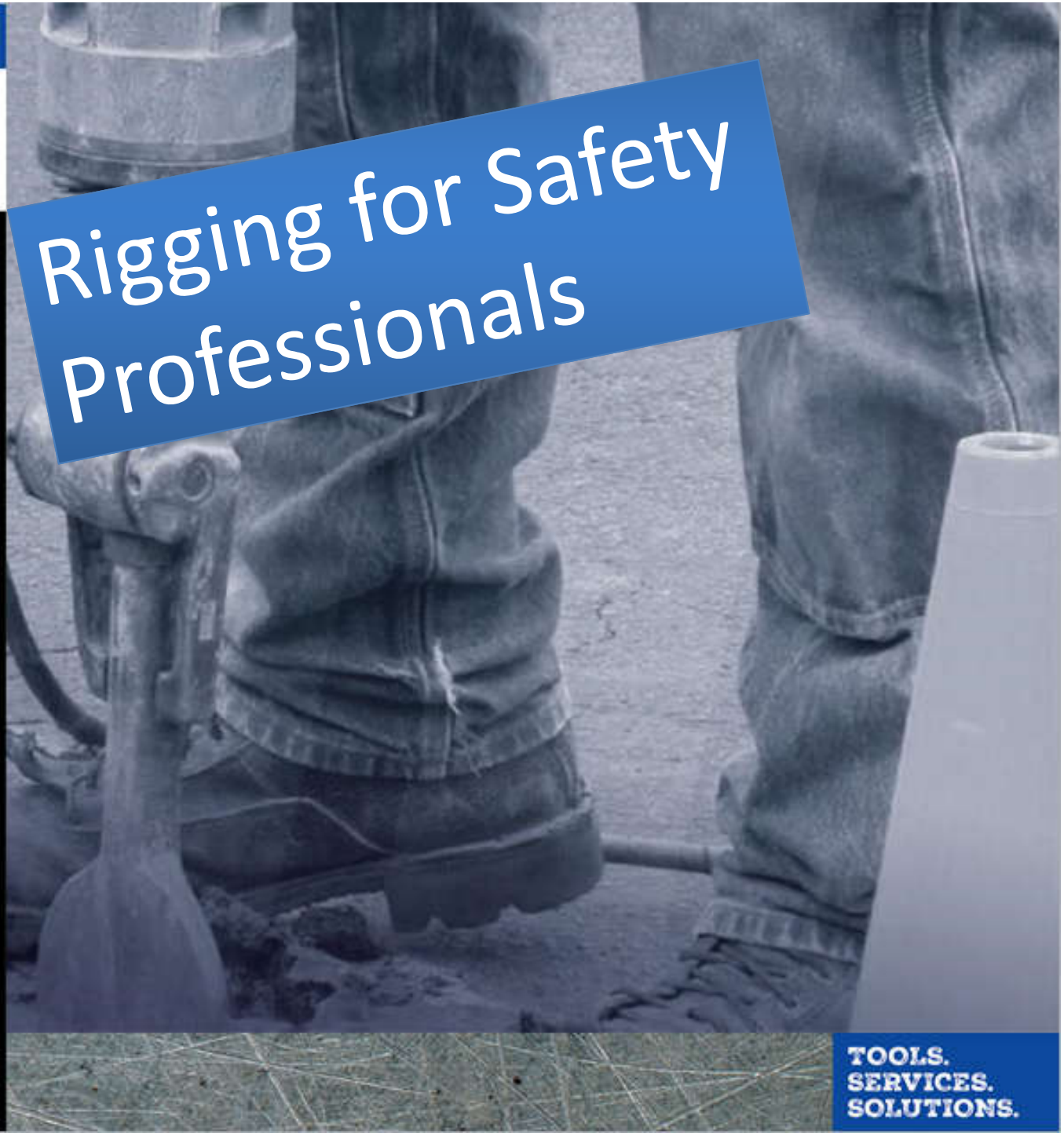
TOOLS RENTAL REPAIR RIGGING SAFETY

TOTAL TOOL SUPPLY, INC.

# Rigging for Safety Professionals



YOUR ONE SOURCE FOR CONSTRUCTION & INDUSTRIAL NEEDS.

TOOLS. SERVICES. SOLUTIONS.

# Introduction – Dan Swenson

- Started with Total Tool In December of 1991
- Performed 1000's of sling, hardware and crane inspections
- GM of our overhead crane division for 15years
  - Design of cranes, runways, custom lifting beams
  - NOT a PE
- Commonly perform lift planning and specification rigging
- Performed rigging and OH crane safety training
- Received countless hours of safety training

# Introduction

- Total Tool Supply Inc.
  - Started In 1977
  - Purchased SafeWay Sling in 1990
  - 14 Locations
  - Operate 4 Rigging Shops
  - Produce over 150,000 rigging assemblies annually
  - Provide Qualified Rigger and Signal Person Training

# Disclaimer for Total Tool Rigging & Lifting Safety Education

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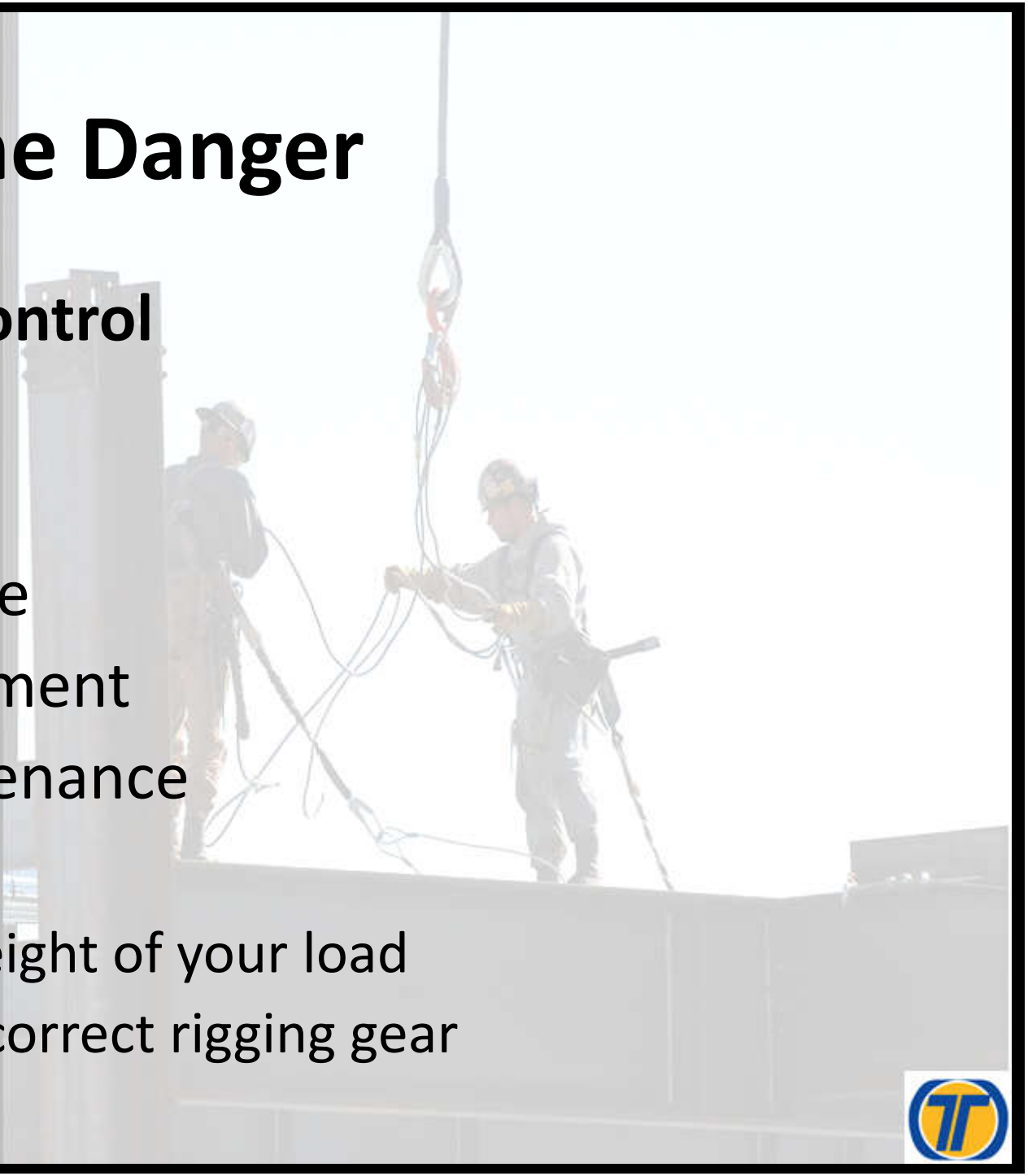
# Rigging for Safety Professionals

- Introduction
- Applicable Standards
- General Concepts and Examples
- Discussion of:
  - Slings
  - Below the Hook Lifters
  - Manual Hoists/Power Hoists
  - Overhead Cranes
    - Monorails, Jib Cranes

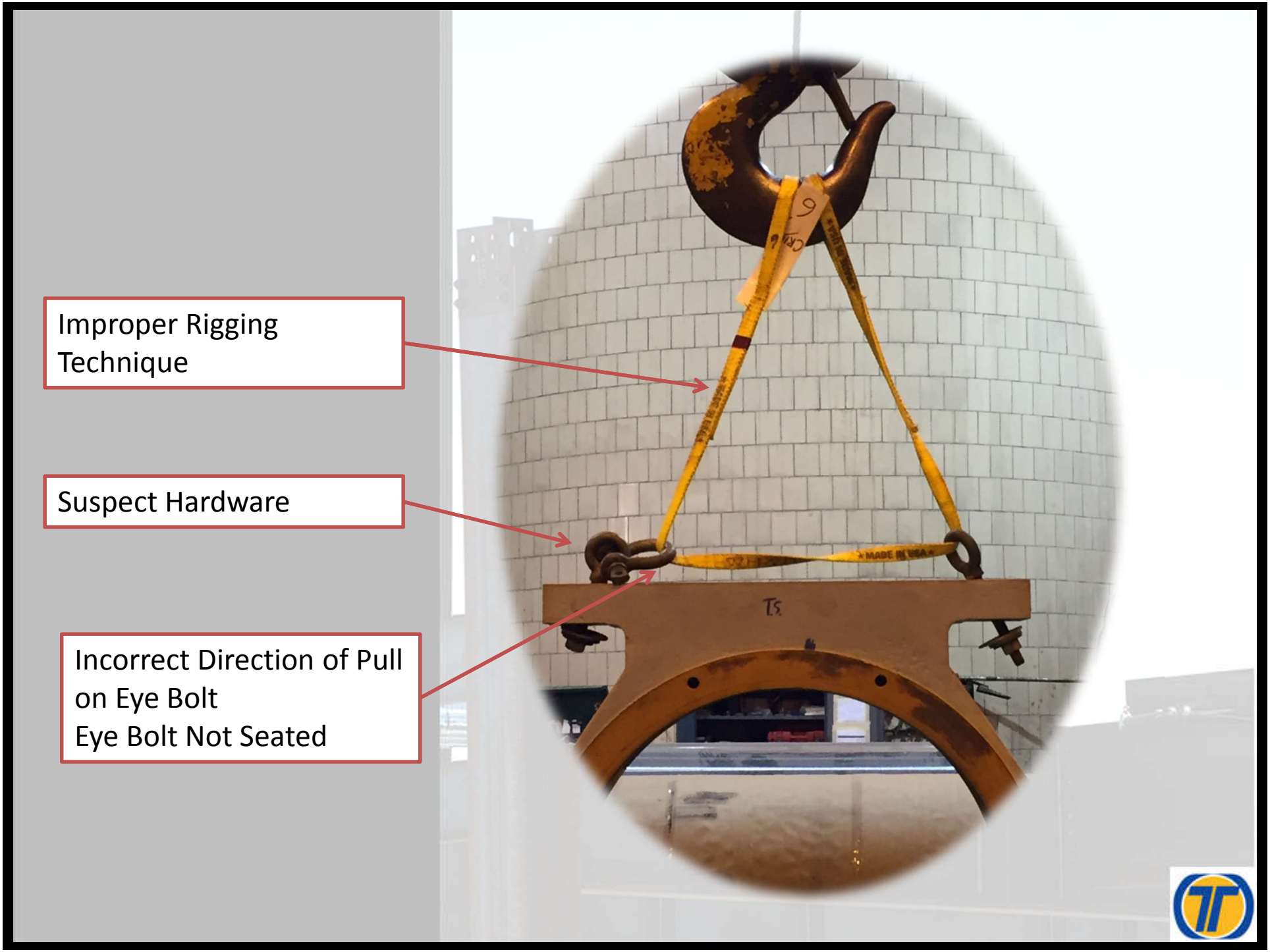
# Safety Share – Rigging Follies

# Mitigate The Danger

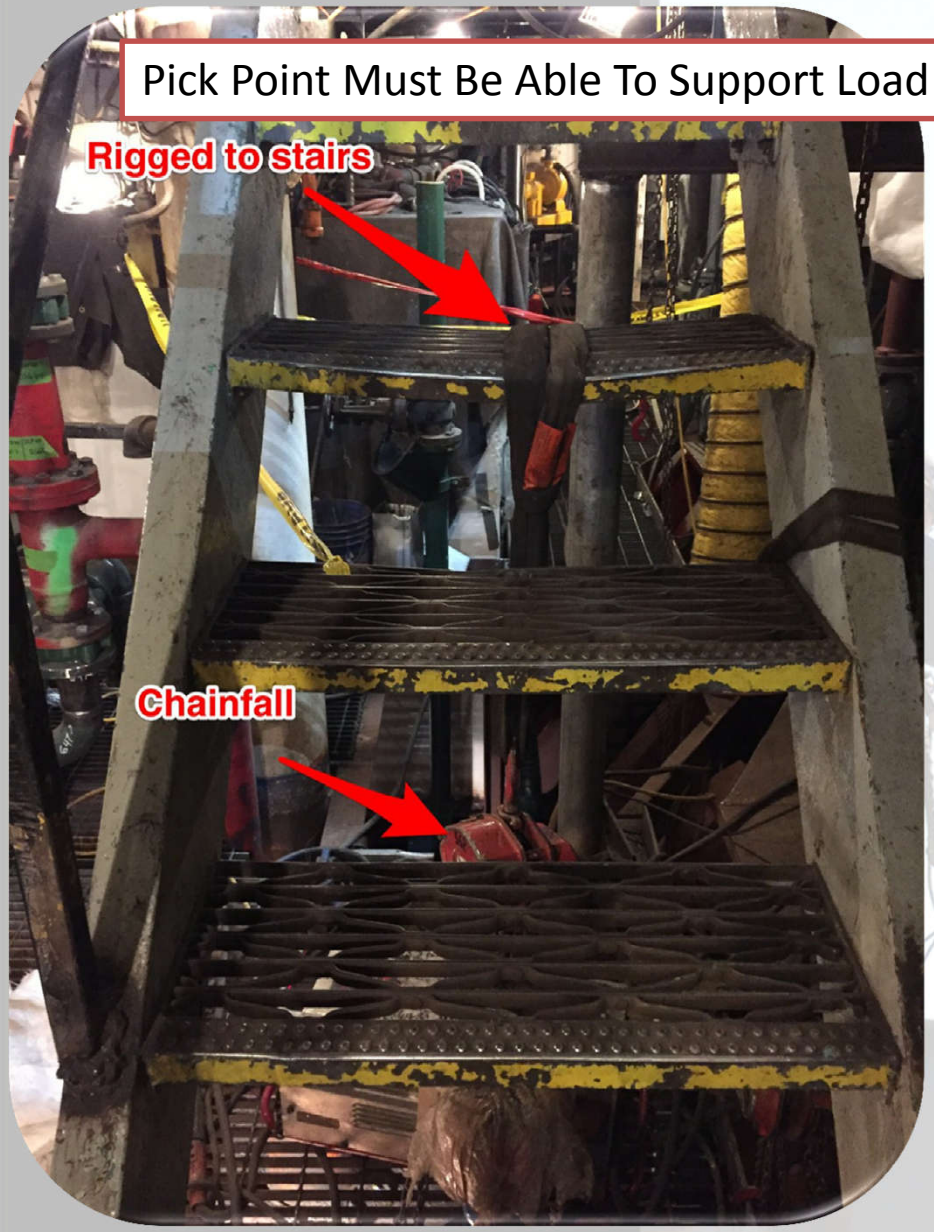


**What we can control**

- Training
- Inspections
- Proper storage
- Proper equipment
- Proper maintenance
- Lift Planning
  - Know the weight of your load
  - Provide the correct rigging gear

