North American Cargo Securement Standard

Training Program Participants Guide

Edition 1 - December 2003

North American Cargo Securement Training

Introduction

Proper Securement Matters

North American Cargo Securement Training

Introduction-2

Proper Securement Matters

North American Cargo Securement Training

Introduction-3

Proper Securement Matters

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Introduction-4

Introductions

- Name
- Type of work you do
- Kinds of loads you haul
- Situations you have seen or been in and would like to know how to handle better
- Any other expectations

North American Cargo Securement Training Introduction-5

Purpose

- Carriers, drivers, shippers and enforcement personnel understand the requirements for safe cargo securement
- Carriers, drivers, and enforcement personnel will receive the same training

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What You Will Learn

- The requirements of the North American Cargo Securement Standard
- How the cargo securement principles apply to different commodities

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What You Will Learn (cont'd)

- What is required to properly load and secure different commodities including:
  - Placement
  - Types of cargo securement devices
    - Number
    - Placement
    - Capacity
- What securement systems are not in compliance with the Standard

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Basis For The Course

- Training is based on North American Cargo Securement Standard
- If you follow the Standard, you will be in compliance with provincial rules and Federal regulations
- Local regulations may be different
- Local jurisdictional requirements may be more or less stringent than the Standard

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Course Structure and Materials

- Training is modular
- First 2 modules are for everyone (carriers, drivers, shippers and enforcement)
- 11 other modules are based on participants' needs

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Available Modules

- The Standard and Basic Physics Principles*
- General Cargo Securement Requirements: Equipment and Methods *
- Logs
- Dressed Lumber and Similar Building Materials
- Metal Coils
- Paper Rolls
- Concrete Pipe Loaded Crosswise on a Platform Vehicle
- Intermodal Containers
- Automobiles, Light Trucks, and Vans
- Heavy Vehicles, Equipment, and Machinery
- Flattened or Crushed Vehicles
- Roll-on/Roll-off and Hook Lift Containers
- Large Boulders

* For everyone

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Course Materials

- Participant Manual
- Activity Sheets
- Driver's Handbook on Cargo Securement

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Why is it important that cargo is secured properly?

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Improperly Secured Loads

- Can result in:
  - Loss of life
  - Loss of load
  - Damage to freight
  - Damage to vehicles
  - Destabilizing the vehicle
  - A crash
  - Issuance of citations/fines to driver/carrier
  - Vehicle placed Out-of-Service

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Who benefits if the load is secured properly?

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North American Cargo Securement Standard

- Applies to vehicles with gross vehicle weight, gross vehicle weight rating, or gross combination weight rating in excess of 4,500 kg (10,000 lb.)
- Standard specifies how cargo carried by these vehicles must be secured
- Standard serves as basis of the training

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Application

- Section 1.1 (Application) describes what vehicles are covered by the Standard

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Requirement

Section 1.2. (Requirement) Cargo must be contained, immobilized, or secured so that it may not:

- Leak
- Spill
- Blow
- Fall from vehicle
- Fall through vehicle
- Otherwise become dislodged from vehicle
- Shift upon or within vehicle so that vehicle's stability or maneuverability is affected

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Performance Criteria

- Section 1.3 (Performance Criteria)
  - Addresses the cargo securement system and how strong it needs to be

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Part 2

- General Provisions and Requirements
  - Securement systems (anchor points, tiedowns, vehicle structures, dunnage, etc.)
  - Cargo placement
  - Inspections of cargo

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Part 3

- Specific Securement Requirements by Commodity Type
  - Covers 11 specific types of cargo
  - This course has modules on each of those types

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Part 4

- Definitions
  - Explains the terms used in the Standard

* Anchor point – Part of the structure, fitting or attachment on a vehicle or cargo to which a tiedown is attached.

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Part 5

- Cargo Securement Components: Referenced Standards
  - Lists the industry standards used when developing the North American Cargo Securement Standard

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Part 6

- Default Working Load Limits for Unmarked Tiedowns
  - Provides some references for tiedowns that aren't marked with a working load limit (WLL)

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Inspection for Wear

Chains, load binder attachments, and anchor points must be maintained in good condition. A complete listing of what constitutes defective securing devices can be found in the Commercial Vehicle Safety Alliance's (CVSA) Cargo Securement Tiedown Requirements and Out-of-Service criteria. Here are some commonly cited deficiencies that would prohibit the use of tiedown equipment.

The following conditions in tiedowns are **not** acceptable for load securement:

- Chain containing cracked welds or links
- Chain containing bent, twisted, stretched, or collapsed links
- Chain links weakened by gouges, nicks or pits
- Chains incorrectly repaired
- Links obviously worn or showing other visible evidence of loss of strength
- Knots in any portion of the chain, wire rope, or webbing
- Spread or disturbed grabhooks
- Cuts, nicks, or splits in nylon webbing
- Wire cable with missing strands or wraps
- An anchor point that is weakened or shows loss of strength due to cracks, breaks, or distortion
- Split lumber that is used as dunnage to prevent movement or distribute the load.

Why Was The Standard Developed?

- In early 1990s several serious accidents involving loss of cargo prompted Canadian and US governments to call for review of adequacy of cargo securement regulations
- In 1993, government and industry groups from both countries agreed to sponsor major research program

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Why Was The Standard Developed? (cont'd)

- 1993-1997 research conducted
  - Better understanding of the mechanics of cargo securement on trucks
  - Effectiveness of different cargo securement techniques
- Findings presented to joint Canada/US committee for use in preparing new North American Cargo Securement Standard

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Who Developed The Standard?

Volunteer experts from Canada and US:

- Federal, state, and provincial highway agencies
- Police, enforcement agencies, and highway safety organizations
- Trucking industry
- Truck and trailer manufacturing industries
- Cargo securement equipment manufacturing industries and associations
- Manufacturing and processing industry sectors and associations (e.g., steel, aluminum, forest products, concrete, recycling)
- Research and standards setting organizations

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What You Have Learned

- Benefits of properly secured cargo
- What the Standard is and how it came about
- Requirements of the Standard

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What's Next

- The Standard
  - What vehicles it applies to
  - What cargo it applies to
  - What is the right securement system
- Basic Physic Principles
  - Fundamentals of object movements

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Introduction-29

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The Standard and Basic Physics Principles

What You Will Learn

- What vehicles are required to comply with the Standard
- The Standard's general requirements for cargo securement
- How forces affect cargo (Laws of Physics)
- Performance Criteria in the Standard

North American Cargo Securement Training Standard - 2

Guiding Principle of Public Safety

- Cargo being transported on the highway must remain secured on or within the transporting vehicle:
  - Under all conditions expected to occur in normal driving situations
  - When a driver is responding in emergency situations, short of a crash

North American Cargo Securement Training Standard - 3

When Standard Applies: Vehicles

- For cargo transported on a public highway
- Commercial vehicles with a gross weight rating over 4,500 kg (10,000 lb.)
- Combination of vehicles with a gross combination weight rating over 4500 kg (10,000 lb.)

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Exception

It is assumed that heavy loads carried under special permits would be subject to securement standards contained in the special permit, which may differ from the North American Standard. Check with Federal, Provincial, or State government for permit requirements.

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When Standard Applies: Cargo

Applies to ANY cargo, including dangerous goods/hazardous materials

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When Standard Applies: Cargo (cont'd)

- Covers all general freight
- Includes equipment carried for vehicle operation and intermodal containers and their contents

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Standard - 7

When Standard Applies: Cargo (cont'd)

- Some specific commodities have additional or different securement requirements
- Additional requirements may apply for certain types of dangerous goods or hazardous materials (under separate regulations)

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Standard - 8

If cargo is contained or immobilized or secured properly, there are certain things that the cargo shouldn't do. What are they?

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How Cargo Must Be Contained/Immobilized/Secured

- So that it does not:
  - Leak
  - Spill
  - Blow
  - Fall from vehicle
  - Fall through vehicle
  - Shift, making vehicle unstable or affecting its maneuverability

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Can You Prevent All Cargo From Shifting?

- NO
- There can be some movement if it doesn't reduce effectiveness of securement system

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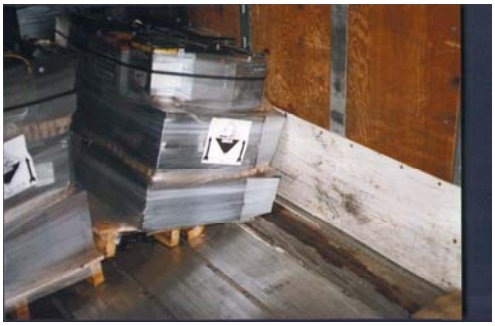
How can you tell that a cargo system has failed?



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Cargo Securement System Has Failed If:

- Cargo dislodges from vehicle
- Cargo shifts, making vehicle:
  - Unstable
  - Difficult to drive
  - Roll over
- Cargo shifts, reducing effectiveness of securement system

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Consequences of Improperly Secured Loads Activity

What are the potential problems if you don't follow proper methods when securing cargo or when inspecting cargo and securement systems?

- To you?
- To others?

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The Laws of Physics

- An object at rest will stay at rest
- An object in motion will stay in motion
- Objects change their motion when they are subjected to a force

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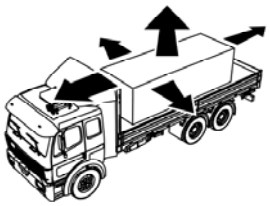
Laws of Physics Activity

A truck is traveling down a highway. The cargo is not secured to the vehicle. Under normal driving conditions what situations would create a force that would change the motion of the cargo?



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Module 2 - Law of Physics Activity

A truck is traveling down a highway. The cargo is not secured to the vehicle. Describe the situations, under normal driving conditions, that would create a force that would change the motion of the cargo.

- In a forward direction:

  _____

- In a rearward direction:

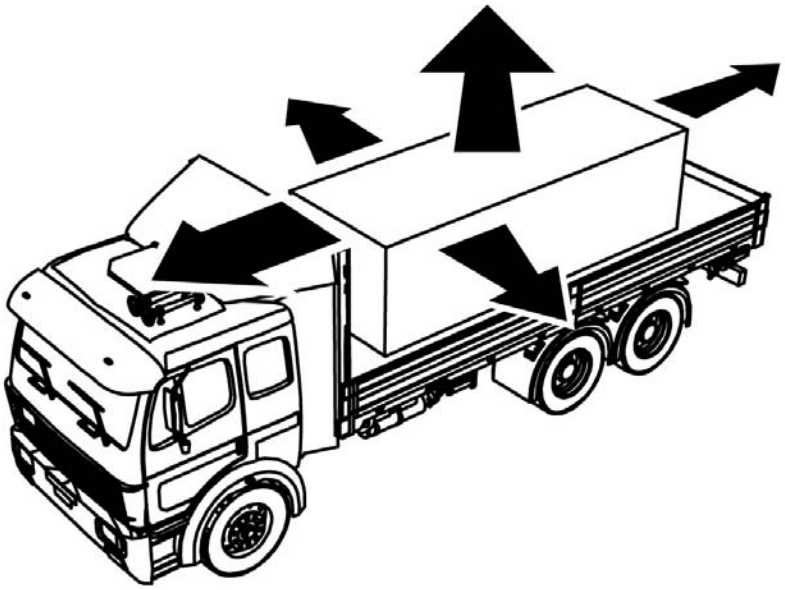
  _____

- In a sideways direction:

  _____

- In an upward direction:

  _____



What Are Performance Criteria?

- Performance Criteria describe what force a loaded vehicle must withstand in certain circumstances

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Limits of Performance Criteria

- Criteria not designed to keep cargo secured on or in vehicle during crash
  - Forces in collision situations are considerably higher than could be handled by conventional securement systems
- Criteria ensure that cargo securement system is strong enough to handle forces expected to occur:
  - Under all normal driving conditions
  - During emergency maneuvers, up to but short of crash

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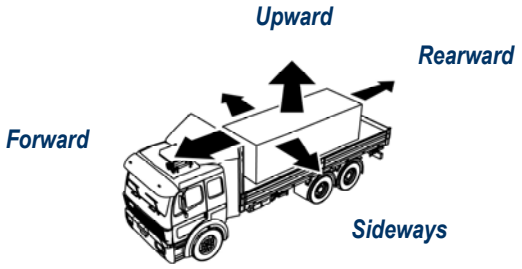
Review of Forces



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Standard - 19

Measure the Force of Gravity

Example

- Force of gravity can be measured in weight
- "g" is the symbol for gravity

.2 g =
- 20% of force of gravity

  AND
- 20% of cargo weight

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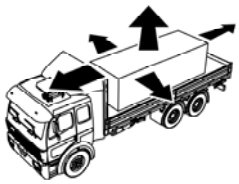
Standard - 20

Performance Criteria - Forward

- Force in forward direction most often occurs when vehicle is braking
- Cargo securement system must be able to resist a force equal to 80% of cargo weight

0.8 g
(80%)



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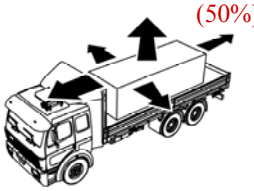
Standard - 21

Performance Criteria - Rearward

- Force in rearward direction occurs when vehicle accelerates, shifts gears while climbing a hill, or brakes in reverse
- Cargo securement system must be able to resist force equal to 50% of cargo weight

0.5 g
(50%)



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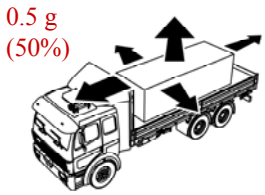
Standard - 22

Performance Criteria - Sideways

- Force in the sideways direction occurs when vehicle is turning, changing lanes, or braking while turning
- Cargo securement system must be able to resist a force equal to 50% of cargo weight



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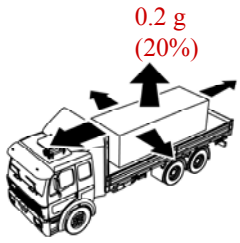
Standard - 23

Performance Criteria - Upward

- Force in upward direction occurs when vehicle is traveling over bumps in road or cresting a hill
- Cargo securement system must be able to resist force equal to 20% of cargo weight (unless cargo is fully contained)
- Requirement is usually met if cargo is secured by tiedowns



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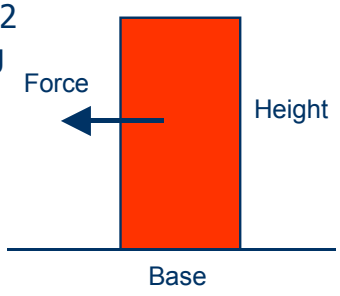
Standard - 24

Tipping

- If height is more than 2 times the base, tipping can occur at 0.5 g acceleration
- If height is more than 1.25 times the base, tipping can occur at 0.8 g acceleration



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What You Have Learned

- When the Standard applies (types of vehicles an cargo)
- Why it is important to properly contain, immobilize, and secure cargo
- How the basic Laws of Physics apply to cargo
- What the resistance requirements are for forces from 4 directions

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What's Next
Various components of the cargo system
How they are used
North American Cargo Securement Training
Standard - 27

Name The Component

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Name The Component (cont'd)

North American Cargo Securement Training Securement Requirements-2

Name The Component (cont'd)

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Securement Requirements-3

Cargo Securement Requirements: Equipment and Methods

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Securement Requirements-4

What You Will Learn

- Elements of a securement system
- Methods of using tiedowns and how they work
  - Tiedowns attached to cargo
  - Tiedowns that pass over cargo

North American Cargo Securement Training Securement Requirements-5

What You Will Learn (cont'd)

- When no additional securement is required
- How to identify Working Load Limit (WLL) for marked and unmarked securing devices
- How to calculate aggregate WLL
- Inspection requirements

North American Cargo Securement Training Securement Requirements-6

Cargo Securement Principle

- Cargo being transported on highway has to remain secured on or within transporting vehicle

North American Cargo Securement Training Securement Requirements-7

How do you keep cargo in place?

North American Cargo Securement Training Securement Requirements-8

How well do you have to secure it or contain it or immobilize it?

North American Cargo Securement Training Securement Requirements-9

Is there a way to tell if you have secured it properly?

North American Cargo Securement Training Securement Requirements-10

How do you keep cargo from tipping?

North American Cargo Securement Training Securement Requirements-11

What is included in the cargo securement system?

North American Cargo Securement Training Securement Requirements-12

Cargo Securement System

- Includes vehicle structure, blocking and bracing equipment, and securing devices
- Is maintained by carriers and drivers
- Must be in good working order, no obvious signs of damage or weakness
- Must be used within its capability

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What does "used within its capability" mean?

North American Cargo Securement Training Securement Requirements-14

How do you know if the cargo securement system is in good working order and doing its job?

North American Cargo Securement Training Securement Requirements-15

Inspection Methods

- Driver
  - Pre-trip inspections and periodic inspections during transit
- Enforcement
  - Roadside inspections in accordance with federal, state, or provincial laws

North American Cargo Securement Training Securement Requirements-16

Elements of Securement System

- One or combination of following elements:
  - Vehicle structure
  - Securement devices
  - Blocking and bracing

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Need to Know

- What those elements are
- What is included in each of those elements
- How to make sure that those elements are in good working order and are being used properly

North American Cargo Securement Training Securement Requirements-18

Securement System

- Must be suited to type of load
  - Size
  - Shape
  - Strength
  - Characteristics
- Must meet the Performance Criteria specified in the Standard

North American Cargo Securement Training Securement Requirements-19

Element 1: Vehicle Structure

What vehicle structure components could be used to make up a cargo securement system?

North American Cargo Securement Training Securement Requirements-20

Element 1: Vehicle Structure (cont'd)

- Floors
- Walls
- Decks
- Headboards
- Bulkheads
- Stakes
- Posts
- Anchor points

North American Cargo Securement Training Securement Requirements-21

Can the cab shield be used as part of the securement system?

North American Cargo Securement Training Securement Requirements-22

Element 1: Vehicle Structure (cont'd)

- Must be strong enough to withstand forces in Performance Criteria
- Must be in proper working order with no obvious damage or weakness if used as part of cargo securement system

Anchor Point

North American Cargo Securement Training Securement Requirements-23

Element 2: Securement Systems

What are the types of securing devices?

North American Cargo Securement Training Securement Requirements-24

Element 2 : Securement Systems (cont'd)

- Wire rope
- Chain
- Webbing
- Cordage
- Grab hooks
- Binders
- Winches
- Blocking
- Bracing
- Friction mats
- Shackles
- Stake pockets
- D-rings
- Pocket
- Webbing ratchet
- Tiedowns
- Front-end structure

Follow manufacturer's instructions for use and repair.

North American Cargo Securement Training Securement Requirements-25

What is a tiedown?

North American Cargo Securement Training Securement Requirements-26

Tiedowns

- Combination of securing devices that forms an assembly that:
  - Attaches cargo to, or restrains cargo on, a vehicle or trailer AND
  - Is attached to anchor points

North American Cargo Securement Training Securement Requirements-27

Tiedowns Attached to Cargo

- Provide direct resistance to oppose forces that are acting on cargo
- Restrain cargo from movement

North American Cargo Securement Training Securement Requirements-28

Tiedowns That Pass Over Cargo

- Create downward force that increases effect of friction between cargo and deck
- Friction restrains cargo

North American Cargo Securement Training Securement Requirements-29

Tiedown Requirements

- Except for steel strapping, tiedowns <u>must</u> be designed, constructed and maintained so they can be tightened by driver
- Tiedowns <u>must</u> be inspected and retightened by driver during transit, when required

North American Cargo Securement Training Securement Requirements-30

Tiedown Requirements (cont'd)

- Each tiedown must be attached and secured so it does not become loose or unfastened while vehicle is in transit

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Securement Requirements-31

Tiedown Requirements (cont'd)

- Tiedowns must be in good working order:
  - No knots or obvious damage
  - No distress
  - No weakened parts
  - No weakened sections

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Securement Requirements-32

Tiedown Requirements (cont'd)

- Tiedowns must be within rub rails for platform type vehicles to protect tiedown from impact
  - Unless load extends to or beyond rub rails

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Tiedown Requirements (cont'd)

- Edge protection must be used if a tiedown may be cut or worn where it touches cargo

Edge Protector

North American Cargo Securement Training Securement Requirements-34

Tiedown Requirements (cont'd)

- Edge protection must also resist abrasion, cutting, or crushing

Edge Protection

North American Cargo Securement Training Securement Requirements-35

Element 3: Blocking and Bracing

- Material used must be strong enough not to be split or crushed by cargo or tiedowns

Blocking and Bracing

North American Cargo Securement Training Securement Requirements-36

Element 3: Blocking and Bracing (cont'd)

Blocking Securement

Void Filler

North American Cargo Securement Training Securement Requirements-37

Element 3: Blocking and Bracing (cont'd)

- If wood is used:
  - Hardwood is recommended
  - It should be properly seasoned
  - It should be free from rot or decay, knots, knotholes, and splits
  - Grain should run lengthwise when using wood for blocking or bracing

North American Cargo Securement Training Securement Requirements-38

What Comes Next?

