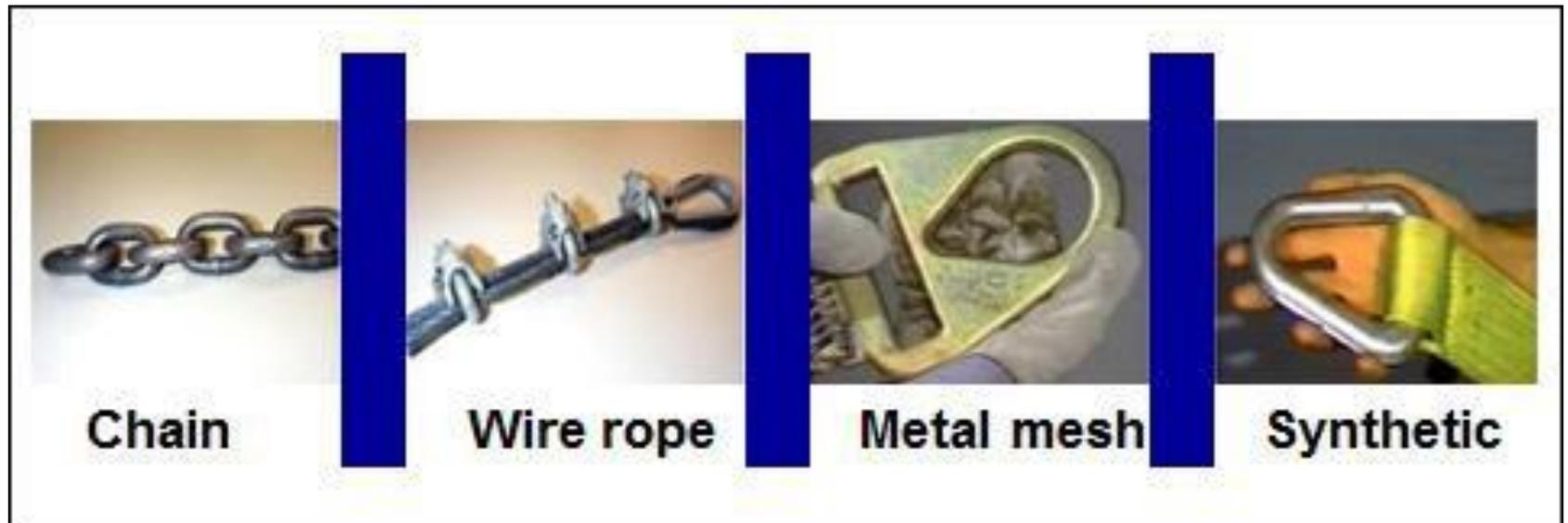


Material Handling Equipment

Module 3

Rigging Equipment

OSHA 1910.184 Slings: governs slings made from alloy steel chain, wire rope, metal mesh, natural or synthetic fiber rope, and synthetic web.



Material Handling and Storage

Module 3

To safely use slings take the following precautions:

- A competent person should conduct inspections of slings before and during use
- Remove damaged or defective slings from service

Material Handling and Storage

Module 3

To safely use slings take the following precautions:

- “Do not kink sling legs
- Do not load slings beyond their rated capacity
- Keep suspended loads clear of all obstructions
- Remain clear of loads about to be lifted and suspended
- Do not engage in shock loading
- Avoid sudden crane acceleration and deceleration when moving suspended loads”
- Do not use knots or bolts or other makeshift devices to shorten slings

Material Handling Equipment

Module 3

Chains



Overhead crane, chain, hook and hardware used to move beams during fabrication

Material Handling Equipment

Module 3

Chains

- Inspect prior to use – each shift and during use
- Discard defective equipment
- Do not over load rigging
- Specialized Hooks – clamps – should be proof tested



Do not use because of different
Grade of material



Chain marking

Material Handling Equipment

Module 3

- ID tag attached
- Listing -- size, grade, rated capacity & Mfg
- Hook – ring – load rating not less than chain's rating
- No make shift equipment – hook, rods, bolts
- When to discard chain?
- Wear exceeds limits of 1910 Table N-184-1
- Inspections based on:
 - Frequency of use
 - At least yearly
 - Severity of service
 - Nature of lift
 - Use common sense
 - Document dates of inspection



ID Attached to hook

Material Handling Equipment

Module 3

Chains

- Job or shop hooks and links or makeshift fasteners are not allowed
- Use the correct size pin for the job



Right



Wrong

Material Handling Equipment

Module 3

Chains

- AISC has a daily chain inspection form available at it's website

[:Company Name- Daily Chain Inspection Record Bay: _____ Date: _____			
	<input checked="" type="checkbox"/> Check	Okay	Bad
Tag Present		—	—
Excessive Wear, Nicks, or Gouges		—	—
Wear		—	—
Cracked or Broken Links or Components		—	—
Bent, Twisted, or Deformed Chain or Components		—	—
Stretched or Elongated Chain		—	—
Discoloration (Exposure to Heat / Weld Spatter)		—	—
Excessive Corrosion		—	—

Any discrepancy which interferes with the safe use of the chain will immediately be brought to the foremen's attention and appropriate action taken.

Material Handling Equipment

Module 3

Wire rope

- Cover/protect protruding ends of strands from splices
- Lubricate – protect wire rope
- Splice requirements
- Use wire rope 'U-bolt' clamp
- Check load capacity tables
- End attachments need to be proof tested



Wire rope end attachment

Material Handling Equipment

Module 3

Wire rope

- Do not pull sling from under loads
- Do not use if:
 - More than 10% of visible strands are broken
 - Signs of excess wear, corrosion, or defect
 - Protect slings from sharp edges
 - Sling – wires are kinked

