

## **Guarding Machinery at Metal & Nonmetal Mines**



Mine Safety & Health Administration – Oct. 2012

**This guide provides compliance information to help the metal and nonmetal mining industry meet current requirements of the Mine Safety and Health Administration's (MSHA's) guarding standards addressing machinery. This document is also intended to enhance awareness of guarding compliance for miners, mine operators, miners' representatives, independent contractors, equipment manufacturers, and MSHA's Metal and Nonmetal enforcement personnel with compliance issues related to guarding machinery.**

**This guide should be used to supplement existing guarding guidance contained in "MSHA's Guide to Equipment Guarding" published in 2004, and in MSHA's existing Program Policy Manual.**

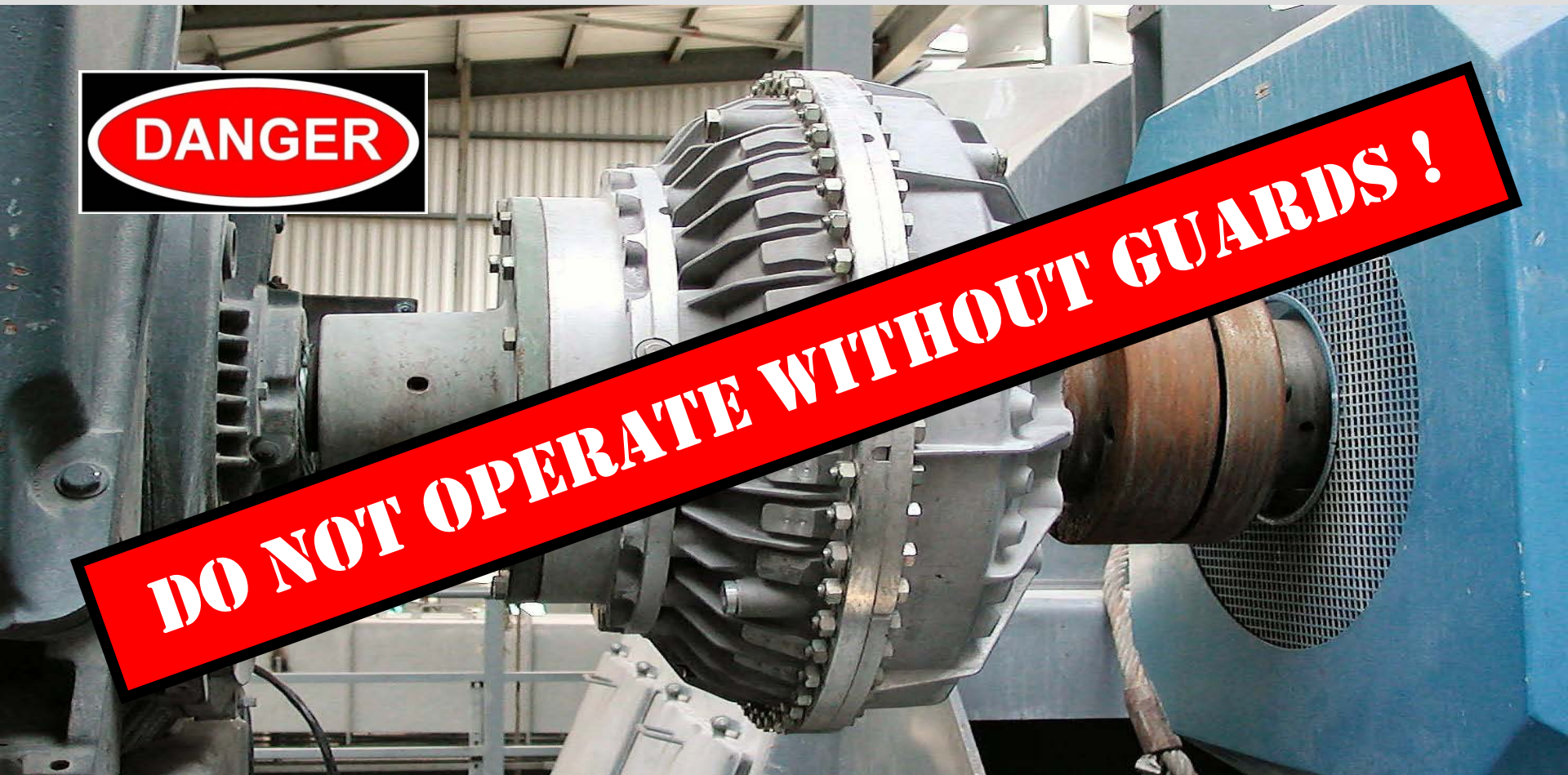


# **Navigating this Presentation**

**Most of the slides in this presentation have explanatory notes that are critical to understanding the content. If using the PowerPoint® version, be sure to adjust the display on your computer screen to be able to read the notes, or print the slides using the “Notes Pages” option. If using the PDF version, the notes can be read by hovering your cursor over or clicking on the orange icon in the upper left corner of the slide.**



# Guarding Machinery at Metal & Nonmetal Mines



**Mine Safety & Health Administration – Oct. 2012**

# Table of Contents

- Guarding goals; injury & citation statistics 6
- Moving machine parts: §§ 56/57.14107 9
- Inadvertent & work-related contact 12
- Types of guards 19
  - Point-of-contact guarding 20
  - Location guarding 22
  - Area guarding 25
- Guarding shafts 35
- Guard construction, maintenance, attachment  
and fasteners: §§ 56/57.14112 40
  - Securely in place 48



# Table of Contents, continued

- Procedures during repairs & maintenance:
  - §§ 56/57.14105 54
- Overhead drive belts: §§ 56/57.14108 58
- Flying or falling materials: §§ 56/57.14110 61
- Slusher & backlash guards: §§ 56/57.14111 64
- Stationary grinding machines: §§ 56/57.14115 66
- Safety defects: §§ 56/57.14100 76
- Miscellaneous & recommendations
  - Administrative controls & maintenance 77
  - Misc. ejected materials hazards 79
  - Openings in guards 81
  - Risk management, compliance & closing 85

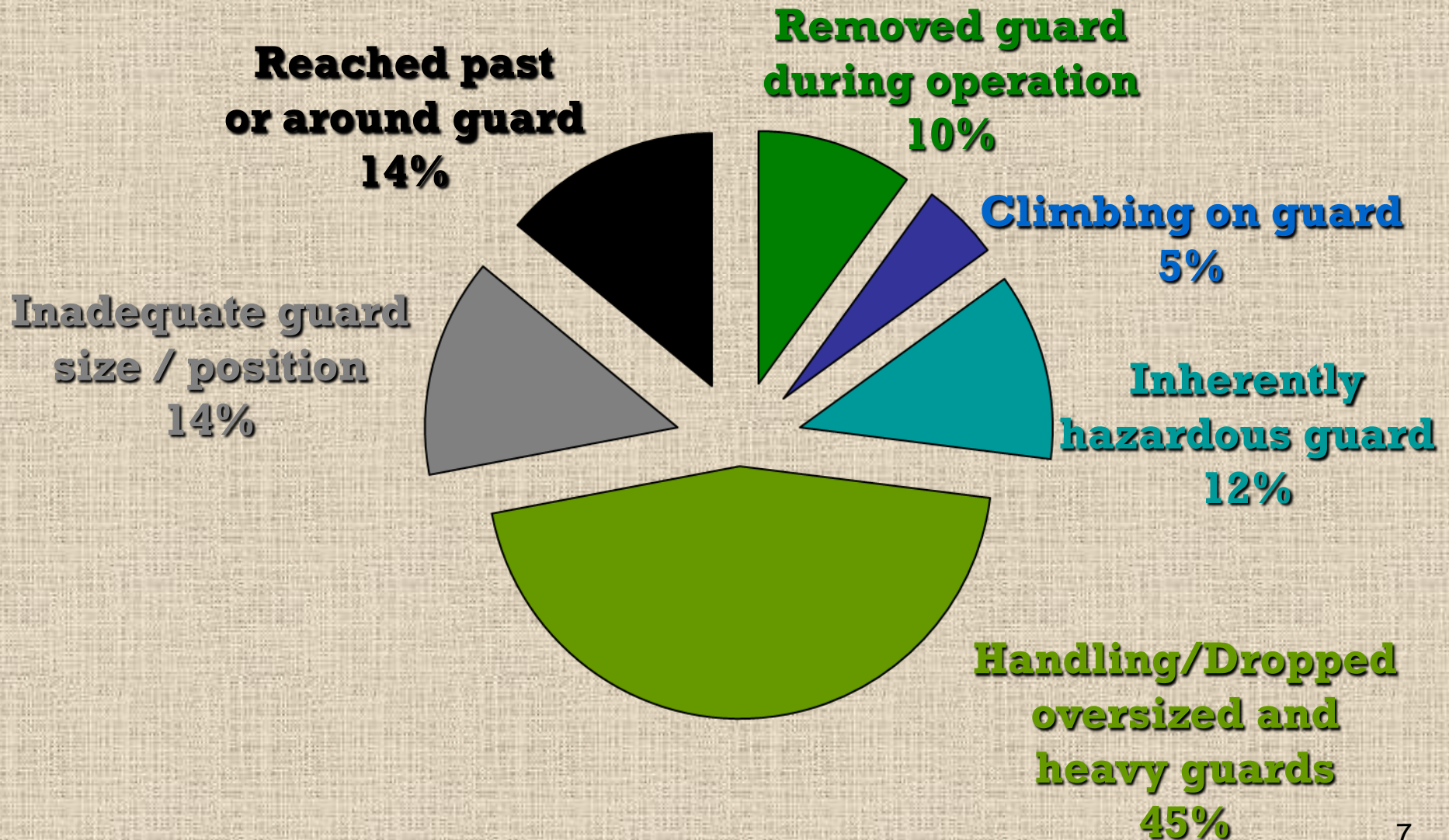


# Goals & Objectives

- **Protecting miners by:**
  - **Improving industry's understanding of good guarding principles**
  - **Ensuring the construction, installation and maintenance of high quality, effective guards**
  - **Improving inspection and enforcement consistency**
- **This will result in ... *REDUCED* :**
  - **Serious and fatal accidents**
  - **Risk of injury to miners**



# Injuries Related to Equipment Guarding




# Guarding Citations (MNM)

<b>Fiscal Year</b>	<b>Total Citations &amp; Orders *</b>	<b>Guarding Citations &amp; Orders *</b>	<b>% Guarding Citations &amp; Orders *</b>
<b>2006</b>	<b>62,761</b>	<b>10,102</b>	<b>16.1</b>
<b>2007</b>	<b>58,529</b>	<b>8,668</b>	<b>14.8</b>
<b>2008</b>	<b>67,712</b>	<b>9,704</b>	<b>14.3</b>
<b>2009</b>	<b>68,384</b>	<b>9,853</b>	<b>14.4</b>
<b>2010</b>	<b>74,848</b>	<b>10,877</b>	<b>14.5</b>
<b>2011</b>	<b>65,137</b>	<b>8,037</b>	<b>12.3</b>
<b>2012**</b>	<b>46,583</b>	<b>5140 (# 6624)</b>	<b>11.0</b>

**\* Includes all C & O for 30 C.F.R. §§ 56/57.14107, .14108, .14109, &.14112**

**\*\* FY 2012 YTD, 7/10/2012; # - Projected through end FY**





# Moving Machine Parts

## 30 C.F.R. §§ 56/57.14107

- (a) Moving machine parts shall be guarded to protect persons from ***contacting gears, sprockets, chains, drive, head, tail and take-up pulleys, flywheels, couplings, shafts, fan blades*** and similar moving parts that can cause injury.
- (b) Guards shall not be required where the exposed moving parts are at least seven feet away from walking or working surfaces.