- General requirements for containing and immobilizing cargo
  - Working load limit or WLL
  - Cargo placement and restraint
  - Aggregate working load limits for tiedowns

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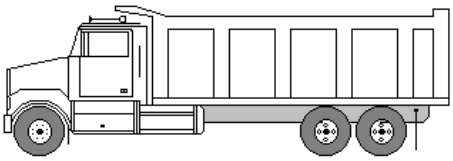
Exceptions to General Requirements

- Commodities in bulk that lack structure or fixed shape



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Exceptions to General Requirements (cont'd)

- Commodities that are transported in device that forms part of structure of commercial motor vehicle:
  - Tank
  - Hopper
  - Box
  - Similar device

North American Cargo Securement Training Securement Requirements-41

Specific Requirements

Standard sets forth specific securement requirements for certain loads:

- Logs
- Dressed lumber, etc.
- Metal coils
- Paper rolls
- Concrete pipe loaded crosswise (platform)
- Intermodal containers
- Autos, light trucks, vans
- Heavy vehicles, equipment, machinery
- Flattened/crushed vehicles
- Roll-on/roll-off and hook lift containers
- Large boulders

North American Cargo Securement Training Securement Requirements-42

Specific Requirements

- If additional securement is required, commodity-specific requirements take precedence
- Requirements described in the Driver's Handbook on Cargo Securement

North American Cargo Securement Training Securement Requirements-43

Cargo Must Satisfy 1 of 3 Conditions

- Either fully contained
- Or immobilized within vehicle by structures of adequate strength to prevent shifting or tipping
- Or immobilized or secured on or within vehicle to prevent shifting or tipping

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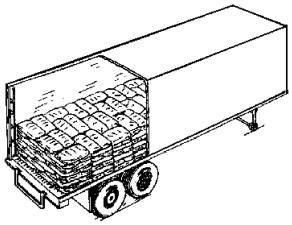
Condition 1: Fully Contained

- Cargo is fully contained by structures of adequate strength



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Securement Requirements-45

What is "Fully Contained"?

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Securement Requirements-46

Fully Contained Cargo

- Cargo is restrained against horizontal movement by:
  - Vehicle structure
  - Other cargo
- Load can't shift or tip

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Fully Contained Cargo (cont'd)

- Cargo that fills a sided vehicle of adequate strength
- Vehicle structure must be strong enough to withstand all of the forces in the Performance Criteria
  - Fully contained cargo is deemed to meet the Performance Criteria

North American Cargo Securement Training Securement Requirements-48

Permitted Shifting

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Securement Requirements-49

Condition 2: Immobilized by Structure

- Cargo is immobilized to prevent shifting or tipping by:
  - Structures of adequate strength
  - Combination of structure, blocking, and bracing

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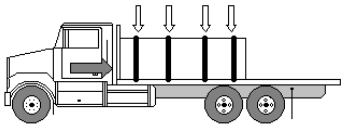
Securement Requirements-50

Condition 3: Immobilized/ Secured by Other Means

- Immobilized or secured on or within a vehicle to prevent shifting or tipping by:
  - Blocking
  - Bracing
  - Friction mats
  - Tiedowns
  - Other cargo void fillers
  - Combination of these



Friction (tiedowns) + Blocking

North American Cargo Securement Training Securement Requirements-51

Condition 3: Immobilized Secured by Other Means (cont'd)

Blocking in a Van

Blocking and Bracing on a Trailer

North American Cargo Securement Training Securement Requirements-52

What is Working Load Limit (WLL)?

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Securement Requirements-53

WLL: Working Load Limit

- Maximum load that may be applied to a component of a cargo securement system
- Usually assigned by manufacturer of component

North American Cargo Securement Training

Securement Requirements-54

WLL: Working Load Limit (cont'd)

- WWW of a tiedown
  - = WWW of weakest part, including anchor points and tensioning devices
- For synthetic webbing
  - = Working load limit of tiedown assembly or anchor point, whichever is less

North American Cargo Securement Training Securement Requirements-55

WLL: Working Load Limit (cont'd)

- Most components have WLL on them
- Some manufacturers mark tiedown assemblies, or components, with numeric WLL value
- If marking can't be read, it will be treated at default value

North American Cargo Securement Training Securement Requirements-56

WLL: Working Load Limit (cont'd)

- Others mark components using code or symbol that is defined in a recognized standard

North American Cargo Securement Training Securement Requirements-57

Unmarked Component WLL

- WLL of the weakest grade or classification for the type and size of component
- Provided in Driver's Handbook on Cargo Securement

North American Cargo Securement Training Securement Requirements-58

Chain

	Working Load Limit				
Size	**Grade 30 proof coil**	**Grade 43 High test**	**Grade 70 Transport**	**Grade 80 Alloy**	**Grade 100 Alloy**
7 mm (1/4 in)	580 kg (1300 lb)	1180 kg (2600 lb)	1430 kg (3150 lb)	1570 kg (3500 lb)	1950 kg (4300 lb)
8 mm (5/16 in)	860 kg (1900 lb)	1770 kg (3900 lb)	2130 kg (4700 lb)	2000 kg (4500 lb)	2600 kg (5700 lb)
10 mm (3/8 in)	1200 kg (2650 lb)	2450 kg (5400 lb)	2990 kg (6600 lb)	3200 kg (7100 lb)	4000 kg (8600 lb)
11 mm (7/16 in)	1680 kg (3700 lb)	3270 kg (7200 lb)	3970 kg (8750 lb)	-	-
13 mm (1/2 in)	2030 kg (4500 lb)	4170 kg (9200 lb)	5130 kg (11300 lb)	5440 kg (12000 lb)	6800 kg (15000 lb)
16 mm (5/8 in)	3130 kg (6900 lb)	5910 kg (13000 lb)	7170 kg (15800 lb)	8200 kg (18100 lb)	10300 kg (22600 lb)
Chain Marks					
Example 1 Example 2 Example 3	3 30 300	4 40 400	7 70 700	8 80 800	10 100 1000

Note: Chain that is not marked is considered Grade 30.

Synthetic Webbing

Width	WLL
45 mm (1-3/4 in)	790 kg (1750 lb)
50 mm (2 in)	910 kg (2000 lb)
75 mm (3 in)	1360 kg (3000 lb)
100 mm (4 in)	1810 kg (4000 lb)

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)

Manila Rope

Diameter	WLL
10 mm (3/8 in)	90 kg (205 lb)
11 mm (7/16 in)	120 kg (265 lb)
13 mm (1/2 in)	150 kg (315 lb)
16 mm (5/8 in)	210 kg (465 lb)
20 mm (3/4 in)	290 kg (640 lb)
25 mm (1 in)	480 kg (1050 lb)

Polypropylene Fiber Rope (3-Strand and 8-Strand Constructions)

Diameter	WLL
10 mm (3/8 in)	180 kg (400 lb)
11 mm (7/16 in)	240 kg (525 lb)
13 mm (1/2 in)	280 kg (625 lb)
16 mm (5/8 in)	420 kg (925 lb)
20 mm (3/4 in)	580 kg (1275 lb)
25 mm (1 in)	950 kg (2100 lb)

Polyester Fiber Rope (3-Strand and 8-Strand Constructions)

Diameter	WLL
10 mm (3/8 in)	250 kg (555 lb)
11 mm (7/16 in)	340 kg (750 lb)
13 mm (1/2 in)	440 kg (960 lb)
16 mm (5/8 in)	680 kg (1500 lb)
20 mm (3/4 in)	850 kg (1880 lb)
25 mm (1 in)	1500 kg (3300 lb)

Nylon Rope

Diameter	WLL
10 mm (3/8 in)	130 kg (278 lb)
11 mm (7/16 in)	190 kg (410 lb)
13 mm (1/2 in)	240 kg (525 lb)
16 mm (5/8 in)	420 kg (935 lb)
20 mm (3/4 in)	640 kg (1420 lb)
25 mm (1 in)	1140 kg (2520 lb)

Double Braided Nylon Rope

Diameter	WLL
10 mm (3/8 in)	150 kg (336 lb)
11 mm (7/16 in)	230 kg (502 lb)
13 mm (1/2 in)	300 kg (655 lb)
16 mm (5/8 in)	510 kg (1130 lb)
20 mm (3/4 in)	830 kg (1840 lb)
25 mm (1 in)	1470 kg (3250 lb)

Steel Strapping

Width-thickness mm (in)	WLL
31.7 x 0.74 (1-1/4 x 0.029)	540 kg (1190 lb)
31.7 x 0.79 (1-1/4 x 0.031)	540 kg (1190 lb)
31.7 x 0.89 (1-1/4 x 0.035)	540 kg (1190 lb)
31.7 x 1.12 (1-1/4 x 0.044)	770 kg (1690 lb)
31.7 x 1.27 (1-1/4 x 0.050)	770 kg (1690 lb)
31.7 x 1.5 (1-1/4 x 0.057)	870 kg (1925 lb)
50.8 x 1.12 (2 x 0.044)	1200 kg (2650 lb)
50.8 x 1.27 (2 x 0.050)	1200 kg (2650 lb)

Friction Mat

- Securement device placed between:
  - Deck of vehicle and cargo
  - Articles of cargo
- Increases effect of friction that exists naturally between these surfaces

North American Cargo Securement Training Securement Requirements-59

Friction Mat (cont'd)

- Friction mat is assigned resistance value of 50% of weight of cargo resting on mat, unless otherwise marked by manufacturer

Unmarked friction mat

North American Cargo Securement Training Securement Requirements-60

WLL: Working Load Limit (cont'd)

- Although working load limits incorporate safety factors, these limits should not be exceeded:
  - Materials can be deformed
  - Materials can become weakened without notice
- When in doubt, add extra securement

North American Cargo Securement Training Securement Requirements-61

Activity: Identify Working Load of an Unmarked Securing Device

North American Cargo Securement Training Securement Requirements-62

Module 3
Identifying WLL Of An Unmarked Securing Device

Using the Driver Handbook on Cargo Securement, record the working load limits for the following unmarked securing devices.

Securement System Component	Working Load Limit (WLL)
1) 8 mm (5/16 in) chain	
2) 50 mm (2 in) webbing	
3) 13 mm (1/2 in) wire rope (6x37, fiber core)	
4) 25 mm (1 in) manila rope	
5) 50.8 x1.27 (2 in x 0.050) steel strapping	

Requirements for Cargo

- Packing cargo
- Placing cargo
- Restraining cargo

North American Cargo Securement Training Securement Requirements-63

Packing Cargo

- Packaging, unitization, or stacking must be strong enough to withstand forces of:
  - Loading
  - Securement
  - Transportation

North American Cargo Securement Training Securement Requirements-64

What happens if a package collapses in transit?

North American Cargo Securement Training Securement Requirements-65

Whose responsibility is it to make sure that the packaging is strong enough to withstand the forces during transport?

North American Cargo Securement Training Securement Requirements-66

Shipper's Job

- Shipper needs to make sure packages are strong enough to withstand forces during transport

North American Cargo Securement Training Securement Requirements-67

Driver's Job

- Driver must inspect packaging and inform carrier if packaging is not adequate; for example:
  - Banding is loose or not symmetrical on package
  - Banding attachment device(s) are inefficient
  - Wrapping is broken or ineffective
  - Pallets are broken

North American Cargo Securement Training Securement Requirements-68

Most Important Securement Task

- Problem:

  Prevent article from moving when driver brakes or maneuvers

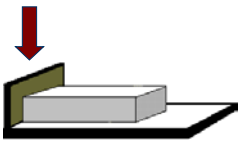
- Solution:

  Immobilize article

North American Cargo Securement Training Securement Requirements-69

Immobilize Cargo #1

- Place cargo against:
  - Headboard
  - Bulkhead
  - Stakes or other vehicle structure
  - Other cargo immobilized in that manner



North American Cargo Securement Training Securement Requirements-70

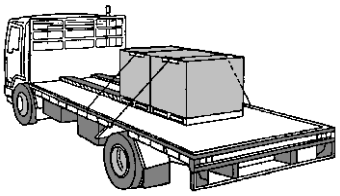
Immobilize Cargo #2

- Place something between article and vehicle structure
  - Blocking and bracing
  - Other cargo
  - Void-filler
  - Friction mat

North American Cargo Securement Training Securement Requirements-71

Immobilize Cargo #3

- Immobilize cargo with tiedown(s)



North American Cargo Securement Training Securement Requirements-72

Side-by-Side Cargo Placement

- Articles must be prevented from shifting towards each other
- Applies to all layers and stacks of articles loaded across vehicle

North American Cargo Securement Training

Securement Requirements-73

Placement Problem

- Tiedowns can lose their initial tension very quickly in normal driving if there are gaps between articles

North American Cargo Securement Training

Securement Requirements-74

Placement Solution

- Place cargo in contact with each other to eliminate gaps
- Block cargo
- Fill space with other cargo

North American Cargo Securement Training Securement Requirements-75

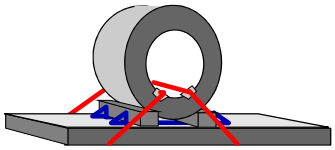
How can you restrain cargo if it has a tendency to roll?

North American Cargo Securement Training Securement Requirements-76

Roll Prevention

- If cargo has tendency to roll, provide more than one point of contact:
  - Lift it off the deck AND/OR
  - Place chocks, wedges, cradle, or other equivalent means that prevent rolling

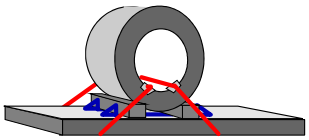
NOTE: Chocks, wedges, and other blocking must be secured to deck.



North American Cargo Securement Training Securement Requirements-77

Roll Prevention (cont'd)

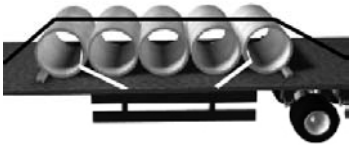
- Lifting cargo off deck helps stabilize cargo and reduces tendency of cargo to roll and thus loosen securement system
  - Required for metal coils
- A cradle with 45° angle provides good restraining force



North American Cargo Securement Training Securement Requirements-78

Roll Prevention (cont'd)

- Where multiple similar articles are placed against each other
  - Tendency to roll can be controlled if tiedowns through 2 end articles pull articles together
  - Longitudinal tiedown also required



North American Cargo Securement Training Securement Requirements-79

Roll Prevention (cont'd)

- Means of preventing rolling must not be capable of becoming unintentionally unfastened or loose while the vehicle is in transit

North American Cargo Securement Training Securement Requirements-80

How can you restrain cargo if it has a tendency to tip?

North American Cargo Securement Training

Securement Requirements-81

Brace It

- Tall cargo needs to be braced so it doesn't tip over
- Bracing also prevents shifting

Not braced

North American Cargo Securement Training

Securement Requirements-82

What does the term "aggregate working load limit" mean?

North American Cargo Securement Training Securement Requirements-83

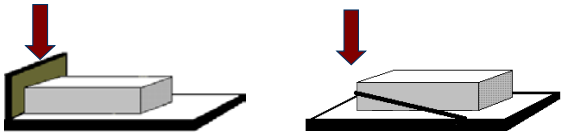
Aggregate Working Load Limit

Sum of working load limits of all devices that are used to secure an article on a vehicle

North American Cargo Securement Training Securement Requirements-84

Strength Ratings for Blocking Systems

- Aggregate WLL of all components used to block cargo from forward movement must be 50% (or more) of weight of article being blocked



North American Cargo Securement Training Securement Requirements-85

Aggregate WLL for Tiedowns

- Each device contributes to securement system
- NOTE: 50% is the minimum requirement
- More tiedown capacity should be used if required to secure an article against any movement

North American Cargo Securement Training Securement Requirements-86

Aggregate WLL for Tiedowns (cont'd)

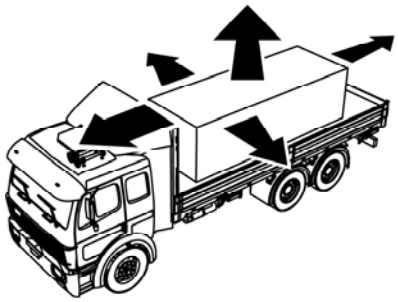
- Options for situations with low friction between cargo and the deck (e.g., snow, ice, sand, gravel, and oil)
  - Use tiedown attached to cargo
  - Use means to improve effect of friction (e.g., friction mats)

North American Cargo Securement Training Securement Requirements-87

Tiedowns attached to cargo

North American Cargo Securement Training Securement Requirements-88

Performance Criteria and Tiedowns



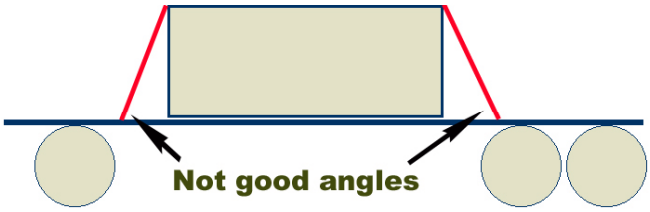
North American Cargo Securement Training Securement Requirements-89

Angle of Tiedown

- Shallow angle is better
  - Where tiedown attaches to vehicle
  - Where tiedown attaches to cargo

North American Cargo Securement Training Securement Requirements-90

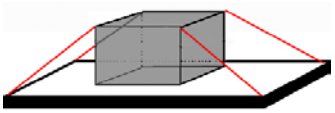
Angle of Tiedown (cont'd)



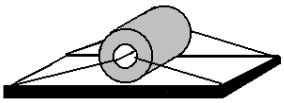
North American Cargo Securement Training Securement Requirements-91

Aggregate WLL For Tiedowns Attached To Cargo

- Determine number of tiedowns used to secure an article
  - Between vehicle and cargo



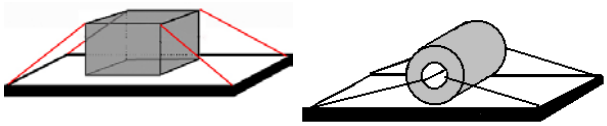
  - Attached to vehicle, passes through or around article, or is attached to it, and is again attached to vehicle



North American Cargo Securement Training Securement Requirements-92

Calculate Aggregate WLL

- Get sum of one-half of WLL for each end section of a tiedown that is attached to an anchor point and 50% WLL of each end section attached to cargo

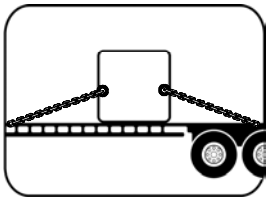


How many anchor points?

North American Cargo Securement Training Securement Requirements-93

Find The Aggregate WLL

- If each tiedown in this figure has a working load limit of 1,820 kg (4,000 lb.), what is the aggregate working load limit (WLL) for this securement system?



North American Cargo Securement Training Securement Requirements-94

Solution

100% x 4,000 + 100% x 4,000 = 8,000 lb.
(Left Tiedown) (Right Tiedown)

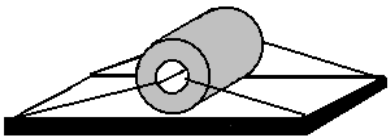
Or

100% x 1,820 + 100% x 1,820 = 3,640 kg
(Left Tiedown) (Right Tiedown)

North American Cargo Securement Training Securement Requirements-95

Find The Aggregate WLL

- If each tiedown in this Figure has a WLL of 1,820 kg (4,000 lb.), what is the aggregate WLL?



North American Cargo Securement Training Securement Requirements-96

Solution

50% x 4,000 + 50% x 4,000 +
50% x 4,000 + 50% x 4,000 = 8,000 lb.

Or

50% x 1,820 + 50% x 1,820 +
50% x 1,820 + 50% x 1,820 = 3,640 kg

North American Cargo Securement Training Securement Requirements-97

Aggregate Working Load Limit Activity For Tiedowns Attached To Cargo

North American Cargo Securement Training Securement Requirements-98

Module 3
Aggregate Working Load Limit Activity
For Tiedowns Attached To Cargo

Determine the Aggregate Working Load Limits (WLL) for the following situations.

#1. A 4,545 kg (10,000 lb.) steel coil has two G7 8 mm (5/16 in) chains through the eye for securement that are affixed to the trailer at four locations.