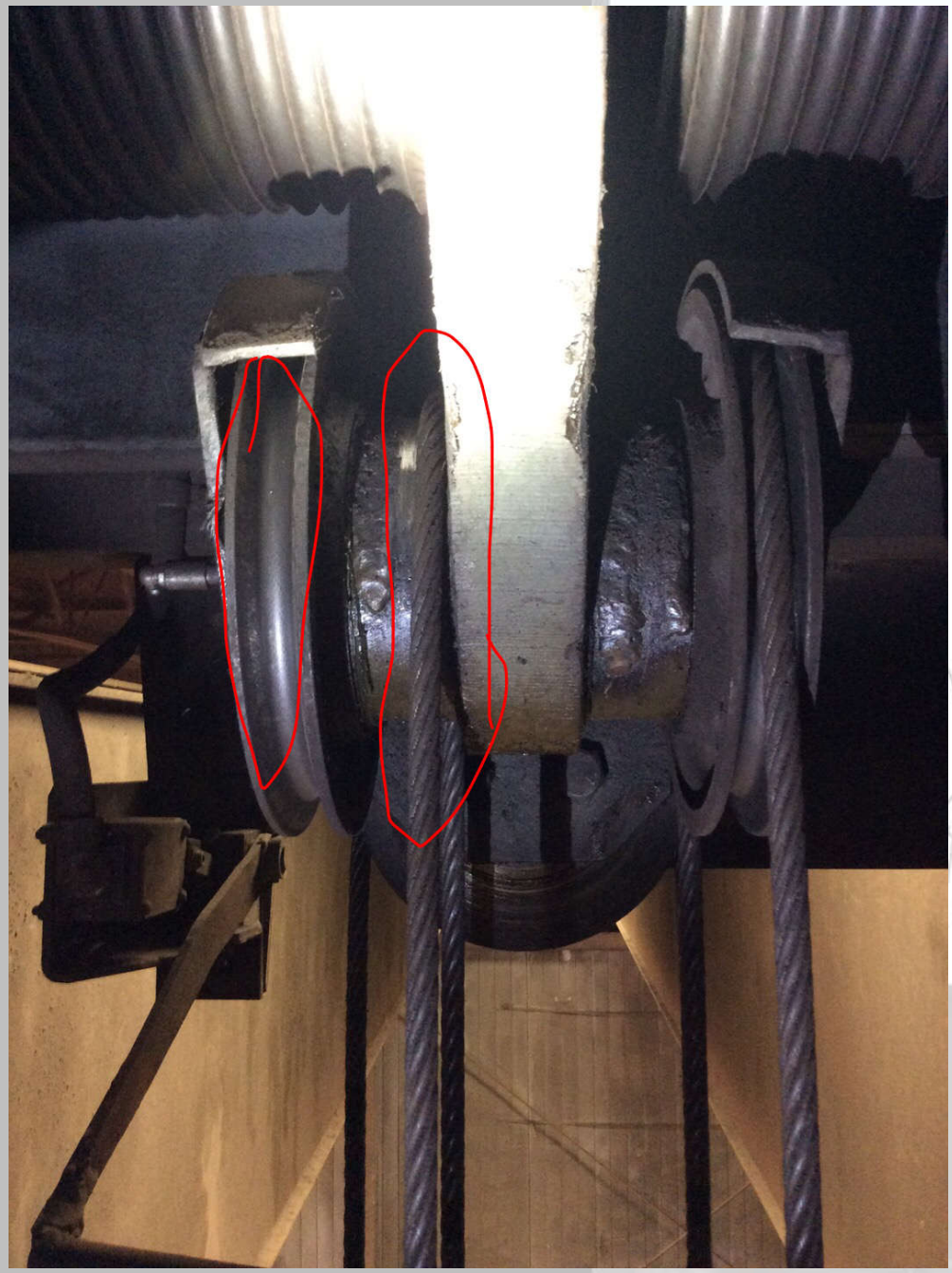

Improper Rigging Technique
Suspect Hardware
Incorrect Direction of Pull on Eye Bolt
Eye Bolt Not Seated

Pick Point Must Be Able To Support Load

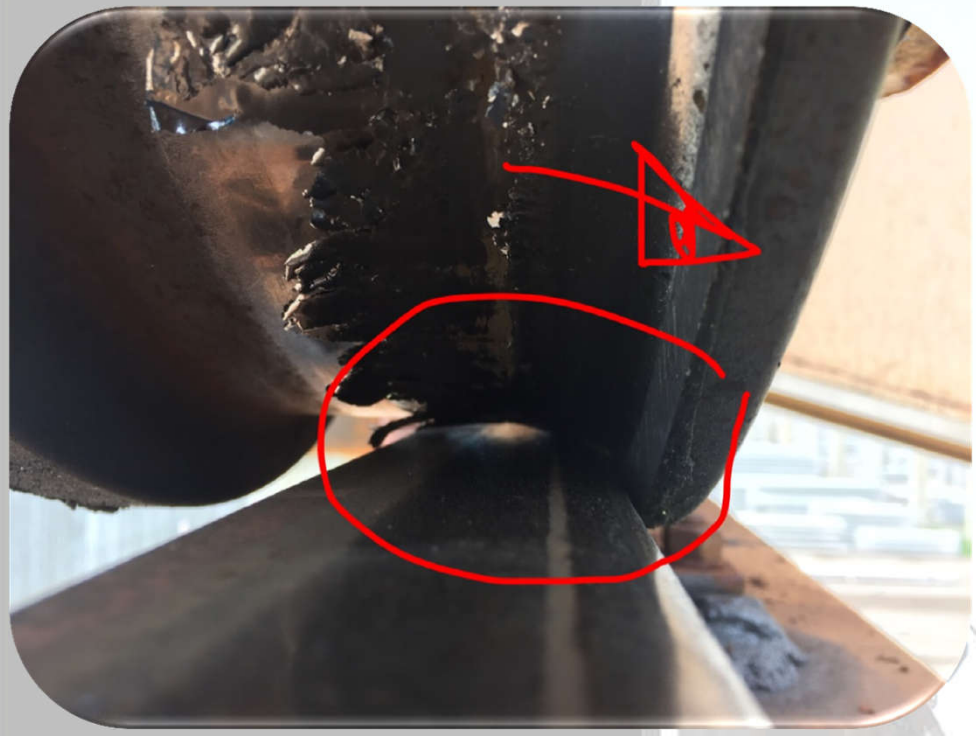


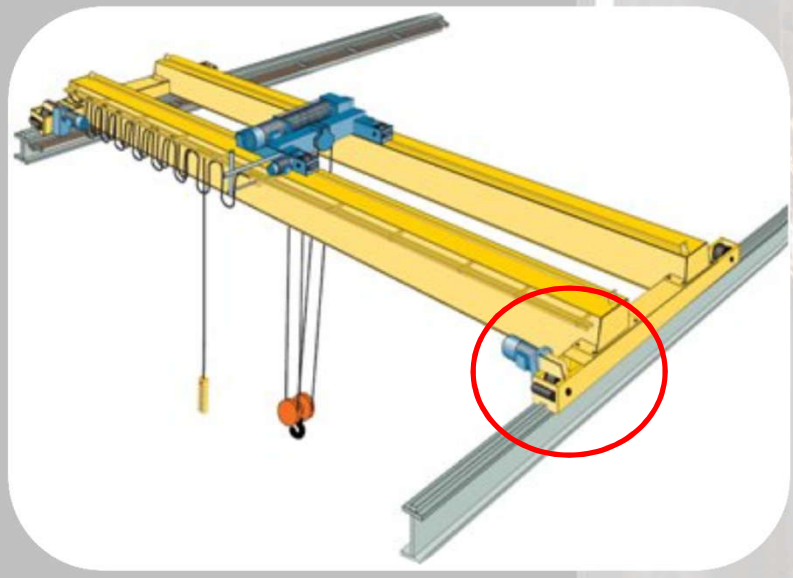


Improper Storage



Proper Daily Inspection Would/Should Catch This





Proper Maintenance

# Stats

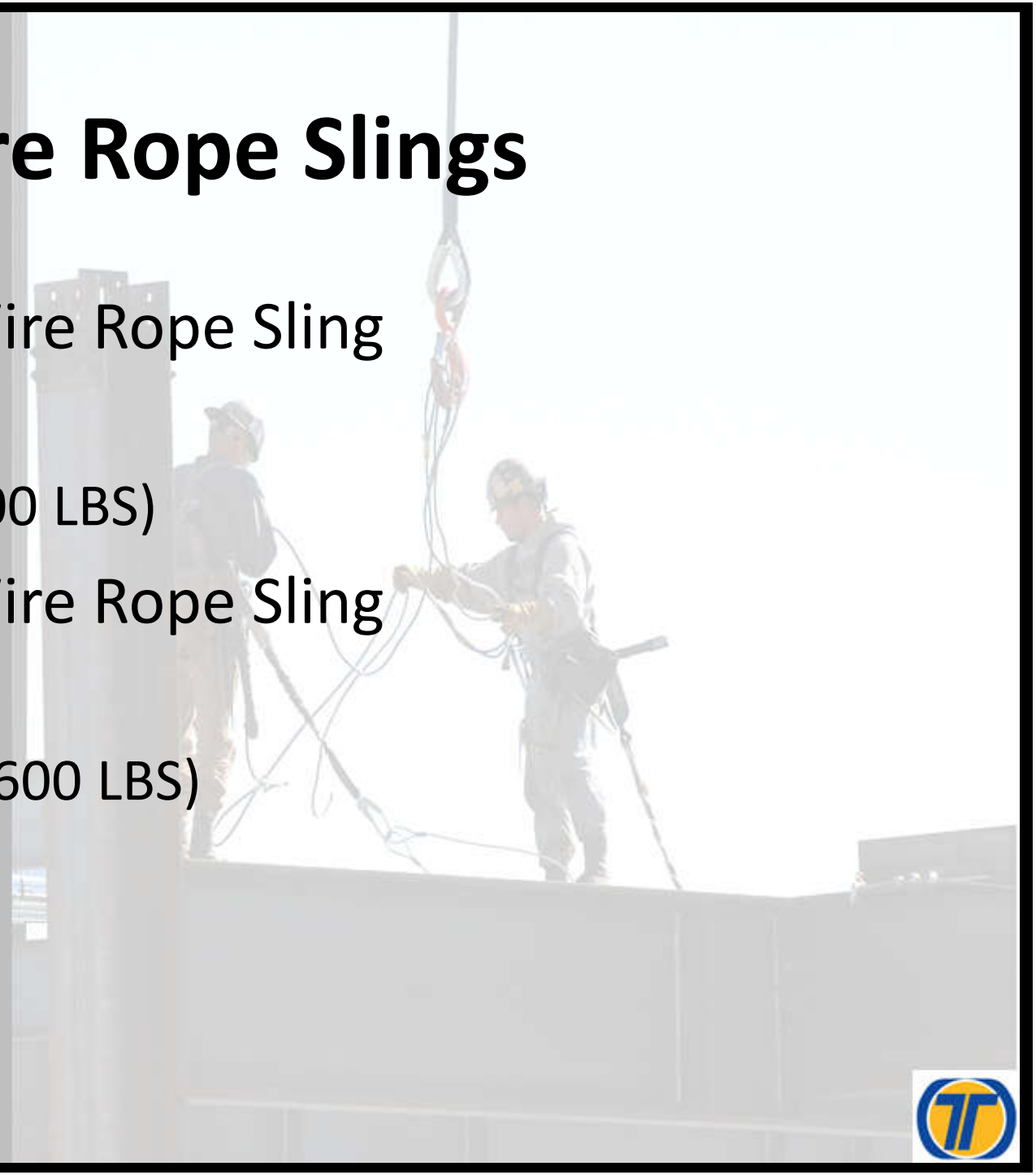
- An OSHA 1988 staticall summary of 1000 crane accidents showed poor rigging or slings to be the cause in 34% of the cases
- Statistics show that nearly 20 people died in 2012 as a result of accidents with overhead hoists.
  - That's because the loads being lifted by overhead hoists tend to be fairly heavy and cause serious damage if dropped. Slings and attachments that aren't secured properly can be a major safety hazard, and when objects begin to slip, they will eventually crash to the floor below.

