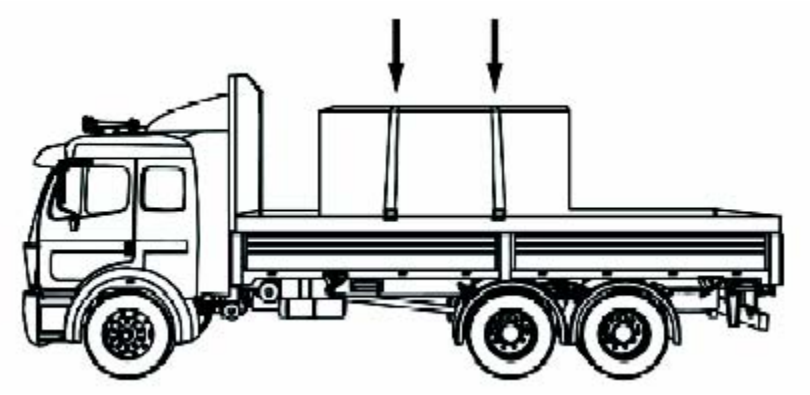


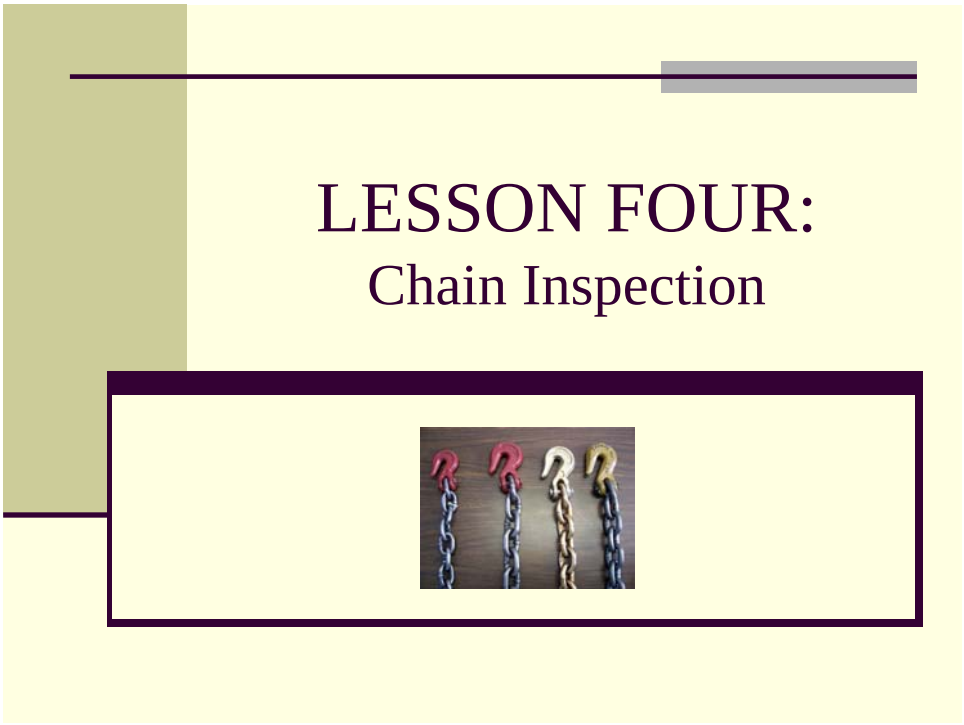
Figure 3-5

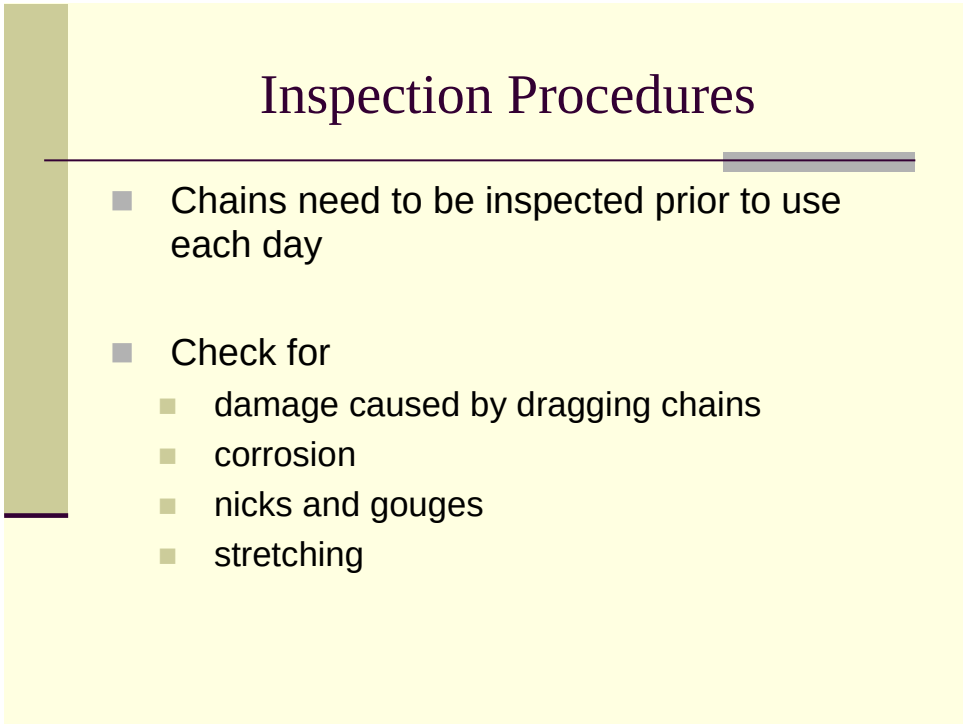
iii. Additional tie-downs

- One additional tie-down for every 10 ft. of article length, or fraction thereof, beyond the first 10 ft. of length

b. If an individual article is required to be blocked, braced or immobilized by a header board, bulkhead, other articles which are adequately secured or by an appropriate blocking or immobilization method to prevent movement in the forward direction, it must be secured by at least one tie-down for every 10 ft. of article length, or fraction thereof

Lesson Four: Chain Inspection





A. <u>Inspection Procedures</u>

1. **Chains must be inspected prior to use each day**

2. **Wear can occur in any portion of a link subject to rubbing or contact with another surface. Looking at a strand of chain will reveal that its natural shape confines wear (for practical considerations) to two areas.**

    a. At the bearing points of the interlink (curved ends)

    b. On the outside of the straight side barrels

3. **Look for damage caused by chains dragging along hard surfaces or out from under loads**

4. **Corrosion**

    a. Can damage a chain and make its markings difficult to view

    b. According to Federal standards, any chain with an undeterminable WLL will automatically be designated as grade 30

5. Nicks and gouges

a. Most often occur on the outside of the straight barrels rather than on the ends of the link

b. Outsides of the barrels are exposed to contact with foreign objects and therefore receive damage from other objects

c. The chain must be taken out of service and repaired if it contains a gouge

6. Stretching

a. Determination can be made on whether a chain has been stretched by looking at the barrels

b. The barrels will be oblong in shape and may even be bowed in

c. A stretched chain has lost its strength and must be taken out of service or repaired