# **Machinery and Components to Guard**



- Crushers and screens
- Rotating equipment
- Drive & power transmission components
- Packaging and palletizing equipment
- Power tools and auxiliary equipment
- Conveying equipment
- Mobile equipment





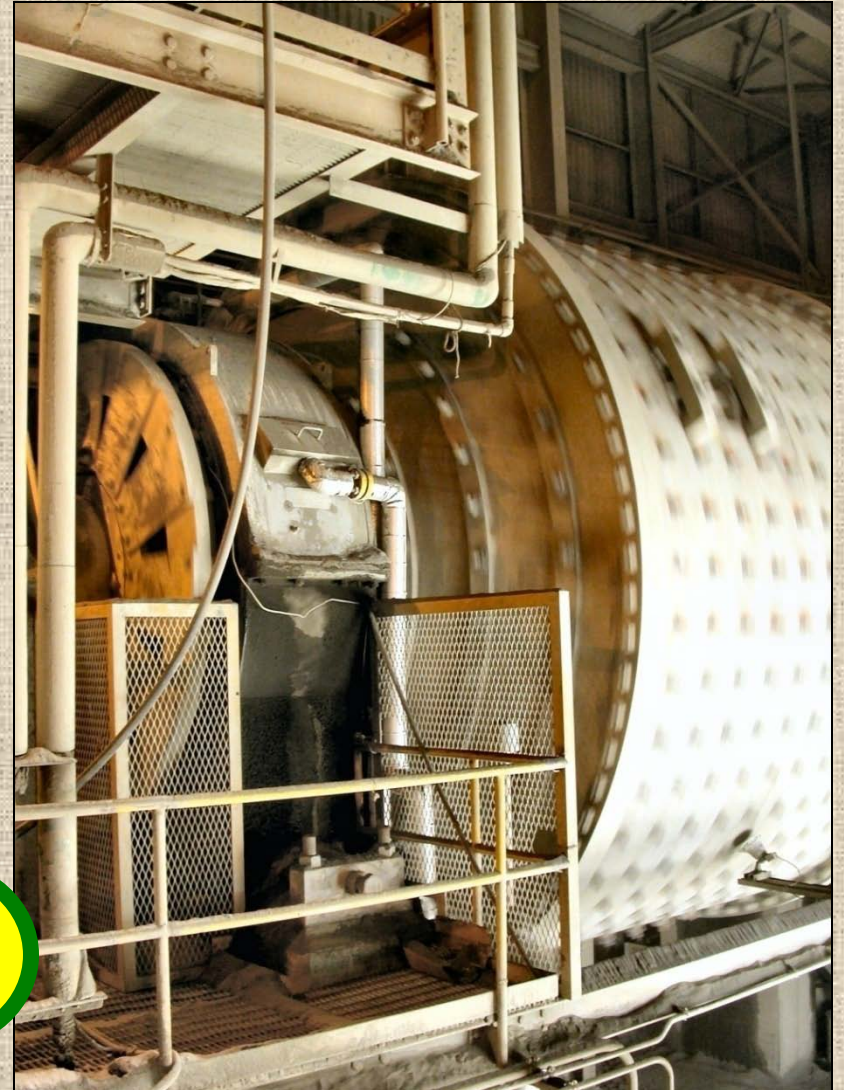
# **Preamble: 30 C.F.R. §§ 56/57.14107**

## **53 Fed. Reg. 32509 (Aug. 25, 1988)**

### **Guards are meant to protect persons from:**

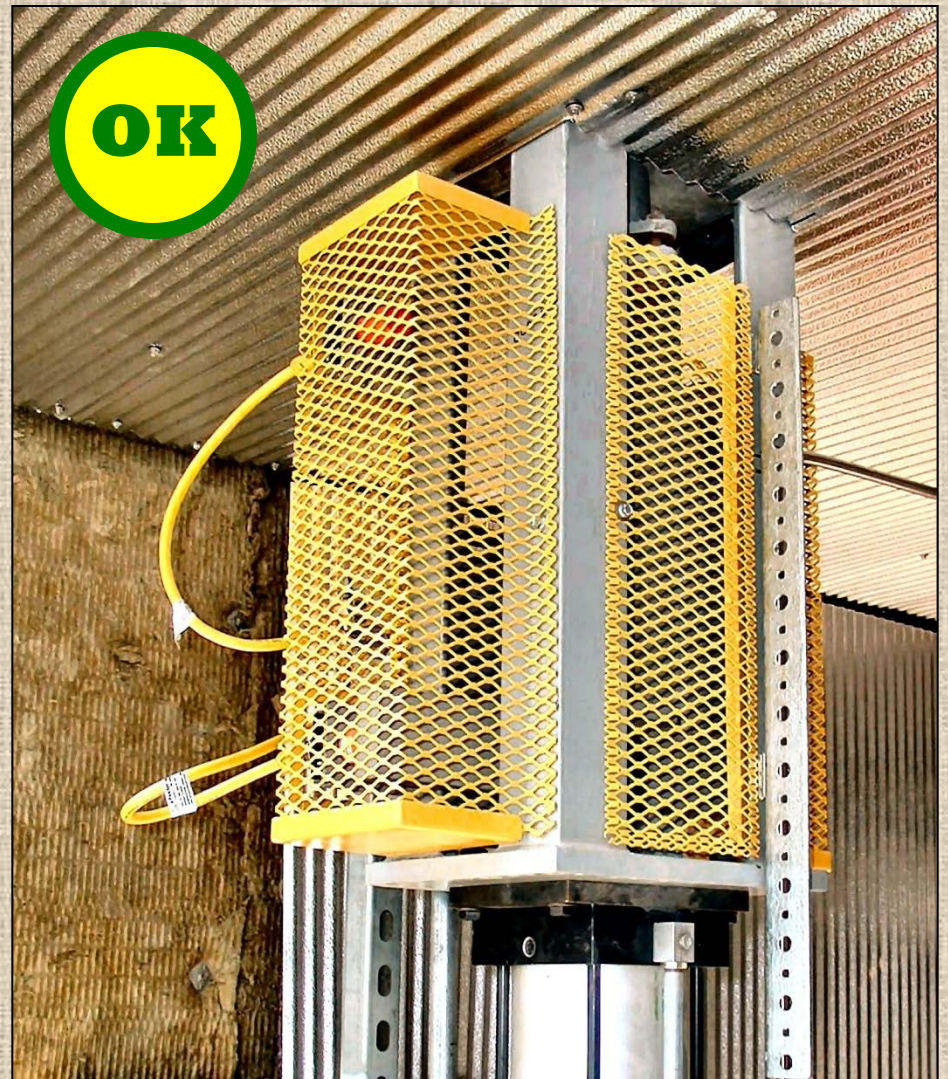
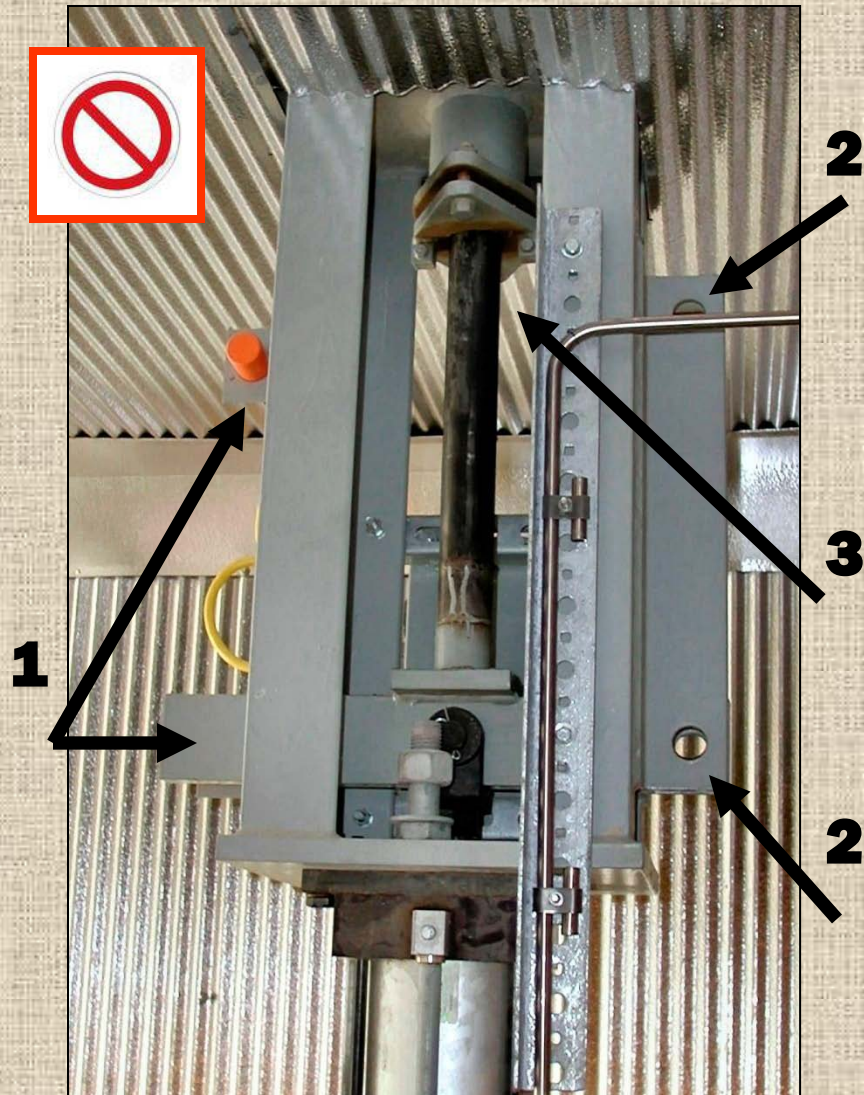
- “inadvertent, careless, or accidental contact” or
- “deliberate or purposeful *work-related* actions...” (inspection, testing, cleaning, maintenance, troubleshooting, lubrication, adjustment, servicing, etc...)
  - ✓ Work does not have to be assigned or directed by management or supervisor
- Standard does not address deliberate or purposeful, NON-work-related actions