Aggregate WLL = _____

#2. An 18,180 kg (40,000 lb.) air-handling unit, which has lifting eyes at each corner, is secured to a trailer by four G7 10 mm (3/8 in) chains. Each chain is affixed to the trailer and to the air-handling unit at each corner. Aggregate WLL = _____

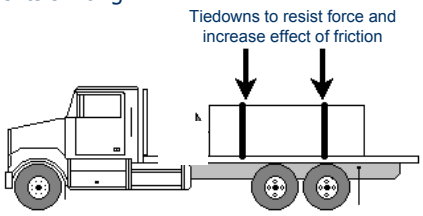
Module 3
Aggregate Working Load Limit Activity
For Tiedowns Attached To Cargo

#3. A bulldozer weighing 10,910 kg (24,000 lb.) is secured with four G43 10 mm (3/8 in) chains, one at each corner hooked to the tracks. Aggregate WLL = _____

#4. A 6.1 m (20 ft) intermodal container is transported on a flatbed trailer. The loaded weight is 15,910 kg (35,000 lb.). It is secured with a G7 8 mm (5/16 in) chain at each corner. The chains are attached to the trailer, go through the corner lock, and then go back to the trailer stake pocket. Aggregate WLL = _____

Tiedowns That Pass Over Cargo

- Increase effective weight of cargo
  - This increases pressure of cargo on deck
    - Increases effect of friction between cargo and deck
    - Prevents shifting



North American Cargo Securement Training Securement Requirements-100

To Prevent Shifting

- Keep cargo together; fill gaps
- Use friction mat or other friction-enhancing device if friction is low
- May need to use tiedowns attached to cargo

North American Cargo Securement Training Securement Requirements-101

To Prevent Shifting (cont'd)

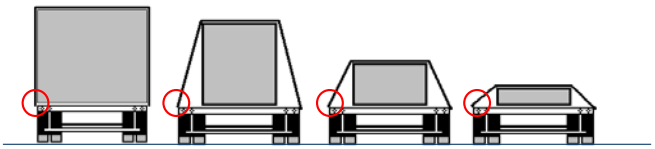
- Tension tiedowns to as high an initial tension as possible
- Maintain tension through trip
- Use tensioning devices in accordance with manufacturer recommendations

North American Cargo Securement Training Securement Requirements-102

To Prevent Shifting (cont'd)

- Steeper the tiedown angle, greater the apparent weight

Example: Tension in tiedown = 500 lb



Angle:	90 degrees	60 degrees	45 degrees	30 degrees
Downforce:	1,000 lb.	866 lb.	707 lb.	500 lb.

North American Cargo Securement Training Securement Requirements-103

Aggregate WLL for Tiedowns That Pass Over Cargo

- Calculated same as for tiedowns attached to cargo
  - To establish WLL of one tiedown, count 50% of WLL for each end section of a tiedown attached to an anchor point
  - Add together the WLL of each tiedown used to secure cargo

North American Cargo Securement Training Securement Requirements-104

Minimum Number of Tiedowns

- Cargo that IS NOT blocked from forward movement

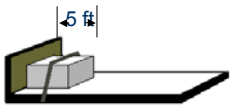
Article Decription	Required Minimum Number of Tiedowns Over Cargo
1.52 m (5 ft) or shorter 500 kg (1,100 lb.) or lighter	1
1.52 m (5 ft) or shorter over 500 kg (1,100 lb.)	2
Between 1.52 m (5+ft) and 3.04 m (10 ft)	2
Longer than 3.04 m (10 ft)	2 + 1 tiedown for every additional 3.04 m (10 ft), or part thereof

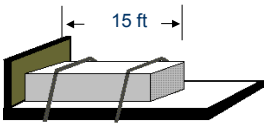
North American Cargo Securement Training Securement Requirements-105

Minimum Number of Tiedowns (cont'd)

- Cargo that IS blocked against forward movement

Article Description	Required Minimum Number of Tiedowns Over Cargo
All cargo	1 tiedown for every 3.04 m (10 ft), or part thereof





North American Cargo Securement Training Securement Requirements-106

Special Purpose Vehicles

- Minimum number of tiedowns does not apply to a vehicle transporting one or more articles of cargo such as, but not limited to:
  - Machinery or fabricated structural items which must be fastened by special methods because of design, size, shape or weight
- Any article of cargo carried on that vehicle must be securely and adequately fastened

North American Cargo Securement Training Securement Requirements-107

Example #1

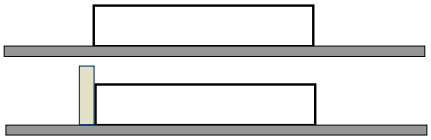
- One article - 1.52 m (5 ft) long

	Up to 500 kg (1,100 lb.)	Over 500 kg (1,100 lb.)
Case 1: Not Blocked Against Forward Movement		
Required Number of Tiedowns Over Cargo	___	___
Case 2: Blocked Against Forward Movement		
Required Number of Tiedowns Over Cargo	___	__

North American Cargo Securement Training Securement Requirements-108

Example #2

- One article - 3.04 m (10 ft) long



Case 1: Not Blocked Against Forward Movement Number of Tiedowns Over Cargo Required	___
Case 2: Blocked Against Forward Movement Number of Tiedowns Over Cargo Required	___

North American Cargo Securement Training Securement Requirements-110

Example #3

- Two articles - each 3.04 m (10 ft) long

Case 1: Not Blocked Against Forward Movement Number of Tiedowns Over Cargo Required	___
Case 2: Blocked Against Forward Movement Number of Tiedowns Over Cargo Required	___

North American Cargo Securement Training Securement Requirements-112

Activity: Determine Aggregate Working Load Limit For Tiedowns That Pass Over Cargo

North American Cargo Securement Training Securement Requirements-114

Module 3
Aggregate Working Load Limit Activity For Tiedowns Pass Over Cargo

Determine the Aggregate Working Load Limits (WLL) for the following situations.

#1. Four 50 mm (2 in) webbings pass from the left to the right side of a trailer over a load of 2x4's. The webbing is unmarked. Aggregate WLL = _____

#2. A wooden box, 1.5 m x 1.5 m (5 ft x 5 ft), has one G43 10 mm (3/8 in) chain passing over it. Aggregate WLL = _____

Inspecting Securement Systems

North American Cargo Securement Training

Securement Requirements-116

Inspection Requirement #1

To operate a commercial motor vehicle:

- Properly distribute and secure cargo
- Secure components for fastening cargo
- Secure these items:
  - Tailgate
  - Tailboard
  - Doors
  - Tarpaulins
  - Spare tire
  - Equipment used in operation of vehicle

North American Cargo Securement Training

Securement Requirements-117

Inspection Requirement #2

- Cargo or other objects must not:
  - Obscure driver's view ahead, right, or left
  - Interfere with free movement of driver's arms or legs
  - Prevent driver's access to accessories required for emergencies
  - Prevent free and ready exit of any person from vehicle's cab or driver's compartment

North American Cargo Securement Training Securement Requirements-118

Inspection Requirement #3

- Driver must inspect cargo securement at certain intervals and make adjustments as necessary
- Inspect as often as necessary to maintain tiedown tension but at least:
  - Within first 80 km (50 miles) of start of trip
  - When duty status of driver changes
  - After 3 hours or after 240 km (150 miles), whichever happens first

North American Cargo Securement Training Securement Requirements-119

Requirement #3 (cont'd)

- If adjustments need to be made at any inspection, driver must make them
- Driver may have to add additional devices to ensure that load is properly secured
  - Vehicle should carry or be equipped with additional tiedowns for this purpose

North American Cargo Securement Training Securement Requirements-120

Exceptions to Requirement #3

- Inspection is not required if:
  - Vehicle is sealed and driver ordered not to inspect cargo
  - Vehicle has been loaded in a manner to make inspection impractical

North American Cargo Securement Training Securement Requirements-121

On-Highway Inspection

- All loads including exceptions are subject to on-highway inspection
- Driver and/or carrier could be cited for a violation/laid with a charge

North American Cargo Securement Training Securement Requirements-122

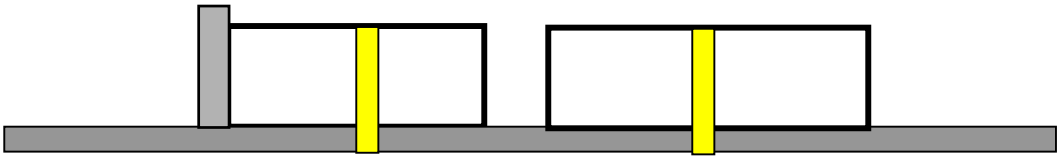
Activity: Determine If Cargo is Secured Properly

- In small groups, read scenario on worksheet
- Answer question(s) on worksheet
- Choose someone to be your spokesperson

North American Cargo Securement Training Securement Requirements-123

Module 3 – Scenario 1
Determine If Cargo Is Secured Properly Activity

Instructions: Read the scenario and answer the questions.



Scenario:

A truck equipped with a headboard is transporting 2 concrete sewer boxes. Each box weighs 1,360 kg (3,000 lb.) and is 1.5 m (5 ft) square.

The front box is against the headboard and secured with one tiedown that passes over the box.

The rear box is 1.85 m (6 ft) from the headboard and secured with one tiedown that passes over the box. Both tiedowns have a working load limit of 3,000 kg (6,600 lb.).

~~**Question #1:** Is any part of the cargo secured properly (in accordance with the~~
Standard)? If so, what part? Describe how the securement complies with the Standard.

~~**Question #2:** Is any part of the cargo not secured properly (in accordance with the~~
Standard)? If so, what part? Describe how the securement system needs to be changed to comply with the Standard.

Module 3 – Scenario 2
Determine If Cargo Is Secured Properly Activity

Instructions: Read the scenario and answer the question.

Scenario:

Twenty-five mattresses are to be transported in a van type truck.

~~**Question:** How should this cargo be secured to be in accordance with the Standard?~~

Module 3 – Scenario 3
Determine If Cargo Is Secured Properly Activity

Instructions: Read the scenario and answer the questions.

Scenario:

A load of auto parts in racks needs to be transported.

The racks are stacked four high. Each stack is 1.22 x 1.22 x 2.7 m (4 x 4 x 9 ft) high.

Twelve stacks will be transported. Each stack weights 907 kg (2000 lb.) A 16.15 m (53 ft) van semi trailer will be used.

~~**Question #1:** How should the cargo be loaded (in accordance with the Standard)?~~

~~**Question #2:** How should the cargo be secured properly (in accordance with the~~ Standard)?

Module 3 – Scenario 4
Determine If Cargo Is Secured Properly Activity

Instructions: Read the scenario and answer the questions.

Scenario:

A semitrailer will transport 20 pallets of brick. Each loaded pallet weighs 816 kg (1800 lb.). Each loaded pallet is 1.22 x 1.22 x .91 m (4 x 4 x 3 ft) high.

~~**Question #1:** How should the cargo be loaded (in accordance with the Standard)?~~

Question #2: How should the cargo be secured properly (in accordance with the Standard)?

Module 3 – Scenario 5
Determine If Cargo Is Secured Properly Activity

Instructions: Read the scenario and answer the questions.

Scenario:

A 16.15 m (53 ft) van is transporting 22 pallets of unitized copy paper. The pallets weigh 952 kg (2100 lb.) each. They are 1.22 x .91 x 1.27 m (48 x 36 x 50 in) tall. The cargo is loaded side by side down the center of the trailer, starting against the nose of the trailer. Due to axle-loading issues, the pallets are loaded with the 1.22 m (48 in) dimension parallel to the trailer length.

~~**Question #1:** Is this cargo properly secured in accordance with the Standard?~~

Question #2: If parts of the load are not properly secured, what are the problems?

Module 3 – Scenario 5
Determine If Cargo Is Secured Properly Activity

Question #3: If you have decided that there are problems with this load, how would you correct them?

What You Have Learned

- What cargo securement system includes and how it must be maintained and used
- 4 securement categories
  - Vehicle structure and anchor points
  - Securement system
  - Securement components
  - Material for blocking and bracing
- WLL for marked and unmarked components

North American Cargo Securement Training Securement Requirements-124

What You Have Learned (cont'd)

- Two types of tiedowns and how they work
- How to calculate aggregate WLL
- Inspection requirements

North American Cargo Securement Training Securement Requirements-125

North American Cargo Securement Training

Logs

What kinds of problems have you encountered transporting logs?

North American Cargo Securement Training Logs-2

What You Will Learn

- How cargo securement principles apply to logs
- What is required to properly load and secure logs for different types of vehicles, including:
  - Number
  - Placement
  - Types of cargo securing devices
- When securement systems are not in compliance and what is required to correctly secure the load

North American Cargo Securement Training Logs-3

What Is a Log?

- Natural wood that retains original shape of bole (trunk) of tree
- Logs can be:
  - Raw: All tree species that have been harvested, with bark; may have been trimmed or cut to length
  - Partially processed: Fully or partially debarked, or further reduced in length
  - Fully processed: Utility poles, treated poles, log cabin building components

North American Cargo Securement Training Logs-4

Principles for Securing Logs

North American Cargo Securement Training Logs-5

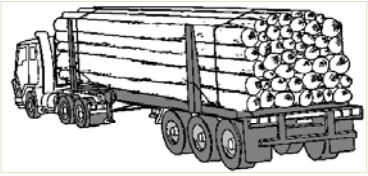
Characteristics of Logs

- Long, cylindrical shape of logs allows them to easily roll
- Logs can slide against each other or vehicle
  - Nature of logs (wet and slippery)
  - Nature of loading environment

North American Cargo Securement Training Logs-6

Planning a Securement System

- A specially designed vehicle
- Something to cradle the logs and prevent rolling
- Use tiedowns that go over logs to prevent upward and sliding movement of logs



North American Cargo Securement Training Logs-7

Guidelines

- Guidelines apply to raw and processed logs loaded on log truck or flatbed
- Some logs can be secured in accordance with general cargo securement requirements
  - Logs that are unitized
  - No more than 4 processed logs

North American Cargo Securement Training Logs-8

Guidelines (cont'd)

- Some short logs must be transported in sided vehicle, for example:
  - Firewood
  - Stumps
  - Log debris
- Longer logs may be transported in a sided vehicle

North American Cargo Securement Training Logs-9

What is the difference between longwood and shortwood?

North American Cargo Securement Training Logs-10

Shortwood

- Shortwood
  - No longer than 4.9 m (16 ft) in length
  - Normally up to about 2.5 m (100 in) in length
  - Some logs as short as 1.2 m (4 ft)
    - Transported with 2 stacks side-by-side

North American Cargo Securement Training Logs-11

Longwood

- Longwood is anything not considered shortwood

North American Cargo Securement Training Logs-12

Longwood and Shortwood Stacks

- Some stacks of logs may be made up of both shortwood and longwood
- Any stack that includes shortwood must follow shortwood securement requirements
- A stack that contains shortwood, but is embedded in a load of longwood, can be treated as longwood

North American Cargo Securement Training Logs-13

Log Securement: The Vehicle

- Must be designed and built, or adapted, for transportation of logs

North American Cargo Securement Training Logs-14

Log Securement: The Vehicle (cont'd)

- Bunks, bolsters, stakes or standards
  - Cradle logs
  - Keep logs together and prevent logs from rolling

North American Cargo Securement Training Logs-15

Log Securement: The Vehicle (cont'd)

- Stack of logs engages bunk securing load in front to back
  - Friction serves as primary securement
  - Tiedowns simply keep logs together in a stack

North American Cargo Securement Training Logs-16

Log Securement: Vehicle Components

- Must be designed and built to withstand all anticipated operational forces without:
  - Failure
  - Accidental release or
  - Permanent deformation

North American Cargo Securement Training Logs-17

Log Securement: Components Not Permanently Attached

- Stakes that simply sit in a pocket must be secured by some other method so that they cannot separate from vehicle

North American Cargo Securement Training Logs-18

What is the difference between rail, frame, and flatbed vehicles?

North American Cargo Securement Training Logs-19

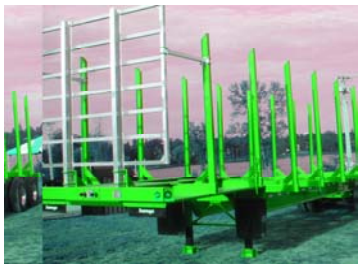
Rail Vehicle

- Skeletal frame
- Fitted with stakes at front and rear to contain stack of shortwood loaded crosswise

North American Cargo Securement Training Logs-20

Frame Vehicle

- Skeletal frame fitted with bunk units
  - Number/location of bunk units depends on length of logs
- Bunk unit
  - 2 bunks that together cradle a stack of logs



North American Cargo Securement Training Logs-21

Frame Vehicle (cont'd)

- Bunk
  - Horizontal bolster that is welded, bolted, or otherwise firmly attached to frame of vehicle
  - Has stake at each end
  - Often gusseted
    - For additional strength
    - To prevent front-to-back slippage

North American Cargo Securement Training Logs-22

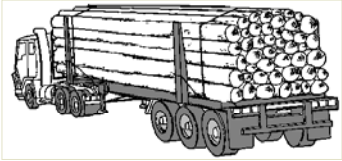
Flatbed Vehicles

- Vehicle with a deck but no permanent sides

North American Cargo Securement Training Logs-23

Tiedown Requirements

- Side-to-side tiedowns <u>must</u> be used to ensure stack of logs stays together
- Tiedowns increase the effect of the friction:
  - Between logs in stack
  - Between stack and vehicle



North American Cargo Securement Training Logs-24

Tiedown Requirements (cont'd)

- Use in combination with stabilization provided by bunks, stakes, or standards and bolsters
- Standard requires tiedowns to have working load limit not less than 1,800 kg (4,000 lb.); local jurisdictions may vary
- Tiedowns must be tensioned as tightly as possible

North American Cargo Securement Training Logs-25

Is Additional Securement Needed?

- Standard requires additional tiedowns or securement devices when:
  - It is likely that there is low friction
  - Logs will slip upon each other

North American Cargo Securement Training Logs-26

Times When Logs Slip

- Some species are naturally rather "slippery." especially when wet
- Some species tend to slide out from their bark if the logs dry out awaiting transportation
- Partially or fully processed logs retain a coating of sawdust that allows them to slip upon each other

North American Cargo Securement Training Logs-27

In Low-Friction Situations

- Stack of logs must be crowned
- Tiedowns must be applied with high initial tension
- Tiedown tension must be maintained throughout trip

North American Cargo Securement Training Logs-28

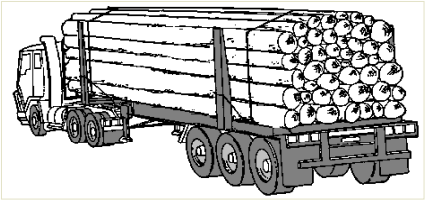
Importance of Stable Stack

- Logs must be solidly packed
- If they settle during transit, tiedowns lose tension and become ineffective

North American Cargo Securement Training Logs-29

Packing Outer Logs

- Outer bottom logs must be in contact with and resting solidly against:
  - Bunks
  - Bolsters
  - Stakes/ Standards



North American Cargo Securement Training Logs-30

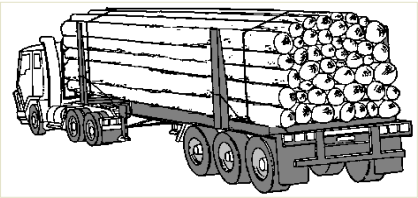
Packing Outer Logs (cont'd)

- Each outside log on the side of a stack, must touch at least 2 stakes/standards, bunks, or bolsters
- If one end does not touch stake, it must:
  - Rest in a stable manner on other logs
  - Extend beyond stake/standard, bunk, or bolster

North American Cargo Securement Training Logs-31

Packing Outer Logs (cont'd)

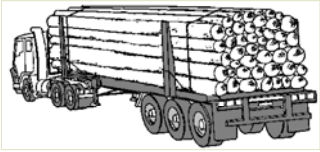
- Center of highest outside log on each side or end must be below top of each stake/standard or bunk



North American Cargo Securement Training Logs-32

Packing Upper Logs

- Upper logs that form the top of the load must be:
  - Crowned
  - Held in place by a tiedown if not held in place by contact with other logs, stakes/ standards, or bunks



North American Cargo Securement Training Logs-33

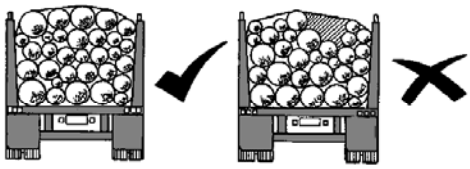
Packing Upper Logs (cont'd)

- Crowning represents natural shape of group of logs held together
- Crowning ensures logs on edges of crown are held in place by tiedowns
- High-tension tiedown over crowned stack causes logs to bunch and interlock together

North American Cargo Securement Training Logs-34

Packing Upper Logs (cont'd)

- Okay for logs in center of stack to exceed height of stakes if:
  - Stack doesn't exceed allowable height
  - Each log forming crown is supported on each side by another log or stakes



North American Cargo Securement Training Logs-35

Tightening and Checking Loads

- All tiedowns <u>must</u> be tightened after loading
- Load and all tiedowns <u>must</u> be checked and adjusted (if necessary):
  - At entry from forestry road to public road
  - At intervals specified in Standard's general requirements

North American Cargo Securement Training Logs-36

What are the pre-trip inspection requirements when transporting logs?

North American Cargo Securement Training Logs-37

What are the in-transit inspection requirements when transporting logs?