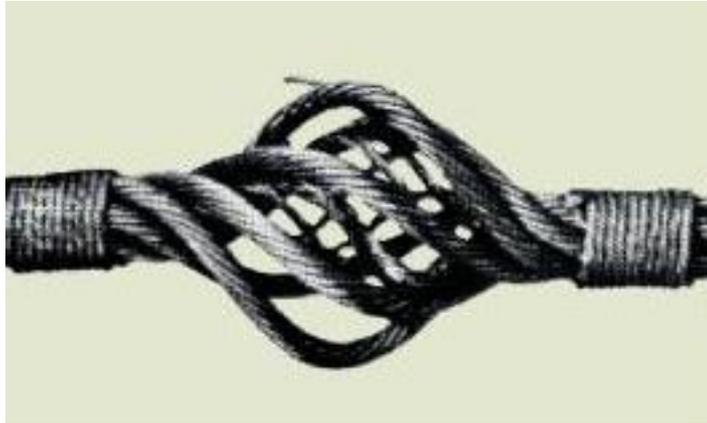


Remove from service

Material Handling Equipment

Module 3

Wire rope



Bird Caging



Kinking

Crushing



If these happen, remove the wire rope sling from service

Material Handling Equipment

Module 3

Wire Ropes

- ❑ AISC has a wire rope inspection form posted at it's website

WIRE ROPE SLING INSPECTION FORM					JOB # _____ JOB NAME: _____ SUPERVISOR _____		
					DATE _____ INSPECTED BY _____		
SLING	SLING ID	LOCATION	SIZE	LENGTH REACH	CONDITION CODE	COMMENT	ACTION
1							
2							
3							
4							
5							
6							
7							
8							
Condition Code		CONDITION			ACCEPTABLE	EXCESSIVE	Take any piece of rigging with excessive wear or damage out of service <u>immediately</u> . Destroy any piece of rigging taken out of service by cutting the eyes.



Material Handling Equipment

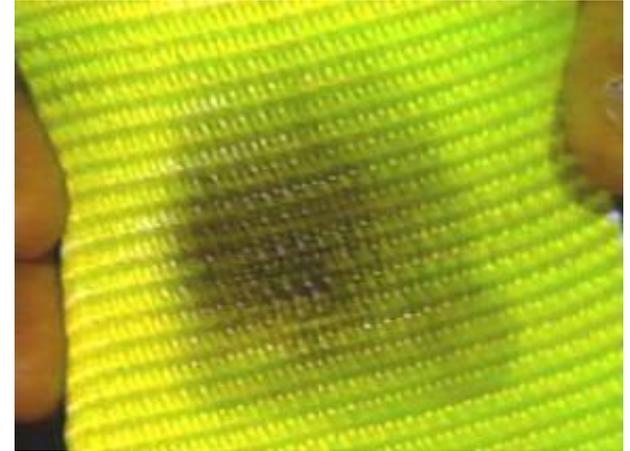
Module 3

Synthetic Web Slings

Remove from service if any of these are present:

- Acid or caustic burns
- Melting or charring of any part
- Snags, punctures, tears or cuts
- Broken or worn stitches
- Red core warning thread visible
- Distortion of fittings

Red core warning thread visible



Heat Damage



Material Handling Equipment

Module 3

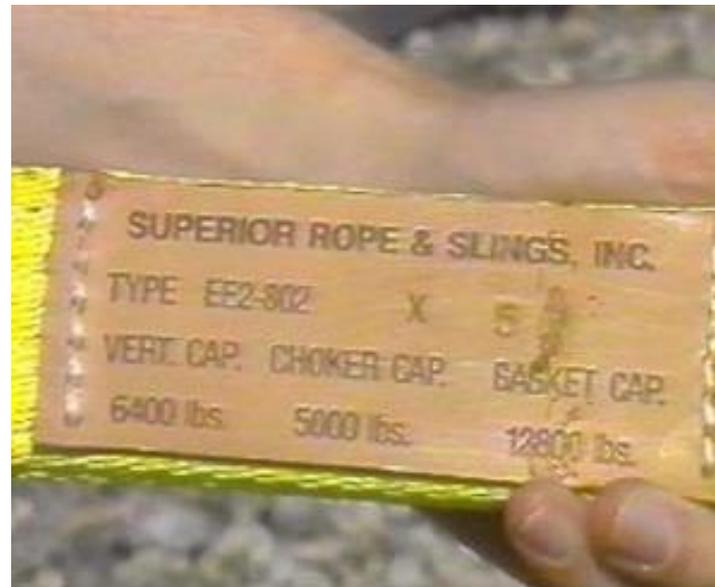
Synthetic web

- Mfg identification tag attached & legible
- Tag list rated capacity for type of hitch used
- Avoid sharp edges and high temperature with sling



Pending photo approval

Look for sling ID tag



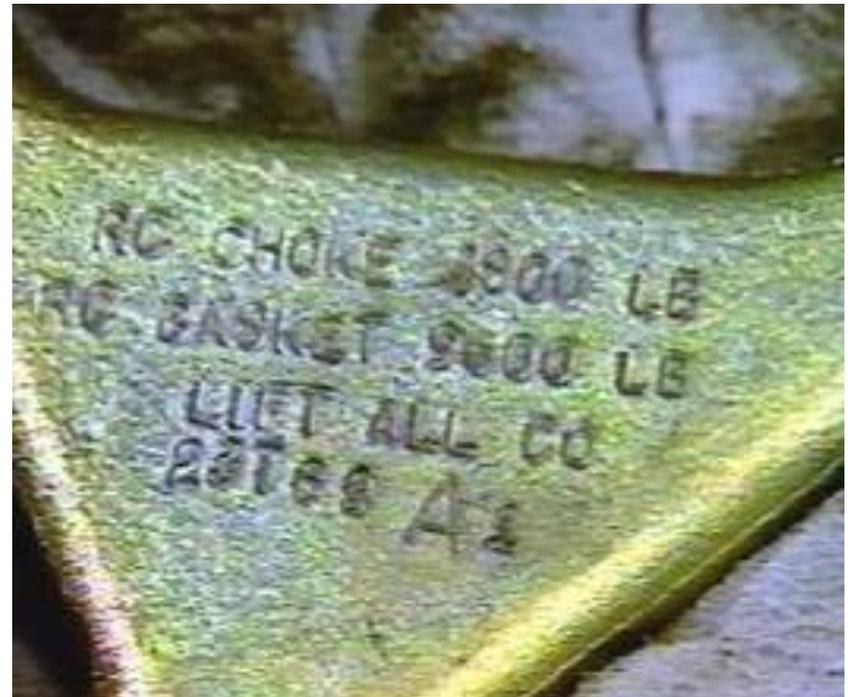
Material Handling and Storage

Module 3

Synthetic Web Slings

Fittings must be:

- At least as strong as that of the sling
- Free of sharp edges that could damage the webbing