# Costs – Web Slings

- 2IN x 6ft TWO PLY EYE&EYE WEB SLING
  - $15 -$20 - EE2902X6
- – 1IN x 6ft TWO PLY EYE&EYE WEB SLING
  - $10-$13 - EE1902X6
- – 2IN x 20ft TWO PLY EYE&EYE SLING
  - $50, EE2902X20

# Costs – Wire Rope Slings

- 3/8IN x 6ft Wire Rope Sling
  - $15-$20
  - 1.6 ton (3,200 LBS)
- 1/2IN x 6ft Wire Rope Sling
  - $18-$25
  - 2.8 ton – (5,600 LBS)



# Yet Some Times it's treated Like Gold!

# Applicable Standards

- OSHA Regulations are the LAW
- ASME / ANSI rules are created by industry-leading authorities
  - AWRF, WSTDA
  - In a court of law they can be just as binding as OSHA
- When OSHA and ASME vary, it is prudent to follow the most stringent to protect employees

# Applicable Standards

- In cases where OSHA doesn't have anything written they will use the "General Duty Clause"
  - Reference ASME as a: "National Consensus Standard"
  - Excerpt from OSHA Interpretation Letter

*"While OSHA as yet has no standard of its own covering monorail systems and underhung cranes, under Section 5(a)(1) (the general duty clause) of the Occupational Safety and Health Act all employers have a legal responsibility to provide safe and healthful workplaces for their employees. OSHA's policy is that the general duty clause requires employers to comply with safety standards recognized in the industry, such as ANSI B30.11"*

# Applicable Standards Rigging

- OSHA
  - 1910.184 - General Industry – Slings
  - 1926.251– Construction – Rigging / Slings
- ASME
  - ASME B30 series of standards:
    - B30.9 Slings
    - B30.10 Hooks
    - B30.20 Below the Hook Lifters (Beams, Clamps, etc.)
    - B30.26 Rigging Hardware

# Applicable Standards OH Cranes and Hoists

- OSHA
  - 1910.179 - General Industry – Overhead and Gantry Cranes
  - 1926.554– Construction – Overhead hoists (Lever, Manual Chain, Electric Chain/Wire Rope Hoists)
- ASME
  - ASME B30 series of standards:
    - B30.2 – OH Cranes Top Running
    - B30.11 – Monorails Underhung Cranes
    - B30.16 – Overhead Hoists Underhung
    - B30.17 – Cranes & Monorails - Underhung
    - B30.21 – Lever Hoists

# Applicable Standards – Key Point

- As relates to:
  - Jib Cranes
  - Monorail Cranes
  - Electric Hoists
  - Manual Hoists

- OSHA SAYS VERY LITTLE
  - General duty clause
    - Based on ASME B30 series of standards
    - National Consensus Standard
  - 1926.554 – Overhead Hoists
    - “Follow Manufactures Recommendations”

# Applicable Standards

ASME B30.11 Monorails and Under-Hung Cranes

ASME B30.16 Overhead Hoist Underhung

ASME B30.10 Hook

ASME B30.9 Slings/OSHA 1910.184

ASME B30.20 Below-the-Hook Lifter

ASME B30.10 Hook

ASME B30.26 Rigging Hardware

ASME B30.9 Slings/OSHA 1910.184

ASME B30.26 Rigging Hardware

ASME B30.20 Below-the-Hook Lifter

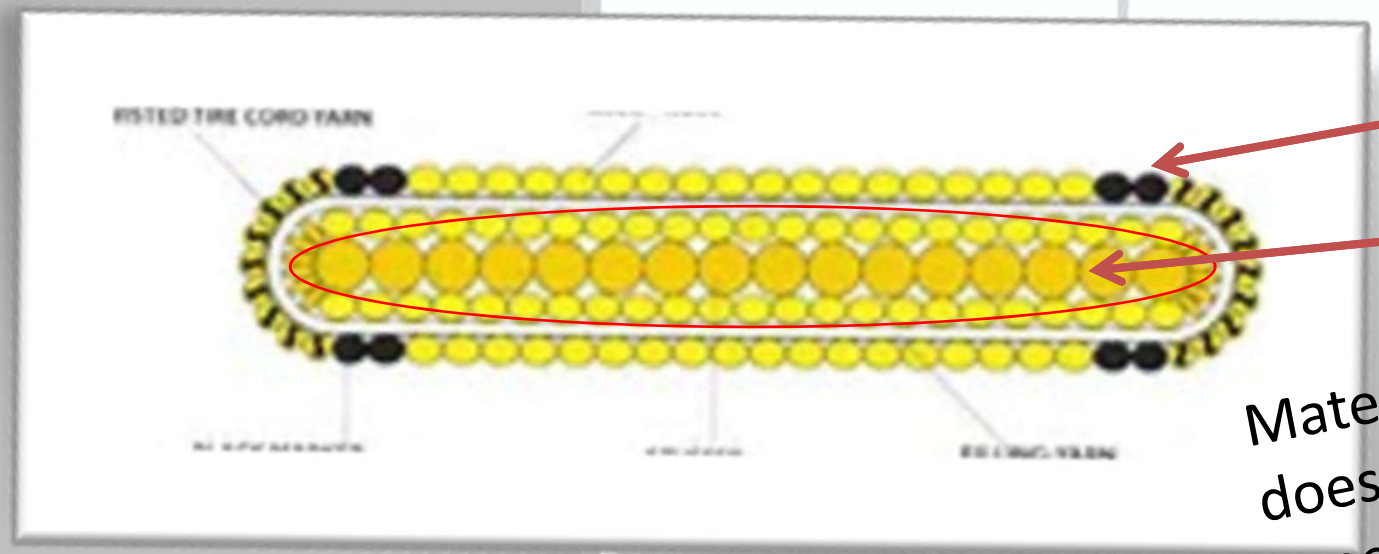
# Inspection

- Inspection IS ABSOLUTELY KEY
  - Pre-Use
  - Annual / Documented(?)
- OSHA & ASME agree that **anything** used for lifting **requires** a pre-use pre/shift inspection
- Common sense says:
  - To perform a proper inspection you have to know what to look for - Training
  - You cant make a safe pick with unsafe rigging gear

# Do I need to Document Annual Inspections?

# Visual Inspections

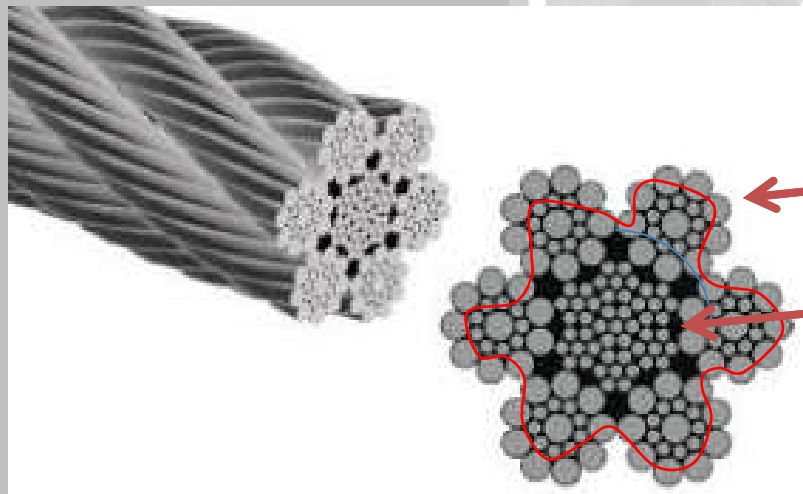
- 20% Fact
- 80% Hope
- On just about any type of sling you can only see about 20% of the load bearing material.
- This DOESN'T mean inspections are hopeless or useless, we simply need to take this fact into consideration when performing inspections.



Fact

Hope

Material can and does penetrate wire rope, web and round slings that will cause early failure!



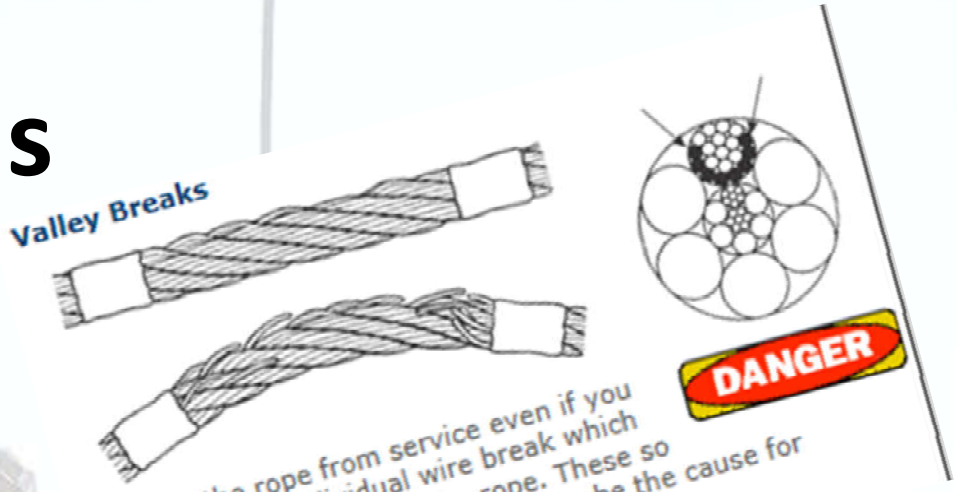
6x19Seale IWRC

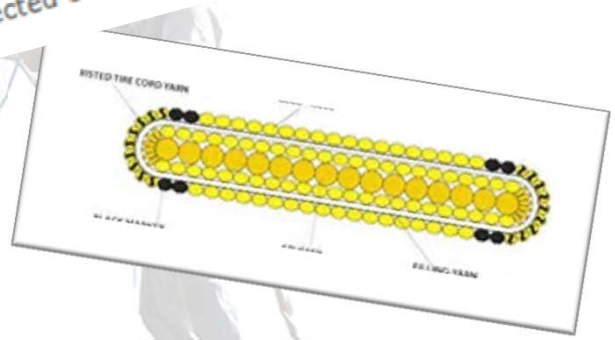
Fact

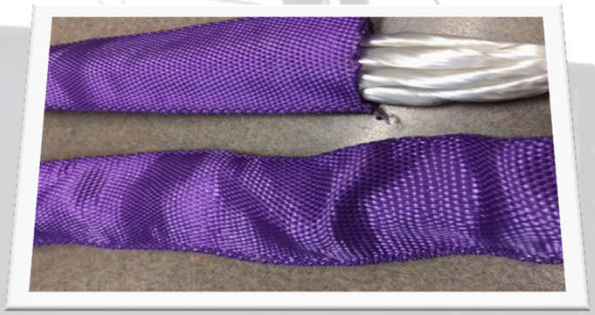
Hope

# Visual Inspections

- Experience Counts
- If it looks that bad on the outside what does it look like inside?





# Tags

- **All slings** MUST BE TAGGED
- All Below Hook Lifters Must be Tagged
- All hoisting equipment must be tagged
- Tags must be legible
- Including warning label

LOGIC

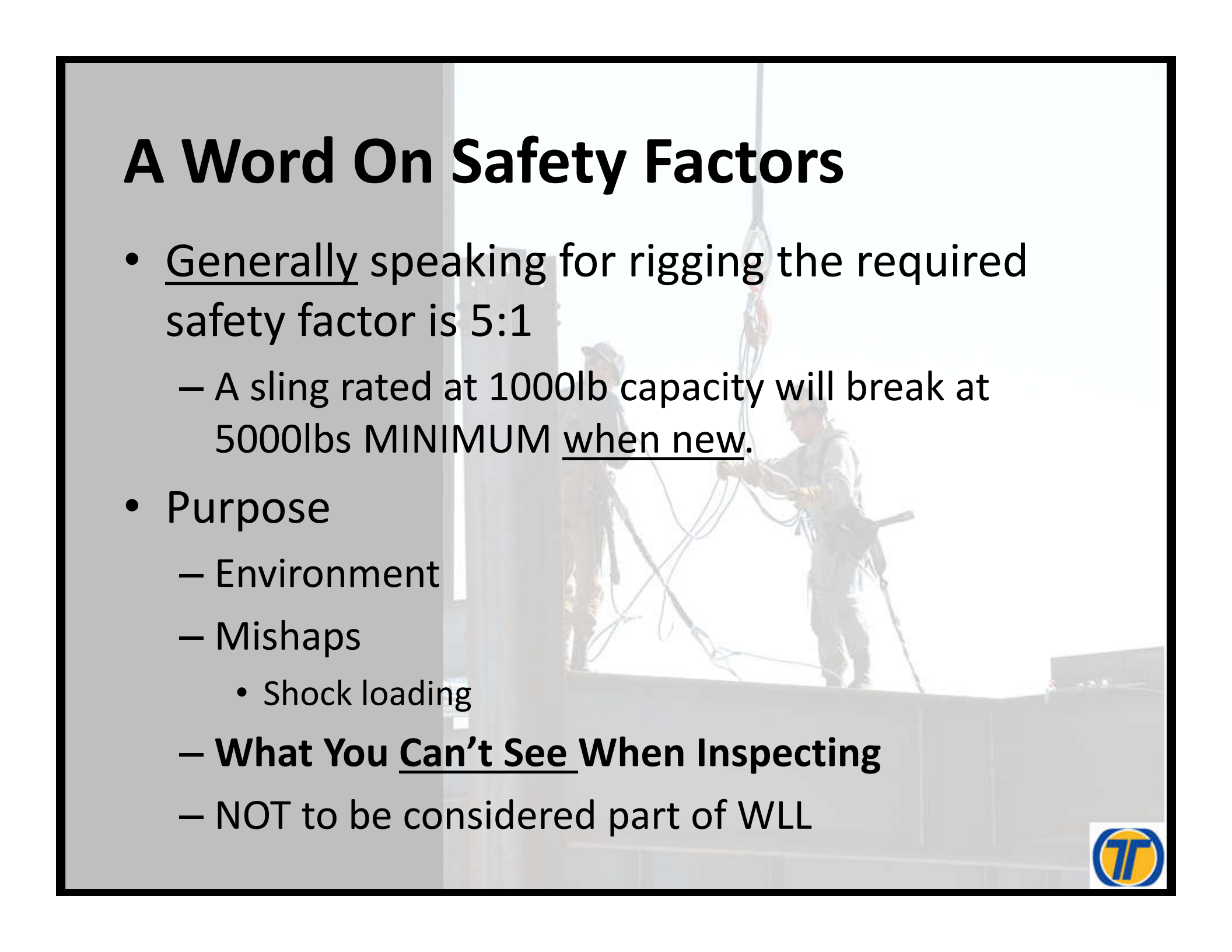
How can you do a safe pick if you don't know the capacity of the rigging gear!