Repair Links

- **Used to complete a securement system or to repair a broken chain**
- **The Loc-A-Loy link is used at ODOT and has the same strength as a grade 80, 3/8 inch chain**

7. Repair links

a. There are several repair links on the market, but the only repair link used at ODOT is the Loc-A-Loy

Figure 4-1 Loc-A-Loy repair link

b. The Loc-A-Loy has the same strength as a grade 80, 3/8 inch chain

Lesson Five: Trailer Hook-Up

Hooking up the Trailer

- Select the correct trailer for the job
- Most of the time a pintle hitch trailer will be used

A. <u>Hooking up the Trailer</u>

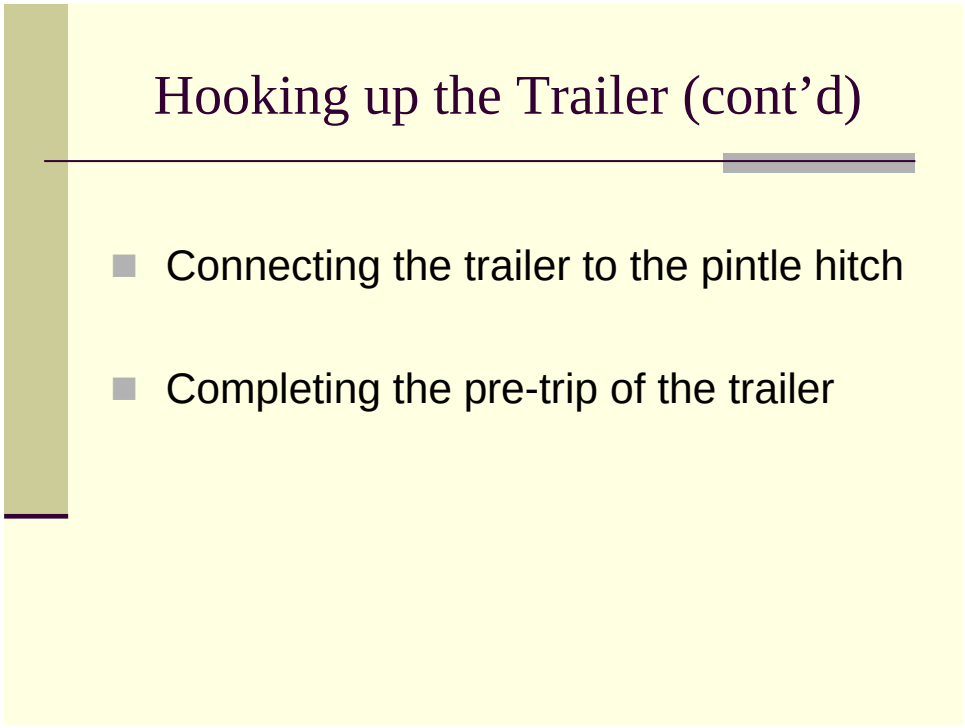
1. **Select the correct trailer for the job by knowing the weight of the item being hauled. Select a trailer weight rated for the job.**

The trailer's weight rating can be found on the tongue of the trailer

a. The vertical load limit on ODOT's pintle hitches is 6,000 pounds

b. The draw bar load limit is 50,000 pounds

2. **Most of the time a pintle hitch trailer will be used**



3. Connecting the trailer to the pintle hitch

a. Crank the trailer jack up to elevate the trailer's tongue to proper height for connection to the vehicle

b. Ensure the pintle hitch on the vehicle is open prior to backing the vehicle up to the trailer

c. Back the vehicle up to the trailer, aligning the trailer tongue with the pintle hitch

d. Crank the trailer jack back down to couple the trailer tongue with the pintle hitch

e. Close the pintle hitch

f. Lock the latch in position

g. Fully insert the cotter pin

h. Connect the trailer safety chains

i. Safety chains are an integral part of the coupling system

ii. The safety chain system keeps the towing and towed vehicle together and controls the towed vehicle's

direction of travel in the event of a coupling device failure

iii. The safety chain must be

a) Short enough to keep the drawbar from contacting the ground and

b) Crossed beneath the tongue of the towed vehicle

iv. If the towed trailer accidentally becomes disconnected, the tongue would then be supported by the chains. This will prevent the tongue from digging into the ground, resulting in the sudden overload (and failure) of the safety chains.

v. For this reason, the safety chains should be no longer than necessary to provide enough slack for turning. Crossing the safety chains also provides directional control to the towed vehicle.

4. Completing the pre-trip of the trailer

a. Ensure the brake lines (air or electrical) are connected properly

b. Make sure the electrical connection is hooked up and all the lights and reflectors are working properly

c. Check the frame for bends or cracks

d. Check the tires, rims, lug nuts, valve stems, caps and hub oil seals

e. Ensure the trailer deck is clean of debris and there are no broken or missing boards. When loading is actually occurring is the wrong time to find out there is a loose board or a hole in the deck.

f. It is the operator's responsibility to check the deck after loading for debris which could come off during transport

Loading Procedures

- Loading and unloading the trailer is one of the most hazardous parts of load securement
- Equipment position
- Securing the equipment to the trailer

B. <u>Loading Procedures</u>

1. Loading and unloading the trailer is one of the most hazardous parts of load securement. Use the following guidelines:

a. Prior to loading, place chock blocks in front of the trailer tires and behind the truck tires. Place chocks on the passenger side.

b. Confirm the trailer deck is clean of debris and there are no broken or missing boards

c. Make sure the trailer is on firm, level ground

d. Whenever possible use a spotter to help load the equipment (see Figure 5-2)

Figure 5-2

i. Drive slowly onto the ramps. If one needs to adjust, back down off of the trailer and adjust on the ground (see Figure 5-3).

Figure 5-3

ii. Once on the trailer, check to ensure the equipment is positioned correctly (see Figure 5-4)

Figure 5-4

2. Equipment position

a. The equipment's position on the trailer is the key to proper loading

i. If the weight is too far forward, too much weight will be placed on the tongue. The excess weight makes the rear of the truck load heavy and can affect steering.

ii. If the weight is too far to the rear of the trailer, the trailer tongue raises the rear of the truck, decreases traction, and can cause the trailer to sway

iii. Assistance may be needed to load or reposition the equipment several times until it is properly positioned. Do not be afraid to ask for help.