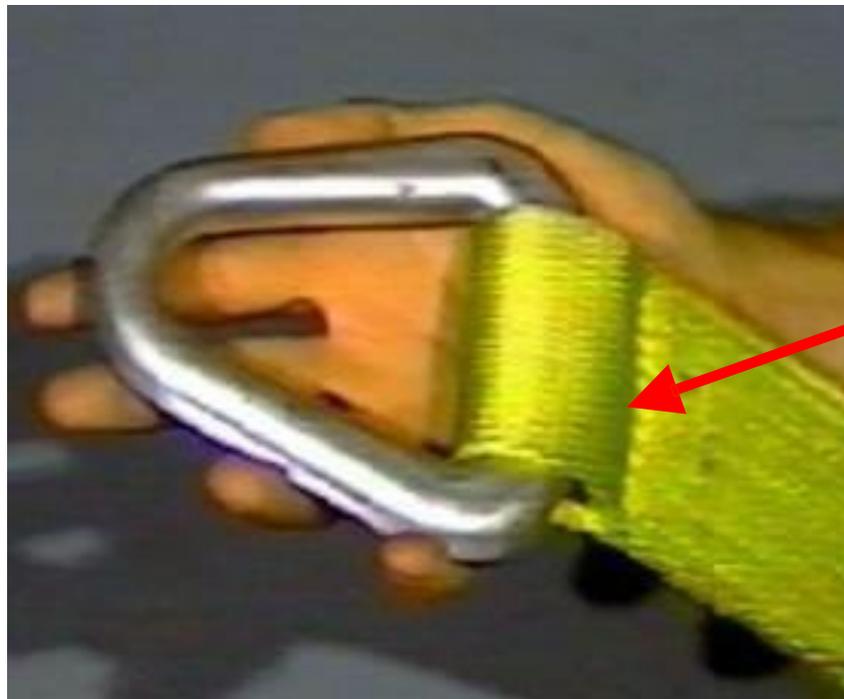


Material Handling and Storage

Module 3

Synthetic Web Sling Stitching

- ❑ Stitching is the only method allowed to attach end fittings to webbing, or to form eyes



Stitching

Material Handling and Storage

Module 3



Eye Size

Eyes should fit freely on the hook. Snug fits greatly increase eye strain.



Choker Hitch

Tight chokes greatly increase sling stress. Full wrap before choke gives no-slip lifting.

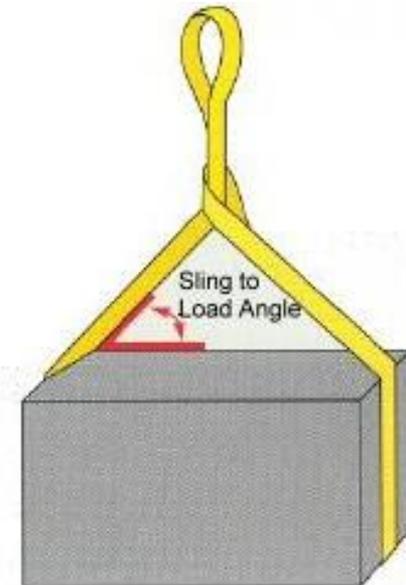
Sling Type	Width (In.)	Rated Capacities (Lbs.)			Length (Ft.)
		Vertical	Choker	Basket	
HEAVY-DUTY TUFF-EDGE SLINGS (SINGLE PLY)					
Eye & Eye	1	1600	1250	3200	4
Eye & Eye	1	1600	1250	3200	6
Eye & Eye	1	1600	1250	3200	8
Eye & Eye	2	3200	2500	6400	4

Sling Load Chart

As the sling-to-load angle decreases, so does the rated capacity of a sling.

Use this chart for all type slings: rope, chain or synthetic web.

Sling-To-Load Angle is always the angle between the sling leg and the horizontal surface.



Material Handling and Storage

Module 3

Inspect slings:

- Each day before use
- Where service conditions warrant
- Remove them from service if damaged or defective or the red core warning thread is visible

Material Handling and Storage

Module 3

AISC has a synthetic sling inspection form on its website

SYNTHETIC SLING INSPECTION FORM						JOB# _____ JOB NAME: _____ SUPERVISOR: _____	
						DATE _____ INSPECTION BY _____	
SLING	SLING ID	LOCATION	SIZE	LENGTH	CONDITION CODE	COMMENTS	ACTION
1							
2							
3							
4							
5							
6							
7							
8							
CONDITION CODE			CONDITION		ACCEPTABLE	EXCESSIVE	Take any piece of rigging with excessive wear or damage out of service <u>immediately</u> . Destroy any piece of rigging taken out of service by cutting the eyes. <i>Do not rigging to employees for their personal use.</i>
			WEAR		X	UN	
			BROKEN STITCHES		X	UN	
			HEAT DAMAGE		X	UN	
			CHEMICAL DAMAGE		X	UN	
			HOLES OR TEARS		X	UN	
			CUTS OR SNAGS		X	UN	
CONDITION OF END FITTING		X	UN				