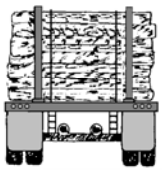
North American Cargo Securement Training Logs-38

Securement Requirements for Shortwood Logs Loaded Crosswise on Frame, Rail, and Flatbed Vehicles

North American Cargo Securement Training Logs-39

Lower Tier Requirements

- End of log in lower tier must NOT extend more than 1/3 of log's total length beyond nearest supporting structure on vehicle
- This prevents tipping when vehicle turns



North American Cargo Securement Training Logs-40

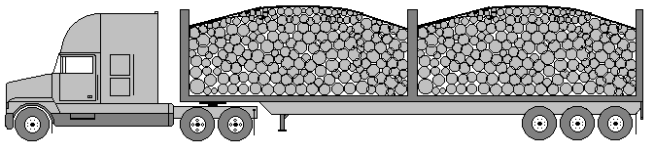
Tiedowns Over the Cargo

- When only one stack of shortwood is loaded crosswise, it must be secured with at least 2 tiedowns
  - Tiedowns must attach to vehicle frame at front and rear of load
  - When 2 tiedowns are used, they must be positioned at approximately 1/3 and 2/3 of length of logs

North American Cargo Securement Training Logs-41

Dividing Vehicles Over 10 m (33 ft)

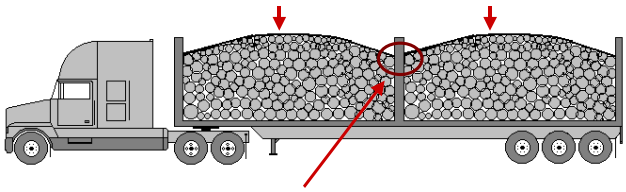
- Vehicle over 10 m (33 ft) in length must be equipped with center stakes, or comparable devices, to divide it into approximately equal sections



North American Cargo Securement Training Logs-42

Tiedown Placement

- In divided vehicle, each tiedown must:
  Secure highest log on each side of center stake



Be fastened below these logs

North American Cargo Securement Training Logs-43

Tiedown Tension Options

- Fixed at each end and tensioned from the middle
- Fixed in the middle and tensioned from each end
- Pass through pulley or equivalent device in middle and be tensioned from one end

North American Cargo Securement Training Logs-44

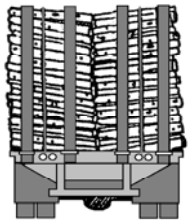
Stakes/Structure and Tiedowns

- Any structure or stake that is subjected to an upward force when tiedowns are tensioned must be anchored to resist that force

North American Cargo Securement Training Logs-45

Securing Two Stacks of Shortwood

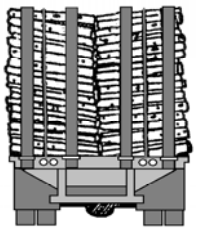
- No space between 2 stacks of logs
- Stack is raised at least 2.5 cm (1 in) within 10 cm (4 in) of end of logs or side of vehicle



North American Cargo Securement Training Logs-46

Securing Two Stacks of Shortwood (cont'd)

- Highest log no more than 2.44 m (8 ft) above deck
- At least one tiedown is used lengthwise across each stack of logs



North American Cargo Securement Training Logs-47

Securement Requirements for Logs Loaded Lengthwise on Flatbed and Frame Vehicles

North American Cargo Securement Training Logs-48

Shortwood and Tiedowns

- Each stack of logs <u>must</u> be secured by at least 2 tiedowns that go over logs

North American Cargo Securement Training Logs-49

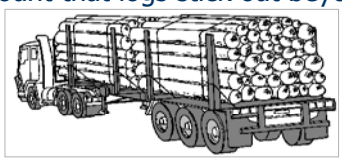
Shortwood and Tiedowns (cont'd)

- May use only one tiedown if all logs in stack are:
  - Blocked in front by headboard or another stack of logs
  - Blocked in rear by another stack of logs or vehicle's end structure
- Tiedown <u>must</u> be positioned about midway between stakes/standards and bunks

North American Cargo Securement Training Logs-50

Shortwood Loading

- When multiple stacks carried behind each other, stack of logs in front and behind an interior stack is equivalent to headboard or vehicle structure
- Applies where gap between stack of logs, to front or rear, is less than amount that logs stick out beyond extreme stakes



North American Cargo Securement Training Logs-51

Longwood and Tiedowns

- Each stack must be secured to vehicle by 2 tiedowns at locations along load that provide effective securement
- Each outer log must be secured by at least 2 tiedowns

North American Cargo Securement Training Logs-52

WLL: Logs Loaded Lengthwise

- For longwood and shortwood, aggregate WLL for all tiedowns must be no less than 1/6 the weight of the stack of logs
- Local requirements may vary

North American Cargo Securement Training Logs-53

Aggregate WLL

- Aggregate WLL of tiedowns securing a stack of logs must be no less than 1/6 the weight of the stack of logs

# of Tiedowns	Minimum WLL	Sufficient Load
2	1,800 kg 4,000 lb.	21,600 kg 48,000 lb.
2	2,268 kg 5,000 lb.	27,216 kg 60,000 lb.

North American Cargo Securement Training Logs-54

Aggregate WLL (cont'd)

- Requirement recognizes restraint provided by bunks
- Since tiedowns hold logs together tightly, stack uses bunk to prevent slippage

North American Cargo Securement Training Logs-55

Longwood Loading

- If shorter logs are carried on top of stack, each log must be secured to vehicle by at least 2 tiedowns

North American Cargo Securement Training Logs-56

Securement Requirements for Logs Transported on Pole Trailers

North American Cargo Securement Training Logs-57

What is a pole trailer?

North American Cargo Securement Training Logs-58

Pole Trailers

- Designed to follow closely in path of tractor
- Dolly or trailer assembly, towed by reach that attaches to an extension of rear of tractor

North American Cargo Securement Training Logs-59

Pole Trailers (cont'd)

- Tractor and trailer each fitted with bunk that is free to rotate
- Stack of longwood is placed in bunks and becomes body of vehicle

North American Cargo Securement Training Logs-60

Pole Trailers (cont'd)

- Reach designed and built to extend and retract as vehicle turns
- Trailer carried on tractor bunk when empty, for transport back to loading site

North American Cargo Securement Training Logs-61

Pole Trailers and Tiedowns

- Two options
  - Secure load at each bunk by at least one tiedown
  - Use at least two tiedowns as wrappers that:
    - Encircle the entire load at locations along the load
    - Provide effective securement

North American Cargo Securement Training Logs-62

Wrapper Requirements

- Most extreme tiedowns must be at least 3.04 meters (10 feet) apart
- Front and rear wrappers must be at least 3.04 meters (10 feet) apart

North American Cargo Securement Training Logs-63

Shift Prevention

- Large diameter single and double log loads must be immobilized with chock blocks or other equivalent means to prevent shifting

North American Cargo Securement Training Logs-64

Additional Tiedowns

- Large diameter logs that rise above bunks <u>must</u> be secured to underlying load with at least 2 additional tiedowns

North American Cargo Securement Training Logs-65

Securing Logs on a Frame, Rail, or Flatbed Vehicle Activity

North American Cargo Securement Training Logs-66

Securing Logs

In a small group, determine how to secure the following log load. Consider the log loading requirements and the number, placement, and type of cargo securing devices. Create a checklist of securement requirements that you would use to ensure the logs are safely secured.

Scenario #1: A load of shortwood is to be transported crosswise in a divided rail vehicle.

Number, Placement, and Type of Cargo Securement Device	Inspection Checklist

Securing Logs

Scenario #2: A load of shortwood (two stacks) is to be transported crosswise on a rail vehicle that is not divided.	
Number, Placement, and Type of Cargo Securement Device	Inspection Checklist

Securing Logs

Scenario #3: A load of shortwood is to be transported lengthwise on a flatbed vehicle.	
Number, Placement, and Type of Cargo Securement Device	Inspection Checklist

Securing Logs

Scenario #4: A load of logs that are 17 ft long is to be transported in one stack on a frame vehicle.	
Number, Placement, and Type of Cargo Securement Device	Inspection Checklist

What are the most important things to remember from this module?

North American Cargo Securement Training Logs-67

What You Have Learned

- Logs require vehicles specially designed for safe transport
- Cargo securement failure modes for log loads include rolling and sliding, especially when wet

North American Cargo Securement Training Logs-68

What You Have Learned (cont'd)

- For all logs it is important to load/pack them properly; there are requirements for:
  - Lower tier
  - Outer logs
  - Top logs
- Some securement requirements depend on:
  - Type of logs (longwood or shortwood)
  - Loaded crosswise or lengthwise

North American Cargo Securement Training Logs-69

What You Have Learned (cont'd)

- Specific loading and securing requirements for:
  - Shortwood transported crosswise on frame, rail, and flatbed vehicles
  - Shortwood and longwood transported lengthwise on flatbed and frame vehicles
  - Logs transported on pole trailers

North American Cargo Securement Training Logs-70

North American Cargo Securement Training

Dressed Lumber and Similar Building Materials

What kinds of problems have you encountered transporting dressed lumber and similar building materials?

North American Cargo Securement Training Lumber- 2

What You Will Learn

- How cargo securement principles apply to dressed lumber loaded on flatbed or open vehicles
- What is required to properly load and secure dressed lumber and similar building materials, including:
  - Bundle placement
  - Types of cargo securing devices
- When securement systems are not in compliance and what is required to correctly secure load

North American Cargo Securement Training Lumber- 3

Principles for Securing Dressed Lumber and Similar Building Materials on a Flatbed or Open Vehicle

North American Cargo Securement Training Lumber- 4

Transporting Dressed Lumber and Similar Building Materials

- 2 options for bundles:
  - May be carried in a closed vehicle
    - Immobilized or contained as described in Module 2, General Cargo Securement Requirements: Equipment and Methods
  - May be transported on a flatbed or open vehicle
    - Module discusses this option

North American Cargo Securement Training Lumber- 5

Characteristics of Bundles of Building Materials

- Bundles in one tier adequately packaged are subject to general cargo securement requirements
  - As described in Module 2, General Cargo Securement Requirements: Equipment and Methods

North American Cargo Securement Training Lumber- 6

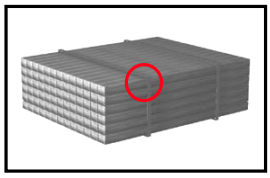
Bundles of Building Materials Failure Mode

- Bundles in multiple tiers is most typical failure mode
  - Higher center of gravity makes load susceptible to tipping
  - Need extra care when being secured since they can easily slide under wet conditions

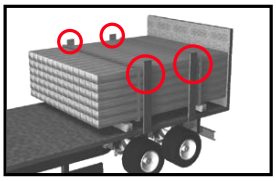
North American Cargo Securement Training Lumber- 7

Planning a Securement System

- Make sure packaging/bundle strapping is capable of keeping bundle of materials in a unit



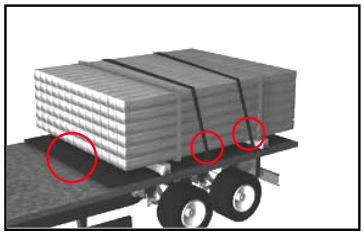
- Block, brace, or immobilize bundles to prevent horizontal movement



North American Cargo Securement Training Lumber- 8

Planning a Securement System (cont'd)

- To prevent sliding, use:
  - Tiedowns that pass over bundles
  - High friction devices



North American Cargo Securement Training Lumber- 9

Application of Standard

- Requirements apply to the transportation of bundles, such as:
  - Dressed lumber
  - Packaged/ engineered lumber
  - Building products (plywood, drywall, etc.)
  - Other similar bundled materials

North American Cargo Securement Training Lumber- 10

Application of Standard (cont'd)

- Requirements do NOT apply to:
  - Shingles
  - Palletized bags
  - Metal products
- However, these products may be transported on the same vehicle as building materials
  - Securement of these products is covered in Module 2, General Cargo Securement Requirements: Equipment and Methods

North American Cargo Securement Training Lumber- 11

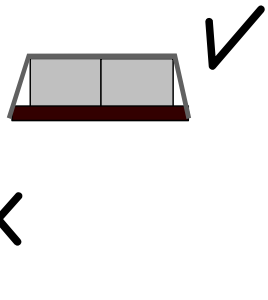
Application of Standard (cont'd)

- Lumber or building products that are not bundled or packaged should be treated as loose items and transported using general cargo securement requirements

North American Cargo Securement Training Lumber- 12

Bundles Placed Side By Side

- Either place side by side in direct contact with each other
- Or provide a means to prevent bundles from shifting towards each other



North American Cargo Securement Training Lumber- 13

Bundles in One Tier

- Must be secured by general cargo securement requirements (Module 2)
- Web tiedowns often used

North American Cargo Securement Training Lumber- 14

Securement System Requirements

- Must meet g forces
  - 0.8 forward
  - 0.5 rearward
  - 0.5 lateral
- Must provide downward force of at least 20% of cargo weight

North American Cargo Securement Training Lumber- 15

Securement System Requirements (cont'd)

- Tiedown components must be in proper working order
- Vehicle structure and anchor points must not be damaged to the extent that their performance for load securement is affected

North American Cargo Securement Training Lumber- 16

Securement System Requirements (cont'd)

- No knots
- Must be attached and secured in a manner so they can't come loose during transit
- Must be able to be tightened during transit
- Must be located inboard of rub rails whenever practicable

North American Cargo Securement Training Lumber- 17

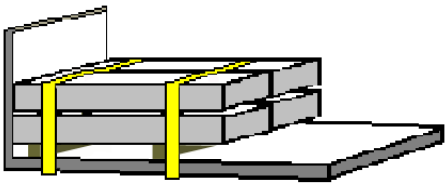
Securement System Requirements (cont'd)

- Edge protection is required when the tiedown may be cut or abraded

North American Cargo Securement Training Lumber- 18

Securing Bundles from Forward Movement

- Option #1: Bulkheads - Most vehicles are equipped with bulkheads



This is the preferred option

North American Cargo Securement Training Lumber- 19

Securing Bundles From Forward Movement (cont'd)

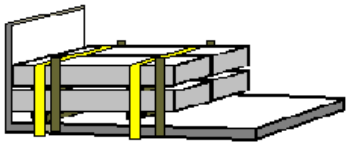
- Option #2: Tiedowns
  - Where different tiers need to be secured, combinations of blocking equipment and tiedowns may be useful

North American Cargo Securement Training Lumber- 20

Securing Multi-tiered Bundles

Option #1

Block bundles against sideways movement by stakes on sides of vehicle; secure bundles by tiedowns that pass over top tier

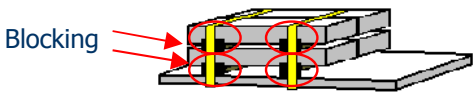


North American Cargo Securement Training Lumber- 21

Securing Multi-tiered Bundles (cont'd)

Option #2

Restrain bundles from lateral movement by blocking or high friction devices between tiers; secure bundles by tiedowns that pass over top tier



North American Cargo Securement Training Lumber- 22

High Friction Device Could Be:

- Friction mat
- Piece of wood with friction surface
- Cleated mat
- Other specialized equipment

North American Cargo Securement Training Lumber- 23

Securing Multi-tiered Bundles (cont'd)

Option #3: Most common

Place bundles on top of each other or of spacers and:

- Secure by tiedowns over second tier of bundles or at 1.85 m (6 ft) above trailer deck (whichever is greater), or not over 1.85 m (6 ft) above the trailer deck for other multiple tiers
- Secure by tiedowns over top tier of bundles with a minimum of 2 tiedowns over each top bundle longer than 1.52 m (5 ft)

North American Cargo Securement Training Lumber- 24

Securing Multi-tiered Bundles (cont'd)

- Option #3 continued:
  - Secure tiedowns in compliance with general cargo securement requirements

North American Cargo Securement Training Lumber- 25

Option #3 Example

Multiple tiers less than 1.83 m (6 ft) high

North American Cargo Securement Training Lumber- 26

Spacers

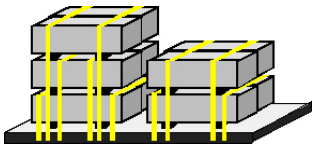
- Spacer Requirements:
  - Support all pieces in bottom row of bundle
  - Width must be equal or greater than height
  - Provide friction between bundles
  - Unitized or fastened together to ensure it does not separate

North American Cargo Securement Training Lumber- 27

Securing Multi-tiered Bundles (cont'd)

Option #4: Another situation

Secure by tiedowns over each tier of bundles with at least 2 tiedowns over each top bundle that is longer than 1.52 m (5 ft)



North American Cargo Securement Training Lumber- 28

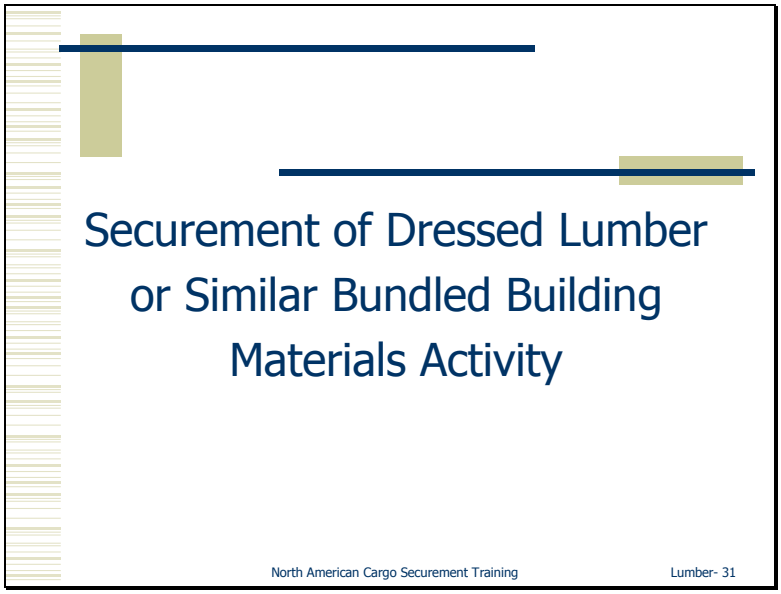
Securing Multi-tiered Bundles (cont'd)

- Secure tiedowns in compliance with general cargo securement requirements

North American Cargo Securement Training Lumber- 29

Securing Mixed Loads

North American Cargo Securement Training Lumber- 30


Securement of Dressed Lumber or Similar Bundled Building Materials Activity
North American Cargo Securement Training
Lumber- 31

Securing Dressed Lumber and Bundled Building Materials

In a small group, determine a safe securement system for the following load of dressed lumber. Consider the bundle loading orientation and the number, placement, and type of cargo securement device. Create a checklist of securement requirements that you would use to ensure that the bundles are safely secured.

Scenario #1: Four bundles of wallboard are to be delivered to a customer by the use of a flatbed truck. Each bundle weighs 907.185 kg (2,000 lb.) and is 1.22 m (4 ft) x 2.44 m (8 ft).

Loading Requirements	Number, Placement, Type of Cargo Securement Device	Inspection Checklist

Securing Dressed Lumber and Bundled Building Materials

Scenario #2: This load of random length green fir 2x4's is shipped loaded on a 16.15 m (53 ft) flat bed trailer without a headboard. All units are 1.22 m (4 ft) wide and 0.76 m (30 in) tall.

1 unit 2.44 m (8 ft) @ 2,800 lbs

1 unit 3.05 m (10 ft) @3,400 lbs

2 units 3.66 m (12 ft) @4,200 lbs

2 units 4.27 m (14 ft) @ 4,900 lbs

2 units 4.88 m (16 ft) @ 5,300 lbs

1 unit 5.49 (18 ft) @ 5,700 lbs

1 unit 6.1 m (20 ft) @6,200 lbs.

10 units in all that weigh a total of 21,273.48 kg (46,900 lb.).

Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Dressed Lumber and Bundled Building Materials

Scenario #3: 2 bundles of 2x12's, 6.1 m (20 ft) long by 1.83 m (6 ft) wide and 1.22 m (4 ft) high. Bundle weight is 3401.94 kg (7,500 lb.).		
Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Dressed Lumber and Bundled Building Materials

Scenario #4: Nine bundles of 6x6's, 4.88 m (16 ft) long by 1.22 m (4 ft) x 1.22 m (4 ft). Bundle weight is 1814.37 kg (4,000 lb.).		
Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Dressed Lumber and Bundled Building Materials

Scenario #5: One bundle of 2x4's, 2.44 m (8 ft) long. Bundle size is 1.22 m (4 ft) x 1.22 m (4 ft). Weight is 907.185 kg (2,000 lb.)		
Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

What are the most important things to remember from this module?

North American Cargo Securement Training Lumber- 32

What You Have Learned

- Securement system requirements:
  - Bundle must stay in a unit
  - Prevent forward and horizontal movement
  - Prevent sliding and tipping
- Securement requirements apply for all lumber and building products packaged in bundles

North American Cargo Securement Training Lumber- 33

What You Have Learned (cont'd)

- Specific securement requirements for:
  - Loading bundles in a tier
  - Preventing front – to – back movement for bundles (2 options)
  - Preventing side – to – side movement for bundles (four options)

North American Cargo Securement Training Lumber- 34

North American Cargo Securement Training

Metal Coils

What kinds of problems have you encountered transporting metal coils?

North American Cargo Securement Training Coils-2

What You Will Learn

- How cargo securement principles apply to metal coils
- Properly load and secure metals coils, including the:
  - Metal coil orientation
  - Number
  - Placement
  - Types of cargo securing devices
- When securement systems that are not in compliance

North American Cargo Securement Training Coils-3

What Is a Metal Coil?