3. Securing the equipment to the trailer

a. Lower and secure to the trailer all accessories – i.e., hydraulic shovels, booms, etc

b. Restrain articulated vehicles to prevent articulation while in transit

c. Set the parking brake on the equipment being transported

d. Restrain cargo with at least four tie-downs, each having the proper WLL

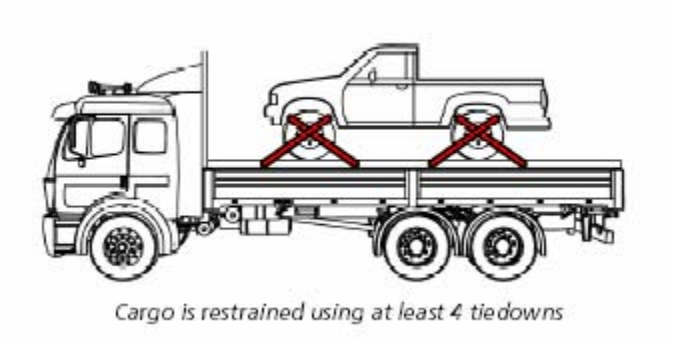
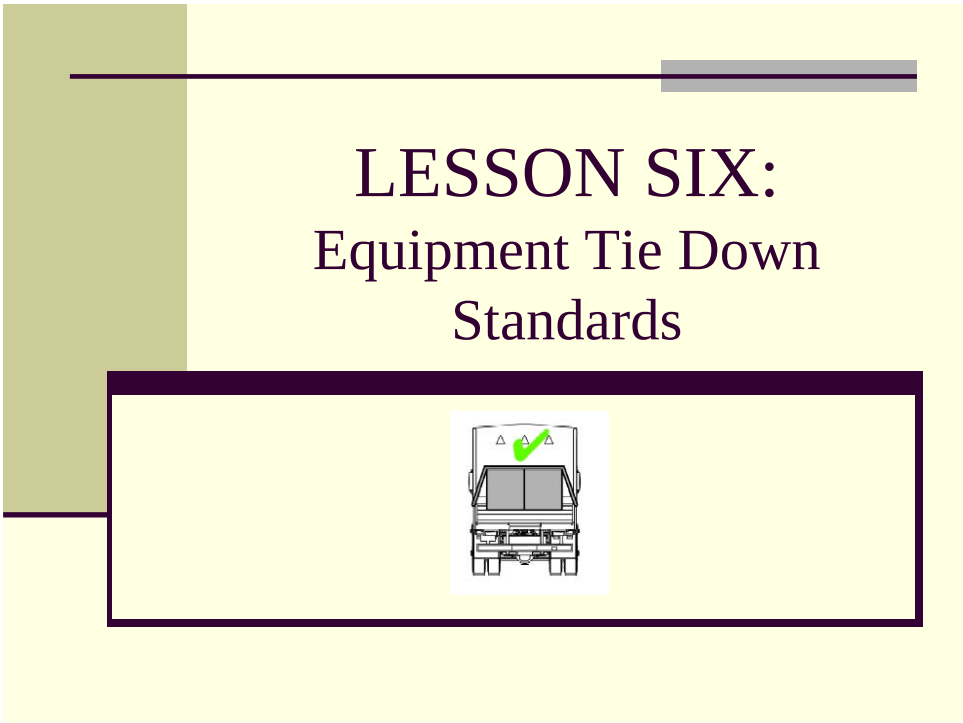


Figure 5-5

Lesson Six: Equipment Tie-down Standards



Installing Equipment Tie-Downs

- There are many different ways to tie down a piece of equipment. The operator hauling the equipment is responsible for ensuring it is tied down correctly.
- All aspects of the law for transporting equipment must be met
- The amount of chains is determined by different considerations

A. <u>Installing Equipment Tie-downs</u>

1. **There are many different ways to tie down a piece of equipment. The operator hauling the equipment is responsible for ensuring it is tied down correctly.**
2. **All aspects of the law for transporting equipment must be met**
3. **The amount of chains is determined by**
    a. The length of the load,
    b. The weight of the load,
    c. WLL determined by direct or indirect tie-downs and
    d. The Federal Motor Carrier Regulations

Installing Equipment Tie-Downs (cont'd)

- When possible, an X pattern should be used to tie down equipment. This will enable the chains to pull against each other and all chains to pull to the middle.

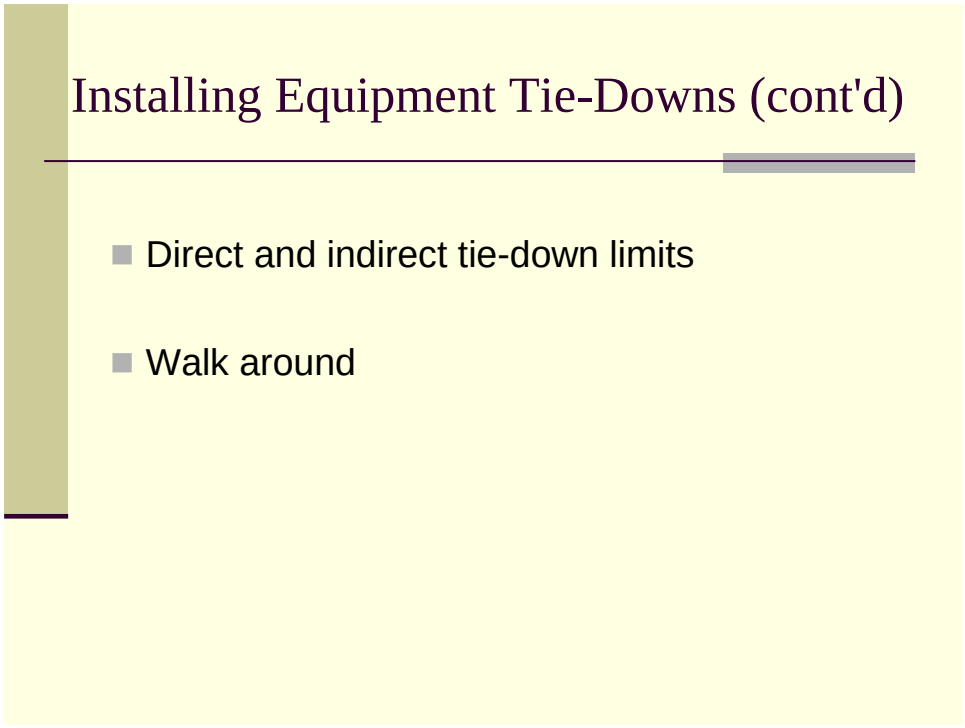
4. **When possible, an X pattern should be used to tie down equipment. This will enable the chains to pulling against each other and all chains to pull to the middle.**

Installing Equipment Tie-Downs (cont'd)

- Even when all the FMCSA requirements are met, if the operator feels more chains are needed, add them
- When finished securing the load, walk around the trailer and ask this question:
  - If I lose this chain or tie-down, what happens to the load? If the answer is the load can move, not enough tie-downs have been used or they are not in the correct positions.