Material Handling and Storage

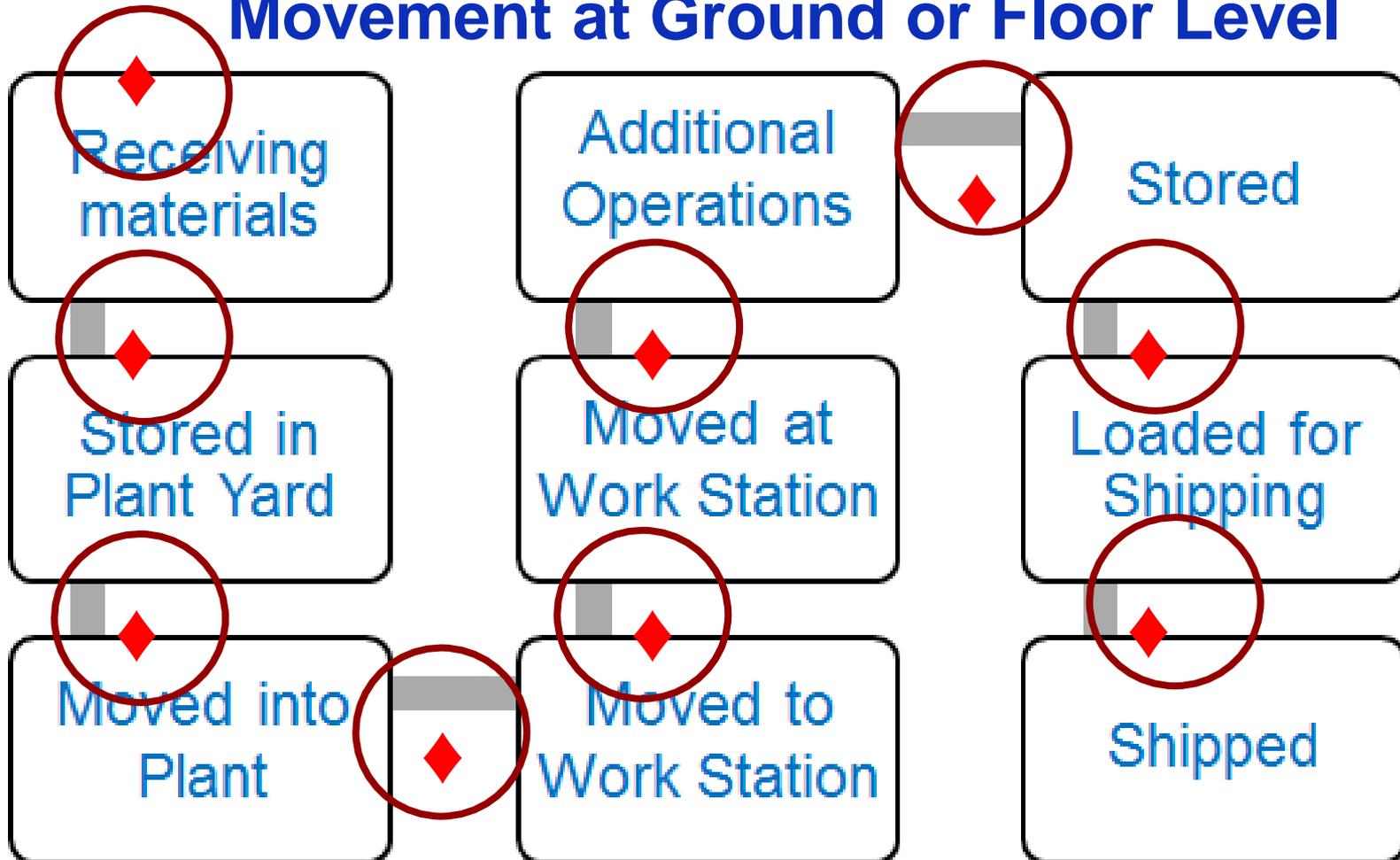
Module 3

Questions on slings and rigging?

Material Handling and Storage

Module 3

Movement at Ground or Floor Level

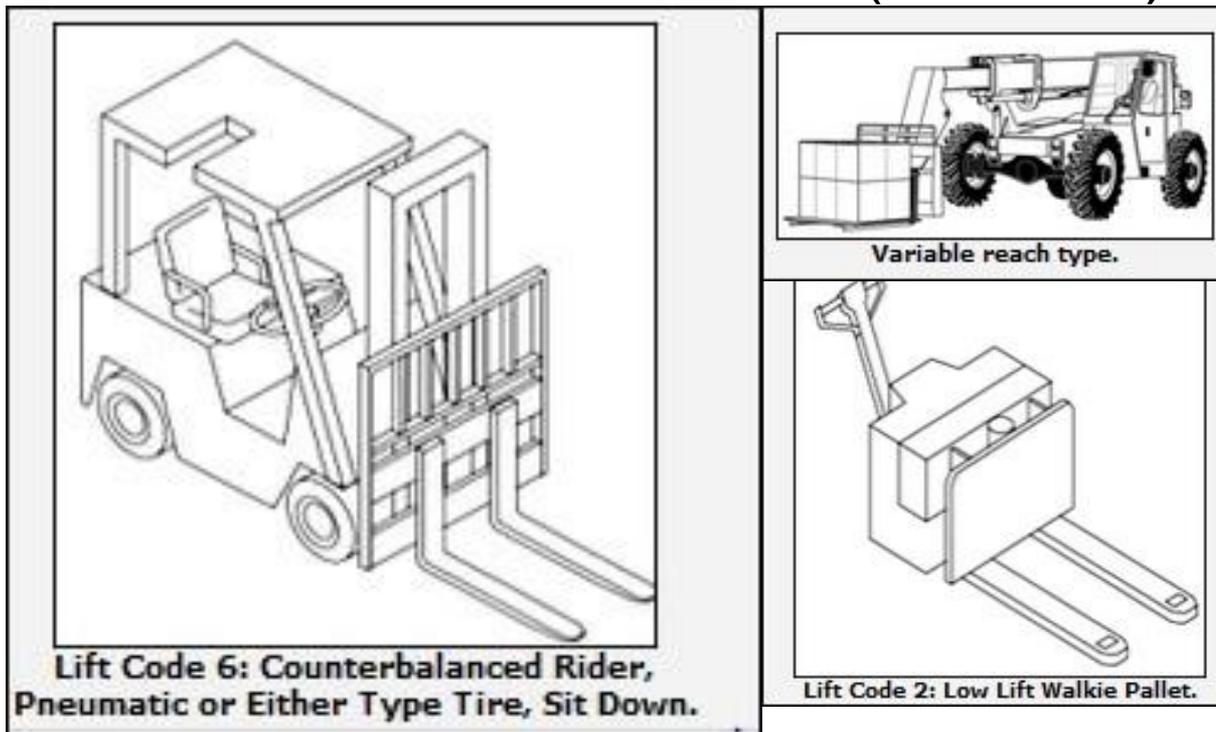


Material Handling and Storage

Module 3

Movement at Floor or Ground Level-Key Topics

❑ Powered Industrial Trucks-(Forklifts)



Drawings from

<https://www.osha.gov/SLTC/etools/pit/forklift/types/classes.html#class1>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts)

Hazard: “Approximately 100 employees are fatally injured and approximately 95,000 employees are injured every year while operating powered industrial trucks.”

“Forklift turnover accounts for a significant number of these fatalities.”



Material Handling and Storage

Module 3

Potential Hazards: Moving material within the shop-Powered Industrial Trucks-(Forklifts)

- ❑ Tipping, struck by caught between, wrong equipment for hazard classification

Hazard Avoidance:

- ✓ Select proper equipment for application and hazard
- ✓ Only qualified operators should use equipment
- ✓ Check equipment before use
- ✓ Do not overload
- ✓ Center loads

Material Handling and Storage

Module 3

Potential Hazards: Moving material within the shop-Powered Industrial Trucks-(Forklifts)

- ❑ Tipping, struck by caught between, wrong equipment for hazard classification

Hazard Avoidance:

- ✓ Drive safely
- ✓ No horseplay
- ✓ Watch for obstructions
- ✓ Do not leave unattended vehicles running
- ✓ Proper maintenance

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts)-Equipment

- Powered industrial trucks (forklifts) must meet requirements of American National Standard for Powered Industrial Trucks, Part II ANSI B56.1-1969
- Do not modify or make attachments without written approval from the manufacturer
- Nameplates and markings must be in place and legible
- Forklifts that are used in hazardous locations are required to be appropriately marked/approved for such use

<https://www.osha.gov/Publications/OSHA2236/osha2236.html>

<https://www.osha.gov/Publications/OSHA3252/3252.html>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts)-Operator Qualifications