- Metal coil is a coil of rolled sheet metal
- Definition does <u>not</u> include coiled wire
  - Coiled wire must be secured using general cargo securement requirements in Module 2

North American Cargo Securement Training Coils-4

Principles for Securing Metal Coils

North American Cargo Securement Training Coils-5

Metal Coil Characteristics

- Heavy, cylindrical objects that can easily roll if not correctly secured
- Commonly transported one of 3 ways:
  - Eyes vertical
  - Eyes crosswise
  - Eyes lengthwise
- Need to be restrained from movement in all directions

North American Cargo Securement Training Coils-6

Transportation Vehicles

- General purpose vehicles
- Custom designed vehicles

Custom trailer

North American Cargo Securement Training Coils-7

Metal Coil Failure Modes

- Failure modes for metal coil securement:
  - Sliding
  - Rolling
  - Tipping
- Need to design a securement system to prevent failure modes

North American Cargo Securement Training Coils-8

Application of Standard

- Metal coil shipments that, individually or together, have a weight of 2,268 kg (5,000 lb.) or more
- Shipments less than 2,268 kg (5,000 lb.) may be secured in accordance with general securement requirements
- Best to use requirements in this section for any size coils to prevent them from rolling, tipping, and sliding

North American Cargo Securement Training Coils-9

Requirements for Securing Coils

- Covers these vehicles:
  - Flatbed
  - Sided
  - Intermodal containers that have anchor points
- Other requirements for sided vehicles and intermodal containers without anchor points

North American Cargo Securement Training Coils-10

Application of Standard (cont'd)

- Requirements do NOT apply to:
  - Shingles
  - Palletized bags
  - Metal products
- However, these products may be transported on the same vehicle as building materials
  - Securement of these products is covered in Module 2, General Cargo Securement Requirements: Equipment and Methods

North American Cargo Securement Training Lumber- 11

Requirements for Securing Coils

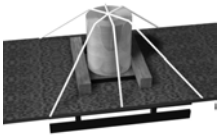
- Covers these vehicles:
  - Flatbed
  - Sided
  - Intermodal containers that have anchor points
- Other requirements for sided vehicles and intermodal containers without anchor points

North American Cargo Securement Training Coils-10

Requirements for Securing Coils (cont'd)

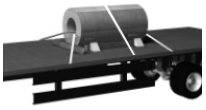
- Covers these coils

Eyes vertical



Eyes crosswise

Eyes lengthwise



North American Cargo Securement Training Coils-11

Securement Requirements for Coils with Eyes Vertical

North American Cargo Securement Training Coils-12

Coils with Eyes Vertical

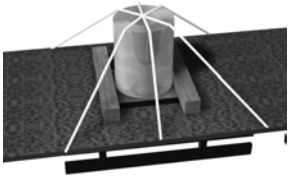
- Requirements apply to coils shipped with their eyes vertical
- If coil is mounted on a pallet:
  - Coil must be fastened to pallet
  - Pallet must also be strong enough that it does not collapse under forces from Performance Criteria

North American Cargo Securement Training Coils-13

Securing an Individual Coil with Eye Vertical

3 tiedowns to prevent tipping:

- One passed over eye of coil diagonally from left to right side of vehicle
- One passed over eye of coil diagonally from right to left side of vehicle
- One passed over eye of coil from side to side



North American Cargo Securement Training Coils-14

Securing an Individual Coil with Eye Vertical (cont'd)

- To prevent forward movement, use:
  - Blocking OR
  - Bracing OR
  - Friction mats OR
  - A tiedown passed around front of coil

North American Cargo Securement Training Coils-15

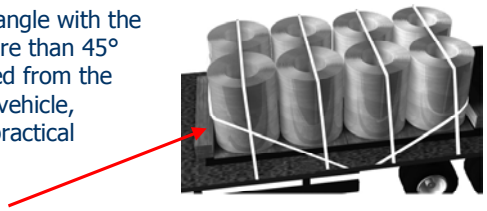
Securing an Individual Coil with Eye Vertical: Special Notes

Note 1	Recommended to use a friction mat.
Note 2	Coil must be secured to pallet to withstand all forces in the Performance Criteria.
Note 3	Sum of WLLs of all tiedowns must be at least 50% of weight of coils, based on requirements.

North American Cargo Securement Training Coils-16

At Least 3 Tiedowns

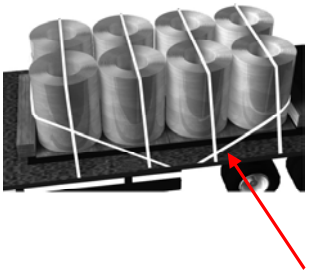
- One tiedown against front row of coils, restraining against forward motion
  - Making an angle with the floor no more than 45° when viewed from the side of the vehicle, whenever practical



North American Cargo Securement Training Coils-17

At Least 3 Tiedowns (cont'd)

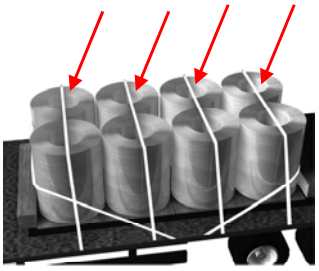
- One tiedown against rear row of coils, restraining against rearward motion
  - Making an angle with the floor no more than 45° when viewed from the side of the vehicle, whenever practical



North American Cargo Securement Training Coils-18

At Least 3 Tiedowns (cont'd)

- One tiedown passed over top of each coil or side-by-side row of coils, restraining against vertical motion

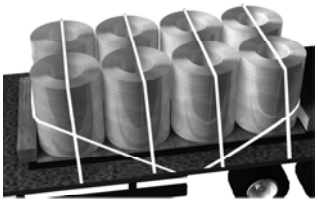


NOTE: Tiedowns passing over top of coil(s) must be as close as possible to eye of coil.

North American Cargo Securement Training Coils-19

Securing Rows of Coils (cont'd)

- Arrange securement to prevent shifting or tipping in all directions



North American Cargo Securement Training Coils-20

Use of Friction Mats

- Recommended to use friction mat between vehicle and cargo
- Provides greater friction than exists naturally between these surfaces

North American Cargo Securement Training Coils-21

Securement Requirements for Coils with Eyes Crosswise

North American Cargo Securement Training Coils-22

Coil Securement Requirements: Eyes Crosswise

- 3 requirements for coils with eyes horizontal:
  - Prevent coil from rolling
  - At least one tiedown forward
  - At least one tiedown rearward

North American Cargo Securement Training Coils-23

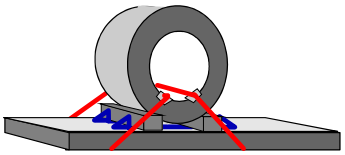
Prevent Coil From Rolling

- Support coil above deck, just enough to ensure it is not touching
  - Make clearance as small as possible

North American Cargo Securement Training Coils-24

Prevent Coil From Rolling (cont'd)

- Supports must not come loose during trip
  - Timbers, chocks, or wedges used must be held in place by coil bunks, or equivalent, to prevent loosening



North American Cargo Securement Training Coils-25

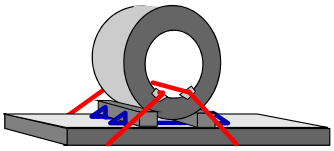
Prevent Coil From Rolling (cont'd)

- You must not use any of these:
  - Nailed blocking or cleats as the sole means to secure:
    - Timbers
    - Chocks
    - Wedges
  - Nailed wood cradle

North American Cargo Securement Training Coils-26

Prevent Coil From Rolling (cont'd)

- Most common method to block coil is with 2 hardwood timbers and 2 coil bunks, forming a cradle



A cradle prevents a cylindrical object from rolling

North American Cargo Securement Training Coils-27

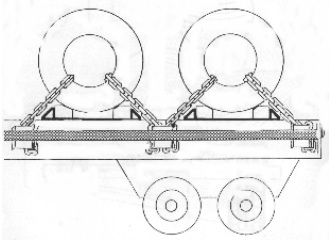
Prevent Coil From Rolling (cont'd)

- Restrain cradle against sliding by one of following:
  - Place friction mats under cradle
  - Use nailed wood blocking or cleats against front timber
  - Place tiedown directly around front of cradle
- Cradle should always be restrained by such means if friction is reduced

North American Cargo Securement Training Coils-28

Tiedowns

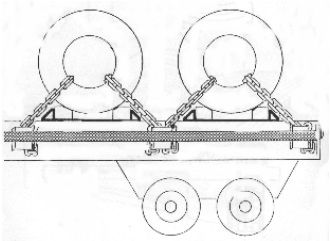
- At least one tiedown must pass through eye of coil, restricting forward motion, making an angle with floor no more than 45° when viewed from side of vehicle



North American Cargo Securement Training Coils-29

Tiedowns (cont'd)

- At least one tiedown must pass through eye of coil, restricting rearward motion, making an angle with floor no more than 45°, when viewed from side of vehicle



North American Cargo Securement Training Coils-30

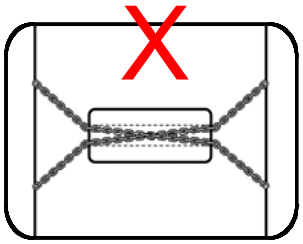
Chains as Tiedowns

- Chains should be used for tiedowns through coil
  - Synthetic webbing too flexible; can be cut
- If more than 2 chains are required, place them symmetrically on either side of coil
  - If odd number of chains is required, greater number should pull toward rear

North American Cargo Securement Training Coils-31

No Crossing Tiedown Chains

- Do NOT diagonally cross tiedown chains for coils with eyes loaded crosswise



North American Cargo Securement Training Coils-32

Why can't you attach tiedowns diagonally through the eye of a coil to form an X-pattern?

North American Cargo Securement Training Coils-33

Tiedowns (cont'd)

- Tiedown attached around front of cradle does not count towards aggregate WLL for tiedowns through eye of coil

North American Cargo Securement Training Coils-34

Securement Requirements for One Coil with Eyes Lengthwise

North American Cargo Securement Training Coils-35

Individual Coil, Eyes Lengthwise

- 3 options for securing coil with eyes lengthwise
- Blocking and supporting are similar for each option; difference is in tiedown arrangement

North American Cargo Securement Training Coils-36

Option #1: Individual Coil, Eyes Lengthwise

Step #1: Prevent Coil From Rolling

- Use timbers, chocks or wedges, cradle, etc. to prevent coil from rolling
- Means of preventing rolling must support coil above deck and must not become loose
- If timbers, chocks, or wedges are used, they must be held in place by coil bunks, or equivalent to prevent coming loose

North American Cargo Securement Training Coils-37

Option #1: Individual Coil, Eyes Lengthwise (cont'd)

Step #1: Prevent Coil from rolling(cont'd)

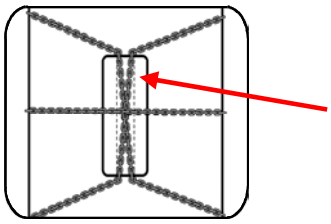
- Use of nailed blocking or cleats as sole means to secure items is prohibited

North American Cargo Securement Training Coils-38

Option #1: Individual Coil, Eyes Lengthwise (cont'd)

Step #2: Tiedown Through Eye of Coil

- At least one diagonal tiedown attached through eye of coil
- From left to right
- Angle viewed from side = max 45 degrees



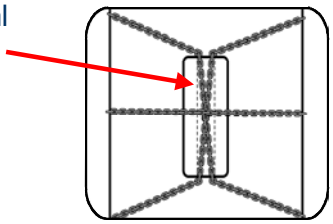
Front of vehicle

North American Cargo Securement Training Coils-39

Option #1: Individual Coil, Eyes Lengthwise (cont'd)

Step #3: Tiedown Through Eye of Coil

- At least one diagonal tiedown attached through eye of coil
- From right to left
- Angle viewed from side = max 45 degrees



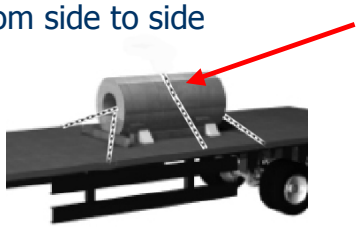
Front of vehicle

North American Cargo Securement Training Coils-40

Option #1: Individual Coil, Eyes Lengthwise (cont'd)

Step #4: Tiedown Passed Over Coil

- At least one tiedown that passes over top of coil from side to side

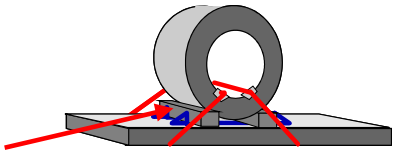


North American Cargo Securement Training Coils-41

Option #1: Individual Coil, Eyes Lengthwise (cont'd)

Step #5: Blocking or Friction Mats

- Use either blocking or friction mats to prevent forward movement

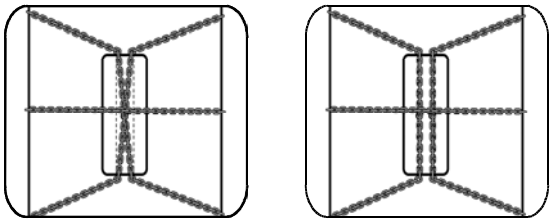


North American Cargo Securement Training Coils-42

Option #2: Individual Coil, Eyes Lengthwise

- Support and blocking same as Option #1
- Tiedowns are straight instead of diagonal

Option #1 Option #2

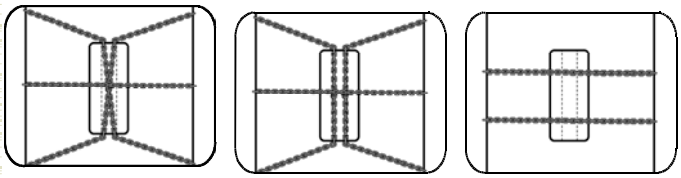


North American Cargo Securement Training Coils-43

Option #3: Individual Coil, Eyes Lengthwise

- 2 tiedowns directly attached through eye of coil replaced with 2 tiedowns that pass over front and rear parts of coil

Option #1 Option #2 Option #3



North American Cargo Securement Training Coils-44

Securement Requirements for Rows of Coils with Eyes Lengthwise

North American Cargo Securement Training Coils-45

Row of Coils, Eyes Lengthwise

- A row of coils is made up of 3 or more coils loaded in the same way and in a line
- Requirements for securing a row of coils is similar to securing individual coils (Similar to option #3)

North American Cargo Securement Training Coils-46

Step #1: Prevent Coil From Rolling

- Use timbers, chocks or wedges, cradle, etc. to prevent coil from rolling
- Means of preventing rolling must support coils above deck and must not become loose
- If timbers, chocks, or wedges are used, they must be held in place by coil bunks, or equivalent, to prevent coils from coming loose
- Use of nailed blocking or cleats as sole means to secure items is prohibited

North American Cargo Securement Training Coils-47

Step #2: Tiedowns

- At least 2 tiedowns over top of each coil or transverse row
  - One near forward-most part of coil
  - One near rearmost part of coil

North American Cargo Securement Training Coils-48

Step #3: Blocking/Bracing or Friction Mats

- Use either blocking, bracing, or friction mats to prevent forward movement for each coil

North American Cargo Securement Training Coils-49

Securing Metal Coils Activity

North American Cargo Securement Training Coils-50

Securing Metal Coils

In small groups, determine how to secure the following loads of metal coils. Consider the loading orientation and the number, placement, and type of cargo securing devices. Create a checklist of securement requirements that you would use to ensure the loads of metal coils are safely secured.

Scenario #1: A 13,600 kg (30,000 lb.) steel coil that is 1.85 m (6 ft) long and 1.25 m (4 ft) in diameter is to be transported on a flatbed semi-trailer. The purchaser insists that the coil must be shipped with the eye vertical.

Loading Requirements	Number, Placement, Type of Cargo Securement Device	Inspection Checklist

Metal Coils
Securing Metal Coils with Eyes Loaded Vertical

Scenario #2: Four steel coils, each weighing 4,500 kg (10,000 lb.) and which are 1.5 m (5 ft) long and 1 m (3 ft) in diameter are to be transported on a flatbed. Again the purchaser wants the eyes to be vertical.

Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Metal Coils

Scenario #3: A 13,600 kg (30,000 lb.) steel coil that is 1.85 m (6 ft) long and 1.25 m (4 ft) in diameter is to be transported on a flatbed semi-trailer with an oily deck. The purchaser insists that the coil must be shipped with the eye horizontal.

Loading Requirements	Number, Placement, Type of Cargo Securement Device	Inspection Checklist

Securing Metal Coils

Scenario #4: Four steel coils, each weighing 4,500 kg (10,000 lb.) and are 1.5 m (5 ft) long and 1 m (3 ft) in diameter are to be transported on a flatbed with an oily deck. Again the purchaser wants the eyes to be horizontal.

Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Metal Coils

Scenario #5: A 50,000lb. master coil will be shipped on a platform vehicle, equipped with anchor points. The coil eye will be lengthwise on the trailer.		
Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securement of Coils Transported in Sided Vehicles or Intermodal Containers without Anchor Points

North American Cargo Securement Training Coils-51

Sided Vehicles, No Anchor Points

- Metal coils must be loaded to prevent shifting or tipping
- Securement system must prevent movement in all directions as presented in Module 1, The Standard and Basic Physics Principles

North American Cargo Securement Training Coils-52

Sided Vehicles, No Anchor Points (cont'd)

- Coils must be prevented from shifting and tipping by using a system of:
  - Blocking and bracing
  - Friction mats
  - Combination of these

North American Cargo Securement Training Coils-53

What are the most important things to remember from this module?

North American Cargo Securement Training Coils-54

What You Have Learned

- Metal coils need special attention because of cylindrical shape and weight on vehicles
- Metal coils need to be secured to prevent rolling or sliding
- Securement requirements apply for single coil or group of coils that individually or together have a weight of 2,268 kg (5,000 lb.) or more

North American Cargo Securement Training Coils-55

What You Have Learned (cont'd)

- Specific securement requirements for:
  - Coils that are loaded with eyes vertical
  - Coils that are loaded with eyes crosswise
  - Coils (single and row) that are loaded with eyes lengthwise
  - Coils that are loaded on sided vehicles or intermodal containers without anchor points

North American Cargo Securement Training Coils-56

North American Cargo Securement Training

Paper Rolls

What kinds of problems have you encountered transporting paper rolls?

North American Cargo Securement Training

Paper Rolls-2

What You Will Learn

- How cargo securement principles apply to paper rolls
- What is required to properly load and secure paper rolls based on their orientation in the vehicle and loading pattern used
- When securement systems are not in compliance

North American Cargo Securement Training Paper Rolls-3

Principles for Securing Paper Rolls

North American Cargo Securement Training Paper Rolls-4

Paper Roll Characteristics

- Easily damaged
- Roll easily when eyes are loaded horizontal
- Can be transported with eyes:
  - Vertical
  - Crosswise
  - Lengthwise
- Shape allows compact packing when being loaded

North American Cargo Securement Training Paper Rolls-5

Paper Roll Failure Modes

- Paper rolls need to be secured in order to counteract forces from Performance Criteria
- Paper rolls can:
  - Slide
  - Tip
  - Roll

North American Cargo Securement Training Paper Rolls-6

Paper Roll Failure Modes

- Paper rolls need to be secured in order to counteract forces from Performance Criteria
- Paper rolls can:
  - Slide
  - Tip
  - Roll

North American Cargo Securement Training Paper Rolls-6

Planning a Securement System (cont'd)

- Prevent significant movement of small groups of paper rolls when movement not prevented by other cargo or by trailer
- Symmetrically stack paper rolls when eyes horizontal and make sure stacks are secured to prevent movement

North American Cargo Securement Training Paper Rolls-8

Planning a Securement System (cont'd)

- Use friction mats to prevent horizontal movement

North American Cargo Securement Training

Paper Rolls-9

Planning a Securement System (cont'd)

- Use tiedowns that pass over paper rolls to increase effect of friction
- Tiedowns are required when rolls are loaded on flatbeds or curtain-sided trailers

North American Cargo Securement Training

Paper Rolls-10

Application of Standard

Cargo Securement Requirements	Paper Roll Weight
Paper rolls	Individual or combined weight of 2,268 kg (5,000 lb.) or more
Paper rolls or General Cargo	Individual or combined weight less than 2,268 kg (5,000 lb.), or when unitized on a pallet

North American Cargo Securement Training Paper Rolls-11

Application of Standard (cont'd)

- Does not apply to small rolls of paper shipped in cartons/containers such as toilet paper or paper towels that would be used in the kitchen
- This type of product covered in general cargo securement requirements (Module 2, Cargo Securement Requirements: Equipment and Methods)

North American Cargo Securement Training Paper Rolls-12

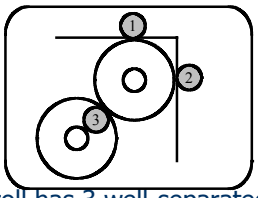
Securement Principles for Paper Rolls, Eyes Vertical, in a Sided Vehicle

North American Cargo Securement Training

Paper Rolls-13

Sided Vehicle: Paper Rolls with Eyes Vertical

- Paper rolls must be placed tightly against:
  - Front of vehicle
  - Wall of vehicle
  - Other paper rolls
  - Other cargo



[Note: Top view]

- Roll is secured if paper roll has 3 well-separated points of contact with vehicle, other rolls, or other cargo

North American Cargo Securement Training

Paper Rolls-14

Prevent Side-to-Side Movement

- If not enough paper rolls in shipment to reach walls of vehicle, use:
  - Blocking
  - Bracing
  - Tiedowns
  - Void filler
  - Friction mats
- Paper rolls may also be banded together

North American Cargo Securement Training

Paper Rolls-15

Prevent Side-to-Side Movement (cont'd)

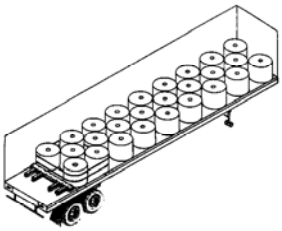
Void filler

North American Cargo Securement Training

Paper Rolls-16

Prevent Rearward Movement

- When void behind group of paper rolls exceeds diameter of rolls, including rolls at rear of vehicle, prevent rearward movement by:
  - Friction mats
  - Blocking
  - Bracing
  - Tiedowns
  - Banding to other rolls



North American Cargo Securement Training

Paper Rolls-17

Prevent Paper Rolls from Tipping Rearward or Sideways

Problem #1:

A paper roll is not prevented from tipping or falling sideways or rearward by vehicle structure or other cargo. Its width is more than 2 times its diameter.