5. **Even when all the FMCSA requirements are met, if the operator feels more chains are needed, add them**

6. **When finished securing the load, walk around the trailer and ask this question: If I lose this chain or tie-down, what happens to the load? If the answer is the load can move, not enough tie-downs have been used or they are not in the correct positions.**



7. Direct and indirect weight limits

a. The aggregate WLL of any securement system used to secure an article or group of articles against movement must be at least one-half the weight of the article or group of articles. The aggregate WLL is the sum of:

i. Direct tie-downs

- *One-half the WLL* of each tie-down going from an anchor point on the vehicle to an attachment point on an article of cargo

ii. Indirect tie-downs

- *The WLL* for each tie-down going from an anchor point on the vehicle through, over or around the cargo and then attaching to another anchor point on the vehicle

b. Heavy vehicles, equipment and machinery which operate on wheels or tracks such as front end loaders, bulldozers, tractors and power shovels and which individually weigh 10,000 lbs. or more and 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 with the proper WLL

c. Each of the tie-downs must be affixed as close as practicable to the front and rear of the vehicle, or to mounting points on the vehicle specifically designed for such purpose

8. Walk around

a. Once the load is secure, walk completely around the trailer and check the load. Look for the following:

i. Dirt, debris, rocks, loose chain ends or other items which could come off during the trip

ii. If the equipment has a Slow Moving Vehicle (SMV) sign and the sign is facing traffic, it must be removed or covered

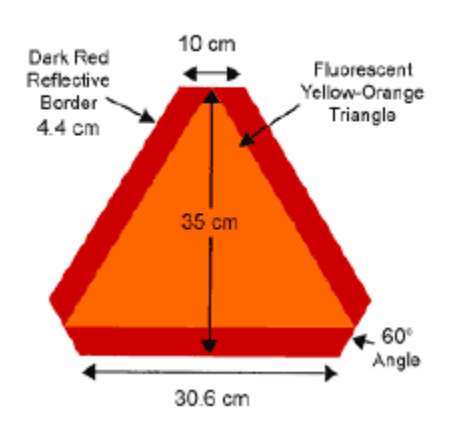


Figure 6-1 Slow moving vehicle sign

iii. If the equipment has a turbo, the exhaust needs to be taped to prevent air from entering

iv. Remove the chock blocks from the truck and trailer

B. Questions Concerning Securement of Heavy Equipment from the FMCSA Website FAQ List

1. **If an item of construction equipment which weighs less than 10,000 lbs. is transported on a flatbed or drop-deck trailer, must the accessory equipment be lowered to the deck of the trailer?**

    - No. However, the accessory equipment must be properly secured using locking pins or similar devices in order to prevent either the accessory equipment or the item of construction equipment itself from shifting during transport.

2. **How should I secure the accessories for an item of construction equipment which weighs 10,000 lbs. or more, if the accessory devices would extend beyond the width of the trailer if they are lowered to the deck for transport?**

    - The accessory devices (plows, trencher bars, and the like) may be transported in a raised position provided they are designed to be transported in that manner. However, the accessory equipment must be locked in place for transport to ensure neither the accessories nor the equipment itself shifts during transport.

3. **A tractor loader-backhoe weighing over 10,000 lbs. is being transported on a trailer. The loader and backhoe accessories are each equipped with locking devices or mechanisms to prevent them from moving up and down and from side-to-side while the construction equipment is being transported on the trailer. Must these accessories also be secured to the trailer with chains?**

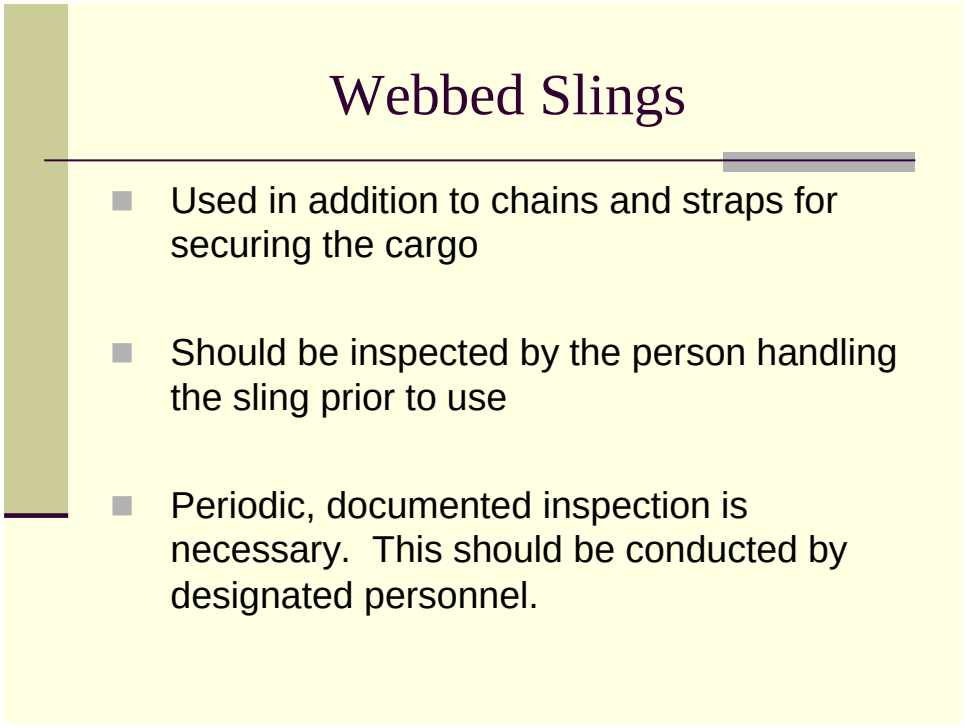
    - No. However, if the construction equipment does not have a means of preventing the loader bucket, backhoe, or similar accessories from moving while it is being transported on the trailer, then a chain would be required to secure those accessories to the trailer.

C. Inspection Requirements for Drivers

Driver action required	Pre-Trip	Within first 80 km (50 mi)	When duty status of driver changes	At 3 hour intervals or every 240 km (150 mi), whichever is first
Inspect Cargo and Securing devices	✔	✔	✔	✔
Inform Carrier if Packaging is Not Adequate	✔			
Adjust Cargo and/or Securing devices	As necessary	As necessary	As necessary	As necessary
Add Additional Securing devices	As necessary	As necessary	As necessary	As necessary

Table 6-1

Lesson Seven: Webbed Slings & Crosby Clips



A. <u>Webbed slings</u>

1. **Used in addition to chains and straps for securing the cargo**
2. **Should be inspected by the person handling the sling prior to use**
3. **Periodic, documented inspection is necessary. This should be conducted by designated personnel. Frequency of the inspection shall be based on the following:**
    a. Frequency of sling use
    b. Severity of service conditions
    c. Experience gained on the service life of a sling used in similar applications
    d. Or at least annually
4. **Remove a sling from service if it has any of the following conditions:**
    a. Acid or caustic burns
    b. Melting or charring of any part of the sling
    c. Broken parts, tears, cuts or snags

d. Broken or worn stitching in load bearing slings

e. Excessive abrasive wear

f. Knots in any part of the sling

g. Excessive pitting or corrosion, or cracked, distorted, or broken fittings

Crosby Clips

- Designed to connect wires used in load securement
- Considerations when using a Crosby Clip
- Wire rope splicing procedures