- Train and certify all operators to ensure safe operation
- Do not operate a forklift if under 18 years old
- Must be competent
- Trainees must be supervised by a competent person and not endanger others
- Refresher training
- Reevaluation every three years
- Training requirements defined in 1910.178

<https://www.osha.gov/Publications/OSHA2236/osha2236.html>

<https://www.osha.gov/Publications/OSHA3252/3252.html>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts) Operation –before you operate:

- Check that rollover protective structure is in place
- Check overhead guards are in place to protect from falling objects
- Reverse signal alarm should be operational
- Check defects before using
- Fill fuel tanks only when the engine is off

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts) Operation-Loads

- Make sure loads are not heavier than the capacity of the industrial truck
- Loads should be stable and safely arranged and within the rated capacity of the truck
- Follow safe operating procedures for picking up, moving, putting down and stacking loads
- Center the load on the forks and as close to the mast as possible to minimize tipping or load falling
- Place the load at the lowest position for traveling
- Don't place extra weight on the rear of a counterbalanced forklift to allow an overload
- Dock boards (bridge plates) are properly secured when loading or unloading from loading docks

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts) Operation-driving and operating

- Drive safely-never over 5 mph- slow at congested areas
- Always wear seat belts
- Keep hands, arms legs and feet inside the truck
- No riders unless there is an approved seat
- Avoid traveling with elevated loads
- Observe all traffic regulations and plant speed limits
- Look in the direction of and keep a clear view of the path of travel
- Run trucks at a safe speed that permits safe stopping

<https://www.osha.gov/Publications/OSHA3252/3252.html>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts) Operation-Continued

- Stunt driving and horseplay are prohibited
- Check for headroom for the fork- lift under overhead installations, lights, pipes, etc
- Operators maintain a safe distance from the edge of ramps or platforms while using forklifts on any elevated dock, platform or freight car

<https://www.osha.gov/Publications/OSHA2236/osha2236.html>

<https://www.osha.gov/Publications/warehousing.html>

<https://www.osha.gov/SLTC/poweredinustrialtrucks/index.html>

<https://www.osha.gov/Publications/OSHA3252/3252.html>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts) Source OSHA Operation-Unattended vehicles

- ❑ “Load engaging means should be fully lowered, with controls neutralized, power shut off and brakes set when a forklift is left unattended”

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts)-Maintenance

- Properly maintain equipment, including tires and batteries
- Remove defective forklifts from service
- Handling batteries can be dangerous and requires special care and qualified personnel
- Charge batteries in designated areas

3220-10N 2004

<https://www.osha.gov/Publications/OSHA3252/3252.html>

Material Handling Equipment

Module 3

Powered Industrial Trucks (Forklifts)

- ❑ OSHA has a number of helpful materials available

The screenshot displays the OSHA website's 'Powered Industrial Trucks (Forklift)' page. The page features a navigation menu with options like 'Home', 'Workers', 'Regulators', 'Information', 'Data & Statistics', 'Training', 'Publications', 'Newsroom', 'Small Business', and 'Anti-Retaliation'. The main content area is titled 'Powered Industrial Trucks (Forklift)' and includes a sub-section for 'Types & Fundamentals'. Under this section, there is a list of 'Forklift Classifications' with links to detailed information for each class. The 'Class I: Electric Motor Rider Trucks' section is highlighted, and it includes three illustrations of different forklift types: a counterbalanced rider type stand-up forklift, a three-wheel electric sit-down forklift, and a counterbalanced rider cushion-tire sit-down forklift.

<https://www.osha.gov/SLTC/etools/pit/forklift/types/classes.html#class1>

Material Handling Equipment

Module 3

Powered Industrial trucks (Forklifts)

Forklift Safety

Safety and Health Topics: Powered Industrial Trucks

OSHA website index links to specific requirements and other Federal agency requirements.

<https://www.osha.gov/SLTC/poweredinustrialtrucks/index.html>

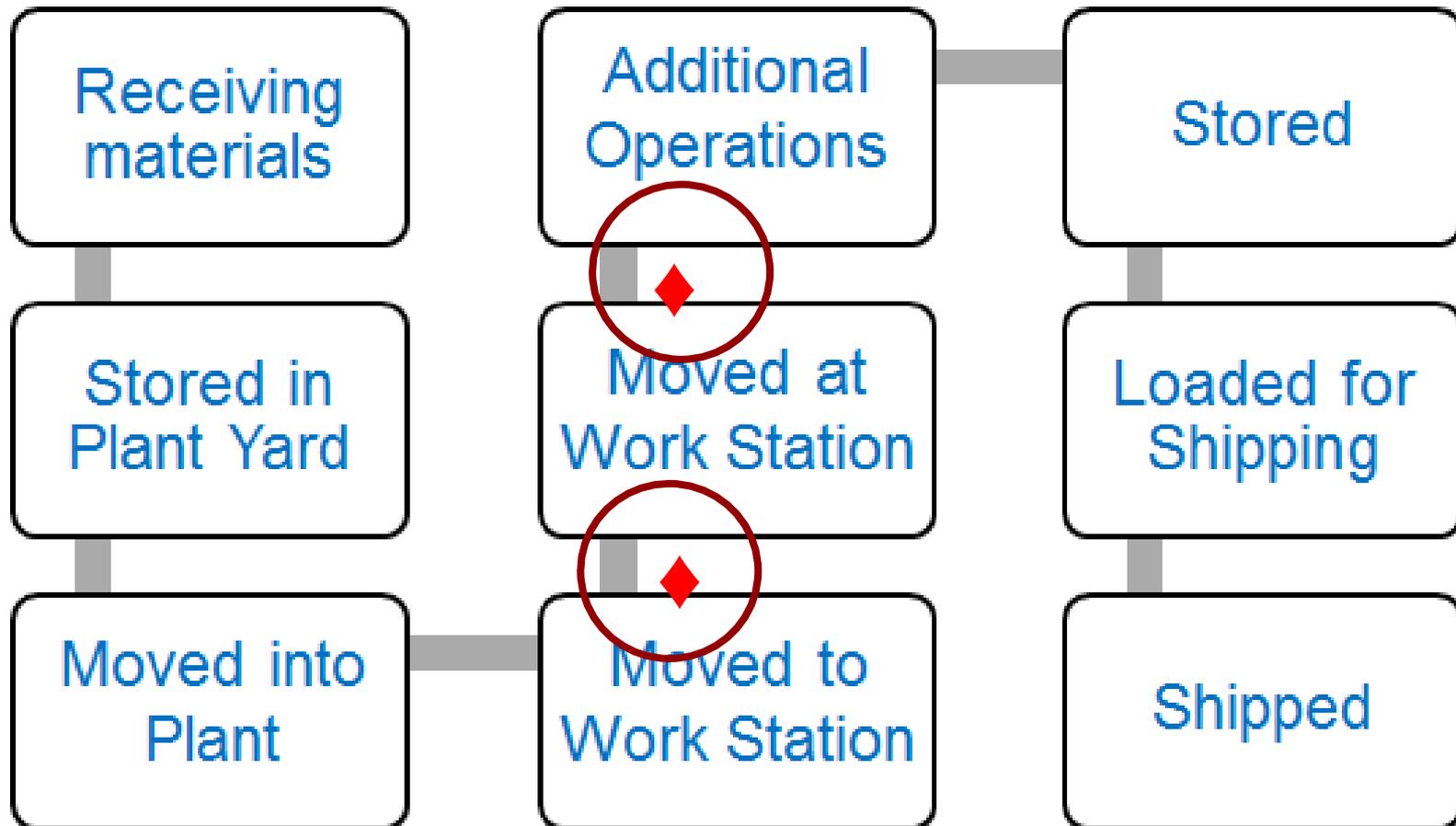
Sample Daily Checklists for Powered Industrial Trucks