# Tags – In General

- Capacity (s)
- Type of Material
  - Many Different Types of Webbing and wire rope
- Serial Number
  - Required by OSHA on Chain Slings
  - GOOD idea on all other types of slings
- Manufacturer
- Must be Legible!
  - Including the warning

# A Word On Safety Factors

- Generally speaking for rigging the required safety factor is 5:1
  - A sling rated at 1000lb capacity will break at 5000lbs MINIMUM when new.
- Purpose
  - Environment
  - Mishaps
    - Shock loading
  - **What You Can't See When Inspecting**
  - NOT to be considered part of WLL



# Rigging / Sling Selection Guide

## DETERMINING PROPER SLING TYPE

All slings have certain unique advantages, as well as limitations. There is no single sling that will accomplish every task. The following are the key pieces of information a rigger takes into consideration when selecting the proper type of sling:

- *WHAT IS BEING LIFTED*
- *SIZE OF LOAD*
- *HOW LOAD WILL BE RIGGED*
- *ENVIRONMENTAL CONDITIONS OF LIFT SITE*
- *WEIGHT OF LOAD*
- *SHAPE OF LOAD*
- *SLING ANGLE*

## SLING COMPARISONS

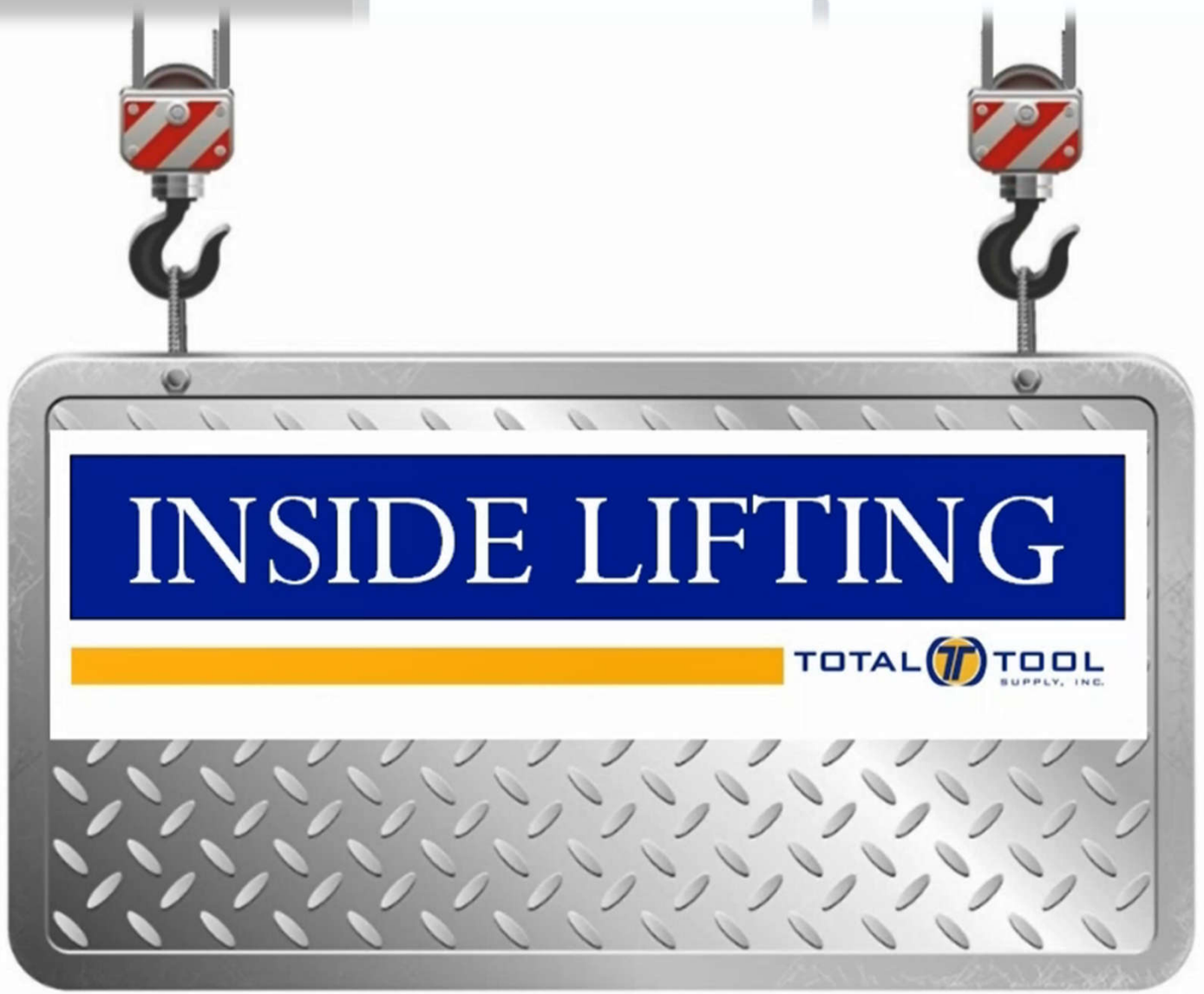
| | PRICE | FLEXIBILITY | WEIGHT | DURABILITY | OPERATOR DANGER | SCRATCHES | HANDLING |
|---|---|---|---|---|---|---|---|
| WIRE | Medium | Low | Average | Medium | Medium | Very Likely | Difficult |
| CHAIN | High | Medium | Heavy | High | Medium | Very Likely | Difficult |
| WEB | Low | High | Light | Light | Low | Not Likely | Easy |
| ROUND | Low | Extreme | Light | Light | Low | Most Protective | Easy |

# Synthetics

- Advantages
  - Light
  - Easy to rig
  - Low cost
  - Reduces damage to load
  - Strength to weight ratio
- Disadvantages
  - Low heat resistance(194 degrees max)
  - Subject to cuts, tears and abrasion
  - Subject to chemical degradation
  - **UV**
  - **Dirt**
  - Not repairable
  - Consumable Item!

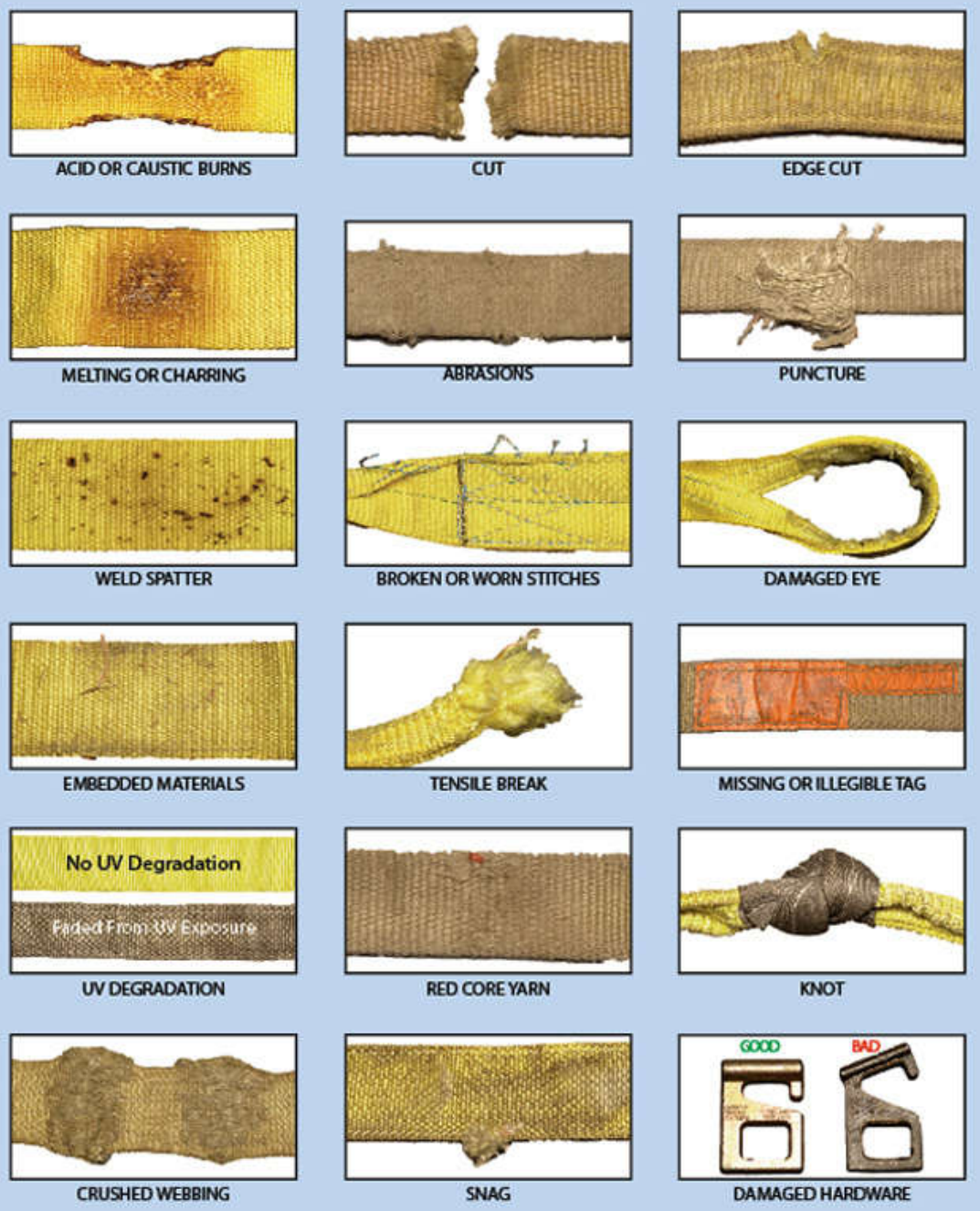
**Should be considered a consumable!**

# Limitations of Synthetic Slings



**Have you seen this chart before?**

**After Seeing those videos what to you think of it?**



# Round Sling Construction

# Round Sling – Advantages Over Web

- More Flexible
  - Particularly in high capacity slings4
- Better protection against abrasions and cuts
  - Load bearing yarns are not in direct contact with the load or other rigging
- Better protection against UV degradation
  - Load bearing yarns are protected from UV damage by the outer cover
- Available in capacities up to 100,000 and larger

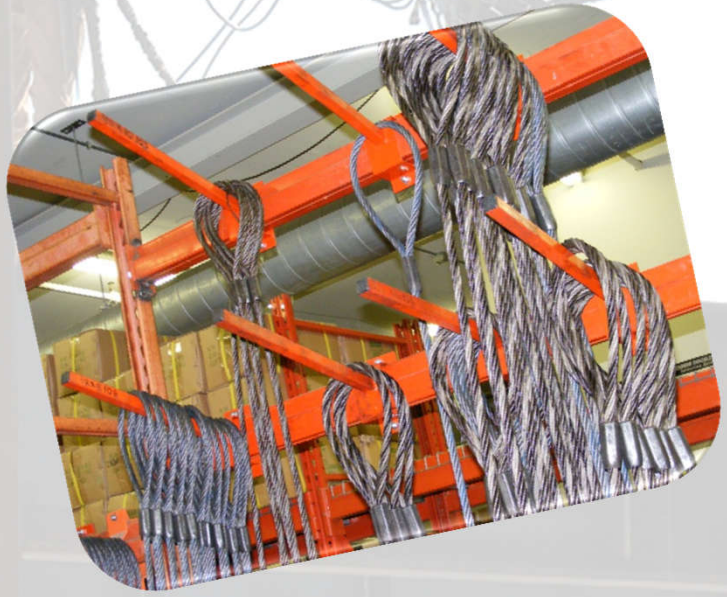
# Wire Rope Slings

## Advantages

- Low cost
- Heat resistant
- Flexibility
- Reusable components
  - Hardware
- Durability

## Disadvantages

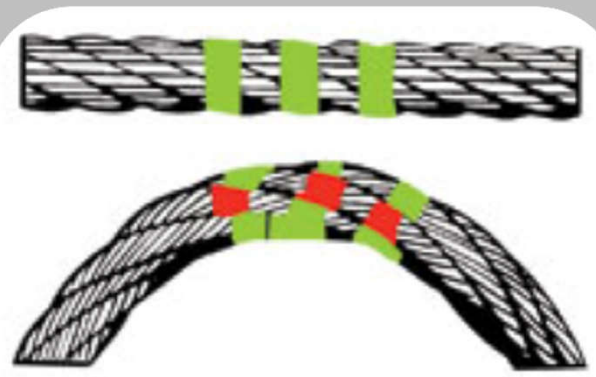
- Internal corrosion
- Not repairable
- Heavy



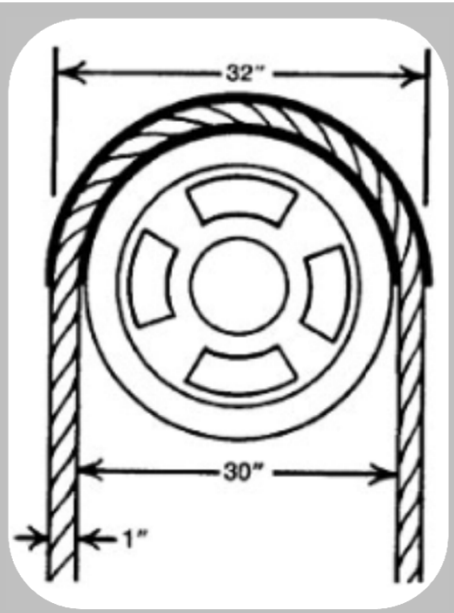
# Wire Rope is a Machine

- A wire rope is a machine, by dictionary definition:
  - "An assemblage of parts…that transmit forces, motion, and energy one to another in some predetermined manner and to some desired end."
- A typical wire rope may contain dozens of individual wires which are formed and fabricated to operate at close bearing tolerances one to another.
- When a wire rope bends, each of its many wires slides and adjusts in the bend to accommodate the difference in length between the inside and the outside bend.
- The sharper bend, the greater movement.

# Wire Rope is a Machine



Flexing the rope makes the strands slide against each other.




- All components of a wire rope MUST move for the rope or sling to reach it's full capacity
- This is important when performing inspections!

# Does This Machine Look Healthy?

# Broken Wires ….. O-My!

OSHA Recognized limits on the number of broken wires include:

- For strand-laid and single-part slings,
  - 10 randomly distributed broken wires in one rope lay, or 5 broken wires in one strand in one rope lay.
- For cable-laid slings
  - 20 broken wires per lay.
- For six-part braided slings
  - 20 broken wires per braid. 4: For eight-part braided slings, 40 broken wires per braid

# Broken Wires ….. O-My!

| ASME No. | Equipment | No. Broken Wires In Running Ropes In | | No. Broken Wires in Standing Ropes In | |
|---|---|---|---|---|---|
| | | one rope lay | one strand | one rope lay | one strand |
| B30.2 | Overhead and gantry crane | 12* | 4 | n/a | n/a |
| B30.4 | Portal, tower and pillar cranes | 6* | 3 | 3* | 2 |
| B30.5 | Crawler, locomotive and truck cranes | 6* | 3 | 3* | 2 |
| B30.6 | Derricks | 6* | 3 | 3* | 2 |
| B30.7 | Base-mounted drum hoists | 6* | 3 | 3* | 2 |
| B30.8 | Floating cranes and derricks | 6* | 3 | 3* | 2 |
| A10.4 | Personnel hoists | 6* | 3 | 2* | 2 |
| A10.5 | Material hoists | 6* | n/a | n/a | n/a |

*Also remove for one valley break. OSHA requires monthly record keeping of wire rope conditions. Note: current industry recommendations and OSHA standards are based upon steel sheaves. The manufacturer of plastic and synthetic sheaves or liners should be consulted for its recommendation on the safe application of the product and inspection criteria.