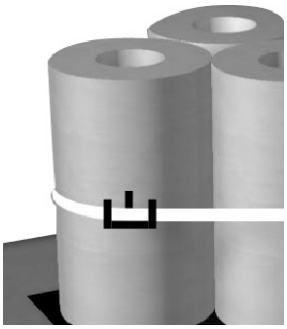
North American Cargo Securement Training

Paper Rolls-18

Prevent Paper Rolls from Tipping Rearward or Sideways (cont'd)

Solution

- Band one roll to other rolls
- Brace
- Use tiedowns



North American Cargo Securement Training

Paper Rolls-19

Prevent Paper Rolls from Tipping Forward (cont'd)

Problem #2:

The forwardmost roll(s) in a group of paper rolls is not prevented from tipping or falling forward by vehicle structure or other cargo. Its width is more than 1.75 times its diameter.

North American Cargo Securement Training

Paper Rolls-20

Prevent Paper Rolls from Tipping Forward (cont'd)

Solution

- Band one roll to other rolls
- Brace
- Use tiedowns

North American Cargo Securement Training

Paper Rolls-21

Prevent Paper Rolls from Tipping Forward (cont'd)

Problem #3: A paper roll or the forwardmost roll in groups of rolls is not prevented from tipping or falling forward by vehicle structure or other cargo. Its width is more than 1.25 times its diameter. Blocking is used to prevent forward movement.

North American Cargo Securement Training

Paper Rolls-22

Prevent Paper Rolls from Tipping Forward (cont'd)

Solution

- Band roll to other rolls
- Brace
- Use tiedowns

North American Cargo Securement Training Paper Rolls-23

Prevent Paper Rolls from Tipping Forward (cont'd)

Problem #4: A paper roll or the forwardmost roll in groups of rolls is not prevented from tipping or falling forward by vehicle structure or other cargo. Its width is more than 1.25 times its diameter and less than 1.76 times its diameter. Only friction mats are used for forward securement.

North American Cargo Securement Training Paper Rolls-24

Prevent Paper Rolls from Tipping Forward (cont'd)

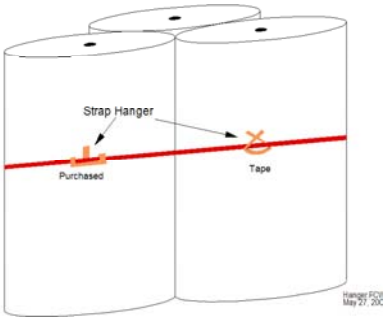
Solution

- Friction mat alone is adequate
- Friction mat allows roll to slide on floor without tipping roll

North American Cargo Securement Training Paper Rolls-25

Banding Application Requirements

- Bands applied tightly
- Bands secured so they cannot fall off rolls or slide down to deck
- Band supports:
  - Tape
  - Hangars
  - Other equivalent means



North American Cargo Securement Training Paper Rolls-26

Friction Mat Requirements

- If friction mat provides principal securement for paper roll, it should extend from beneath footprint of roll in direction of securement

North American Cargo Securement Training

Paper Rolls-27

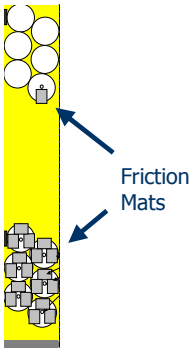
How would you secure a split load of paper rolls with eyes vertical?

North American Cargo Securement Training

Paper Rolls-28

Split Loads of Paper Rolls

- Any paper roll in split load that is not prevented from forward movement by vehicle structure/cargo must be prevented from forward movement by:
  - Filling open space
  - Blocking
  - Bracing
  - Tiedowns
  - Friction mats
  - Combination of these



North American Cargo Securement Training

Paper Rolls-29

Stacked Loads of Paper Rolls

- Must NOT be loaded on layer below it unless that layer extends to front of vehicle
- Rolls in second and following layers must be prevented from forward, rearward, or side-to-side movement by same means as required for bottom layer, or by use of blocking roll from lower layer

North American Cargo Securement Training

Paper Rolls-30

Stacked Loads of Paper Rolls (cont'd)

- Blocking roll must be:
  - At least 38 mm (1.5 in) taller than other rolls, or
  - Be raised at least 38 mm (1.5 in) using dunnage

North American Cargo Securement Training Paper Rolls-31

Stacked Loads of Paper Rolls (cont'd)

- Roll in rearmost row of any layer must not be raised using dunnage
  - Unless roll is blocked/braced or banded or tied down to prevent rearward movement

North American Cargo Securement Training Paper Rolls-32

Securing Paper Rolls with Eyes Loaded Vertical Activity

North American Cargo Securement Training

Paper Rolls-33

Scenario

A van trailer is transporting 8 paper rolls. Each roll weighs 2,608 kg (5,750 lb.) and is 1.47 m (58 in) in diameter by 2.08 m (82 in) wide.

North American Cargo Securement Training

Paper Rolls-34

Securement Requirements for Loading and Securing Paper Rolls with Eyes Horizontal in a Sided Vehicle

North American Cargo Securement Training

Paper Rolls-35

Eyes Crosswise: Roll and Shift Prevention

- Paper rolls, especially front roll, <u>must</u> be prevented from rolling or shifting forward and rearward by:
  - Positioning rolls in contact with vehicle structure or other cargo OR
  - Using chocks, wedges, tiedowns, or blocking and bracing

North American Cargo Securement Training

Paper Rolls-36

Eyes Crosswise: Roll and Shift Prevention (cont'd)

- Chocks, wedges, or blocking must be held in place by something in addition to friction
  - To keep them from becoming unfastened or loose while vehicle is in transit
- Chocks, wedges or blocking used to secure intermediate rolls do not have to be secured in place by some means in addition to friction

North American Cargo Securement Training Paper Rolls-37

Eyes Crosswise: Secure the Rearmost Roll

- Rearmost roll must not be secured by:
  - Rear doors of vehicle or intermodal container
  - Blocking held in place by rear doors
- Doors are not designed or intended as cargo securement device
- Rolls may push doors open during transit or onto loading dock personnel when doors are opened

North American Cargo Securement Training Paper Rolls-38

Eyes Crosswise: Prevent Rolls from Shifting Toward Vehicle Walls

- If there is more than 203 mm (8 in) of space between ends of paper roll, or a row of rolls, and vehicle walls, prevent side-to-side roll movement by using:
  - Void fillers
  - Blocking
  - Bracing
  - Friction mats
  - Tiedowns

North American Cargo Securement Training

Paper Rolls-39

Eyes Crosswise: Securing Stacks from Front-to-Back Movement

- Must NOT be loaded in second layer unless bottom layer extends to front of vehicle
- Must NOT be loaded in subsequent layer unless all wells in lower layer are filled

North American Cargo Securement Training

Paper Rolls-40

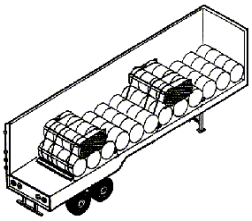
Eyes Crosswise: Foremost Roll or Any Roll With Empty Well Before It

- Secure against forward movement by:
  - Either by placing it in well formed by 2 rolls on lower row whose diameter is equal to or greater than roll on upper row
  - Or by banding it to other rolls
  - Or by blocking against eye-vertical blocking roll resting on floor of vehicle which is at least 1.5 times taller than diameter of roll being blocked

North American Cargo Securement Training Paper Rolls-41

Eyes Crosswise: Rearmost Roll in Upper Layer

- Rearmost roll in each upper layer must be secured by banding to other rolls if located in either of last 2 wells formed by rearmost rolls in layer below



North American Cargo Securement Training Paper Rolls-42

Eyes Crosswise: Upper Layers Side-to-Side Movement

- Secure by same means required for bottom layer when there is more than total of 203 mm (8 in) of space between ends of paper roll and:
  - Other rolls
  - Walls of vehicle
- Same requirements used to secure single layer of paper rolls

North American Cargo Securement Training Paper Rolls-43

Paper Rolls Loaded with Eyes Lengthwise

- Each roll must be prevented from movement:

Direction of Potential Movement	Methods to Prevent Movement
Forward	Vehicle structure, other cargo, blocking, or tiedowns
Rearward	Other cargo, blocking, friction mats, or tiedowns
Side-to-Side	Contact with the vehicle wall or other cargo, or chocks, wedges, or blocking

North American Cargo Securement Training Paper Rolls-44

Paper Rolls Loaded with Eyes Lengthwise (cont'd)

- Chocks, wedges or blocking must be held securely in place by some means in addition to friction, so they cannot become unfastened or loose

North American Cargo Securement Training Paper Rolls-45

Paper Rolls Loaded with Eyes Lengthwise (cont'd)

- Rolls must not be loaded in higher layer if another roll will fit in layer below it
- Upper layer must be formed by placing paper rolls in wells formed by rolls below it

North American Cargo Securement Training Paper Rolls-46

Paper Rolls Loaded with Eyes Lengthwise (cont'd)

- Roll in upper layer must be secured against forward and rearward movement by:
  - Any means allowed for bottom layer
  - Use of blocking roll
  - Banding to other rolls

North American Cargo Securement Training Paper Rolls-47

Securement Requirements for Loading/Securing Paper Rolls on a Flatbed Vehicle or in a Curtain-Sided Vehicle

North American Cargo Securement Training Paper Rolls-48

Eyes Vertical or Lengthwise

- Paper rolls must be loaded and secured as described for earlier sided vehicle
- Entire load must be secured by tiedowns according to general cargo securement requirements
- Stacked loads of paper rolls with eyes vertical are prohibited

North American Cargo Securement Training Paper Rolls-49

Eyes Crosswise

- Paper rolls must be prevented from rolling or shifting forward and rearward by:
  - Contact with vehicle structure
  - Contact with other cargo
  - Use of chocks, wedges, blocking, or bracing OR
  - Tiedowns (as described in general cargo securement requirements)

North American Cargo Securement Training Paper Rolls-50

Eyes Crosswise (cont'd)

Note: Chocks, wedges, and blocking must be held in place by something more than friction so they don't become unfastened or loose while the vehicle is in transit.

North American Cargo Securement Training

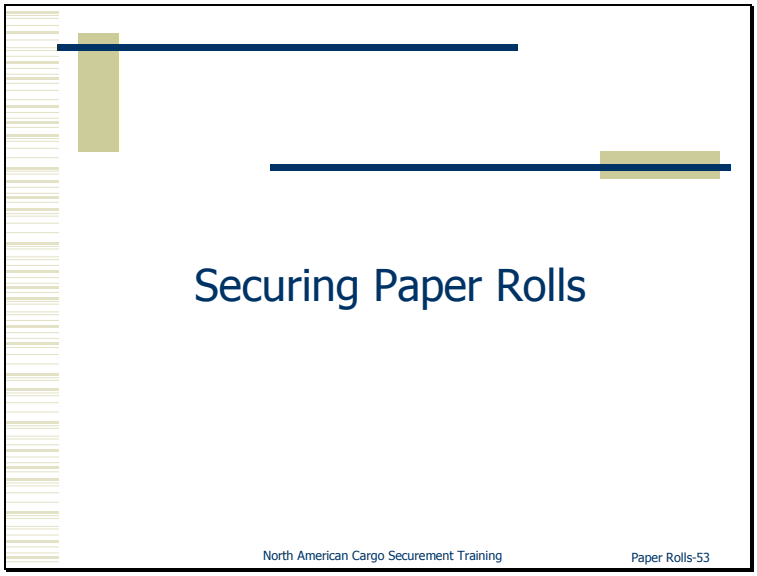
Paper Rolls-51

Eyes Crosswise (cont'd)

- Side-to-side or front-to-back tiedowns must be used to prevent side-to-side movement

North American Cargo Securement Training

Paper Rolls-52


Securing Paper Rolls
North American Cargo Securement Training
Paper Rolls-53

Securing Paper Rolls

In a small group, determine a safe securement system for the following loads of paper rolls. Consider the loading orientation and the number, placement, and type of cargo securement device. Create a checklist of securement requirements that you would use to ensure that the paper rolls are safely secured.

Scenario #1: A 14.63 (48 ft) van trailer is transporting 47 rolls of printing paper. All the rolls are 1.0 m (40 in) in diameter, 0.7 m (28 in) wide and weight 444 kg (980 lbs). The rolls are loaded eye to the sky, in a 2-1-2 pattern, with 30 rolls on the floor.

Loading Requirements	Number, Placement, Type of Cargo Securement Device	Inspection Checklist

Securing Paper Rolls

Scenario #2: A 16.14 m (53 ft) van trailer is transporting 13 rolls of corrugating medium. Each of the rolls is 1.5 m (58 in) in diameter, 1.4 m (55 in) wide and weights 1,590 kg (3,500 pounds).

Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

Securing Paper Rolls

Scenario #3: A driver with a 16.14 m (53 ft) flatbed trailer has the opportunity to haul a load of 18 rolls of newsprint. Each roll weighs 1,275 kg (2,811 lb.) and each roll is 1.25 m (50 in.) in diameter and 1.4 m (55 in.) in width.

Loading Requirements	Number, Placement, Type, of Cargo Securement Device	Inspection Checklist

What You Have Learned

- Specific securement requirements for shipments of paper rolls over 2,268 kg (5,000 lb.)
- In particular, requirements for:
  - Loading, placement, and use of friction mats
  - Using tiedowns, void fillers, bracing, and banding to prevent tipping
  - How to load multi-tiers of paper rolls

North American Cargo Securement Training Paper Rolls-54

What You Have Learned (cont'd)

- Paper rolls are easily damaged and can roll, slide, or tip if not properly secured
- Industry has 3 primary methods for loading:
  - Eyes vertical
  - Eyes horizontal and crosswise
  - Eyes horizontal and lengthwise

North American Cargo Securement Training Paper Rolls-55

North American Cargo Securement Training

Concrete Pipe

What kinds of problems have you encountered transporting concrete pipe?

North American Cargo Securement Training Pipe-2

What You Will Learn

- How cargo securement principles apply to concrete pipe
- What is required to properly secure concrete pipe, including the:
  - Number
  - Placement
  - Types of cargo securing devices
- When securement systems are not in compliance

North American Cargo Securement Training Pipe-3

Principles for Securing Concrete Pipe

North American Cargo Securement Training Pipe-4

Concrete Pipe Characteristics

- Provides high friction, except when ice is present; remove ice if possible
- Rolls easily
- Cylindrical shape allows compact packing

North American Cargo Securement Training Pipe-5

Concrete Pipe Failure Modes

- Needs to be secured for safe transport
- If not secured, it can:
  - Roll
  - Slide, with vibration

North American Cargo Securement Training Pipe-6

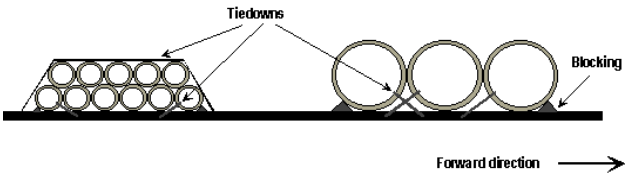
Planning a Securement System

- Load pipe symmetrically to be as compact as possible
- Symmetrically stacked pipe can be immobilized by securing in groups, when possible

North American Cargo Securement Training Pipe-7

Planning a Securement System (cont'd)

- Need blocking systems/tiedowns attached to cargo to prevent rolling
- Need tiedowns that pass over cargo to increase effect of friction



North American Cargo Securement Training Pipe-8

Application of Standard

- Applies to transportation of concrete pipe loaded crosswise on platform trailer or vehicle

North American Cargo Securement Training Pipe-9

Application of Standard (cont'd)

- Exceptions that can be secured by general cargo securement requirements (Module 2):
  - Concrete pipe grouped tightly together into single rigid article that has no tendency to roll
  - Concrete pipe loaded in sided vehicle or container
  - Concrete pipe loaded longitudinally or vertically on a platform vehicle

North American Cargo Securement Training Pipe-10

Application of Standard (cont'd)

- What about concrete pipe loaded vertically and concrete pipe loaded lengthwise?
  - Secure in accordance with general cargo securement requirements (Module 2)

North American Cargo Securement Training Pipe-11

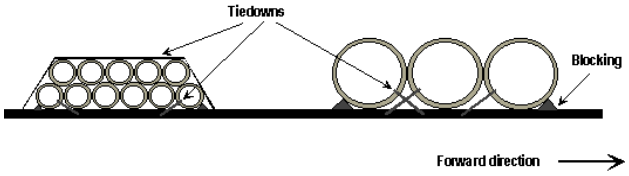
Securement Requirements for Concrete Pipe

North American Cargo Securement Training Pipe-12

Arranging the Load

Pipe of different diameter:

- If pipe of more than one diameter is loaded on vehicle:
  - Groups must be formed of pipe of only one size
  - Each group must be secured separately



North American Cargo Securement Training Pipe-13

Arranging the Load (cont'd)

Bottom Tier:

- Either cover full length of vehicle

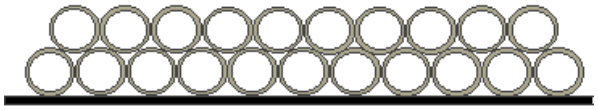
- Or arrange as a partial tier in one group or 2 groups

North American Cargo Securement Training Pipe-14

Arranging the Load (cont'd)

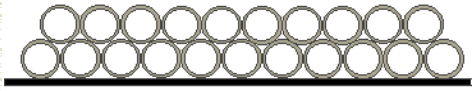
Upper Tier:

- Pipe must be placed only in wells formed by pipes in tier below it
- Additional tier must not be started unless all wells in tier below it are filled



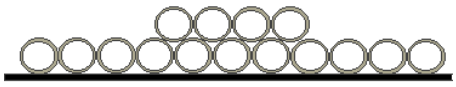
North American Cargo Securement Training Pipe-15

Securement Requirements: Concrete Pipes - Arranging the Load (cont'd)



Complete Tier

Partial Tier in One Group



Partial Tiers in 2 Groups

North American Cargo Securement Training Pipe-16

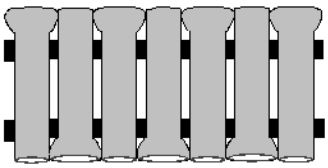
Arranging the Load (cont'd)

- When top tier is partial tier:
  - Front group does not need to be at front of tier below it
  - Rear group does not need to be at rear of tier below it

North American Cargo Securement Training Pipe-17

Loading Bell Pipe

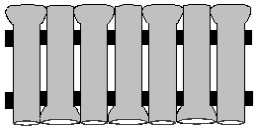
- Loaded on at least 2 longitudinal spacers of sufficient height to ensure bell is clear of deck

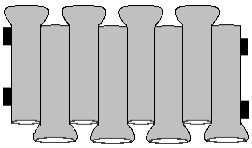


North American Cargo Securement Training Pipe-18

Bell Pipe on One Tier

- Bells alternating on opposite sides of vehicle
- Ends of consecutive pipe must be staggered, if possible within allowable width
  - Otherwise should be aligned

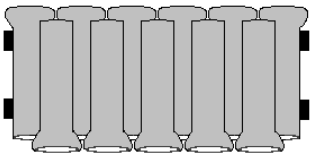




North American Cargo Securement Training Pipe-19

Bell Pipe in More Than One Tier - Using Complete Tiers

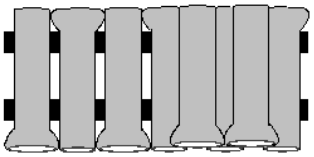
- Bells of bottom tier must be all on same side of vehicle
- Pipe in every upper tier must be loaded with bells on opposite side of vehicle to bells of tier below



North American Cargo Securement Training Pipe-20

Bell Pipe in More Than One Tier - Using Partial Tiers

- If second tier is not complete, pipes in bottom tier that do not support a pipe above must have bells alternating on opposite sides of vehicle



North American Cargo Securement Training Pipe-21

Tiedowns

- Aggregate WLL of all tiedowns on any group of pipe must be at least half (50%) total weight of all pipes in group
- A properly tensioned tiedown through a pipe in an upper tier or over longitudinal tiedowns is considered to secure all pipe beneath it on which that tiedown causes pressure

North American Cargo Securement Training Pipe-22

Concrete Pipes - Blocking

- Blocking must be used to prevent pipe from rolling
- Option #1: One piece of blocking must extend at least half the distance from center to each end of pipe