https://www.osha.gov/dte/library/pit/daily_pit_checklist.html

Material Handling and Storage

Module 3

Movement at the Workstation-Key



Material Handling and Storage

Module 3

Movement at the Workstation-Key Topics

- Jib Cranes
- Carts
- Hoist Balancers
- Tool balancers

Material Handling and Storage

Module 3

Moving material at the work station

- Steel may be moved at the work station or between work stations by:
 - Overhead cranes
 - Jib cranes
 - Rollers
 - Carts and dollies
 - Hoist balancers
 - Tool suspension devices
 - Workers or pairs of workers
 - Others in your shop?**



Jib Crane



Roller system used to move material for fabrication

Material Handling Equipment

Module 3

Lighten the Load- Use Material Handling Equipment



Pallet Jack



Hand carts for moving small materials in the shop

Material Handling and Storage

Module 3

Potential Hazards: Moving material at the work station

- ☐ Injuries from dropped work, pinches, cuts, scrapes, burns from hot work, musculoskeletal injuries

Hazard Avoidance:

- ✓ Use proper PPE for the task
- ✓ Proper equipment use
- ✓ Being aware
- ✓ Being attentive of where your hands and feet are
- ✓ Don't work fatigued
- ✓ Use proper lighting
- ✓ Properly maintained equipment

Material Handling Equipment

Module 3

Lighten the Load- Use Material Handling Equipment

- Carts designed to transport and carry materials can reduce lifting, pushing, and pulling forces
- Allow for heavy materials, tools, or equipment to be moved without carrying
- Save time
- Available in many shapes and sizes

Material Handling Equipment

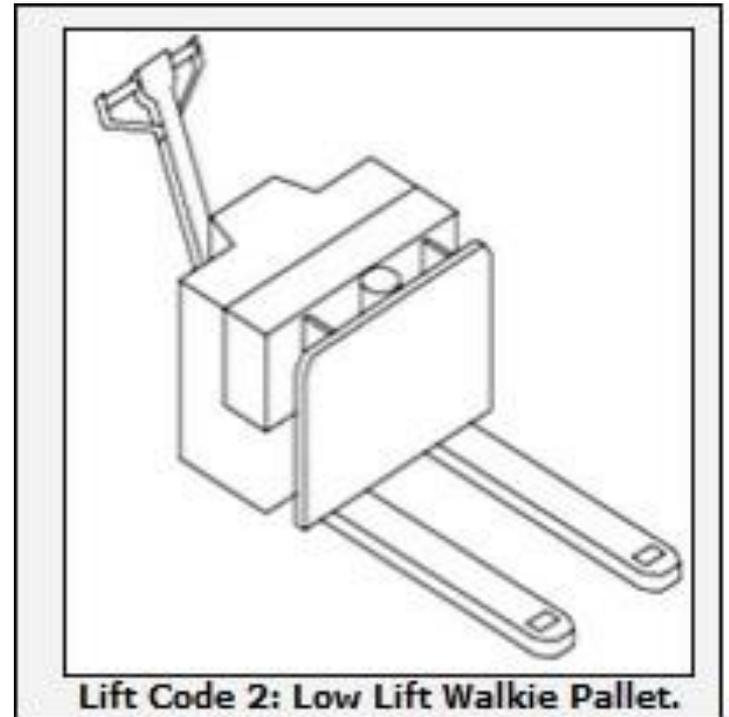
Module 3

Carts



Hand cart for small loads

Photo from CIANBRO



Material Handling Equipment

Module 3

Lighten the Load- Use Material Handling Equipment

Points to Remember:

- Motorized pallet jacks, if available, can be used for frequent or distant movement of materials. Handles should be located at the rear of the cart and positioned at waist level
- Don't obstruct view with the load
- Balance loads and keep load within manufacturer's recommended weight limits
- Pushing is easier than pulling
- Use proper wheels

Material Handling Equipment

Module 3

Jib Cranes

- ❑ “Wall, floor, or pillar mounted I-beam with a rolling trolley/hoist used to lift and position equipment and material”
- ❑ Jib cranes can be used near a work stations to help with tasks



Photo from OSHA 3341-03N 2008

Material Handling Equipment

Module 3

Jib Cranes

- ❑ AISC provides a useful pre-lift checklist. It is included in the training packet.

**Pre-Lift Checklist Manual Hoist
Exceeding 75% of Rated Capacity**

1. Load description			
2. Weight of load	(5)		
3. Slings	Qty	Type	Wt -
	Size	Cap	Wt -
4. Shackles	Qty	Type	Wt -
	Size	Cap	Wt -
5. Softeners	Qty	Type	Wt -
	Other	Qty	Type
6. Weight of rigging	Wt -		
7. Capacity of hoist	(7) Wt		
8. Weight of load + rigging (2-6)	(8) Wt		
9. Safety margin between capacity of hoist and load & rigging (7-8)	(9) Wt		
10. Weight of hoist with chain			
11. Weight of total load below attachment point (5+10) =	(11) Wt		
12. Attachment point capacity adequate to support weight lifting device and maximum anticipated load to be lifted. If no seek advice of qualified team member to determine capacity.	Yes	No	
13. Hoist inspection completed?	Yes	No	
14. Attachment points inspected?	Yes	No	
15. Tag lines required?	Yes	No	
	Size	Length	
16. Signal team member	Yes	No	
17. Spotter name			
18. Is matching Activity Plan done & reviewed by crew?	Yes	No	
Sign-off:			
Competent person (if director)			
Crew	Crew		
Supervisor (if applicable)			

DISCLAIMER: This safety form is a sample document provided by the AISC Safety Committee to be used in the shop or field. It is a sample form only and is intended to be modified by a competent person to meet the specific needs of your facility and operations. AISC is not responsible for the risks involved in using this form.