# Complicated!

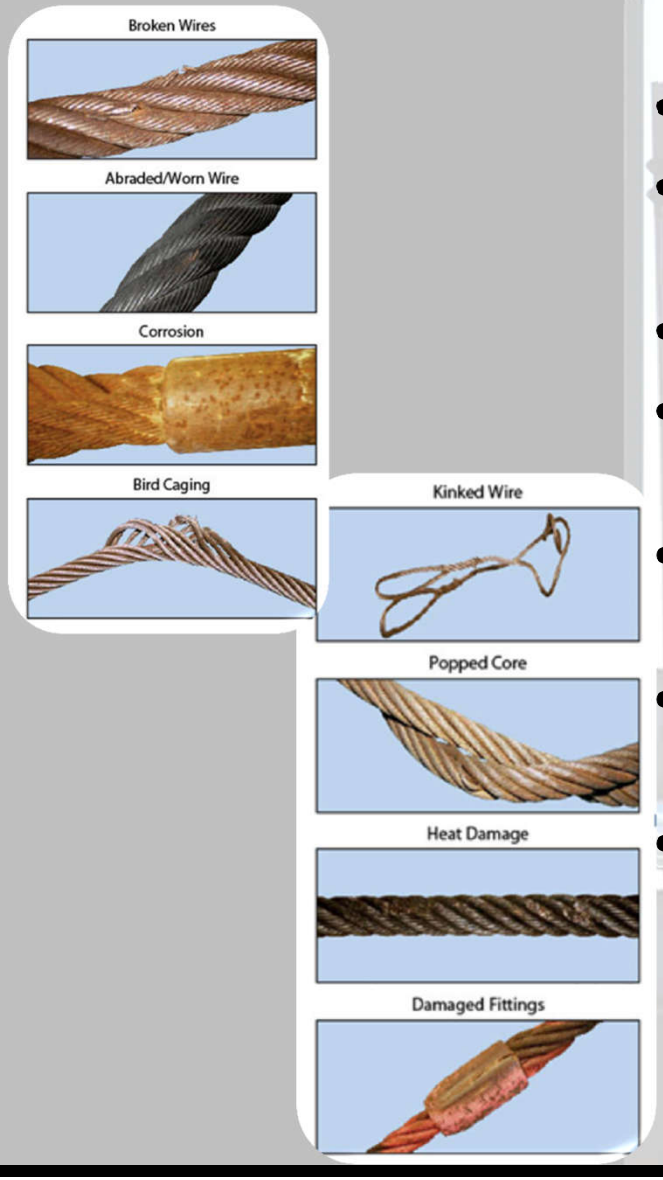
- What type of wire rope
  - Stranded, Cable Laid,
- What type of break
  - Valley, Crown, Fatigue
- What's the lay length
- What type of crane
- Is there other damage

# Keep It Simple

Broken wires are concerning!

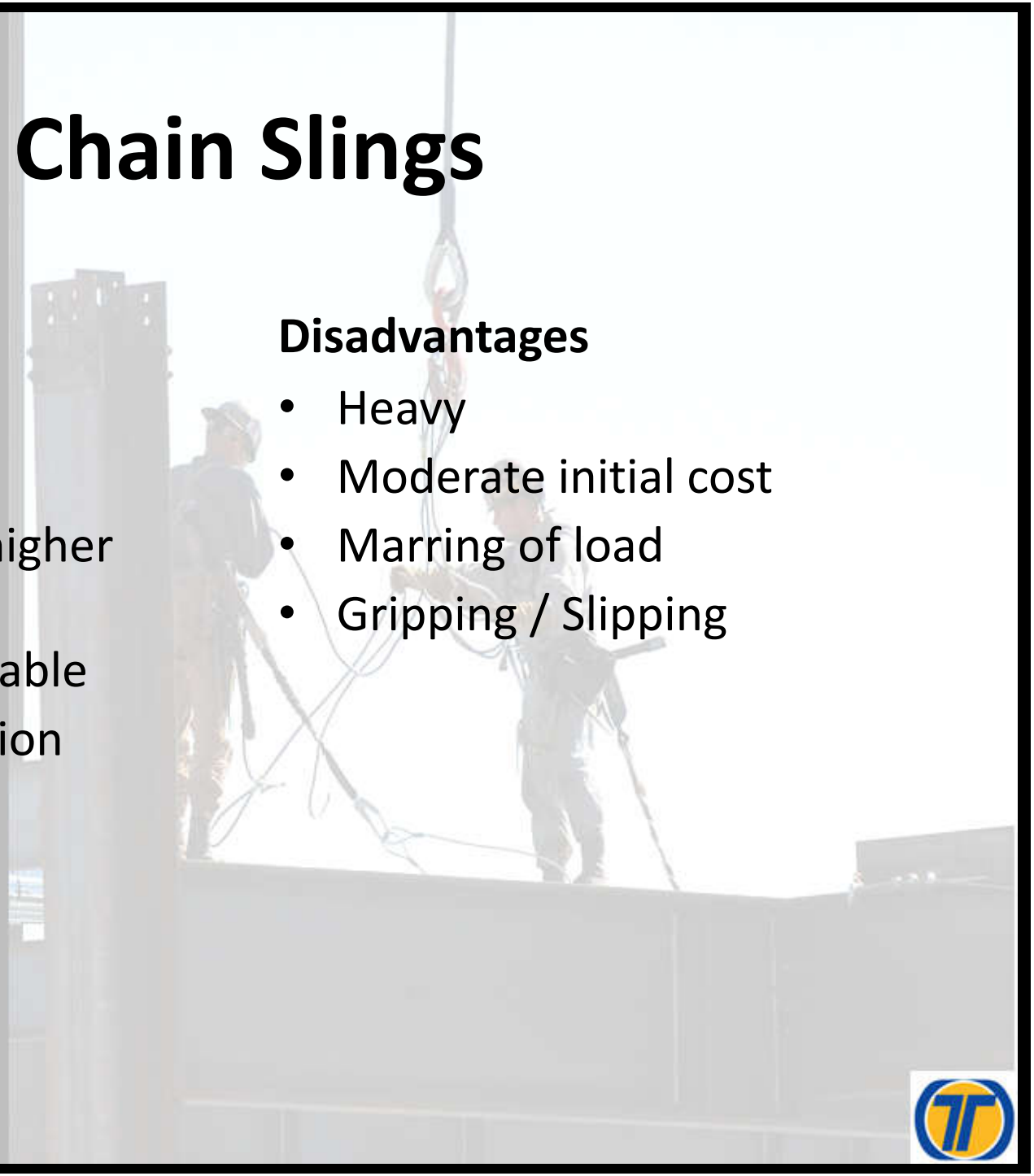
- Most commonly they are the result of some type of abuse
- Generally are accompanied by other damage seen or unseen
- If you spot broken wires:
  - Take the sling out of service
  - Have it evaluated

# Other Wire Rope Removal Criteria




- Severe localized abrasion or scraping,
- Kinking, crushing, bird caging, or any other damage to the rope structure,
- Evidence of heat damage,
- Crushed, deformed, or worn end attachments,
- Severe corrosion of the rope, end attachments or fittings,
- Missing or illegible sling identifications, and
- Other conditions that cause doubt as to continual safe use of the sling.

# Chain Slings



**Advantages**

- Flexibility
- Impact resistance
- Can be used in a higher temperature
- Completely repairable
- Minimum elongation
- Most Durable

**Disadvantages**

- Heavy
- Moderate initial cost
- Marring of load
- Gripping / Slipping

# Chain - Types

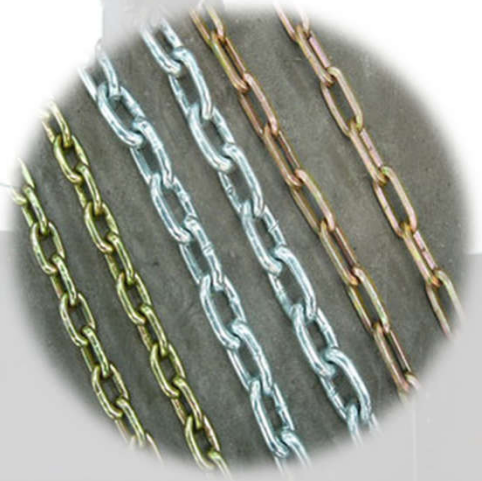
**For Lifting**

Alloy Steel

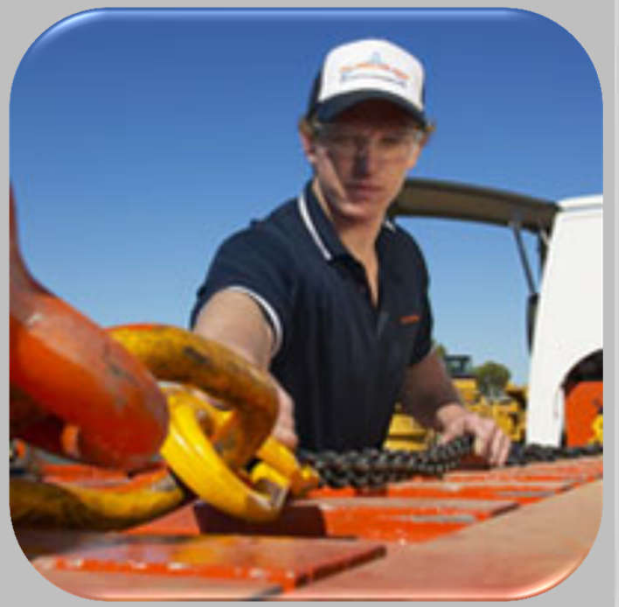
- Grade 80
- Grade 100
- Grade 120

**<u>NOT for Lifting</u>**

- Grade 30
- Grade 40/43
- Grade 70

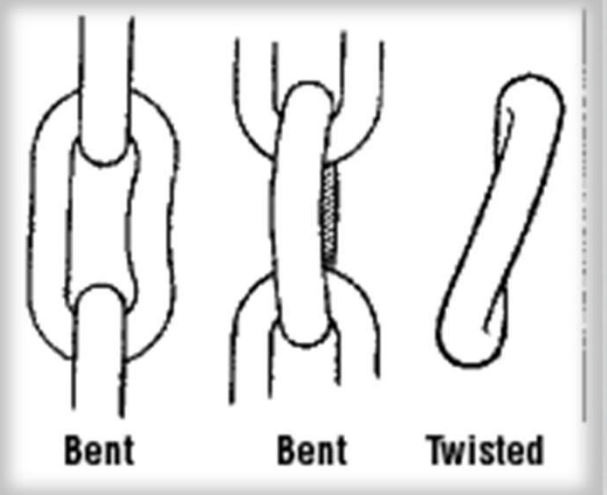


# Chain Slings - Inspection



- OSHA MANDATED
- Minimum annual
- Must be documented
  - Each sling to have it's own record
- Can be repaired

# Chain Slings – Removal Criteria




Per ASME B30.9

- Missing or illegible sling identification tag
- Cracks or breaks
- Excessive wear, nicks, or gouges
- Stretched chain links or components
- Bent, twisted, or deformed chain links or components
- Evidence of heat damage
- Excessive pitting or corrosion
- Lack of ability of chain or components to hinge freely
- Weld splatter
- Other conditions, including visible damage, that cause doubt as to the continued use of the sling

# Manual Hoists

## Types

- Lever operated Hoists
  - Leverhoist
  - Come-a-ling
- Hand chain operated hoists
  - Chainfall

# Manual Hoists - Inspections

## OSHA

- **1926.554(a)(6)** - All overhead hoists in use shall meet the applicable requirements for construction, design, installation, testing, inspection, maintenance, and operation, as prescribed by the manufacturer.
- **1910 –** Doesn't specifically address manual hoist

# Manual Hoists - Inspections

## ASME

- Frequent inspection – visual inspections performed by the operator or other designated personnel and are to be performed daily to monthly and prior to each use.

- Periodic inspections – are visual inspections to be performed every 3 months to 1 year by and designated person who records conditions to provide a basis for continuing evaluations of the hoist

# Manual Hoists – Operating Practices

- All chain used in manual hoists are made specifically for that hoist. No other chain will meet the required dimension to operate safely or correctly in the lift wheels or pockets. The chain could climb out of the pocket and jam the hoist.
- Load chain shall never come in contact with the load being lifted. Only use alloy chain sling for lifting.
- Before using check lower block on reeved hoists to make sure it is not capsized or flipped.
- A small amount of lubricant will greatly increase the life of the load chain

# Manual Hoist – Rigging

# Well Maintained Machine?

# Proper Use?


# Below the Hook Lifters


# Standards

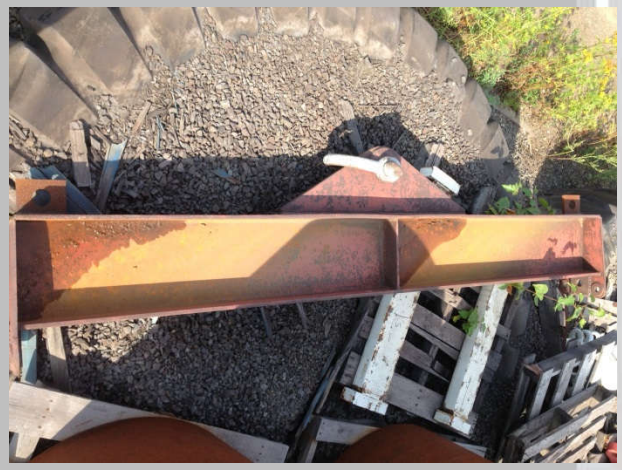
- ASME B30.20 – Below the Hook Lifting Devises
  - **Complete Standard**
  - Addresses: design, fabrication, marking/tagging, inspection and maintenance
- 1910.184 – General Industry – Slings / Rigging
  - Says Virtually Nothing
- 1926.251 – Construction – Slings / Rigging
  - Basically says “special lifters” must be proof tested
  - Interpretation letters invoke the general duty clause and reference ASME B30.20

# Inspections - ASME

- Pre-Shift
- Minimum - Annual
  - 20-1.3.6 – Dated inspection reports shall be made on critical items such as those listed in para. 20-1.3.4. Records should be available to appointed personal for each periodic inspection and when the lifter is either modified or repaired