North American Cargo Securement Training Pipe-23

Concrete Pipes - Blocking

- Blocking must be used to prevent pipe from rolling
- Option #2: 2 pieces must be placed at outside quarter points

North American Cargo Securement Training Pipe-24

Concrete Pipes - Blocking (cont'd)

- Blocking must be:
  - Placed firmly against pipe
  - Secured to prevent it from moving out from under pipe
- Timber blocking must have minimum dimension of 10 x 15 cm (4 x 6 in)

North American Cargo Securement Training Pipe-25

Concrete Pipes - Blocking (cont'd)

- Small wedges are only temporary restraints to prevent rolling during loading and unloading
  - Not considered part of securement system for transportation

North American Cargo Securement Training Pipe-26

Securement Requirements for Concrete Pipe Up To 1.143 m (45 in) in Diameter

North American Cargo Securement Training Pipe-27

Securing Concrete Pipe Up To 1.143 m (45 in) Diameter

- Can form complete single tier on typical flatbed vehicle
  - Larger pipe often can only be carried as partial tier
- Anything bigger than 1.143 m (45 in) diameter is considered "large" pipe

North American Cargo Securement Training Pipe-28

Stabilizing the Bottom Tier

- Load can only be transported safely if bottom tier is loaded and secured so it is stable
- If not stable, load may collapse

North American Cargo Securement Training Pipe-29

Stabilizing the Bottom Tier (cont'd)

#1. Arrange load as described earlier

#2. Immobilize front and rear pipes of every group by:

- Either blocking
- Or wedges
- Or stakes
- Or vehicle end structure
- Or locked pipe unloader
- Or other equivalent means

North American Cargo Securement Training Pipe-30

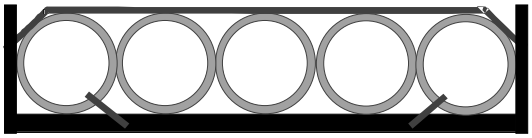
Stabilizing the Bottom Tier (cont'd)

#3. Use additional blocks and/or wedges as needed to hold other pipe in bottom tier in place

North American Cargo Securement Training Pipe-31

Stabilizing the Bottom Tier (cont'd)

#4. Hold every pipe in bottom tier firmly in contact with adjacent pipe by tiedowns through front and rear pipe of every group



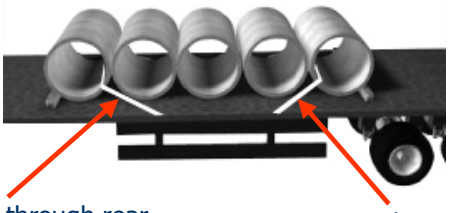
North American Cargo Securement Training Pipe-32

Stabilizing the Bottom Tier (cont'd)

- At least one tiedown through front pipe of bottom tier must run rearward at an angle not more than 45 degrees with the horizontal when viewed from the side of the vehicle, whenever practical
- At least one tiedown through rear pipe of bottom tier must run forward at an angle not more than 45 degrees with the horizontal when viewed from the side of the vehicle, whenever practical

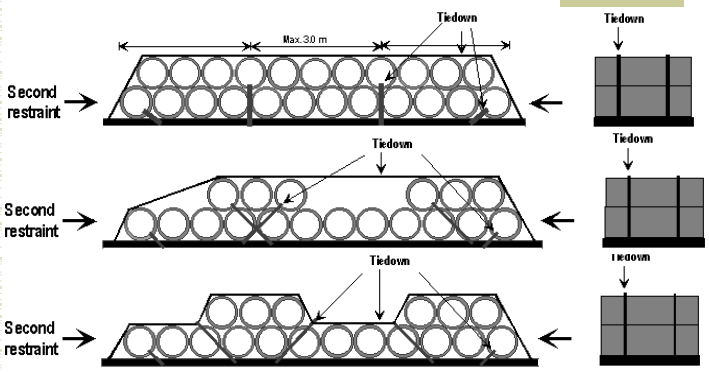
North American Cargo Securement Training Pipe-33

Stabilizing the Bottom Tier (cont'd)



North American Cargo Securement Training Pipe-34

Stabilizing the Bottom Tier (cont'd)



North American Cargo Securement Training Pipe-35

General Use of Tiedowns

- Pipes may be secured individually or as a group
- If secured individually, use tiedown attached through each pipe

North American Cargo Securement Training Pipe-36

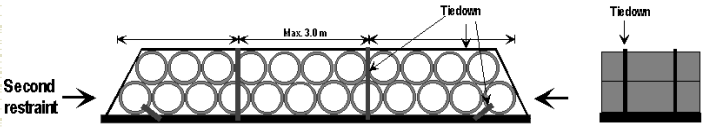
Use of Tiedowns (cont'd)

- If pipe not secured individually with tiedown, it <u>must</u> be secured with a chain or wire rope:
  - Place end-to-end (longitudinally) over group of pipes
    - Either one 13 mm (1/2 in) chain or wire rope
    - Or two 10 mm (3/8 in) chain or wire rope

North American Cargo Securement Training Pipe-37

Use of Tiedowns (cont'd)

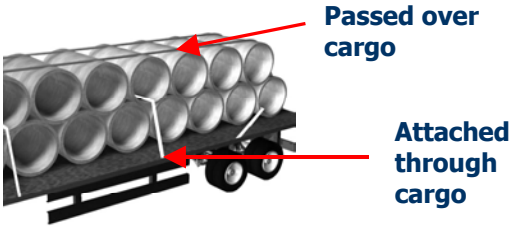
- If pipe not secured individually with tiedown:
  - Use one side-to-side (transverse) tiedown for every 3.0 m (10 ft) of load length
- Side-to-side tiedowns may be placed
  - Either through a pipe
  - Or over longitudinal tiedown(s) between 2 pipes on top tier



North American Cargo Securement Training Pipe-38

General Use of Tiedowns (cont'd)

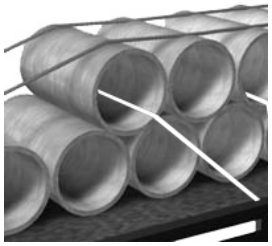
- Tiedown attached through upper tier pipe secures all pipe below it on which that tiedown causes pressure



North American Cargo Securement Training Pipe-39

Stabilizing Top Tier

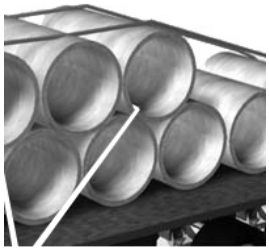
- If first pipe of group in top tier is not placed in first well formed by pipes at front of tier beneath:
  - Secure it by additional tiedown that runs rearward at angle not more than 45 degrees to horizontal, when viewed from side
  - Pass tiedown either through front pipe of upper tier or outside it and over longitudinal tiedown(s)



North American Cargo Securement Training Pipe-40

Stabilizing Top Tier (cont'd)

- If last pipe of group in top tier is not placed in last well formed by pipes at rear of tier beneath:
  - Secure it by additional tiedown that runs forward at angle not more than 45 degrees to horizontal, when viewed from side
  - Pass tiedown either through rear pipe of upper tier or outside it and over longitudinal tiedown(s)



North American Cargo Securement Training Pipe-41

Securement Requirements for Large-Sized Concrete Pipe [over 1.143 m (45 in) in Diameter]

North American Cargo Securement Training Pipe-42

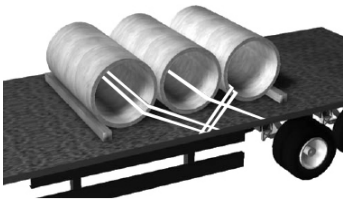
Securing Large-Sized Pipe

- Arrange loading as described earlier
- Front pipe and rear pipe must be secured by:
  - Either blocking (secure it)
  - Or wedges (secure them)
  - Or vehicle end structure
  - Or stakes
  - Or locked pipe unloader
  - Or other equivalent means
- All other pipe
  - Use additional blocks and/or wedges that are nailed in place

North American Cargo Securement Training Pipe-43

Tiedowns

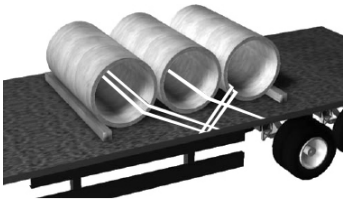
- At least one tiedown through each pipe in front half of load (includes middle one if odd number)
- Tiedown must run rearward at an angle not more than 45 degrees with horizontal, when viewed from side



North American Cargo Securement Training Pipe-44

Tiedowns (cont'd)

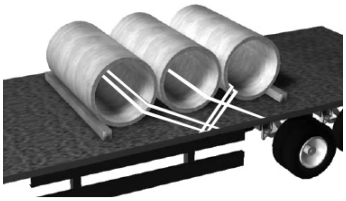
- At least one tiedown through each pipe in rear half of load
- Tiedown must run forward at angle not more than 45 degrees with horizontal (when viewed from side) to hold each pipe firmly in contact with adjacent pipe



North American Cargo Securement Training Pipe-45

Additional Securement

- Add at least 2 tiedowns through front and rear pipe if pipe not also in contact with:
  - Either vehicle end structure
  - Or stakes
  - Or locked pipe unloader
  - Or other equivalent means



North American Cargo Securement Training Pipe-46

Additional Securement (cont'd)

- If only one pipe is transported or if several pipes are transported without contact between other pipes:
  - Requirements of this section apply to each pipe as single front and rear article
  - Tiedowns must be used through that pipe

North American Cargo Securement Training Pipe-47

Securing Concrete Pipe Activity

North American Cargo Securement Training Pipe-48

Scenario #1

- A load of 17 concrete pipes is to be loaded on a flatbed vehicle with a headboard.
  - 11 of the pipes are 0.6 m (2 ft) in diameter and weigh 900 kg (2,000 lb.) each
  - The other 6 pipes are 1.25 m (4 ft) in diameter and weigh 1,350 kg (3,000 lb.) each

North American Cargo Securement Training Pipe-49

Scenario #2

- A load of 11 concrete pipes is to be loaded on a flatbed vehicle without a headboard.
  - 8 of the pipes are 1 m (3 ft) in diameter and weigh 1,360 kg (3,000 lb.) each
  - Other 3 pipes are 1.5 m (5 ft) in diameter and weigh 2,275 kg (5,000 lb.) each

North American Cargo Securement Training Pipe-50

Scenario #3

- A load of 7 concrete pipes is to be loaded on a flatbed vehicle that does not have a headboard.
  - All 7 pipes are 1,85 m (6 ft) in diameter and weigh 3000 kg (6,600 lb.) each

North American Cargo Securement Training Pipe-51

What You Have Learned

- Securement requirements for transportation of concrete pipe loaded crosswise on platform trailer or vehicle
- Load arrangement, including bell pipe, in one or more tiers
- How to properly secure concrete pipe
  - Pipe up to 1.143 m (45 in)
  - Pipe over 1.143 m (45 in)

North American Cargo Securement Training Pipe-52

Remember

- Concrete pipes pack well together and provide high friction when free of ice
- Pipes need to be secured to prevent them from sliding and rolling

North American Cargo Securement Training Pipe-53

North American Cargo Securement Training

Intermodal Containers

What kinds of problems have you encountered transporting intermodal containers?

North American Cargo Securement Training Intermodal-2

What You Will Learn

- How cargo securement principles apply to intermodal containers
- What is required to properly secure and transport intermodal containers, including type of vehicle and number, placement, and types of cargo securing devices
- When securement systems are not in compliance

North American Cargo Securement Training Intermodal-3

Principles for Securing Intermodal Containers

North American Cargo Securement Training Intermodal-4

Intermodal Container Characteristics

- Strong structure supported and secured by four bottom corners
- Strong support structure allows containers to be transported by ship, rail, and highway

North American Cargo Securement Training Intermodal-5

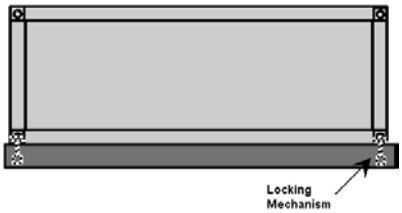
Intermodal Container Failure Modes

- For highway transport
  - Loaded intermodal containers need corners to be positioned and secured to prevent tipping or sliding

North American Cargo Securement Training Intermodal-6

Planning a Securement System

- Vehicle used to transport intermodal containers must be able to immobilize container corners
- Immobilizing devices must not become loose during transport



North American Cargo Securement Training Intermodal-7

Application of Standard

- Applies when transporting intermodal containers
- Cargo contained within intermodal container must be secured in accordance with:
  - General cargo securement requirements (Module 2)
  - If applicable, commodity-specific requirements

North American Cargo Securement Training Intermodal-8

Securement Requirements for Loaded Intermodal Containers

North American Cargo Securement Training Intermodal-9

Chassis Vehicle Requirements

- Secure container to container chassis with securement or integral-locking devices that cannot become unfastened while vehicle is in transit
- Integral-locking devices do not have to be adjustable

North American Cargo Securement Training Intermodal-10

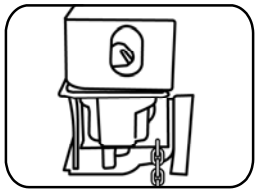
Chassis Vehicle Requirements (cont'd)

- If necessary, use secondary attachments to ensure latches remain fastened in transit

North American Cargo Securement Training Intermodal-11

Chassis Vehicle Requirements (cont'd)

- Securing devices must restrain container from moving more than:
  - 1.27 cm (1/2 in) forward
  - 1.27 cm (1/2 in) aft
  - 1.27 cm (1/2 in) to the right
  - 1.27 cm (1/2 in) to the left
  - 2.54 cm (1 in) vertically



Integral Locking Device

North American Cargo Securement Training Intermodal-12

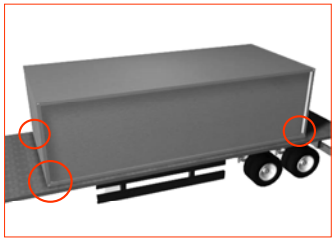
Chassis Vehicle Requirements (cont'd)

- Secure front and rear of container independently
  - 2 latches on chassis engage anchor points towards or at front of container
  - 2 latches engage at or towards rear of container
- If latch is missing or broken, secure corner by alternative means
  - Chain
  - Wire rope

North American Cargo Securement Training Intermodal-13

Non-Chassis Vehicle Requirements

- All lower corners of intermodal container must rest upon vehicle OR
- Corners must be supported by structure capable of bearing weight of container
  - Support structure must be independently secured to vehicle



North American Cargo Securement Training Intermodal-14

Non-Chassis Vehicle Requirements (cont'd)

- All containers must be secured to vehicle:
  - Either by chains, wire rope, or integral locking devices fixed to all lower corners
  - Or by crossed chains fixed to all upper corners
  - Or by both

North American Cargo Securement Training Intermodal-15

Non-Chassis Vehicle Requirements (cont'd)

- Secure front and rear of container independently
- One option:
  - One chain and 2 binders at front
  - One chain and 2 binders at rear

North American Cargo Securement Training Intermodal-16

Non-Chassis Vehicle Requirements (cont'd)

- Each of 4 corners secured using tiedowns:
  - Attached to container
  - With minimum aggregate WLL of 50% of loaded weight of container
- Each chain, wire rope, or integral locking device must be attached to container in manner that prevents it from being unfastened while in transit

North American Cargo Securement Training Intermodal-17

Empty Containers on Non-Chassis Vehicle

- If they meet 4 requirements, empty containers on non-chassis vehicles do not have to have all lower corners:
  - Resting upon vehicle
  - Supported by structure capable of bearing weight of empty container

North American Cargo Securement Training Intermodal-18

Four Requirements

1. Empty intermodal container is balanced and positioned on vehicle before addition of tiedowns or other securement equipment
2. Amount of overhang for empty container on trailer does not exceed 1.5 m (5 ft) on either front or rear of trailer

North American Cargo Securement Training Intermodal-19

Four Requirements

3. Empty intermodal container must not interfere with vehicle's maneuverability
4. Empty intermodal container is secured to prevent lateral, longitudinal, or vertical shifting:
   - Either by following requirements for loaded containers
   - Or by following general cargo securement requirements for tiedowns

North American Cargo Securement Training Intermodal-20

Activity
Securing Loaded Intermodal Containers on a Flatbed Vehicle

North American Cargo Securement Training Intermodal-21

Scenario

An intermodal container with a container weight of 22,700 kg (50,000 lb.) is loaded on a flatbed vehicle equipped with integral locking devices. However, not all the locking devices are in proper working order.

What would be the correct way to secure this container?

North American Cargo Securement Training Intermodal-22

What You Have Learned

- Intermodal containers may slide or tip if corners are not correctly positioned and secured to vehicle
- There are securement requirements for all intermodal containers
  - Loaded
  - Empty

North American Cargo Securement Training Intermodal-23

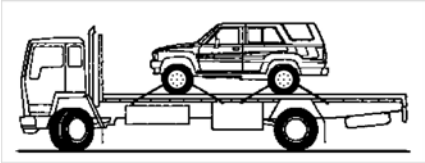
What You Have Learned

- There are securement requirements for transporting intermodal containers
  - On container chassis vehicles
  - On non-chassis vehicles

North American Cargo Securement Training Intermodal-24

North American Cargo Securement Training

Automobiles, Light Trucks, and Vans



What kinds of problems have you encountered transporting automobiles, light trucks, and vans?

North American Cargo Securement Training Autos-2

What You Will Learn

- How cargo securement principles apply to automobiles, light trucks, and vans
- What is required to properly secure automobiles, light trucks, and vans, including type of vehicle and number, placement, and types of cargo securing devices
- When securement systems are not in compliance

North American Cargo Securement Training Autos-3

Principles for Securing Automobiles, Light Trucks, and Vans

North American Cargo Securement Training Autos-4

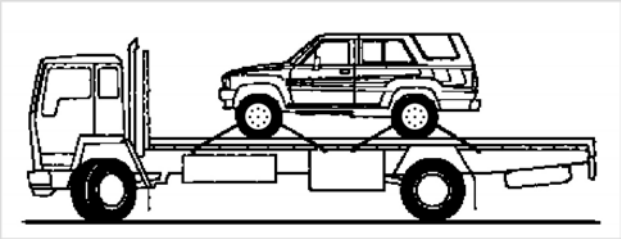
Automobiles, Light Trucks, and Van Failure Modes

- Sliding
- Rolling

North American Cargo Securement Training Autos-5

Planning a Securement System

- Need tiedowns directly attached to vehicle



North American Cargo Securement Training Autos-6

Application of Standard

- Apply when transporting:
  - Automobiles
  - Light Trucks
  - Vans

North American Cargo Securement Training Autos-7

Application of Standard (cont'd)

- Vehicles must individually weigh 4,500 kg (10,000 lb.) or less
- Vehicles heavier than 4,500 kg (10,000 lb.) must be secured using requirements for heavy equipment (Module 10)

North American Cargo Securement Training Autos-8

Securement Requirements

- Using at least 2 tiedowns, cargo must be restrained at both front and rear to prevent movement:
  - Side-to-side
  - Forward and rearward
  - Vertically

North American Cargo Securement Training Autos-9

Securement Requirements: Tiedowns

- Tiedowns that are designed to be attached directly to structure of vehicle being transported must use vehicle securement mounting points

North American Cargo Securement Training Autos-10

Securement Requirements: Tiedowns

- Tiedowns designed to fit over or around wheels of vehicle being transported must provide restraint:
  - Side-to-side
  - Forward and rearward
  - Vertically

North American Cargo Securement Training Autos-11

Securement Requirements: Tiedowns (cont'd)

Note: *More tiedowns may be necessary to satisfy the requirements in Parts 1 and 2 of the Standard. The Standard states: "The aggregate working load limit 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."*

North American Cargo Securement Training Autos-12

Securement Requirements: Edge Protectors

- Edge protectors are not required for synthetic webbing at points where webbing comes in contact with tires

North American Cargo Securement Training Autos-13

Activity: Securing Automobiles, Light Trucks, and Vans

North American Cargo Securement Training Autos-14

Scenario #1

Six automobiles weighing 1,588 kg (3,500 lb.) each are being loaded on a car carrier trailer.

What would be the correct way to secure these vehicles?

North American Cargo Securement Training Autos-15

Scenario #2

One light truck weighing 1,905 kg (4,200 lb.) is being hauled on a flat bed trailer from one job site to another.

What would be the correct way to secure these vehicles?

North American Cargo Securement Training Autos-16

Scenario #3

One automobile weighing 1,451 kg (3,200 lb.) is being hauled in a van trailer from one location to another.

What would be the correct way to secure these vehicles?

North American Cargo Securement Training Autos-17

What You Have Learned

- How to properly secure automobiles, light trucks, and vans
- Remember:
  - Automobiles, light trucks, and vans have suspension systems and wheels that allow for sliding or rolling when being transported
  - Requirements apply for transported vehicles that individually weigh 4,500 kg (10,000 lb.) or less

North American Cargo Securement Training Autos-18

North American Cargo Securement Training

Heavy Vehicles, Equipment, and Machinery

What kinds of problems have you encountered transporting heavy vehicles, equipment, and machinery?