# Inadvertent or Purposeful Work-Related Contact



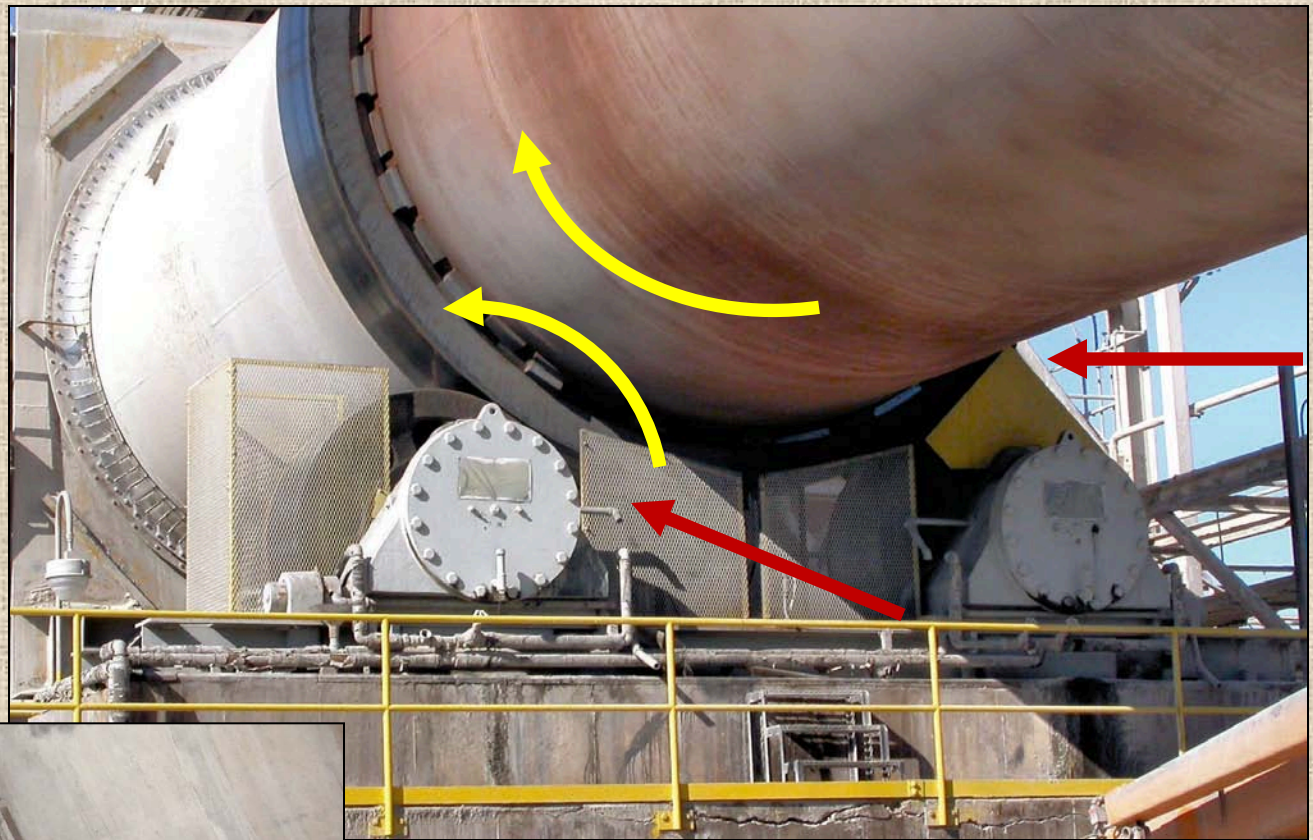


# Inadvertent or Work-Related Contact





# Work-Related Contact



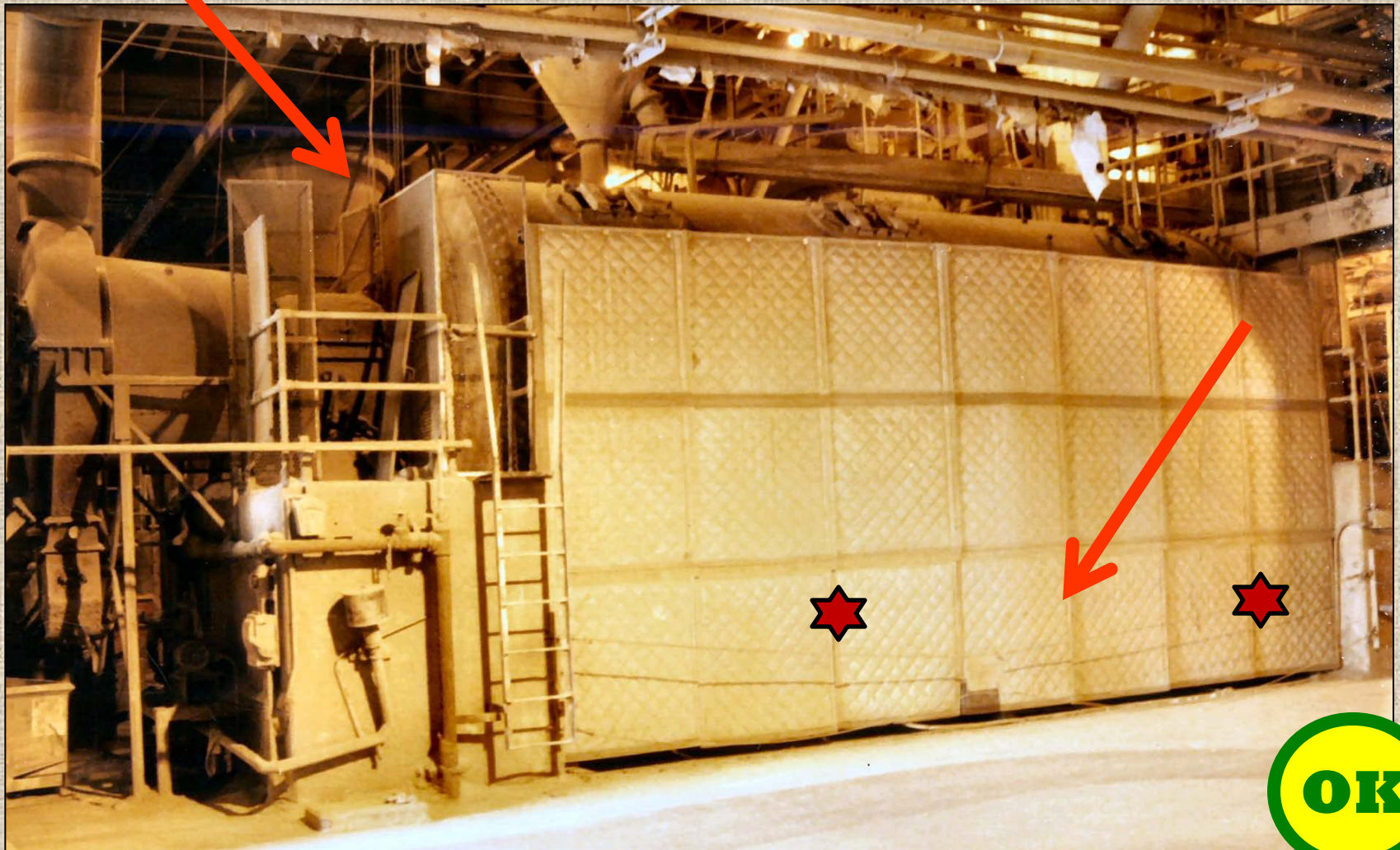


# Inadvertent or Work-Related Contact





# Inadvertent or Purposeful Work-Related Contact



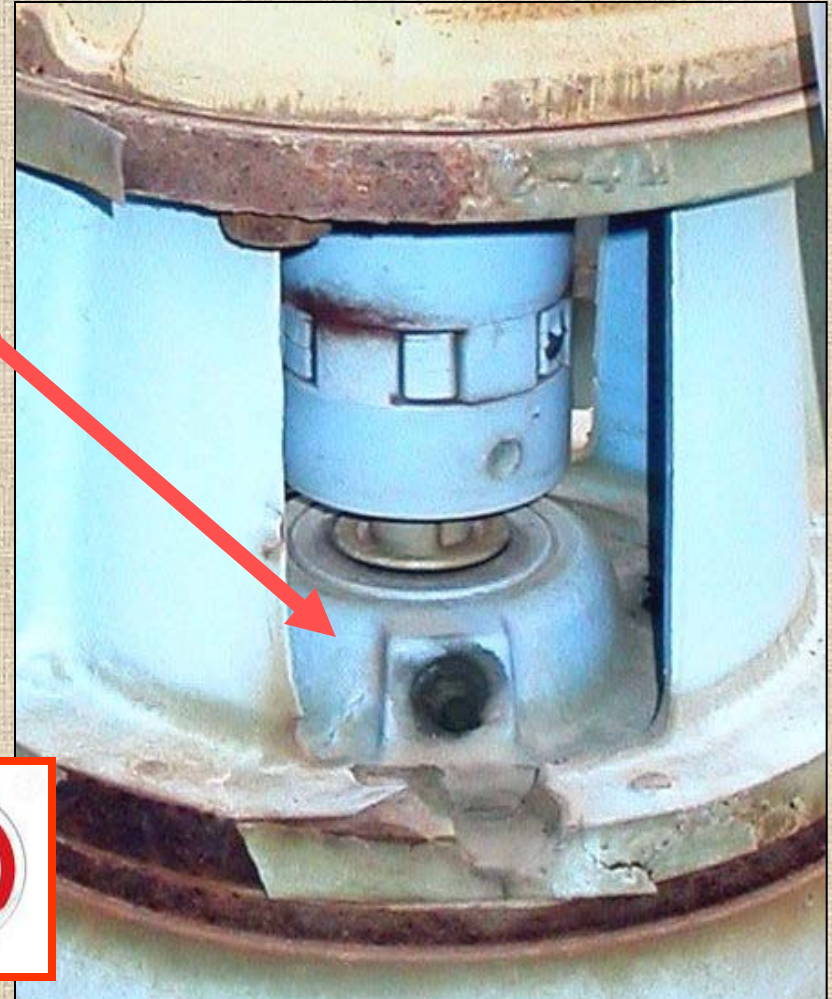


# Purposeful Non-Work-Related Contact





# Work-Related Contact



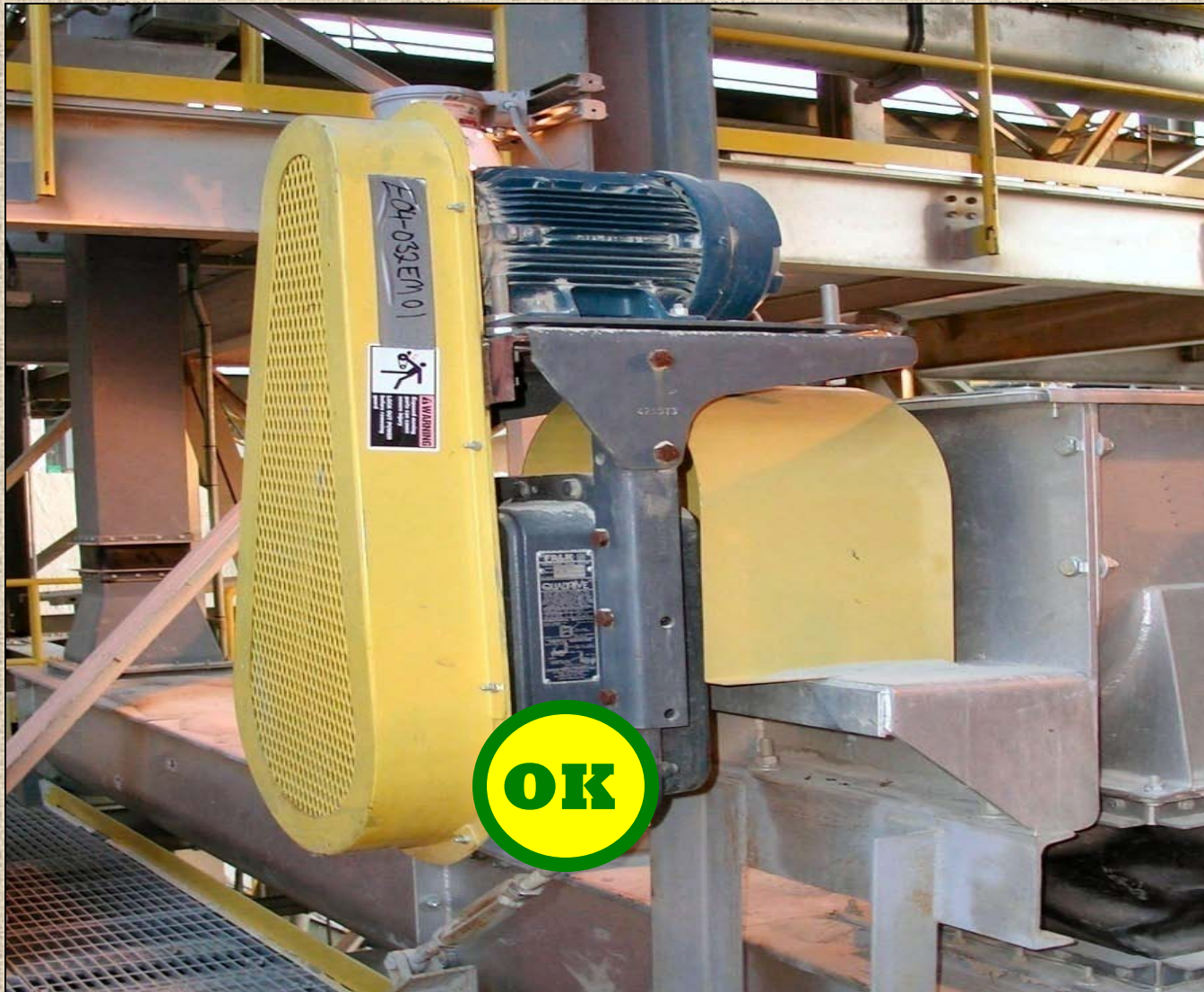




# Types of Guarding

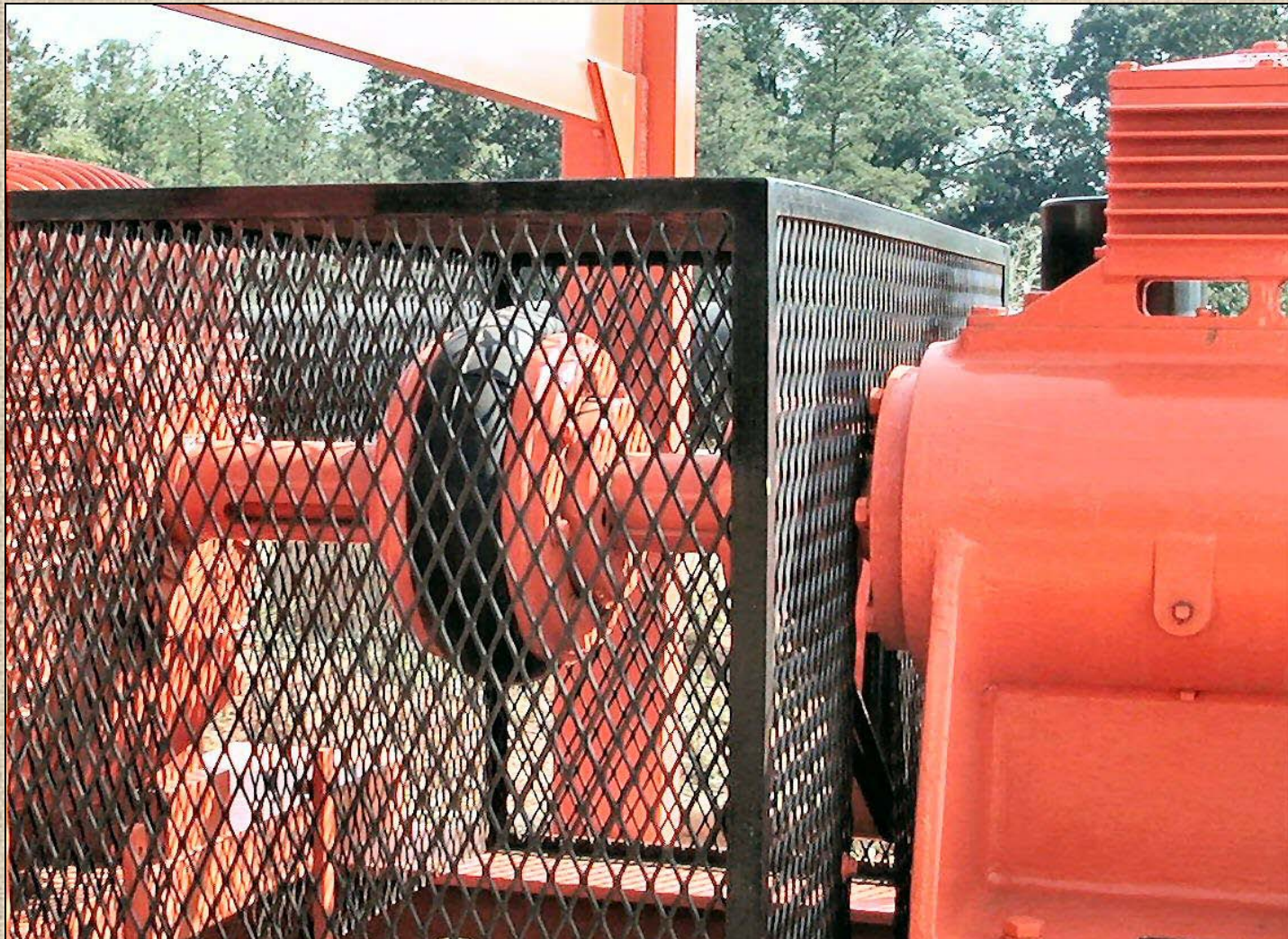
- Point-of-contact guarding
  - Location guarding
    - Area guarding

# Point-of-Contact Guards





# Point-of-Contact Guards

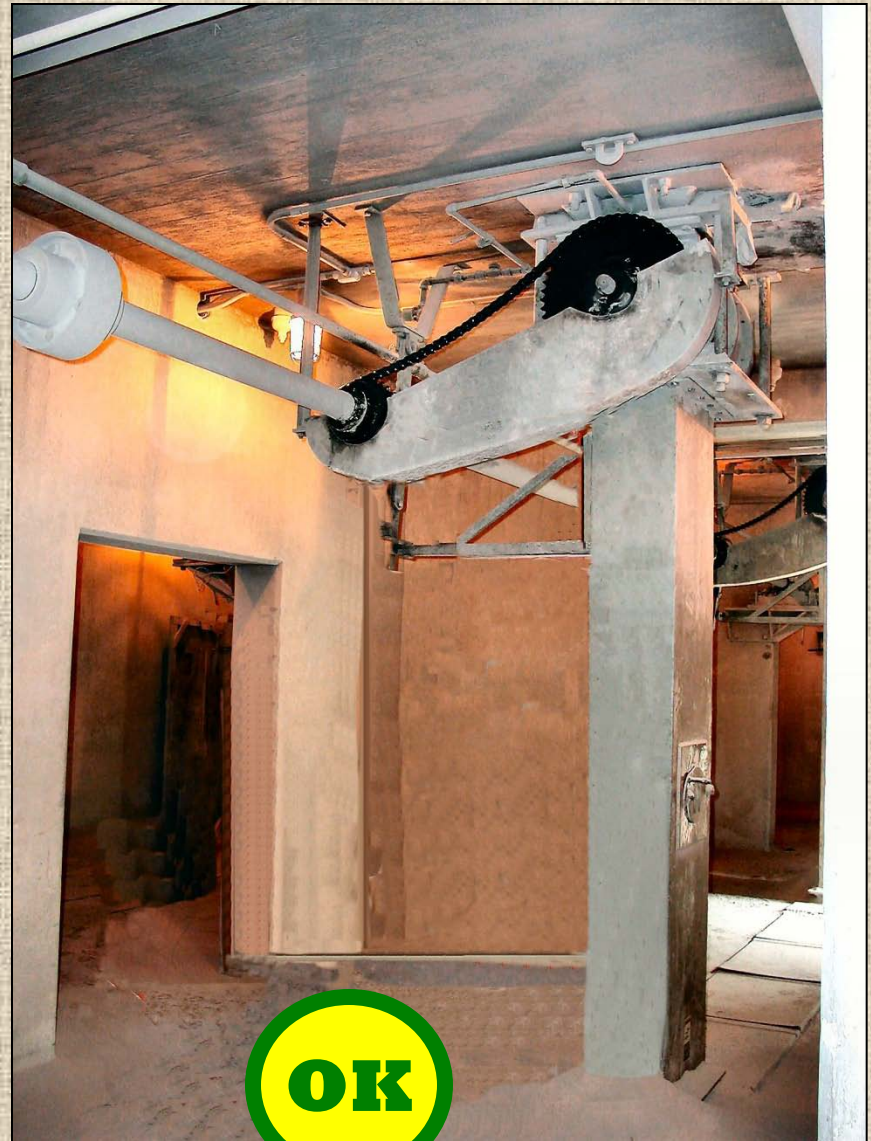




# Guarding by Location

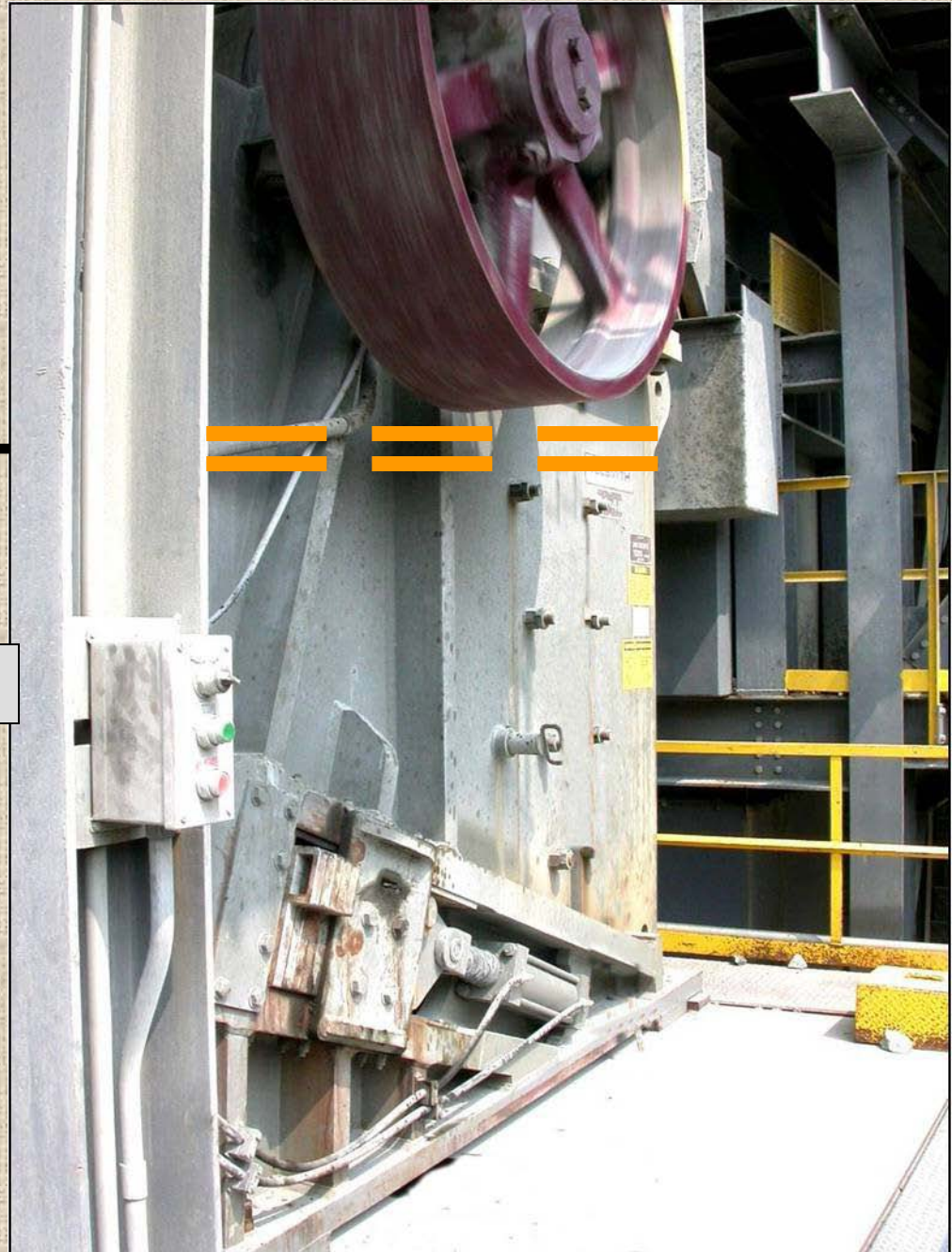
The distance from the floor to the line shaft, sprockets and connecting chain is greater than 7 feet.

The drive motor must be powered OFF and locked out when the elevated components are inspected or repaired.



# Guarded by Location?

7 ft. – 6 in.





# Ladder-less Work Platforms







# Area Guarding

## from MSHA's 2004 “Guide to Equipment Guarding” Handbook

An area guard is a barrier which prevents entry of a miner into an area containing moving machine parts, thus preventing contact with the moving parts. **Effective area guards may require additional practices and provisions, such as signage, locks, color coding, etc., in addition to the physical barrier.** When designing, installing, and/or using area guards, consider:

- Security of the area
  - Is the area guard difficult to defeat?
  - Is it locked or bolted?
  - Does the guard prevent entry into the area and is the guard difficult to defeat?
- How will the moving machine parts be shut down before entry?
  - Will the guard be interlocked with the hazardous equipment so entry will automatically shut down the moving parts?
  - Will manual shutdown be used?
- Is the area guard easily recognized as a guard?
  - Are warning signs or color coding in use?
- Frequency of entry into the guarded area
  - Frequently accessed areas may not be suitable for area guarding.
- Number of people requiring access into guarded area
  - If a large number of people need access to an area, then area guarding may not be suitable.
- Education and training in proper procedures
  - Does the work force understand who may enter area guards?
  - Have lock-out, tag-out procedures been addressed?