Material Handling Equipment

Module 3

Jib Cranes

- ❑ AISC pre-lift checklist continued

+
Sketch Area

Added Information

Wire rope— IWRC—6IPS 6 x 19 5/8 x 37
 Mechanical splice rings capacity in tons

Ring Diameter (Inches)	Ring Weight (Lbs.)	Capacity (Tons)	Capacity (Tons)	Capacity (Tons)
3/4	0.26	1.4	1.1	3.9
1/2	0.46	2.4	1.9	5.1
5/8	0.72	3.9	2.9	7.9
3/4	1.04	5.8	4.1	11
7/8	1.47	7.8	5.6	15
1	1.95	9.8	7.2	20
1 1/8	2.54	12	9.1	24
1 1/4	3.09	15	11	30
1 3/8	3.55	18	13	36
1 1/2	4.18	21	16	42
1 5/8	4.88	24	18	48
1 3/4	5.67	28	21	57
1 7/8	6.50	32	24	64
2	7.39	37	28	72
2 1/8	8.35	40	31	80
2 1/4	9.38	44	35	89
2 3/8	10.4	49	38	99
2 1/2	11.6	54	42	109
2 3/4	14.0	65	51	130

Rated Capacity	Standard Lift	Approximate Weight
1/2 Ton	20	40 lbs.
3/4 Ton	20	60 lbs.
1 Ton	20	110 lbs.
1 1/2 Ton	20	135 lbs.
2 Ton	20	250 lbs.

Manufactures listed are CIA, JET, YALE and HARRINGTON.
 If Brand, Rated Capacity or Standard Lift is not listed, refer to Vendor Catalog for information.

2 Way Spreader Chain Weights

1-Set 3/4" x 20 Spreader Chains each @ 64 lbs.
1-Set 1/2" x 20 Spreader Chains each @ 118 lbs.
1-Set 3/8" x 20 Spreader Chains each @ 184 lbs.

Down Chains

Model No.	WLL Tons	Flange Width Range	Flange Thickness Range (Inches)	Wt. Lbs.
P-4	4	4 to 10	1/2 - 1	70
P-15	15	7 to 17	1/2 - 2	133
NS-15	15	7 to 17	1/2 - 2	133
P-25	25	16 to 24	1-3	290
NS-25	25	16 to 24	1-3	290
P-35	35	16 to 28	1 5/8 - 4	519
NS-35	35	16-28	1 5/8 - 4	519

Crosby screw pin anchor shackles (G-209, S-209)

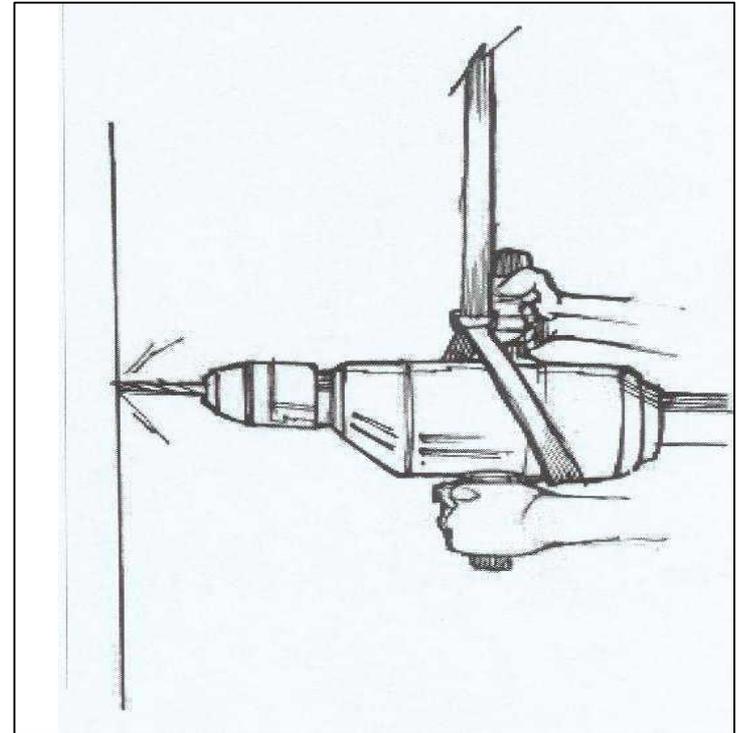
Size	Capacity (T)	Weight (Lbs.)
3/4"	4.00	3
1"	6.00	4
1 1/4"	9.00	5
1 1/2"	12.00	6
2"	16.00	10
2 1/2"	22.00	14
3"	27.00	18
3 1/2"	35.00	22
4"	45.00	28
5"	55.00	35

Material Handling Equipment

Module 3

Tool Balancers

- ❑ Tool balancers help support tools comfortably for operators
- ❑ Tools can be positioned over the work station
- ❑ Can be used with a variety of tools