North American Cargo Securement Training Heavy Equipment-2

What You Will Learn

- How cargo securement principles apply to heavy vehicles, equipment, and machinery
- What is required to properly secure heavy vehicles, equipment, and machinery, including type of vehicle and number, placement, and types of cargo securing devices
- When securement systems are not in compliance

North American Cargo Securement Training Heavy Equipment-3

Principles for Securing Heavy Vehicles, Equipment, and Machinery

North American Cargo Securement Training Heavy Equipment-4

Characteristics

- Securing heavy vehicles, equipment, and machinery can be very challenging
  - Vast number of types
  - Each has different design

North American Cargo Securement Training Heavy Equipment-5

Failure Modes

- Sliding (with vibration) along trailer bed
- Rolling
- Tipping or swinging of accessory equipment

North American Cargo Securement Training Heavy Equipment-6

Planning a Securement System

- To immobilize equipment and accessories and to prevent sliding, rolling, or tipping, use:
  - Parking brakes
  - Tiedowns that go over cargo
  - Tiedowns attached to cargo
  - Other mechanical braking methods

North American Cargo Securement Training Heavy Equipment-7

Application of Standard

- Apply when transporting heavy vehicles, equipment, and machinery that
  - Operate on wheels or tracks AND
  - Individually weigh 4,500 kg (10,000 lb.) or more

North American Cargo Securement Training Heavy Equipment-8

Application of Standard

- Cargo lighter than 4,500 kg (10,000 lb.) must be secured using requirements outlined in:
  - This module
  - Automobiles, Light Trucks, and Vans (Module 9)
  - General cargo securement requirements (Module 2)

North American Cargo Securement Training Heavy Equipment-9

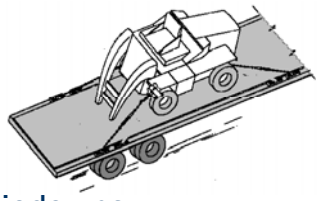
Preparation of Cargo

- Accessory equipment must be completely lowered and secured to vehicle
- Articulated vehicles must be restrained to prevent articulation while in transit

North American Cargo Securement Training Heavy Equipment-10

Securement Requirements

- Restrain cargo in these directions:
  - Side-to-side
  - Forward
  - Rearward
  - Vertically



- Use minimum of 4 tiedowns
  - Each having WLL of at least 2,268 kg (5,000 lb.)

North American Cargo Securement Training Heavy Equipment-11

Securement Requirements: Tiedowns

- Tiedowns attached to cargo <u>must</u> be attached:
  - Either at front and rear of vehicle
  - Or at mounting points on cargo

North American Cargo Securement Training Heavy Equipment-12

Securement Requirements: Tiedowns (cont'd)

- More tiedowns may be necessary to satisfy the general requirements in Part 2 of Standard

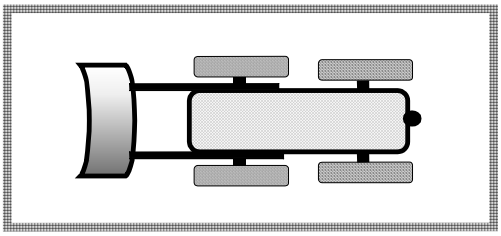
North American Cargo Securement Training Heavy Equipment-13

Securement Requirements: Tiedowns (cont'd)

Remember: *"The aggregate working load limit 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."*

North American Cargo Securement Training Heavy Equipment-14

Activity
Securing Heavy Equipment



North American Cargo Securement Training Heavy Equipment-15

Scenario #1

One tracked Excavator weighing 4,990 kg (11,000 lb.) is to be delivered to a customer using a stepdeck trailer that is equipped with a rub rail. The driver has G70 10 mm (3/8 in) chains to secure the load.

What would be the correct way to secure this vehicle?

North American Cargo Securement Training Heavy Equipment-16

Scenario #2

One wheel loader weighing 4,990 kg (11,000 lb.) is to be delivered to a customer using a lowboy trailer. The driver has G70 10 mm (3/8 in) chains to secure the load.

What would be the correct way to secure this vehicle?

North American Cargo Securement Training Heavy Equipment-17

Scenario #3

One bulldozer weighing 19,051 kg (42,000 lb.) is to be delivered to a customer using a lowboy trailer. The driver has G70 10 mm (3/8 in) chains to secure the load.

What would be the correct way to secure this vehicle?

North American Cargo Securement Training Heavy Equipment-18

Scenario #4

One 42,359 kg (100,000 lb.) press is to be delivered to a customer using a lowboy trailer. The driver has 4 G80 13 mm (½ in) chains and 10 G70 10 mm (3/8 in) chains to secure the load.

What would be the correct way to secure this vehicle?

North American Cargo Securement Training Heavy Equipment-19

What You Have Learned

- How to properly secure heavy vehicles, equipment, and machinery
- Remember:
  - These vehicles have various shapes, sizes, wheels, tracks, and suspension systems
  - Need to be secured to prevent sliding, tipping, or rolling
  - Requirements apply for heavy vehicles, equipment and machinery over 4,500 kg (10,000 lb.)

North American Cargo Securement Training Heavy Equipment-20

North American Cargo Securement Training Program

Flattened or Crushed Vehicles

What kinds of problems have you encountered transporting flattened or crushed vehicles?

North American Cargo Securement Training Crushed Vehicles-2

What You Will Learn

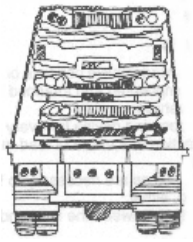
- How cargo securement principles apply when securing flattened or crushed vehicles
- What is required to properly secure flattened or crushed vehicles, including the number, placement, and types of cargo securing devices
- Identify securement systems that are not in compliance

North American Cargo Securement Training Crushed Vehicles-3

Principles for Securing Flattened or Crushed Vehicles

North American Cargo Securement Training Crushed Vehicles-4

Characteristics and Failure Modes



- Characteristics
  - Crushed vehicles have an irregular shape
- Securement Failure Modes
  - Sliding
  - Tipping
  - Loss of parts on highway

North American Cargo Securement Training Crushed Vehicles-5

Planning a Securement System

- Use tiedowns to prevent cargo from sliding or tipping
- Use vehicle sides and covering material to prevent loose parts from falling on highways

North American Cargo Securement Training Crushed Vehicles-6

Application of Standard

- Applies to automobiles, light trucks, and vans that have been flattened or crushed

North American Cargo Securement Training Crushed Vehicles-7

Securement Requirements for Flattened or Crushed Vehicles

North American Cargo Securement Training Crushed Vehicles-8

Securement Requirements

- Flattened or crushed vehicles must be transported so that:
  - Cargo does not shift while in transit AND
  - Loose parts from flattened vehicles do not become dislodged and fall from transport vehicle
- Use of synthetic webbing to secure flattened or crushed vehicles is prohibited

North American Cargo Securement Training Crushed Vehicles-9

Securement Requirement - Option #1

- Containment walls or comparable means on 4 sides that:
  - Extend to full height of load
  - Block against movement in these directions:
    - Forward
    - Rearward
    - Lateral

North American Cargo Securement Training Crushed Vehicles-10

Securement Requirement - Option #2

- Containment walls or comparable means on 4 sides that:
  - Extend to full height of load
  - Block against movement in:
    - Forward direction
    - Rearward direction
    - One lateral direction
- At least 2 tiedowns per stack with minimum working load limit for each tiedown of 2,268 kg (5,000 lb.)

North American Cargo Securement Training Crushed Vehicles-11

Securement Requirement - Option #3

- Containment walls or comparable means on 2 sides that:
  - Extend to full height of load
  - Block against movement in:
    - Forward direction
    - Rearward direction
- At least 3 tiedowns per stack with minimum working load limit for each tiedown of 2,268 kg (5,000 lb.)

North American Cargo Securement Training Crushed Vehicles-12

Securement Requirement - Option #4

- 4 tiedowns per stack with minimum working load limit for each tiedown of 2,268 kg (5,000 lb.)

North American Cargo Securement Training Crushed Vehicles-13

Securement Requirements

Remember: *"The aggregate working load limit 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."*

North American Cargo Securement Training Crushed Vehicles-14

Containment of Loose Parts

- Vehicles used to transport flattened or crushed vehicles must use containment system that prevents:
  - Loose parts from falling from all four sides of vehicle
  - Extends to full height of cargo
- This applies to each of 4 securement options

North American Cargo Securement Training Crushed Vehicles-15

Containment of Loose Parts (cont'd)

- Containment system can consist of one or combination of these:
  - Structural walls
  - Sides or sideboards
  - Suitable covering material
- Synthetic material is permitted for containment of loose parts

North American Cargo Securement Training Crushed Vehicles-16

Scenario

Seventeen crushed vehicles are being transported on a two-sided vehicle (front and back). The front stack weighs about 5,500 kg (12,000 lb.) and the second stack weighs about 7,300 kg (16,000 lb.)

What would be the correct way to secure the load?

North American Cargo Securement Training Crushed Vehicles-17

What You Have Learned

- Flattened or crushed vehicles need to be secured to prevent
  - Sliding
  - Tipping
  - Loss of parts on highway

North American Cargo Securement Training Crushed Vehicles-18

North American Cargo Securement Training

Roll-on/Roll-off and Hook-Lift Containers

Roll-on/Roll-off

Hook-Lift

What kinds of problems have you encountered transporting roll-on/roll-off and hook-lift containers?

North American Cargo Securement Training

Roll-On/Off-2

What You Will Learn

- How cargo securement principles apply to roll-on/roll-off and hook-lift containers
- What is required to properly secure roll-on/roll-off and hook-lift containers, including the number, placement, and types of cargo securing devices
- When securement systems that are not in compliance

North American Cargo Securement Training Roll-On/Off-3

Principles for Securing Roll-on/Roll-off and Hook-Lift Containers

North American Cargo Securement Training Roll-On/Off-4

Roll-on/Roll-off and Hook-Lift Container Characteristics

- Carried on specially designed vehicles equipped with securement devices on vehicle
- When secured, combines container and vehicle into one unit

North American Cargo Securement Training

Roll-0n/Off-5

Roll-on/Roll-off and Hook-Lift Container Failure Modes

- Sliding
- Tipping

North American Cargo Securement Training

Roll-0n/Off-6

Planning a Securement System

- To prevent forward, rearward, side-to-side, and vertical movement, use:
  - Front and rear securement system on vehicle
  - Other tiedowns at rear

North American Cargo Securement Training Roll-On/Off-7

Application of Standard

- For all roll-on/roll-off and hook-lift containers

North American Cargo Securement Training Roll-On/Off-8

Application of Standard (cont'd)

- Requirements apply to situations where a container is carried on vehicle not equipped with "Integral Securement System"

Integral Securement System

North American Cargo Securement Training

Roll-On/Off-9

Securement Requirements

1. Block against forward movement by lifting device, stops, a combination of both, or other suitable restraint mechanism
2. Secure to front of vehicle by lifting device or other suitable restraint against side-to-side and vertical movement
3. Secure to rear of vehicle with at least one of 3 mechanisms

North American Cargo Securement Training

Roll-On/Off-10

Rear Mechanism #1

- One tiedown attached to both vehicle chassis and container chassis

North American Cargo Securement Training

Roll-On/Off-11

Rear Mechanism #2

- Two tiedowns installed lengthwise, each securing one side of container to one of vehicle's side rails

North American Cargo Securement Training

Roll-On/Off-12

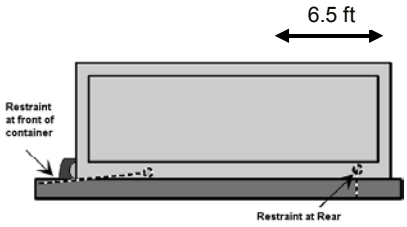
Rear Mechanism #3

- Two hooks, or an equivalent mechanism, securing both sides of container to vehicle chassis at least as effectively as tiedowns in two previous items

North American Cargo Securement Training Roll-On/Off-13

Additional Securement Requirements

- Rear securement mechanisms <u>must</u> be installed no more than two meters (6.5 ft) from rear of container



North American Cargo Securement Training Roll-On/Off-14

Additional Securement Requirements (cont'd)

- Each mechanism must have WLL of at least 2,268 kg (5,000 lb.)
- Install additional tiedowns if one or more of front stops or lifting devices is:
  - Missing
  - Damaged
  - Not compatible

North American Cargo Securement Training Roll-0n/Off-15

Activity
Securing Roll-on/Roll-off and Hook-Lift Containers

North American Cargo Securement Training Roll-0n/Off-16

Scenario

A container weighing 22,700 kg (50,000 lb.) is loaded on a vehicle that does not have an Integral Securement System.

The front stops on the vehicle are not compatible with the container.

What would be the correct way to secure the container?

North American Cargo Securement Training Roll-On/Off-17

What You Have Learned

- Containers and chassis' are secured together to form a complete unit
- Incorrectly secured containers may slide or tip
- The securement requirements apply for transportation of all roll-on/roll-off containers and hook-lift containers

North American Cargo Securement Training Roll-On/Off-18

What You Have Learned (cont'd)

- Additional securement is required for containers not equipped with Integral Securement System
- There are requirements for location and WLL for securing rear end container
- There are requirements for securing front of containers if front stops or lifting device is missing or ineffective

North American Cargo Securement Training

Roll-On/Off-19

North American Cargo Securement Training

Large Boulders

What kinds of problems have you encountered transporting large boulders?

North American Cargo Securement Training

Boulders -2

What You Will Learn

- Explain how the cargo securement principles apply when securing large boulders
- Calculate and determine what is required to properly secure large boulders, including the number, placement and types of cargo securing devices
- Identify securement systems that are not in compliance

North American Cargo Securement Training Boulders -3

Principles for Securing Large Boulders

North American Cargo Securement Training Boulders -4

Characteristics and Failure Modes

- Characteristics
  - No specific or similar shape
- Securement Failure Modes
  - Rolling
  - Sliding along each other or against supporting equipment (skids or trailer bed)

North American Cargo Securement Training Boulders -5

Planning a Securement System

- Tiedowns are used to prevent sliding
- Timbers and tiedowns are used to prevent rolling

North American Cargo Securement Training Boulders -6

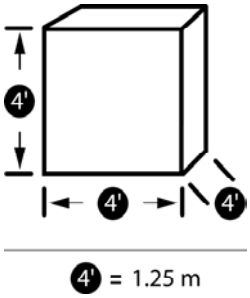
Application of Standard

- Any large boulder that:
  - Either weighs over 5,000 kg (11,000 lb.) or has a volume larger than 2 cubic meters (yards)
  - Is transported:
    - On an open vehicle
    - In a vehicle whose sides are not designed and rated for this purpose

North American Cargo Securement Training Boulders -7

2 Cubic Meters (Yards)

- About size of 1.25 m (4 ft) square box



North American Cargo Securement Training Boulders -8

Application of Standard (cont'd)

- For boulders weighing less than 5,000 kg (11,000 lb.)
  - May be secured using the requirements for large boulders
  - In some situations, can use general cargo securement requirements for cargo (Module 2)
    - If transported in vehicle designed to carry boulders
    - If boulders are stabilized and adequately secured by tiedowns

North American Cargo Securement Training Boulders -9

Application of Standard (cont'd)

- Two securement options for rock which has been formed or cut to shape and provides stable base for securement
  - Use requirements for large boulders
  - Use general cargo securement requirements (Module 2)

North American Cargo Securement Training Boulders -10

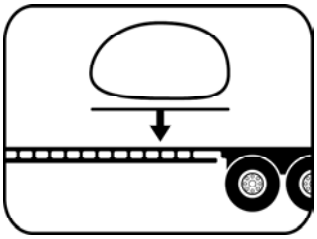
Securement Requirements for Large Boulders

North American Cargo Securement Training

Boulders -11

Boulder Placement

- Place each boulder with its flattest and/or largest side down

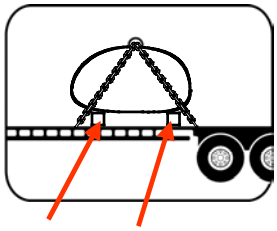


North American Cargo Securement Training

Boulders -12

Stabilize the Boulder

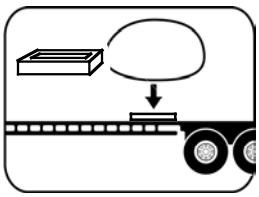
- Support each boulder on at least two pieces of hardwood blocking (at least 10 cm x 10 cm (4 x 4 in) that extending full width of boulder
  - Place hardwood blocking pieces as symmetrically as possible under boulder and support at least 3/4 of length of boulder



North American Cargo Securement Training Boulders -13

Stabilize the Boulder (cont'd)

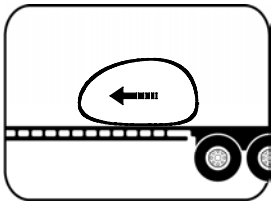
- If flattest side of boulder is rounded or partially rounded (boulder may roll), place it in crib made of hardwood fixed to deck of vehicle
  - Boulder <u>must</u> rest on both deck and timber, with at least 3 well-separated points of contact that prevent rolling in any direction



North American Cargo Securement Training Boulders -14

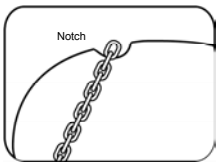
Boulder Placement

- If a boulder is tapered, point narrowest end towards front of vehicle



North American Cargo Securement Training Boulders -15

Tiedown Requirements



- Must use chain tiedowns to secure large boulders
- Tiedowns in direct contact with boulder:
  - Should be located in valleys or notches across top of boulder AND
  - Must be arranged to prevent sliding across rock surface

North American Cargo Securement Training Boulders -16

Three Categories

- Cubic shaped boulder
- Non-cubic shaped boulder with stable base
- Non-cubic shaped boulder with unstable base

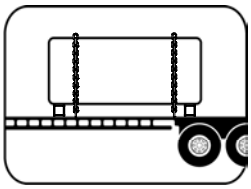
North American Cargo Securement Training Boulders -17

Securement Requirements for Cubic-Shaped Boulders

North American Cargo Securement Training Boulders -18

Cubic-Shaped

- In addition to large boulder requirements:
  - Secure boulder individually with at least two chain tiedowns placed side-to-side across vehicle
  - Aggregate WLL of tiedowns must be at least half weight of boulder
  - Place tiedowns as closely as possible to wood blocking used to support boulder



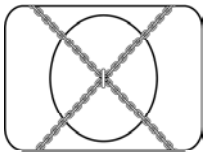
North American Cargo Securement Training Boulders -19

Securement Requirements for Non-Cubic Shaped Boulders with Stable Base

North American Cargo Securement Training Boulders -20

Non-Cubic Shaped, Stable Base

- In addition to large boulder requirements:
  - Secure boulder individually with at least two chain tiedowns forming "X" pattern over boulder
  - Aggregate WLL of tiedowns must be at least half weight of boulder



  - Pass tiedowns over center of boulder; attach to each other at intersection by shackle or other connecting device

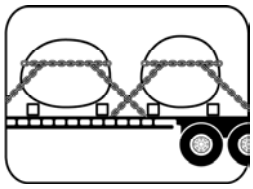
North American Cargo Securement Training Boulders -21

Securement Requirements for Non-Cubic Shaped Boulders with Unstable Base

North American Cargo Securement Training Boulders -22

Non-Cubic Shaped, Unstable Base

- In addition to large boulder requirements, secure each boulder by combination of chain tiedowns:
  - One chain must surround top of boulder (at point between 1/2 and 2/3 its height)
  - Aggregate WLL of tiedowns must be at least half weight of boulder



North American Cargo Securement Training Boulders -23

Non-Cubic Shaped, Unstable Base (cont'd)

- Four chains must be attached to surrounding chain and vehicle to form blocking mechanism to prevent horizontal movement
  - Each chain must have WLL of at least 1/4 the weight of boulder
  - Angle of chain must not exceed 45 degrees from horizontal

North American Cargo Securement Training Boulders -24

Scenario #1

Five cubic shaped boulders, each weighing 6,000 kg (13,200 lb.), are being transported on a flatbed vehicle.

North American Cargo Securement Training Boulders -25

Scenario #2

Four non-cubic shaped boulders each with a stable base and each one about 1.5 m (5 ft) in height, 1.25 m (4 ft) long, and 1.25 m (4 ft) wide are being transported on a flatbed vehicle.

North American Cargo Securement Training Boulders -26

Scenario #3

Three non-cubic shaped boulders with very unstable bases, each weighing about 6,800 kg (15,000 lb.), are being transported on a flatbed vehicle.

North American Cargo Securement Training Boulders -27

Summary

- There are general placement and tiedown requirements for large boulders, along with specific requirements for:
  - Cubic shaped boulders
  - Non-cubic shaped boulders with stable bases
  - Non-cubic shaped boulders with unstable bases

North American Cargo Securement Training Boulders -28

Summary

- Boulders do not have specific, similar shapes
- Boulders must be secured to prevent rolling or sliding
- Tiedowns must be chain
- These securement requirements apply when boulders weigh over 5,000 kg (11,000 lb.) or when volume of boulder is larger than 2 cubic meters (yards)

North American Cargo Securement Training Boulders -29