# Area Guard Best Practices

- Perform risk analysis for equipment considered for area / multiple hazard guarding
- Secure the guard from being easily bypassed
- Make guards easy to recognize
- Include “Area Guarding” in Training Plan
- Adhere to a pre-planned Safe Work Procedure when accessing area-guarded equipment
- Keep the guards, people and training up-to-date



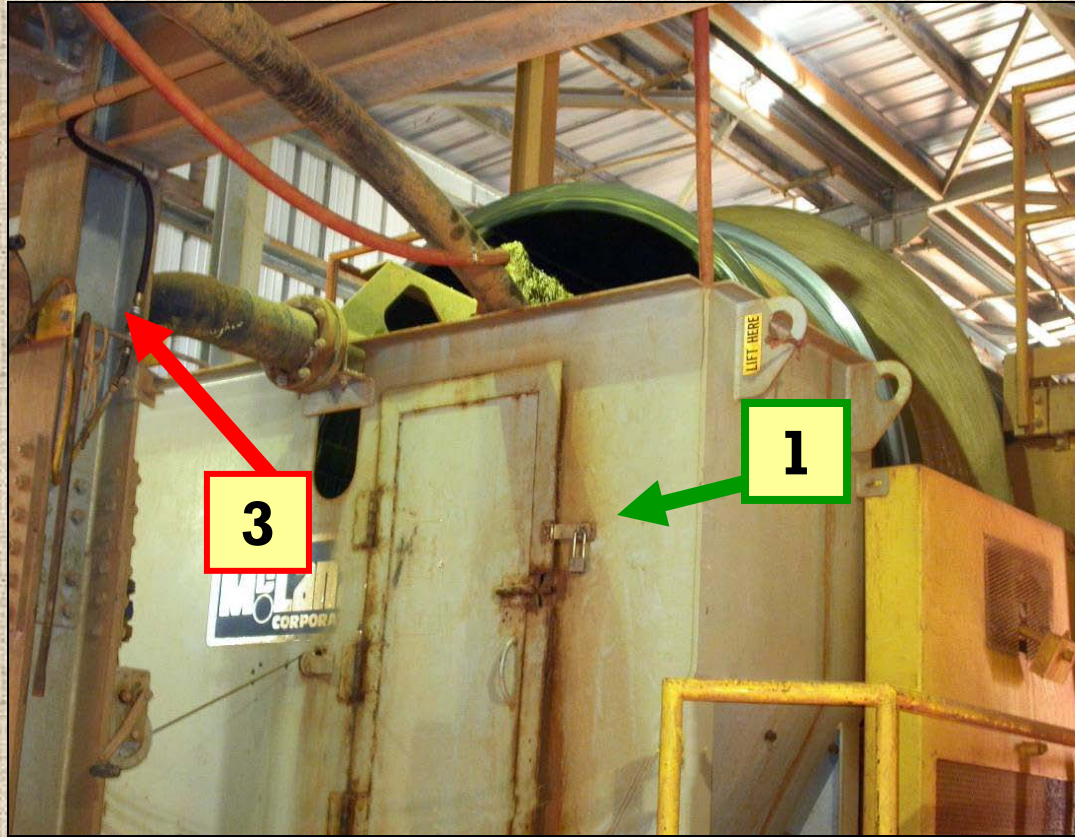
# Area Guarding



**OK**



# Area Guarding





# Area Guarding



?



# Area Guarding



**OK**



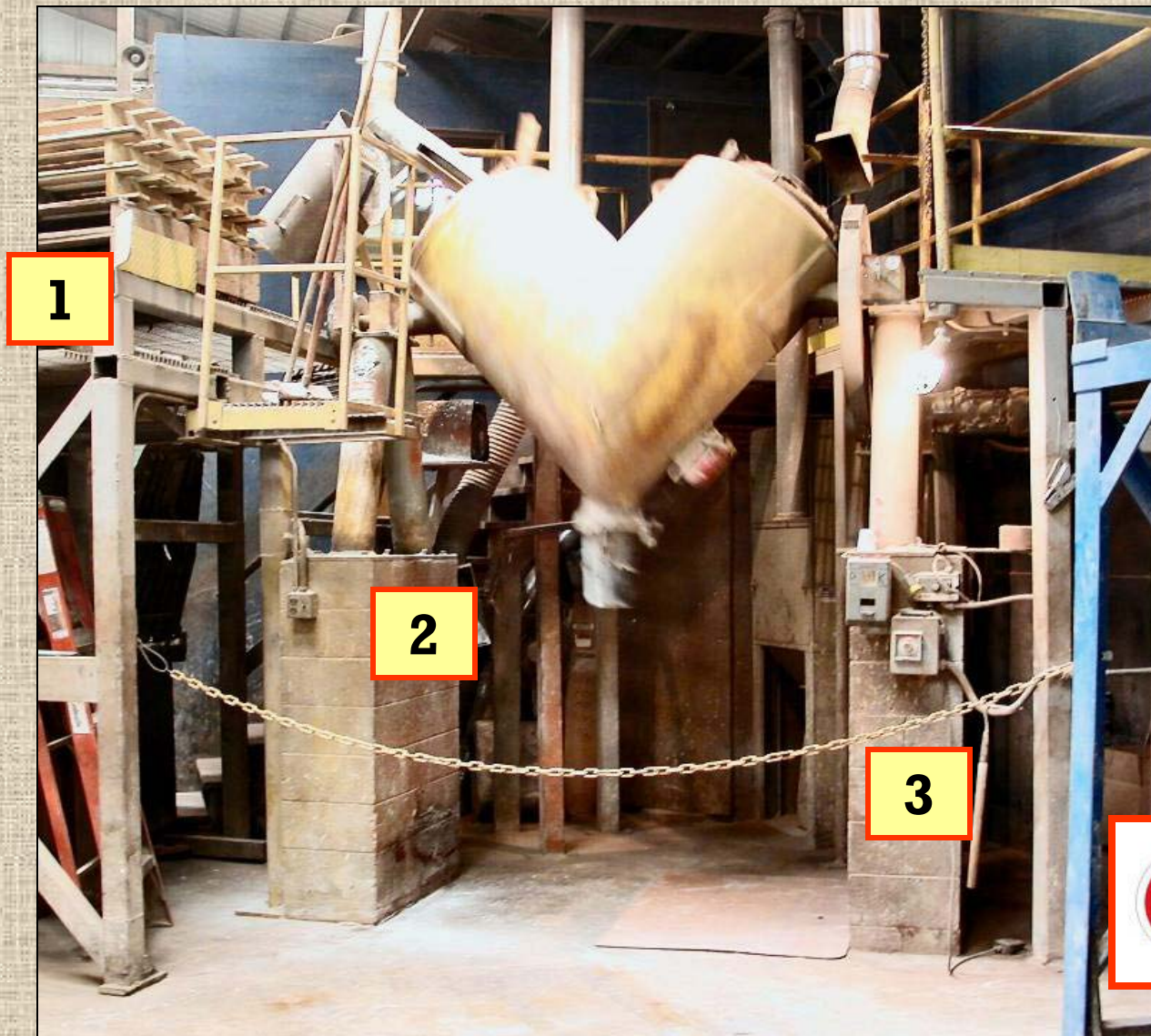


# Area Guarding





# Area Guarding





# Area Guarding





# Non-Compliant Area Guards







# Shaft and Shaft End Guarding

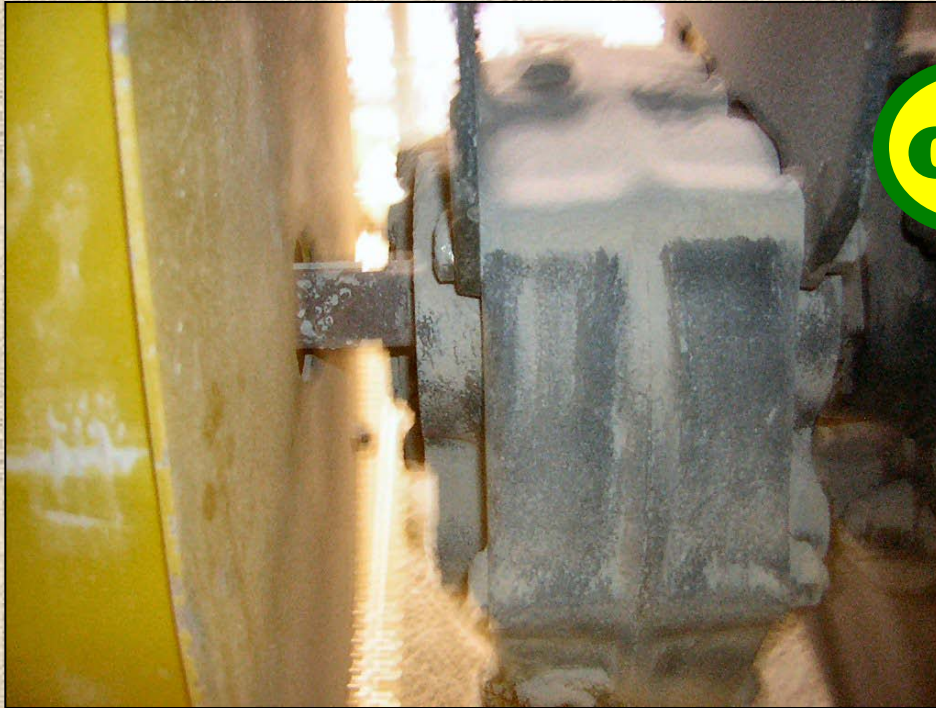
- Point of contact guards are required for shafts and shaft ends that are not guarded by location if they have exposed:
  - Keys, keyways or couplings
  - Setscrews, bolts or other protrusions
  - Burrs
- Smooth shafts and shaft ends – a guard may not necessarily be required.
- Whether a smooth shaft or shaft end requires a guard depends on...
  - Rotation speed
  - Location of shaft in the workplace
  - Diameter and length of exposed shaft
  - Exposed shaft end's extension into work space