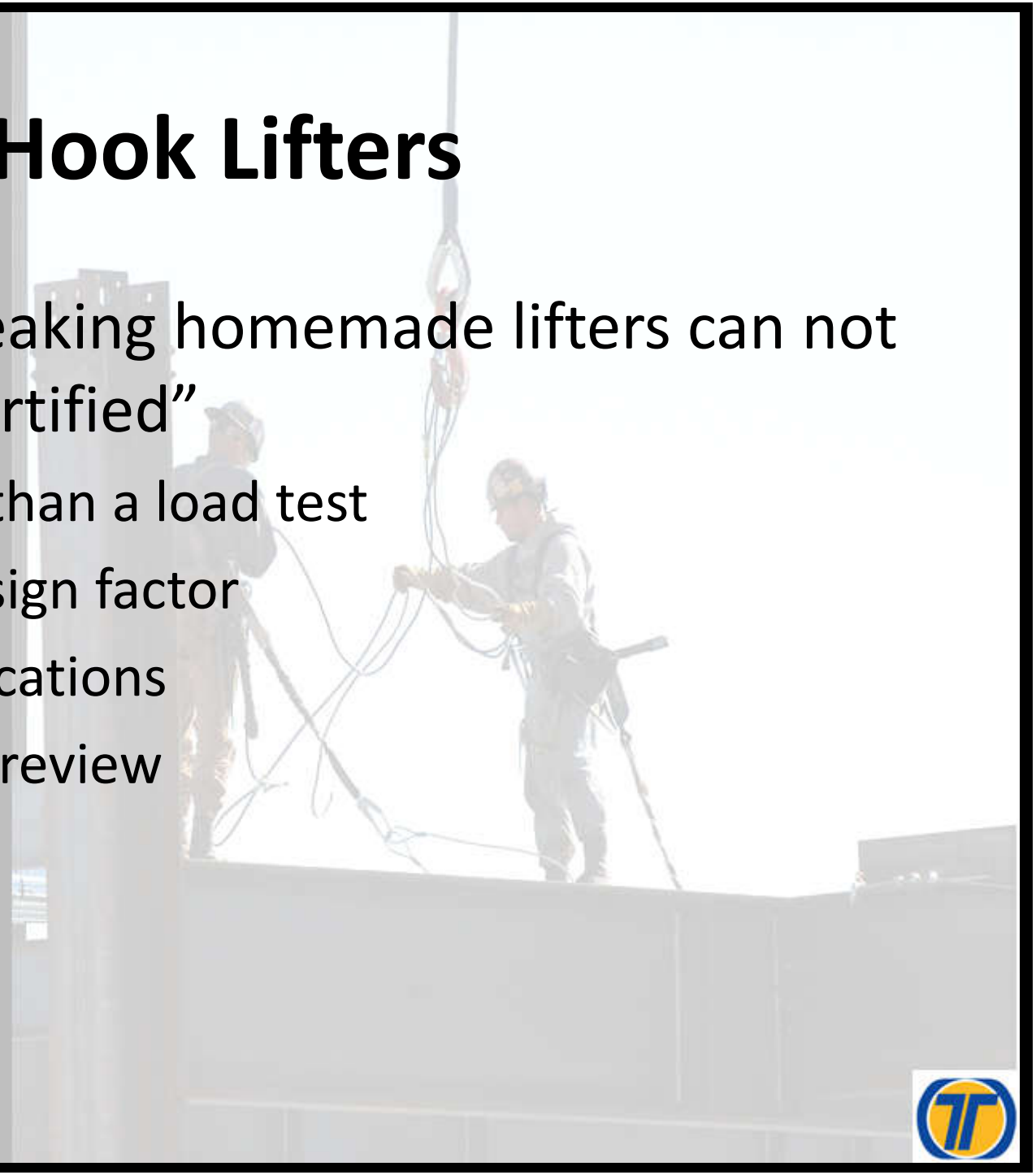
# Below The Hook Lifters

## Homemade = BAD

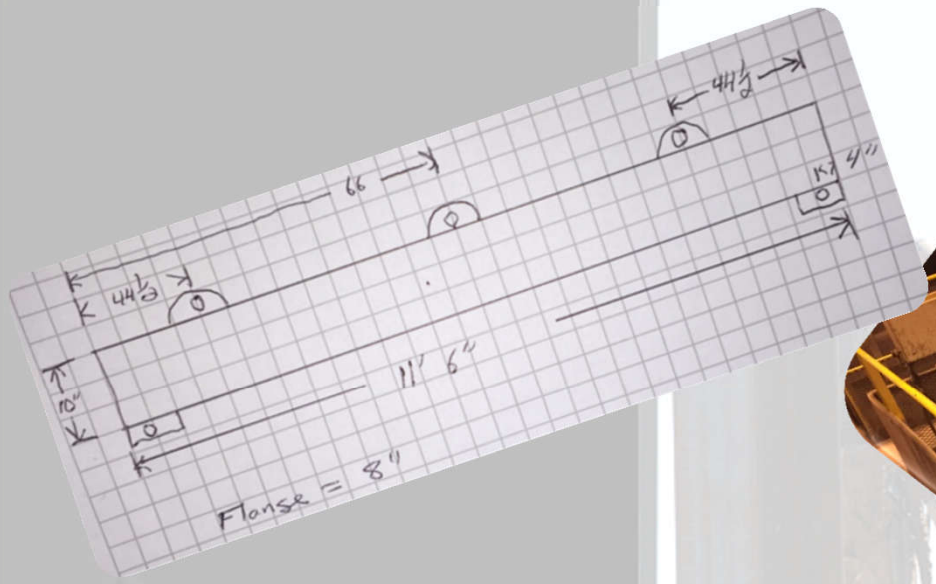


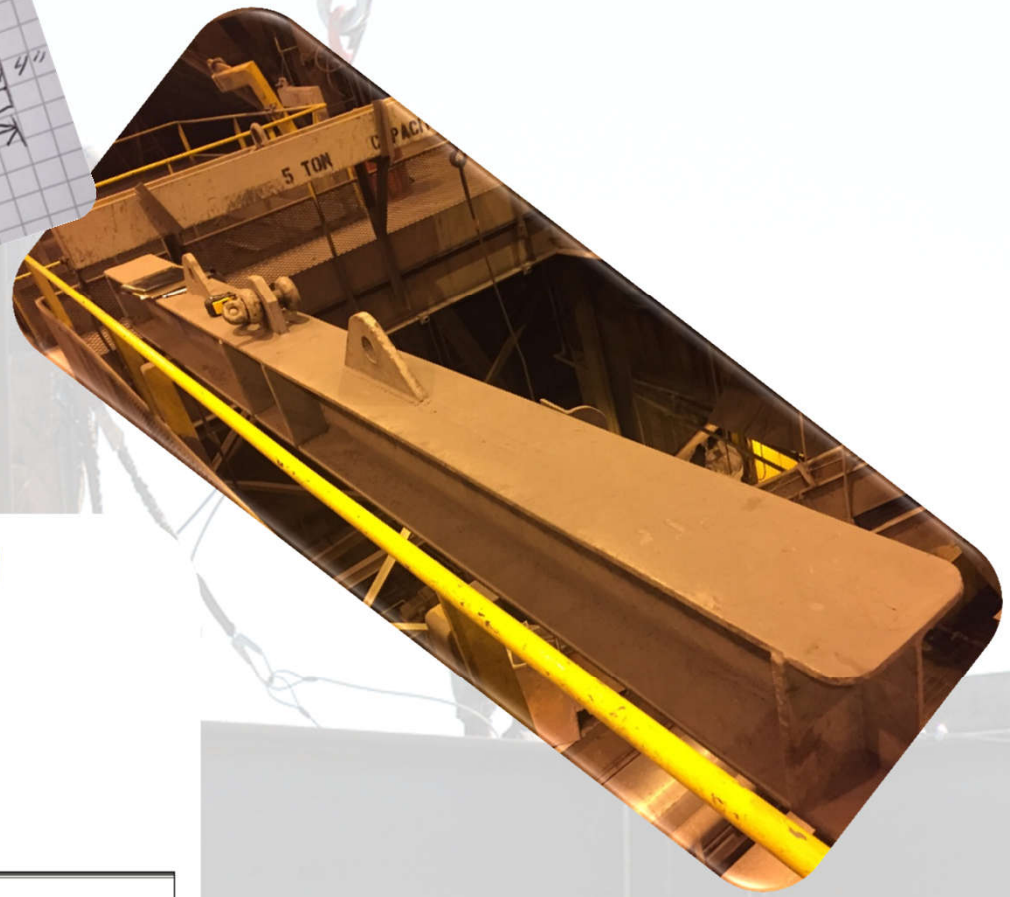
# Below the Hook Lifters

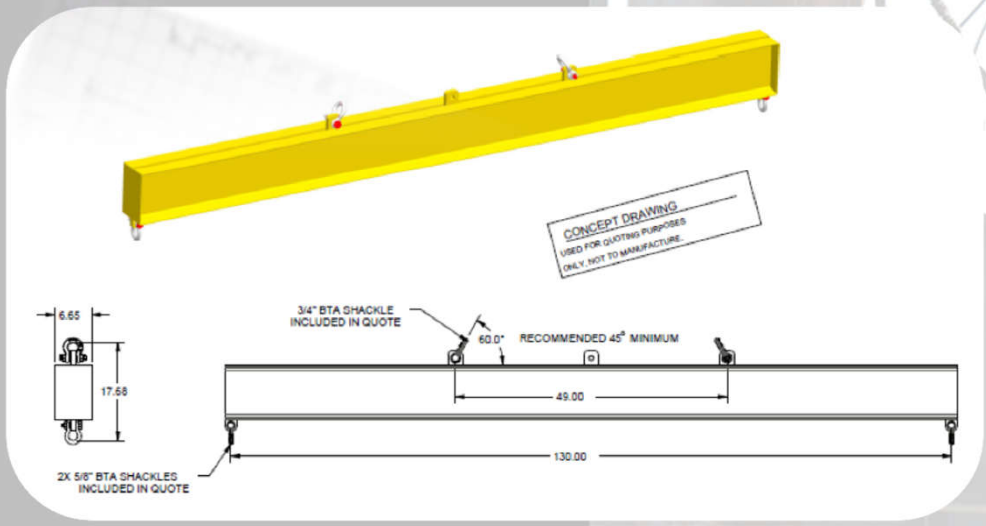
- Generally speaking homemade lifters can not simply be “certified”
  - Takes more than a load test
  - 5 : 1 min design factor
  - Weld specifications
  - Engineering review