B. Crosby Clips

1. Crosby Clips are designed to connect wires used in load securement

a. ODOT very infrequently uses wire to secure cargo

b. If one encounters a situation where wire must be used to secure cargo, the same principles concerning WLLs discussed above apply to the use of wires

c. If the wire is unmarked, the following specifications should be applied when determining the WLLs

WIRE ROPE (6 x 37, Fiber Core)	
Diameter	WLL
7 mm (1/4 in)	640 kg (1400 lb.)
8 mm (5/16 in)	950 kg (2100 lb.)
10 mm (3/8 in)	1360 kg (3000 lb.)
11 mm (7/16 in)	1860 kg (4100 lb.)
13 mm (1/2 in)	2400 kg (5300 lb.)
16 mm (5/8 in)	3770 kg (8300 lb.)
20 mm (3/4 in)	4940 kg (10900 lb.)
22 mm (7/8 in)	7300 kg (16100 lb.)
25 mm (1 in)	9480 kg (20900 lb.)

Table 7-1. Unmarked wire rope WLLs

2. Considerations when using a Crosby Clip

a. Match the same size clip to the same size wire rope

b. Prepare wire rope end termination only as instructed by the manufacturer

c. Do not use Crosby Clips with plastic coated wire rope

d. Apply first load to test the assembly. This load should be of equal or greater weight than loads expected in use. Next, check and retighten nuts to recommended torque (see Table 7-2).

- Efficiency ratings for wire rope and terminations are based upon the catalog breaking strength of the wire rope

e. The number of clips needed is also listed in the table below depending on rope size (see Table 7-2)

f. To attach the wires:

i. Turn back the specified amount of rope from thimble or loop

ii. Apply the first clip one base width from dead end rope

iii. Apply U-bolt over dead end of wire rope – live end rests in saddle

iv. Tighten nuts evenly, alternating from one nut to the other until reaching the recommended torque

v. When two clips are required, apply the second clip as near the loop or thimble as possible

vi. Tighten nuts evenly, alternating until reaching the recommended torque

vii. When more than two clips are required, apply the second clip as near the loop or thimble as possible

viii. Turn nuts on second clip firmly, but do not tighten

ix. When three or more clips are required, space additional clips equally between the first two, take up rope slack and tighten nuts on each U-bolt evenly, alternating from

one nut to the other nut until reaching the recommended torque

Clip Size (in.)	Rope Size (in.)	Minimum No. of Clips	Amount of rope Turn Back in inches	Torque in Ft. Lbs.
1/8	1/8	2	3-1/4	4.5
3/16	3/16	2	3-3/4	7.5
1/4	1/4	2	4-3/4	15
5/16	5/16	2	5-1/4	30
3/8	3/8	2	6-1/2	45
7/16	7/16	2	7	65
1/2	1/2	3	11-1/2	65
9/16	9/16	3	12	95
5/8	5/8	3	12	95
3/4	3/4	4	18	130
7/8	7/8	4	19	225
1	1	5	26	225
1-1/8	1-1/8	6	34	225
1-1/4	1-1/4	7	44	360
1-1/38	1-1/38	7	44	360
1-1/2	1-1/2	8	54	360
1-5/8	1-5/8	8	58	430
1-3/4	1-3/4	8	61	590
2	2	8	71	750
2-1/4	2-1/4	8	73	750
2-1/2	2-1/2	9	84	750
2-3/4	2-3/4	10	100	750
3	3	10	106	1200
3-1/2	3-1/2	12	149	1200
If a pulley (sheave) is used for turning back the wire rope, add one additional clip.				
If a greater number of clips are used than shown in the table, the amount of turn back should be increased proportionately.				
The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.				

Table 7-2

3. Wire rope splicing procedures

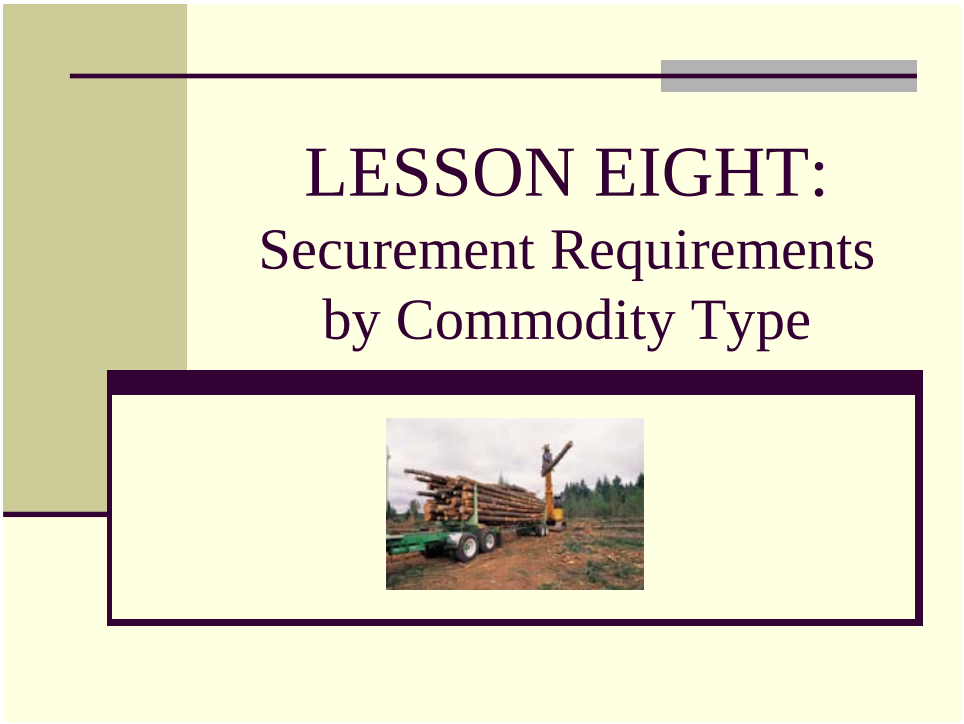
a. The preferred method of splicing two wire ropes together is to use inter-locking turn back eyes, using the recommended number of clips on each eye