# Shaft Guarding





# Shaft Guarding



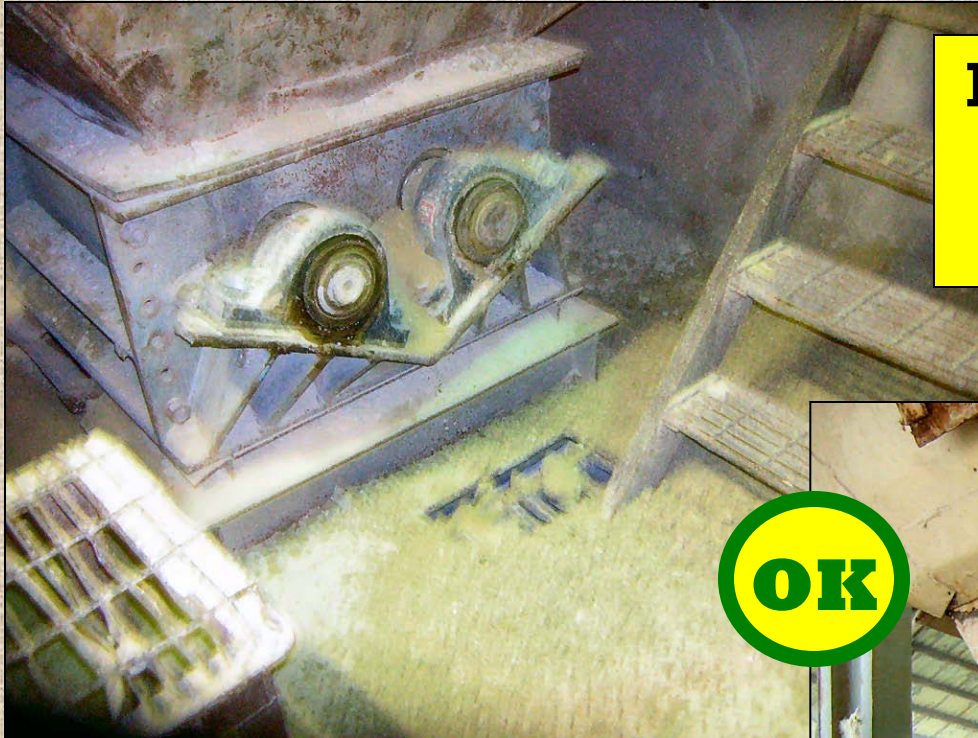
**OK**



**Smooth shafts – guards not required due to location and short length of smooth shaft exposed**



# Shaft End Guarding



**Minimal shaft protrusion,  
slow rotation speed,  
location near floor**

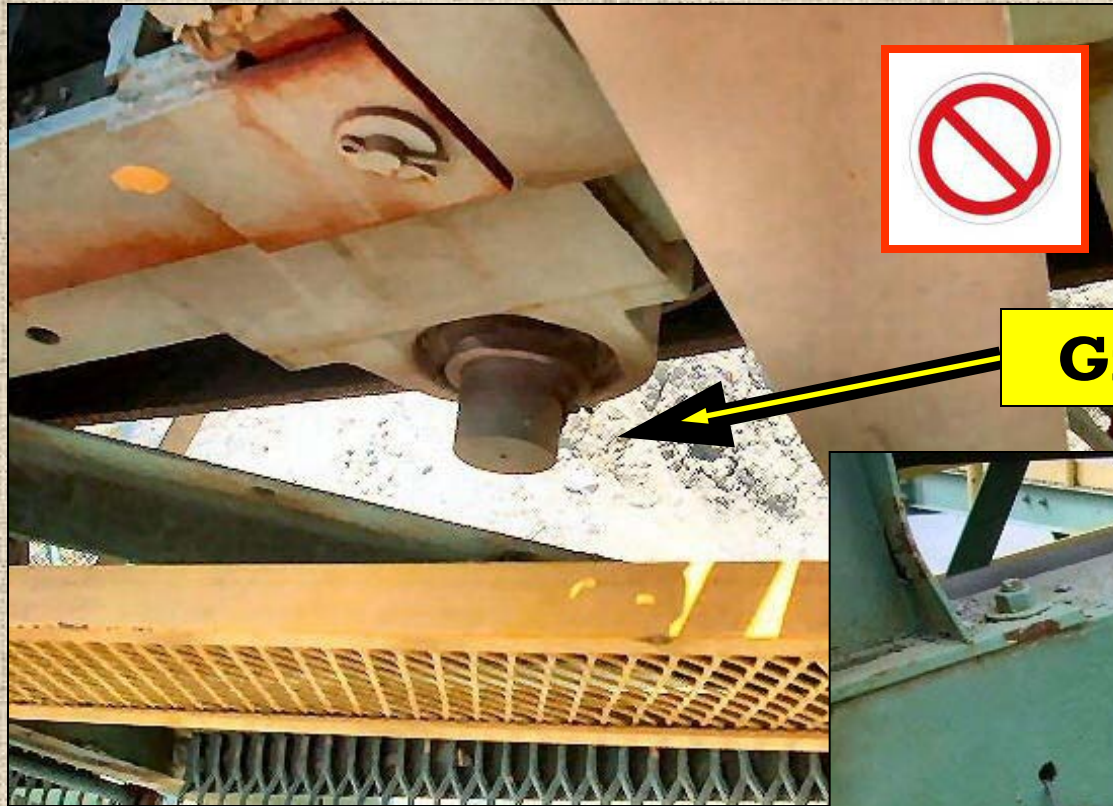
**OK**

**Small shaft protrusion,  
medium rotation speed,  
location out of travelway**





# Shaft End Guarding




**Grease fitting location**



**OK**





# **Construction and maintenance of guards 30 C.F.R. §§ 56/57.14112**

- (a) Guards shall be constructed and maintained to –
  - (1) Withstand the vibration, shock and wear to which they will be subjected **during normal operations**; and
  - (2) Not create a hazard by their use





# Guard Construction - Acceptable Materials

- Metal - Sheet metal, expanded metal mesh, floor grating, chain link fence, used screen deck cloth or punched plate, etc.
- Plastic - Plexiglas and custom shapes are OK. Plastic construction mesh is not substantial, therefore not acceptable.
- Rubber – OK to be flexible; but must be substantially constructed and well-secured. Caution: rubber is combustible.
- Wood – If used, it should be protected, well-maintained and replaced as needed. Water can damage wood. Caution: wood is combustible.



# Protective? Sturdily Constructed?





# Protective? Sturdily Constructed?



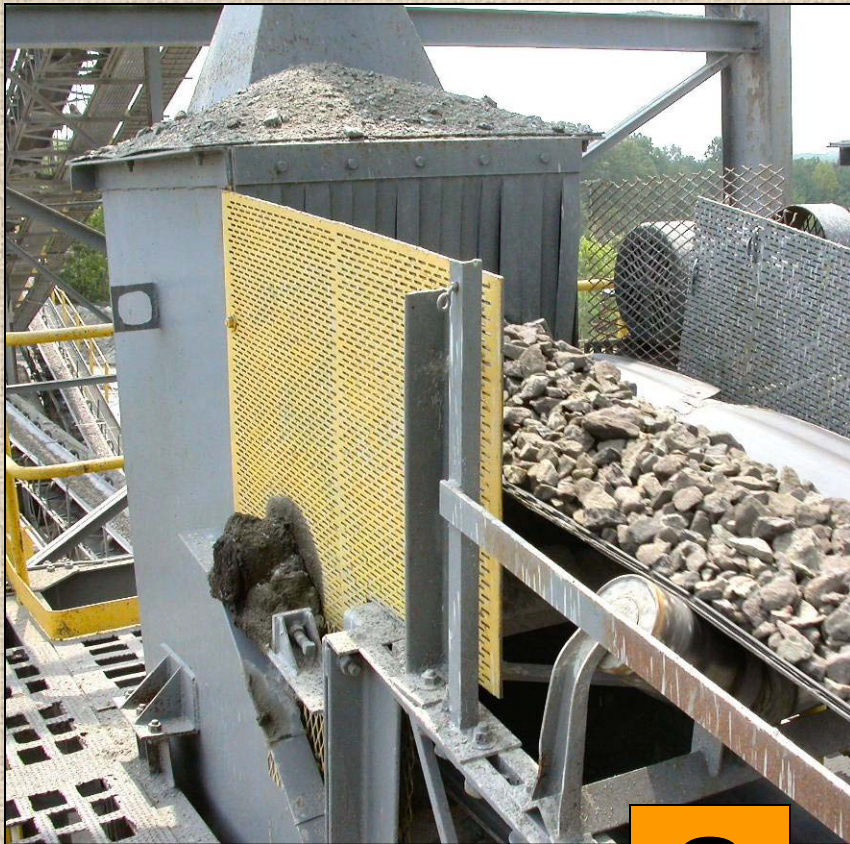


# Guard a Hazard in Itself?

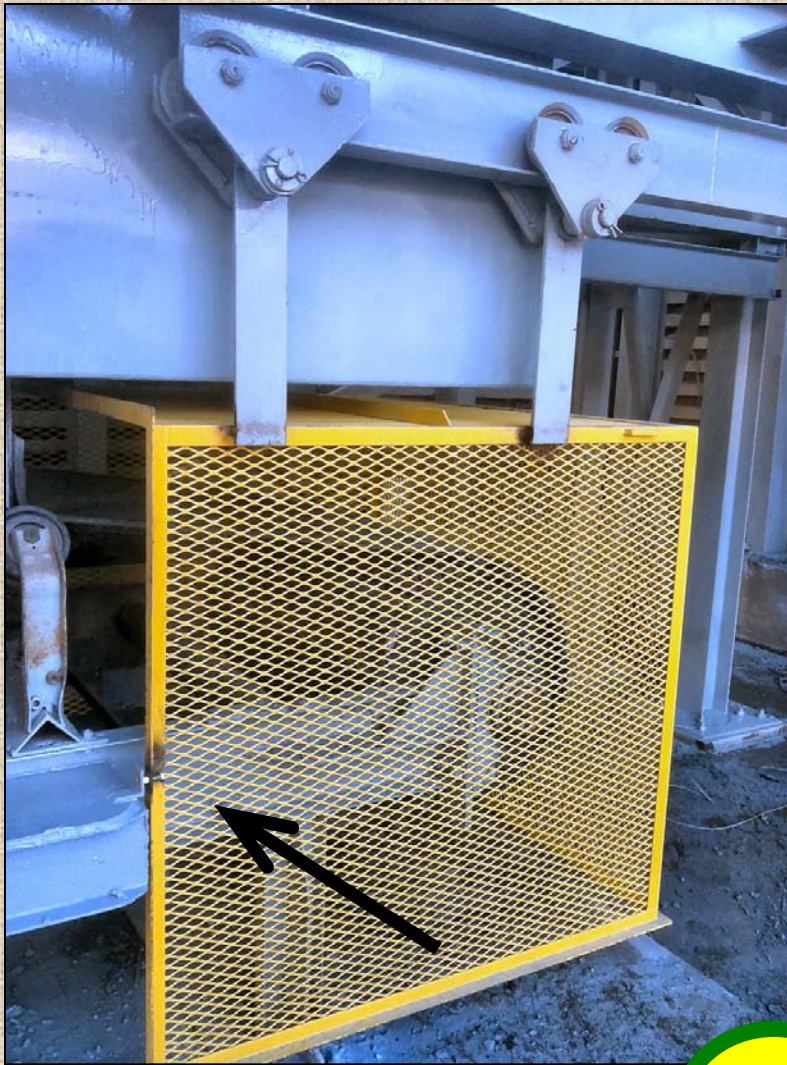




# Easily Handled?








**Easily  
Handled?**

**OK**







# **Construction and maintenance of guards**

## **30 C.F.R. §§ 56/57.14112**

**(b) Guards shall be securely in place while machinery is being operated, except when testing or making adjustments which cannot be performed without removal of the guard.**

**Also consider 30 C.F.R. §§ 56/57.14105 -  
Procedures during repairs or  
maintenance**





# **Securely in Place means “not easily dislodged”**

- Attached to the equipment
- Fastened to a nearby frame or structure
- Hang, sit or otherwise remain in place by its own size, weight, bulk or method of attachment
- Not be easily defeated or bypassed



# Securely in Place?





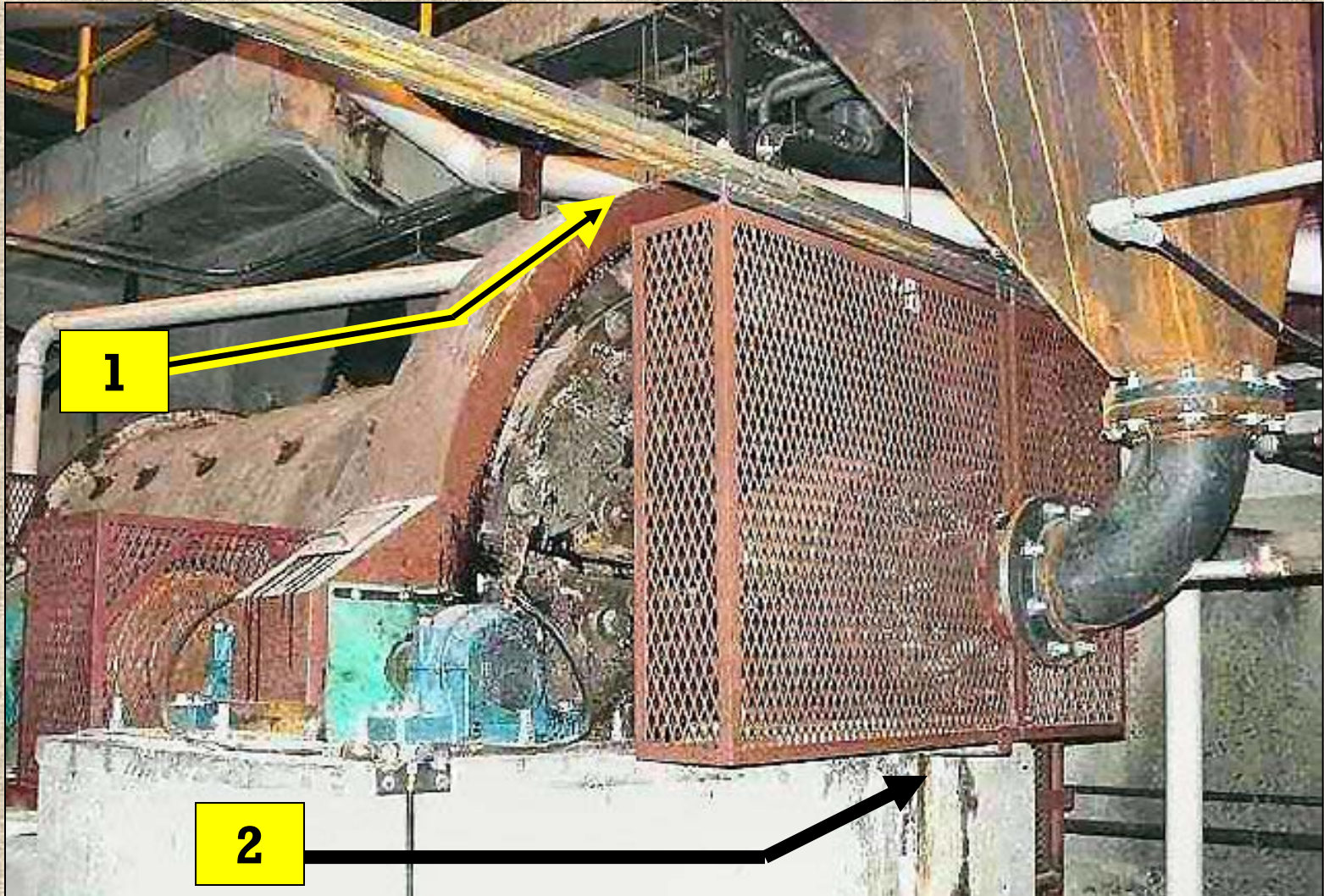
# Securely in Place?