# Below the Hook Lifters

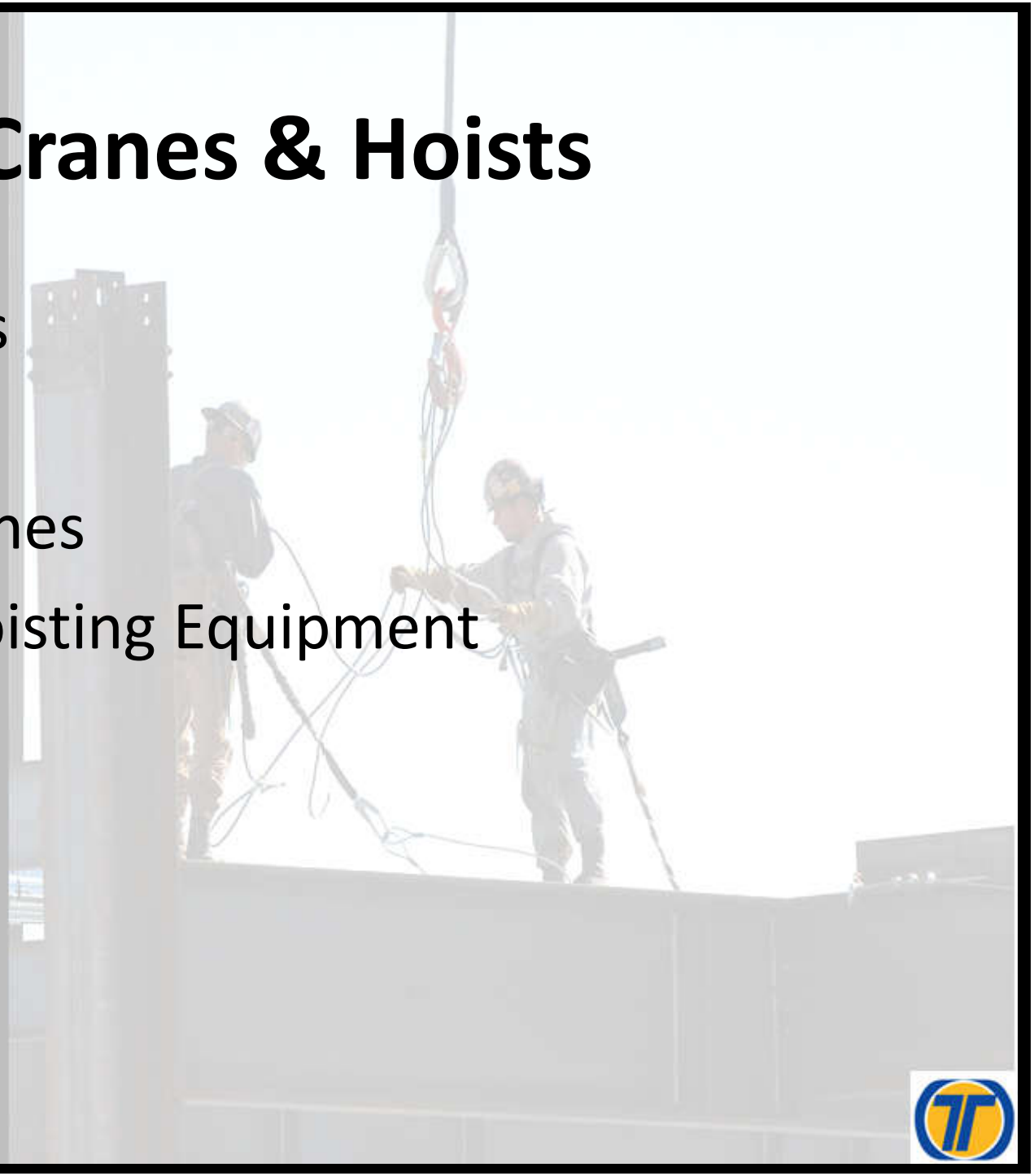


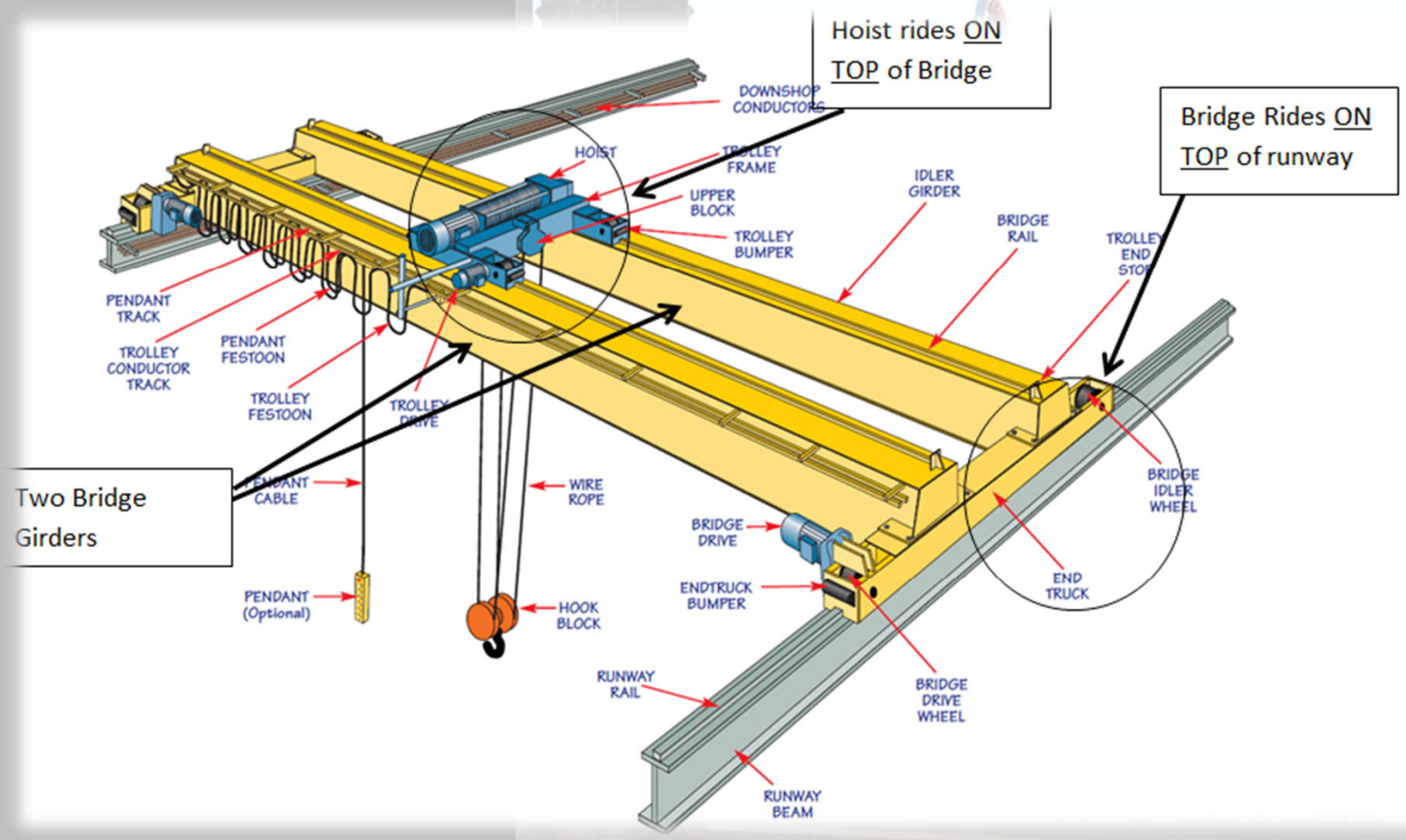



# Overhead Cranes & Hoists

- Bridge Cranes
- Jib Cranes
- Monorail Cranes
- Stationary Hoisting Equipment

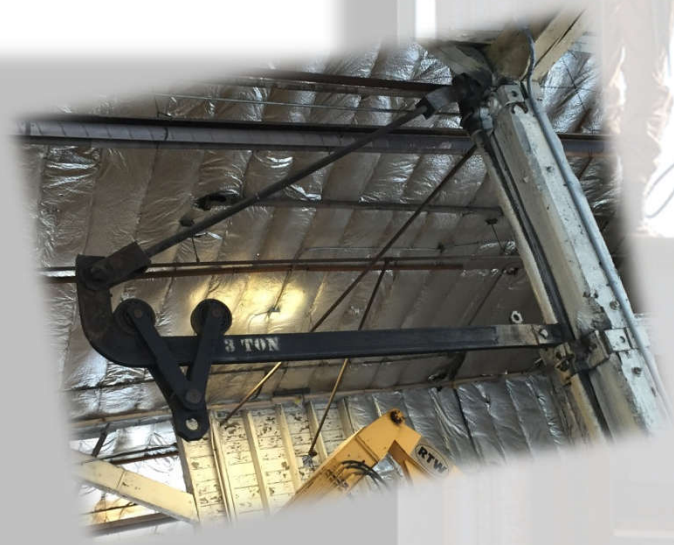


# Bridge Crane
# Double Girder Top Running



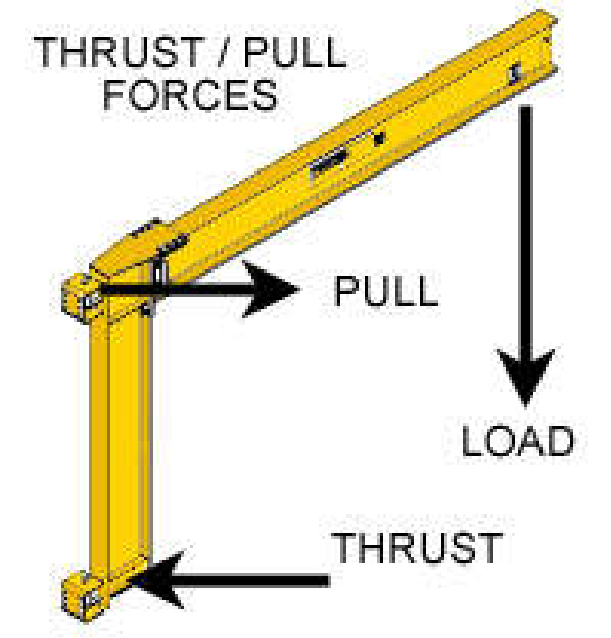
# Jib Cranes





# Wall Mounted Jibs

- Correct Mounting of Wall Mounted Jibs is Critical!
- The building and column must be considered

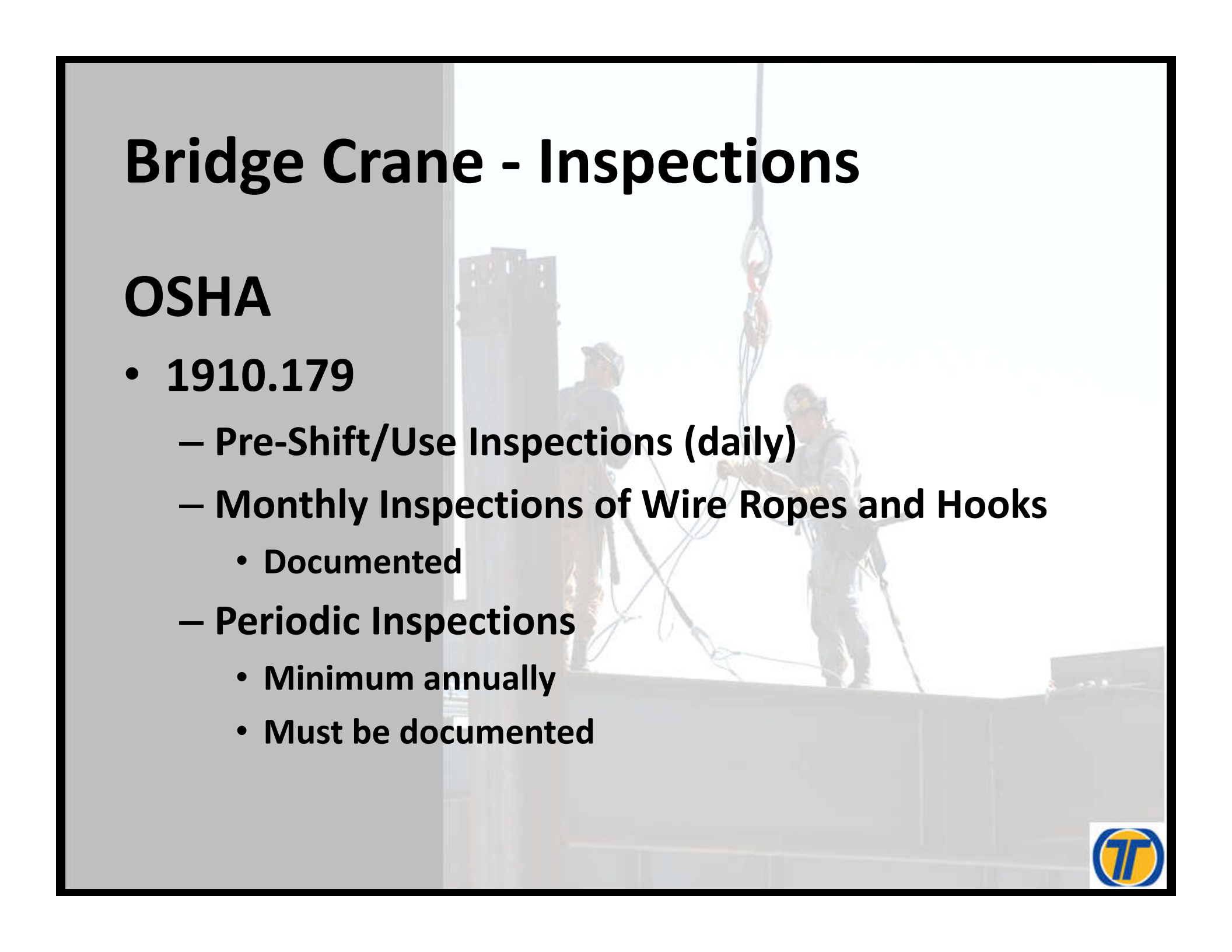


# Monorail Cranes

# Bridge Crane - Inspections

## OSHA

- 1910.179
  - Pre-Shift/Use Inspections (daily)
  - Monthly Inspections of Wire Ropes and Hooks
    - Documented
  - Periodic Inspections
    - Minimum annually
    - Must be documented



# Bridge Crane - Inspections

1910.179(b) - General requirements

1910.179(b)(1)Application. This section applies to overhead and gantry cranes, including semi-gantry, cantilever gantry, wall cranes, storage bridge cranes, and others having the same fundamental characteristics. These cranes are grouped because they all have trolleys and similar travel characteristics.

# Jib & Monorail

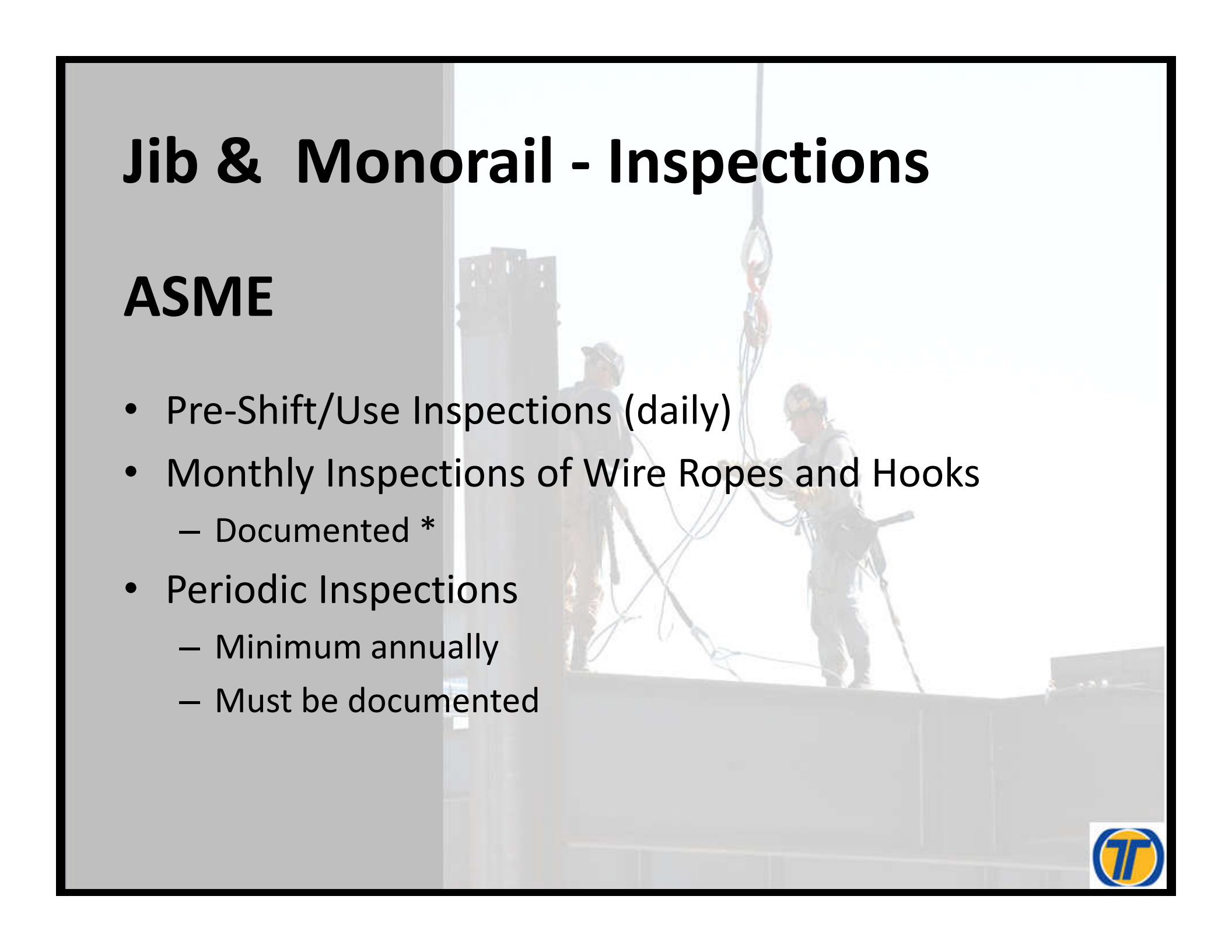
While 1910.179 only applies to overhead bridge/gantry cranes OSHA made it clear in a 1991 letter of interpretation that they will apply the ASME/ANSI B30 national consensus standards where no OSHA standard exists. Below is an excerpt from that letter:

- *"While OSHA as yet has no standard of its own covering monorail systems and underhung cranes, under Section 5(a)(1) (the general duty clause) of the Occupational Safety and Health Act all employers have a legal responsibility to provide safe and healthful workplaces for their employees. OSHA's policy is that the general duty clause requires employers to comply with safety standards recognized in the industry, such as ANSI B30.11"*