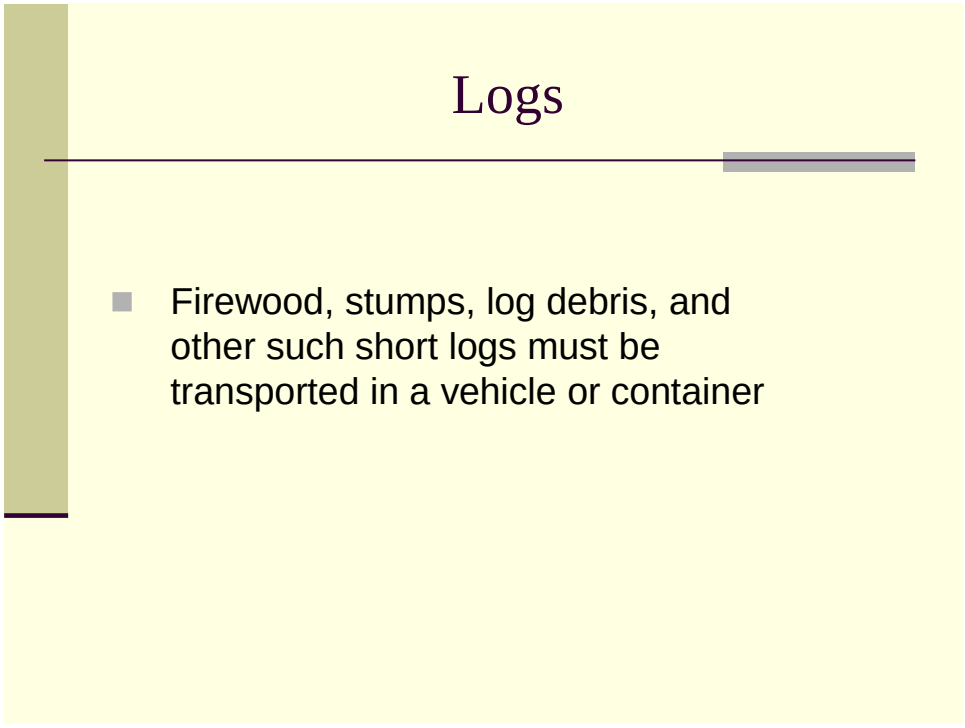
b. An alternate method is to use twice the number of clips as used for a turn back termination

i. The rope ends are placed parallel to each other, overlapping by twice the turn back amount shown in the application instructions

ii. The minimum number of clips should be installed on each dead end. Spacing installation torque and other instructions still apply.

Lesson Eight: Securement Requirements by Commodity Type





A. <u>Logs</u>

1. **Firewood, stumps, log debris, and other such short logs must be transported in a vehicle or container**
    a. Enclosed on
        i. Both sides
        ii. Front
        iii. Rear
    b. Of adequate strength to contain them
2. **Logs must be transported on a vehicle designed and built, or adapted, for the transportation of logs**
    - Any such vehicle must be fitted with bunks, bolsters, or stakes which cradle the logs and prevent them from rolling
3. **All vehicle components involving log securement must be designed and built to withstand all anticipated operational forces without**
    a. Failure
    b. Accidental release

c. Permanent deformation

4. **Tie-downs must be used in combination with the stabilization provided by bunks, stakes and bolsters to secure the load**

    a. All tie-downs must have a working load limit not less than 4,000 lbs.

    b. Tension tie-downs as tightly as possible but not beyond their working load limit

5. **Logs must be solidly packed, and the outer bottom logs must be in contact with and resting solidly against**

    a. The bunks

    b. Bolsters

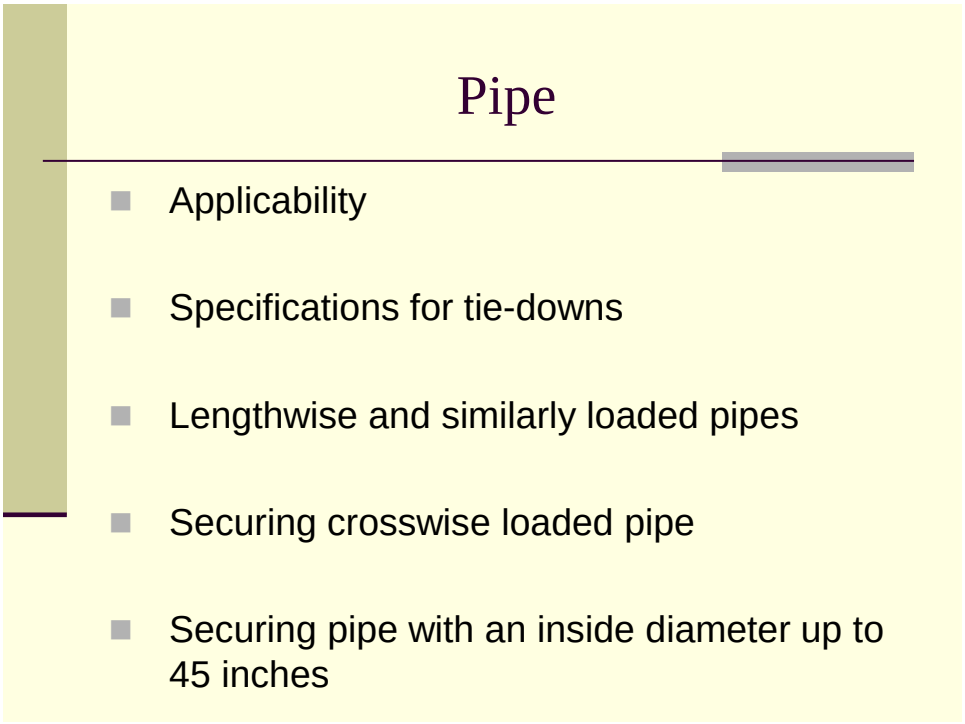
    c. Stakes

    d. Standards

6. **Each outside log must touch at least two stakes, bunks, bolsters or standards**

7. **The center of the highest outside log on each side or end must be below the top of each stake, bunk or standard**

8. **Each log not held in place by contact with other logs or the stakes, bunks, or standards must be held in place by a tie-down**



B. Pipe

1. Applicability

- The information discussed below applies to the transportation of pipe on flatbed trailers, vehicles and lowboy trailers loaded crosswise and or lengthwise

2. Specifications for tie-downs

a. The aggregate WLL of all tie-downs on any group of pipes must not be less than half the total weight of all the pipes in the group

b. A transverse tie-down through a pipe on an upper tier or over longitudinal tie-downs is considered to secure all those pipes beneath on which the tie-down causes pressure

3. Lengthwise and similarly loaded pipes

a. Follow general cargo securement requirements when transporting the following pipe:

i. Pipe grouped together into a single rigid article and which cannot roll

ii. Pipe loaded in a sided vehicle or container

iii. Pipe eyes vertical and pipe loaded lengthwise

b. Blocking lengthwise loaded pipes

i. Blocking must prevent the pipe from rolling or rotating

ii. Blocking may be one or more pieces placed at equal distances from the center of a pipe

iii. There are two blocking options:

a) Place one piece of blocking so it extends at least half the distance from the center to each end of the pipe (see Figure 8-6)