**OK**



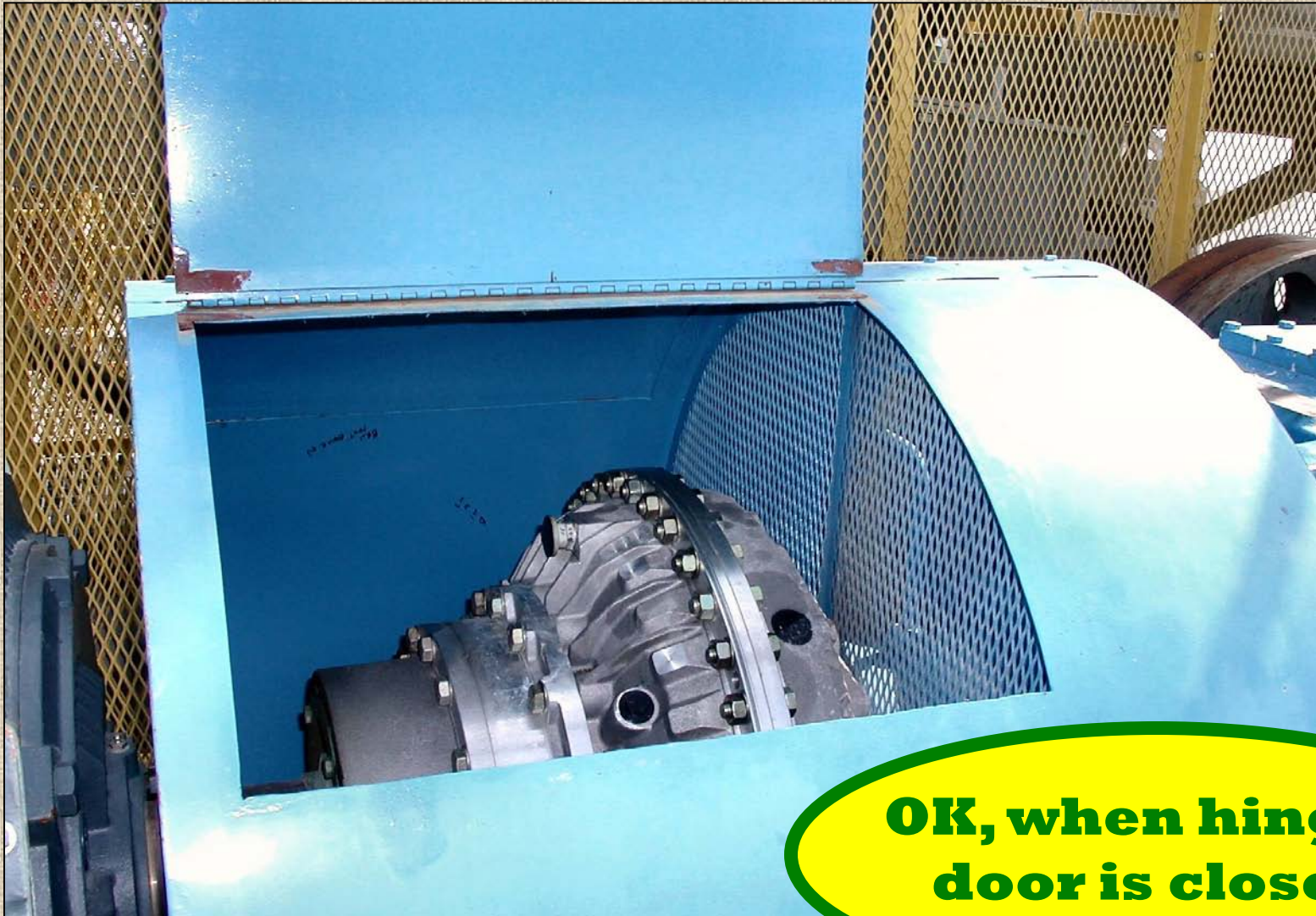


# Securely in Place





# Securely in Place?



**OK, when hinged door is closed**





# Guard Attachment

## Examples of Acceptable Fasteners

- Bolts
  - With nuts / wing nuts
  - In some cases nuts may not be required
- Clamps, bars, wedges
- Cotter pins, pins and sleeves
- Hooks, hinges, J-bolts
- Wire ties – heavy duty plastic or wire

It is not necessary to use fasteners that can only be removed with tools





# Procedures during repairs or maintenance

## 30 C.F.R. §§ 56/57.14105

Repairs or maintenance of machinery or equipment shall be performed only after the power is off and the machinery or equipment blocked against hazardous motion. Machinery or equipment motion or activation is permitted to the extent that adjustments or testing cannot be performed without motion or activation, ***provided that persons are effectively protected from hazardous motion.***



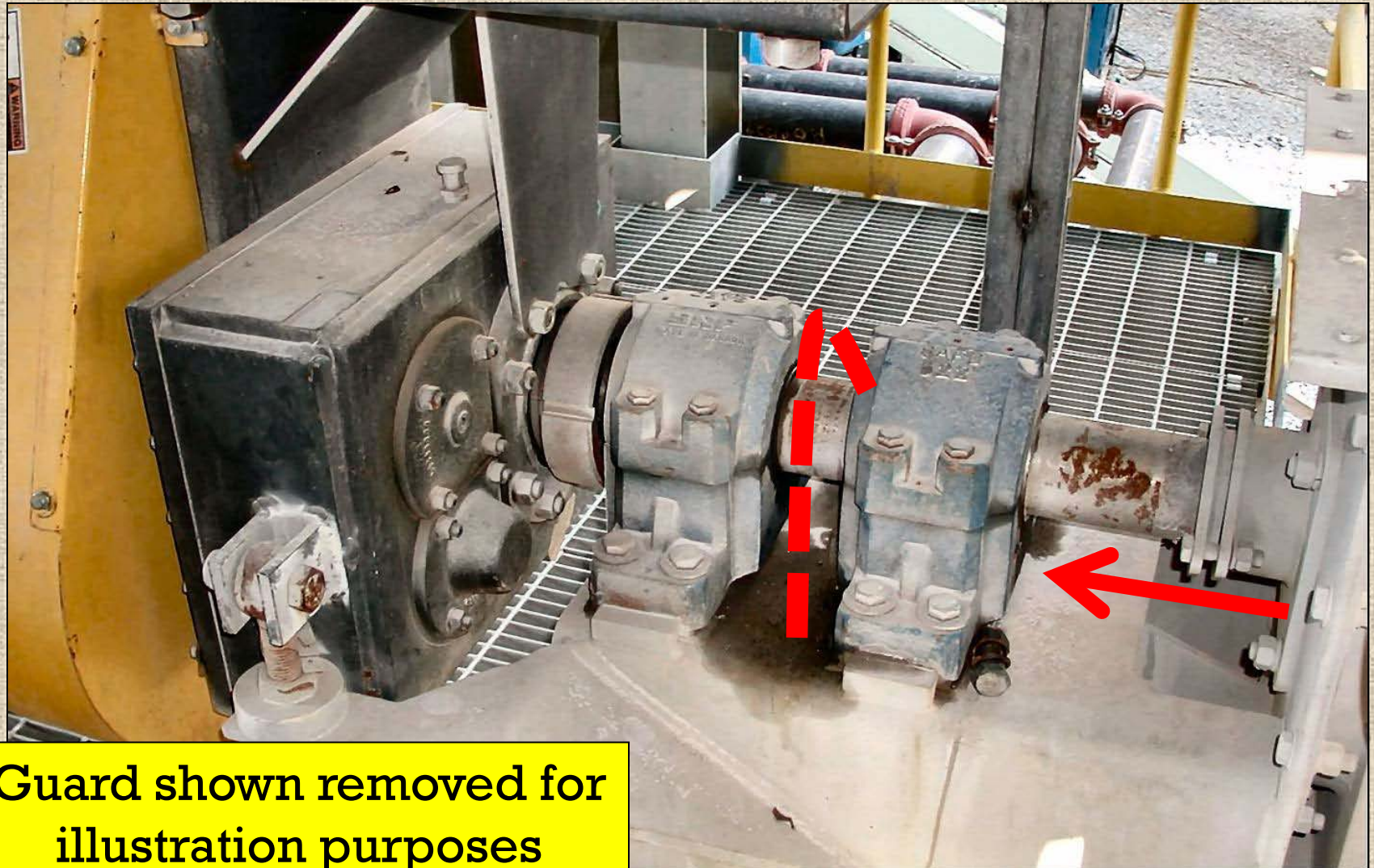


# Preamble: 30 C.F.R. §§ 56/57.14105

53 Fed. Reg. 32508 (Aug. 25, 1988)

- “...permits machinery and equipment motion or activation to the extent necessary for adjustment or testing, ***as long as persons are not exposed to hazardous motion.***”
- Does not address power “lockout”

# Equipment Testing



Guard shown removed for illustration purposes



# Mining and Off-Road Vehicles: Engine Drive Belts





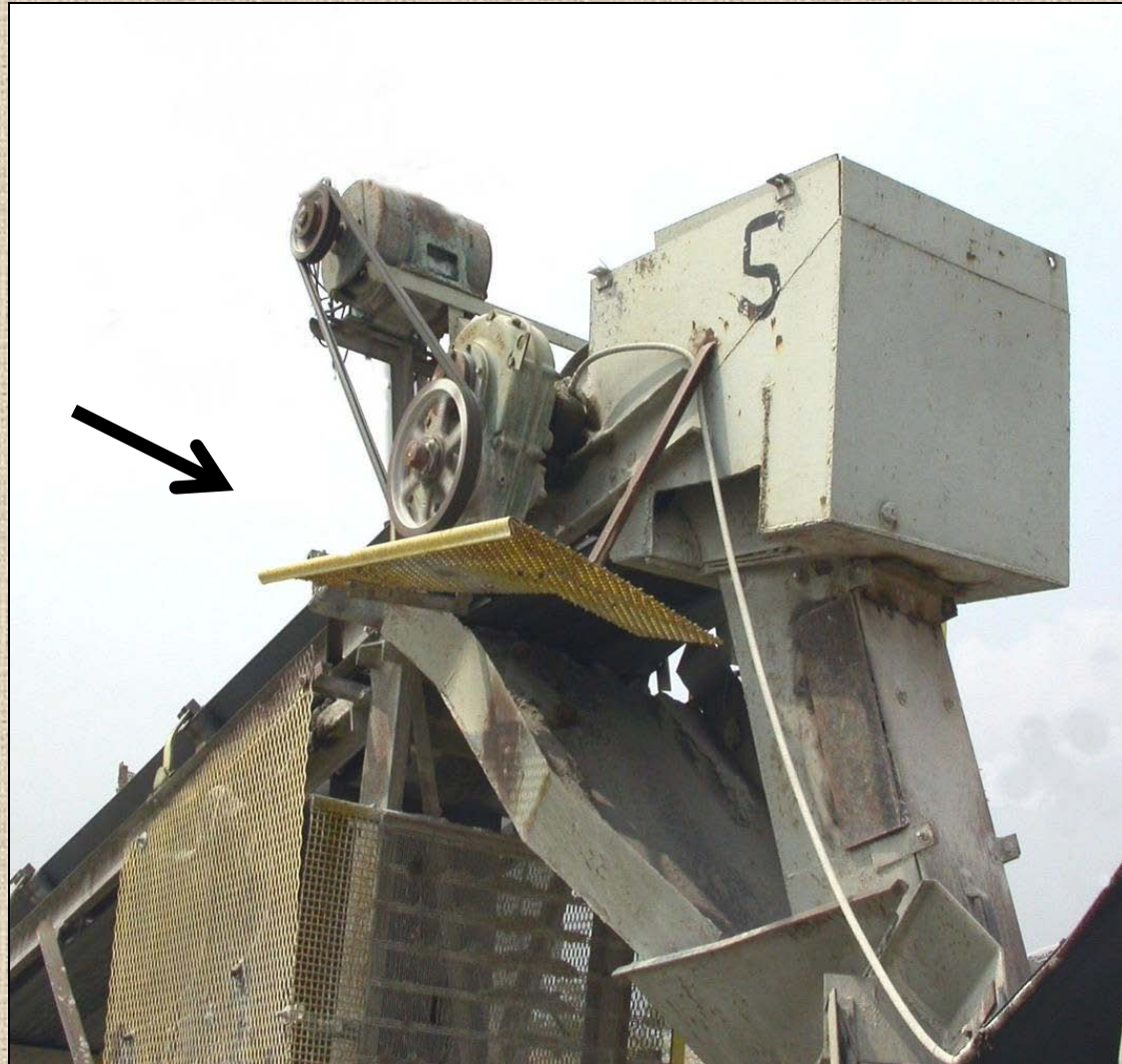
# **Overhead drive belts**

## **30 C.F.R. §§ 56/57.14108**

**Overhead drive belts shall be guarded to contain the whipping action of a broken belt if the action could be hazardous to persons**



# Whipping Action of V-Belts






# Whipping Action of V-Belts







# **Flying or falling materials**

## **30 C.F.R. §§ 56/57.14110**

In areas where flying or falling materials generated from the operation of **screens, crushers or conveyors**, guards, shields or other devices that provide protection against such flying or falling materials shall be provided to protect persons.