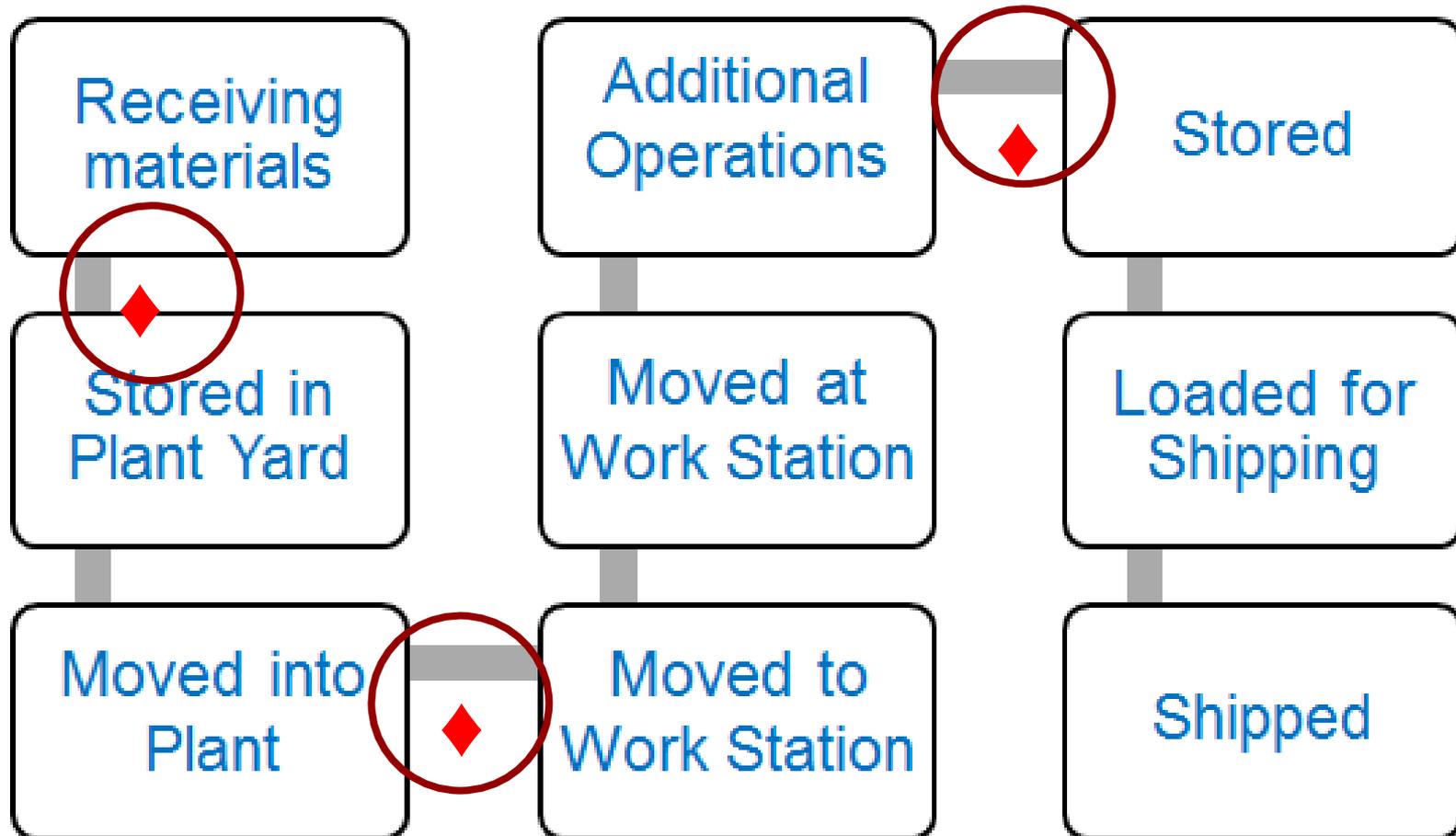


Source CIANBRO

Material Handling and Storage

Module 3

Storage and stacking of material



Material Handling and Storage

Module 3

Storing Materials-Key Topics

- Storing
- Stacking
- Housekeeping



Steel from the mill stored in the yard

Fabricated beams and spandrel frames ready to be shipped to a construction site



Material Handling and Storage

Module 3

Storing and stacking



Steel from the mill stored
Inside shop



Fabricated beams ready to be shipped
to construction site

Material Handling Equipment

Module 3

Storage and stacking



Heavy steel shapes from the mill



Heavy plate from the mill

Material Handling Equipment

Module 3

Hazard Potential: Stored materials

- Improperly stored materials may fall, and injure workers
- Improper manual lifting or carrying loads that are too large or heavy
- Being struck by materials or being caught in pinch points
- Incorrectly cutting ties or securing devices

Hazard Avoidance:

- ✓ “Stack loads evenly and straight
- ✓ Place heavier loads on lower or middle shelves and racks
- ✓ Remove one object at a time from shelves and racks
- ✓ Keep aisles and passageways clear and in good repair”
- ✓ Non-compatible materials should not be stored together

Material Handling Equipment

Module 3

Materials Storage-Steel

- ❑ American National Standard Z229.1-1982 lays out practices for steel fabrication and shops fabricating structural steel
- ❑ Included in ANSI Z229.1-1982 are practices for handling and storing steel material



Steel shapes stacked and nested

Material Handling Equipment

Module 3

Store material in arrangements that allow for:

- Easy movement
- Easy access and movement
- Materials and stacks to be stable



Racks used for storing plate and bar stock

Material Handling Equipment

Module 3

Structural shapes received from the mill

- ❑ Can be nested or blocked
- ❑ Optimize pile height for space and stability
- ❑ ANSI Z229.1-1982 suggested maximum pile heights for wide flange shapes 6-8" deep should be limited to 6'-0" in height for shapes 10-16", 11'-0" in height and for 18-36", is 14 '-0" feet in height.
- ❑ Under general industry standards If workers must work on loads higher than 4 feet, fall protection is required



Nested wide flange shapes

Material Handling Equipment

Module 3

Materials Storage - storage yards and storage areas

- Store material on level surfaces free of trip hazards
- Maintain walkways
- Store on firm ground
- In periods of freezing and thaws inspect areas for stability
- Maintain approach aisles to piles
- Use sound timber blocking for storing steel shapes to maintain pile stability
- Do not extend blocking beyond piles interfering with walkways and adjacent lifts

Material Handling Equipment

Module 3

Stacking



The variety of raw and fabricated steel shapes at the shop require planning and care when stacking

Material Handling Equipment

Module 3

Use of wood blocking between beam material



Wood
Blocking

Wood blocking used between shapes

Material Handling Equipment

Module 3

Stacking Small steel items – angles



Material Handling Equipment

Module 3

Stacking Steel Pipe

Round HSS steel shapes should be blocked, placed in racks or cribbing or bundled and tied together

Blocking



Round HSS shapes stored for fabrication
–blocking is used to prevent shapes from rolling

Material Handling Equipment

Module 3

String coils

- ❑ Steel coils should be blocked to prevent movement



Tapered Blocking

Steel coils weighing 10 tons are blocked to prevent rolling

Material Handling Equipment

Module 3

Materials Storage

- ❑ Secure materials stored in tiers by stacking, racking, blocking, or interlocking to prevent them from falling
- ❑ Post safe load limits of floors and shelves.



Source OSHA 3220-10N 2004

Material Handling Equipment

Module 3

Materials Storage-Fuels

- Store fuel in portable containers
- Transportation of gasoline requires USDOT container
- Tank size – 8 gallon or less
- Approved OSHA can
- Approved USDOT – (stamp-imprint)
- Diesel fuel containers
- Tank size – 119 gallons or less
- Except from using specified container

Material Handling Equipment

Module 3

Q and A Storing Materials



Material Handling Equipment

Module 3

Take a Stretch!