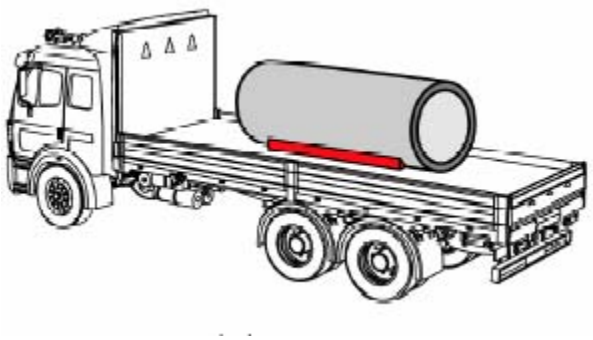


Figure 8-6

b) Place two pieces of blocking at the outside quarter points (see Figure 8-7)

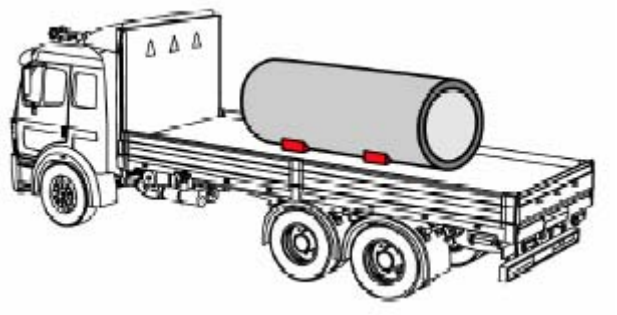


Figure 8-7

c. Blocking must be:

i. Placed against the pipe

ii. Secured to prevent it from moving out from under the pipe

d. Timber blocking must have a minimum nominal dimension of 10 x 15 cm (4 x 6 in.)

4. Securing crosswise pipe

a. To make sure pipe does not roll or slide:

i. Load pipe as compactly as possible

ii. Immobilize symmetrically stacked pipes by securing them in groups

iii. Use blocking systems and tie-downs to increase the effect of friction

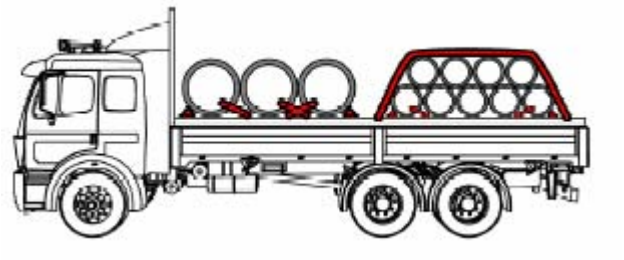


Figure 8-8

b. Requirements for arranging pipe with different diameter

i. Load pipe of more than one diameter in groups consisting of pipe of only one size

ii. Secure each group of pipe separately

Arranging pipe with different diameter

Figure 8-9

c. Requirements for arranging a bottom tier

i. There are two ways to arrange the bottom tier:

a) Cover the full length of the vehicle

Figure 8-10

b) Arrange as a partial tier in one or two groups

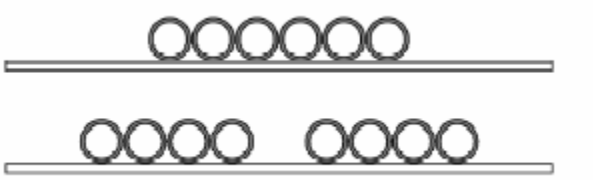


Figure 8-11

d. Requirements for arranging an upper tier

i. Place pipe only in the wells formed by pipes in the tier below

ii. Do not start an additional tier unless all wells in the tier beneath are filled

e. Requirements for arranging the top tier

- Arrange the top tier as a complete tier, a partial tier in one group, or a partial tier in two groups

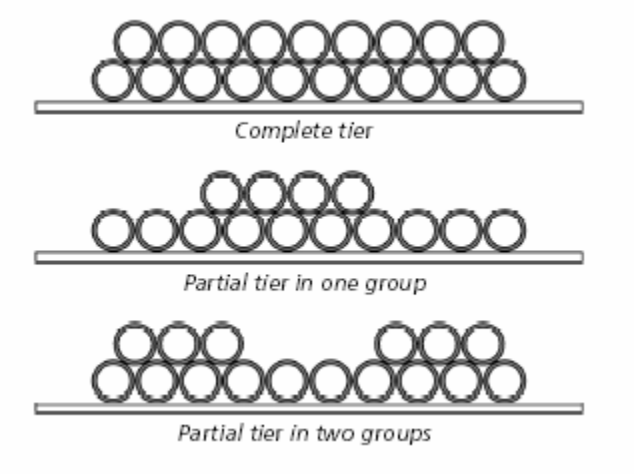


Figure 8-12

5. Securing pipe with an inside diameter up to 45 inches

a. Pipe with an inside diameter up to 45 inches can form a complete single tier on a typical flatbed vehicle. Larger pipe often can only be carried as a partial tier.

i. Arrange the load properly per figure 8-13 below

ii. Immobilize the front and rear pipe with one of the following elements:

a) Blocking

b) Wedges

c) Vehicle end structure

d) Stakes

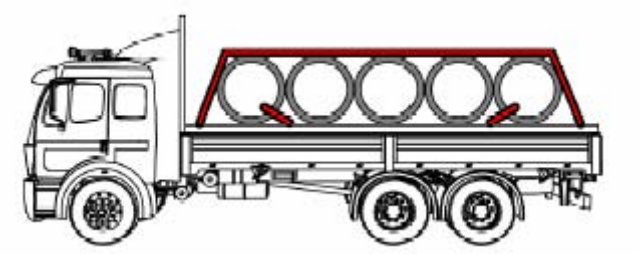


Figure 8-13

b. Tie-down requirements

   i. Pipe may be secured individually or as a group

   ii. Tie-downs through the pipe must be chains

   iii. Front-to-back tie-downs may be chain or wire rope

      a) Individually

         - Run a tie-down though the pipe

      b) As a group

         1) Place lengthwise tie-downs over the group of pipes

            (a) Either 1 ½ inch chain or wire rope

            (b) Or two 3/8 diameter chain or wire ropes

         2) Place one crosswise tie-down for every 10 ft. of load length

            (a) Either attach the side-to-side tie-down through a pipe

            (b) Or pass the tie-down over both front-to-back tie-downs between two pipes on the top tier

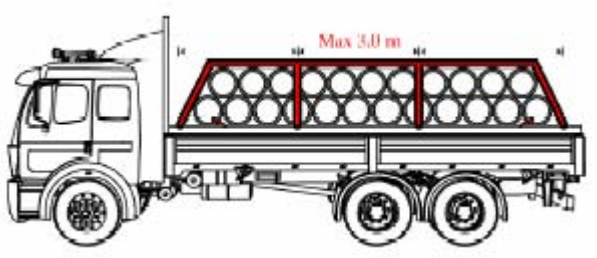


Figure 8-14

c. Requirements for stabilizing the top tier

   i. If the first pipe of a group in the top tier is not at the front of the tier beneath

      a) Attach an additional tie-down running rearwards at an angle not more than 45 inches to the horizontal when viewed from the side of the vehicle, whenever practical

      b) Pass the tie-down either through the front pipe of the upper tier or outside the front pipe and over both longitudinal tie-downs