# Jib & Monorail - Inspections

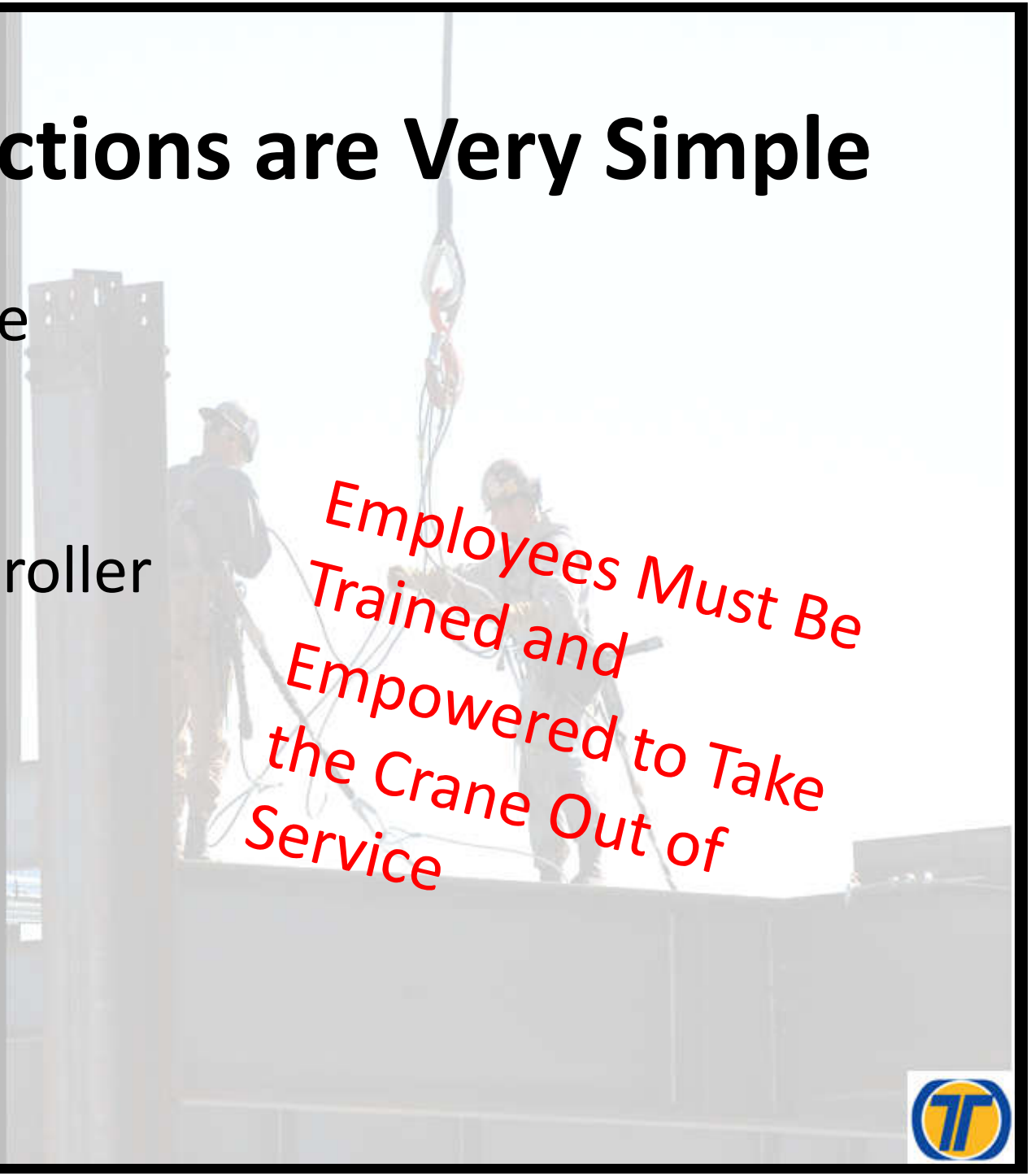
## ASME

- Pre-Shift/Use Inspections (daily)
- Monthly Inspections of Wire Ropes and Hooks
  - Documented *
- Periodic Inspections
  - Minimum annually
  - Must be documented



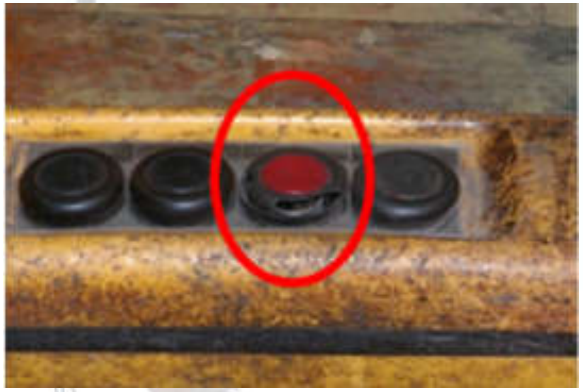
# Daily Inspections are Very Simple

- Run The Crane
  - Look
  - Listen
- Pendant Controller
- Wire Rope
- Hook
- Upper Limit
- Lower Limit



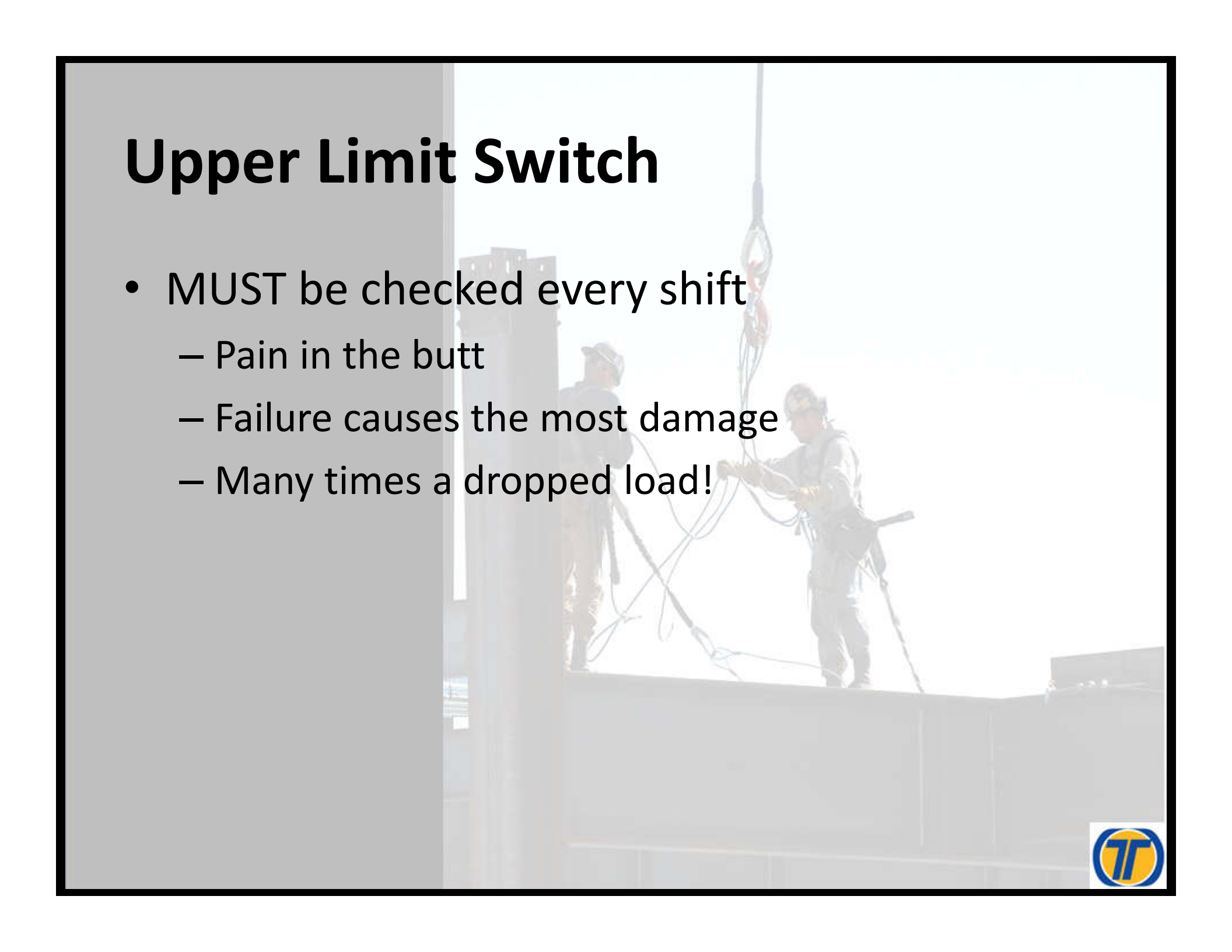
*Employees Must Be Trained and Empowered to Take the Crane Out of Service*

# Pendant Controller



# Upper Limit Switch

- MUST be checked every shift
  - Pain in the butt
  - Failure causes the most damage
  - Many times a dropped load!

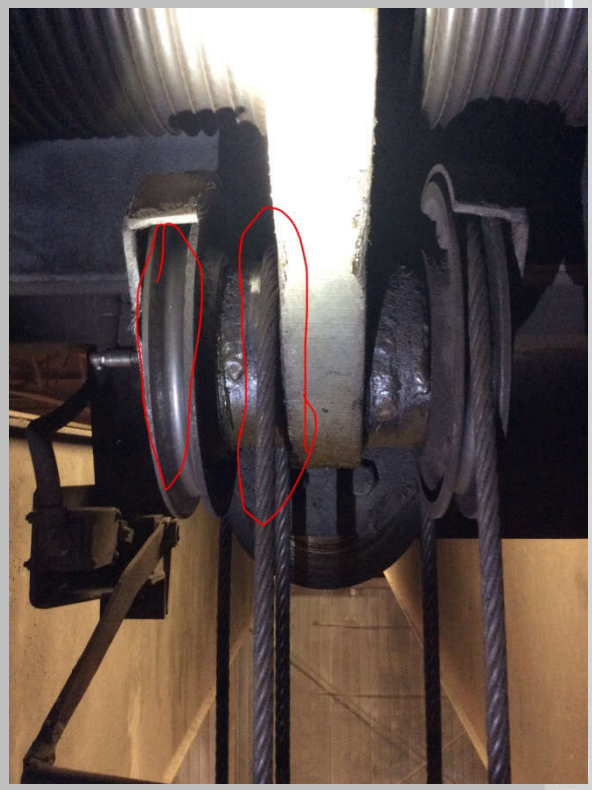


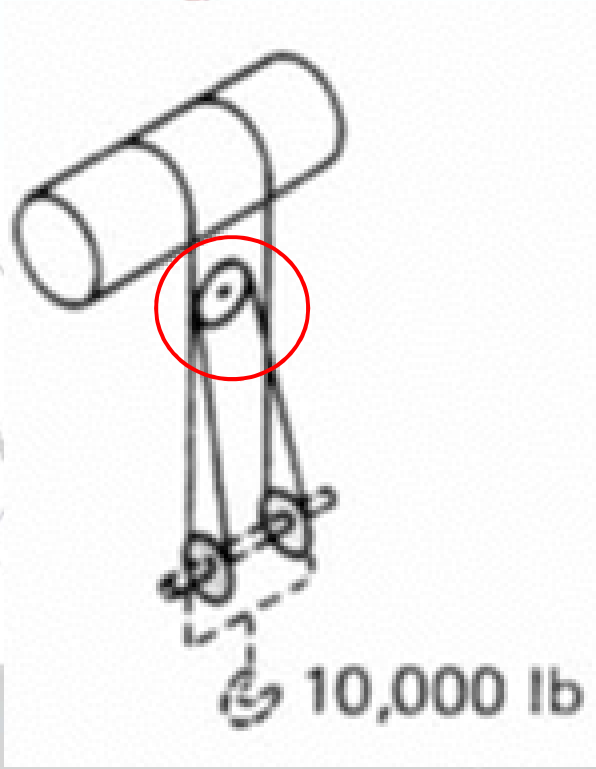
# Monthly Hook, Wire Rope or Chain

**Time to get up close and personal**

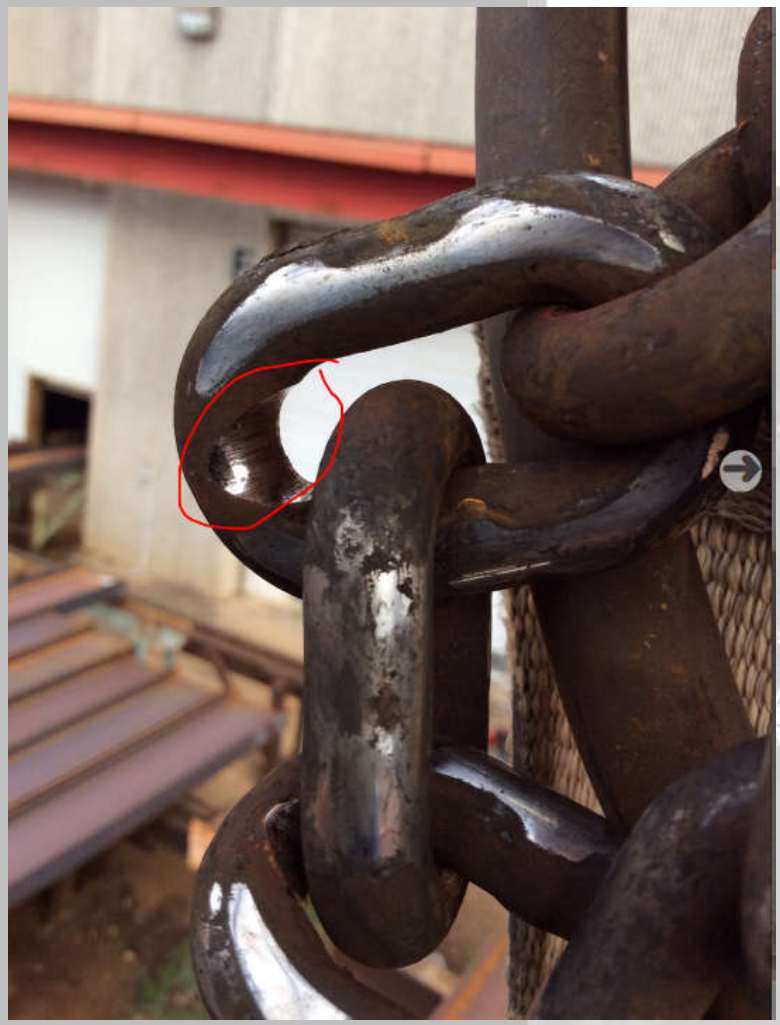
- Chain / Wire Rope Inspections can not be done from the floor!
  - Need to inspect the entire length
  - Particularly the top and bottom
- Inspector Needs to Be Trained
  - We spend 6 hours on the subject with our new service techs
  - As well as several months OJT

# Close up inspection required!





# Close up inspection required!



# Other Considerations

- Train your operators
  - Daily Equipment Inspections
  - Proper Load Handling
  - Safe Operation
- Location of Emergency Disconnects
  - Required by OSHA
  - ALL operators must know where they are

# Mitigate The Danger

**What we can control**

- Training
- Inspections
- Proper storage
- Proper equipment
- Proper maintenance
- Lift Planning
  - Know the weight of your load
  - Provide the correct rigging gear

Don't force People to:
Make Due With What They Have!

Because they will!