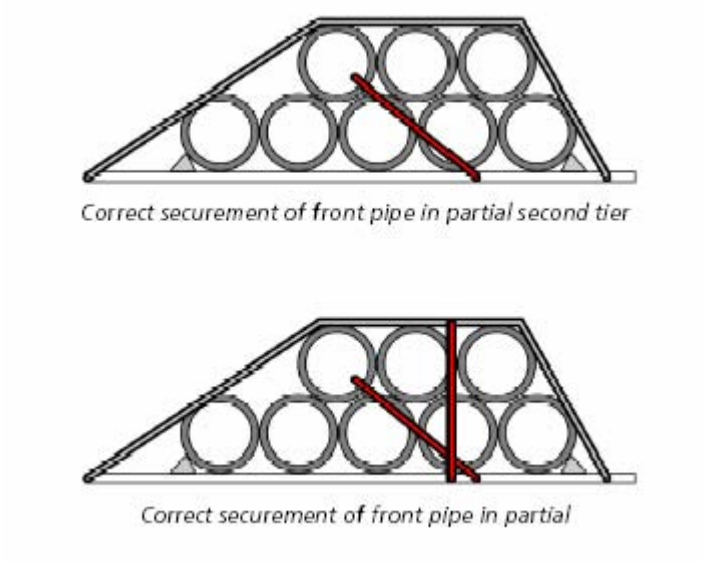


Figure 8-15

d. Requirements for securing the pipe

   i. Secure each pipe with tie-downs through the pipe

   ii. Run at least one tie-down through each pipe in the front half of the load. This includes the middle one if there

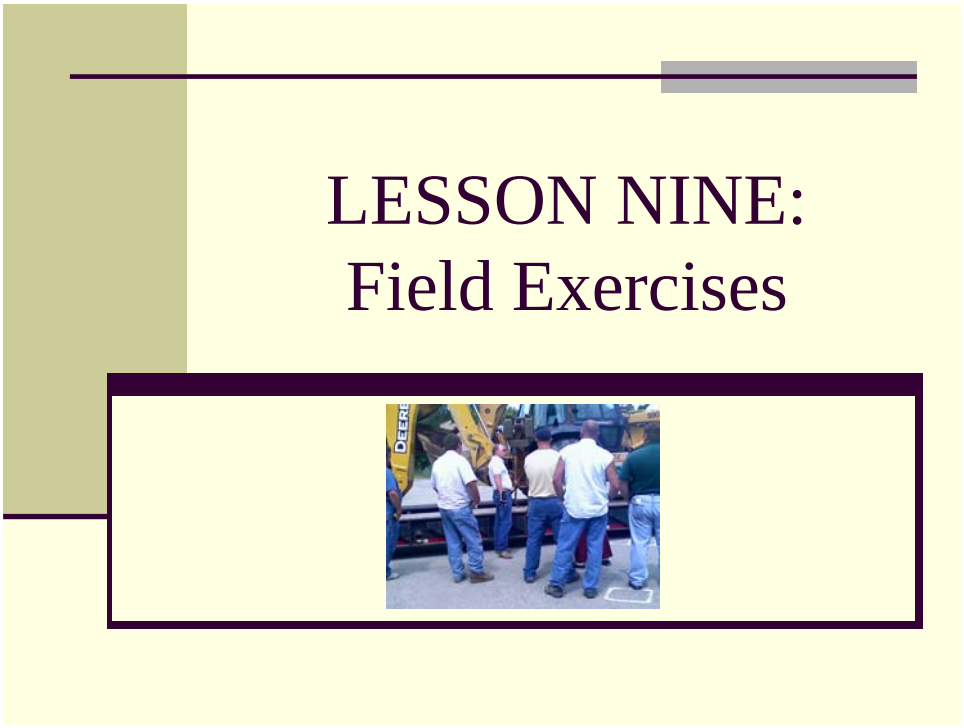
are an odd number. The tie-down must run rearward at an angle not more than 45° with the horizontal tie-down when viewed from the side of the vehicle, whenever practicable.

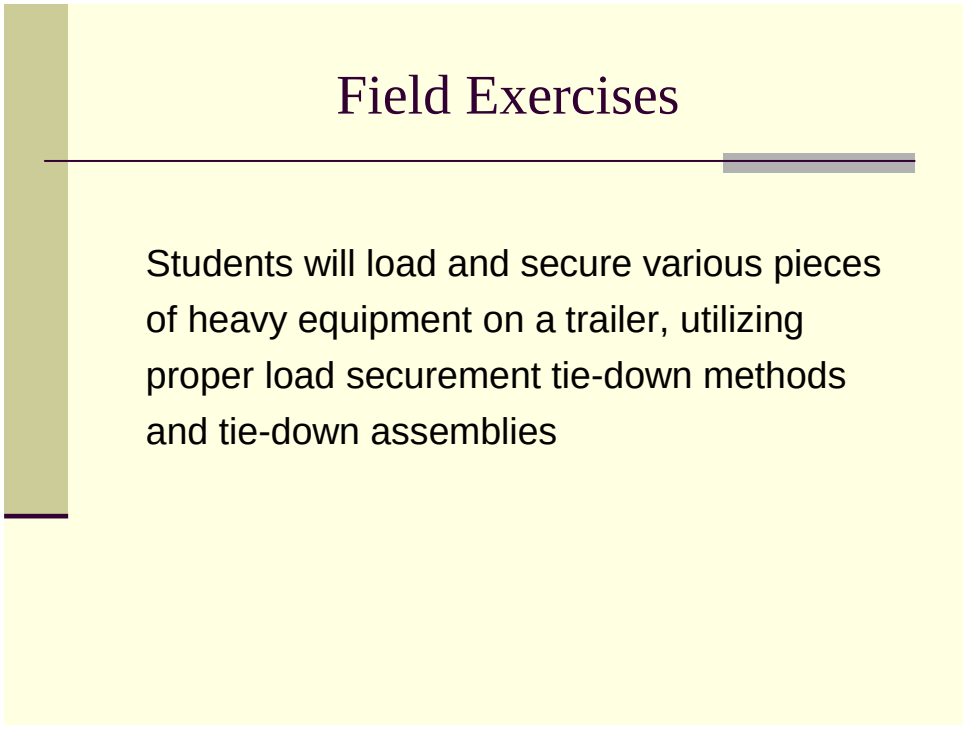
iii. Run at least one tie-down through each pipe in the rear half of the load. The tie-downs must run forward at an angle not more than 45° with the horizontal tie-downs when viewed from the side of the vehicle, whenever practicable. This holds each pipe firmly in contact with adjacent pipe.

iv. Run at least two tie-downs through the front and rear pipe if they are not also in contact with vehicle end structure, stakes, a locked pipe unloader, or other equivalent means

Figure 8-16

Lesson Nine: Field Exercises





A. <u>Field Exercises</u>

- **Students will load and secure various pieces of heavy equipment on a trailer, utilizing proper load securement tie-down methods and tie-down assemblies**