# Flying and Falling Materials








# Flying Materials

**OK**





# **Slusher, backlash guards and securing**


## **30 C.F.R. §§ 56/57.14111**

- (a) When persons are exposed to slushing operations, the slashers shall be equipped with rollers and drum covers and anchored securely before slushing operations are started.









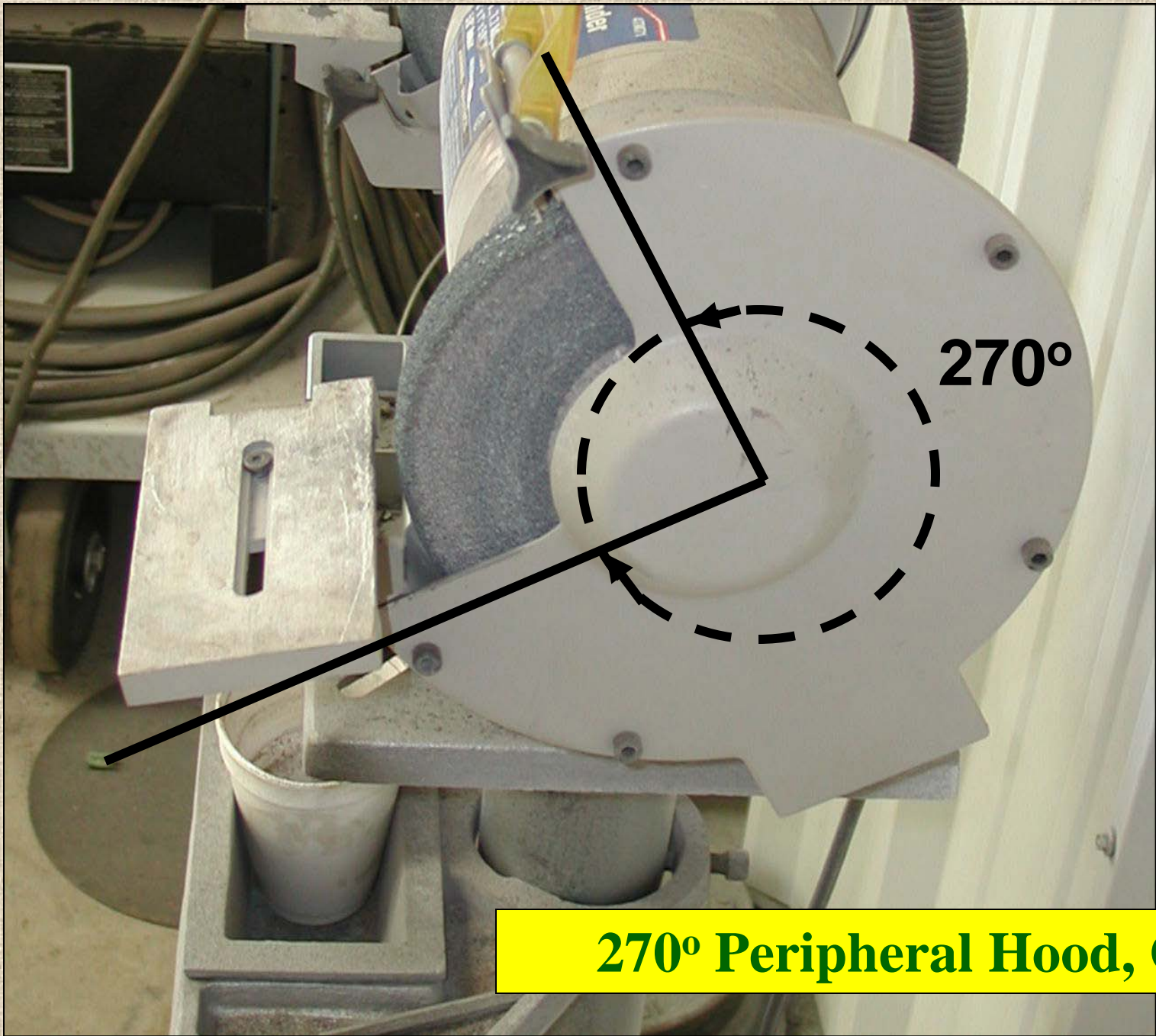
# **Stationary grinding machines**

## **30 C.F.R. §§ 56/57.14115**

**Stationary grinding machines, other than special bit grinders, shall be equipped with -**

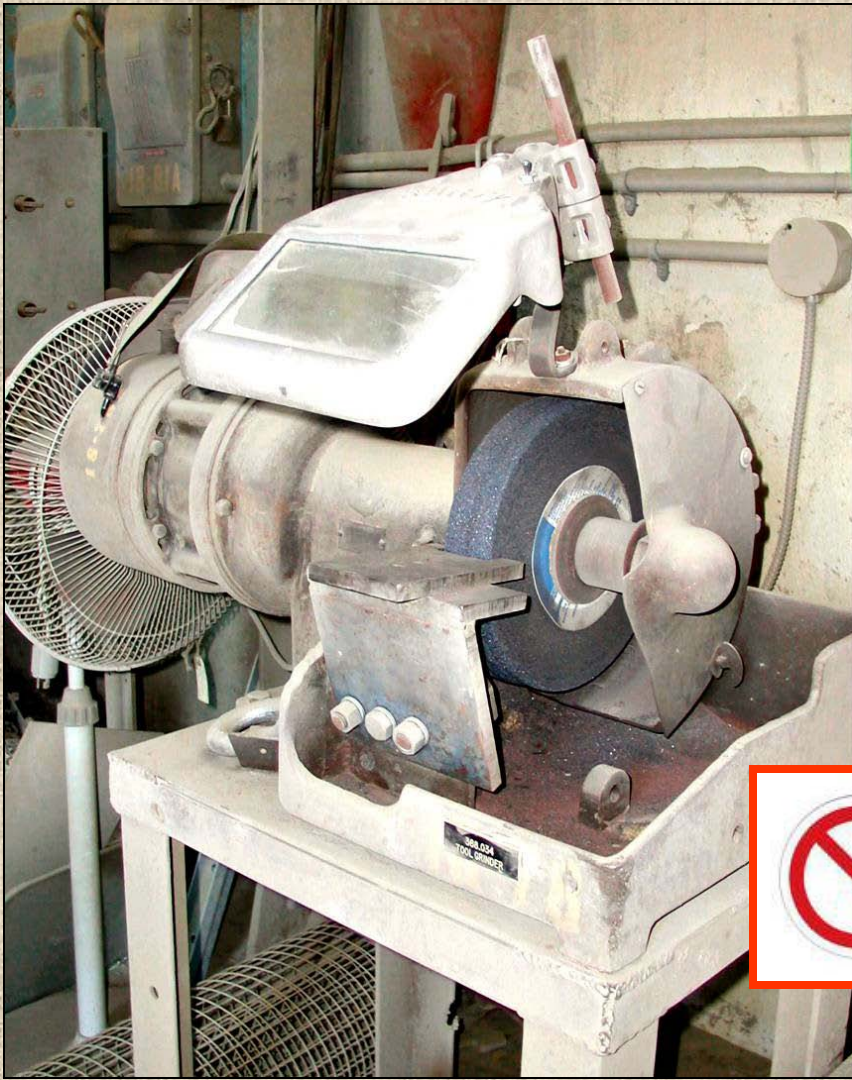
- (a) Peripheral hoods capable of withstanding the force of a bursting wheel and enclosing not less than 270° of the peripheral of the wheel;**





**270° Peripheral Hood, OK**







# Tongue Guards



**OK**



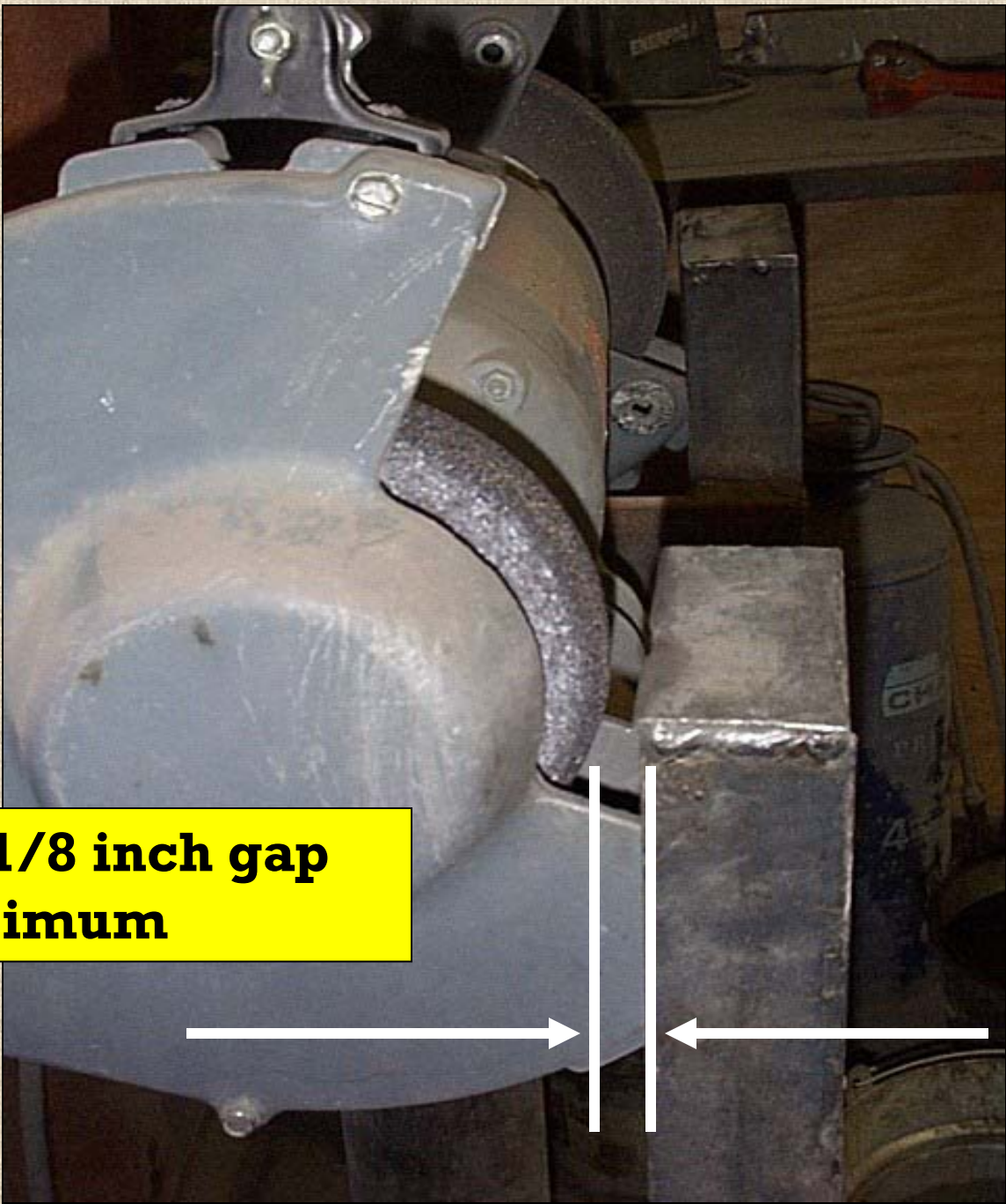


# **Stationary grinding machines**

## **30 C.F.R. §§ 56/57.14115**

- (b) Adjustable tool rests set so that the distance between the grinding surface of the wheel and the tool rest is not more than 1/8 inch; and**
- (c) A safety washer on each side of the wheel.**





**Tool rest: 1/8 inch gap  
maximum**





**Safety washer**

**Note: use of a face shield or goggles is required when operating a grinder.**





# Ring Testing

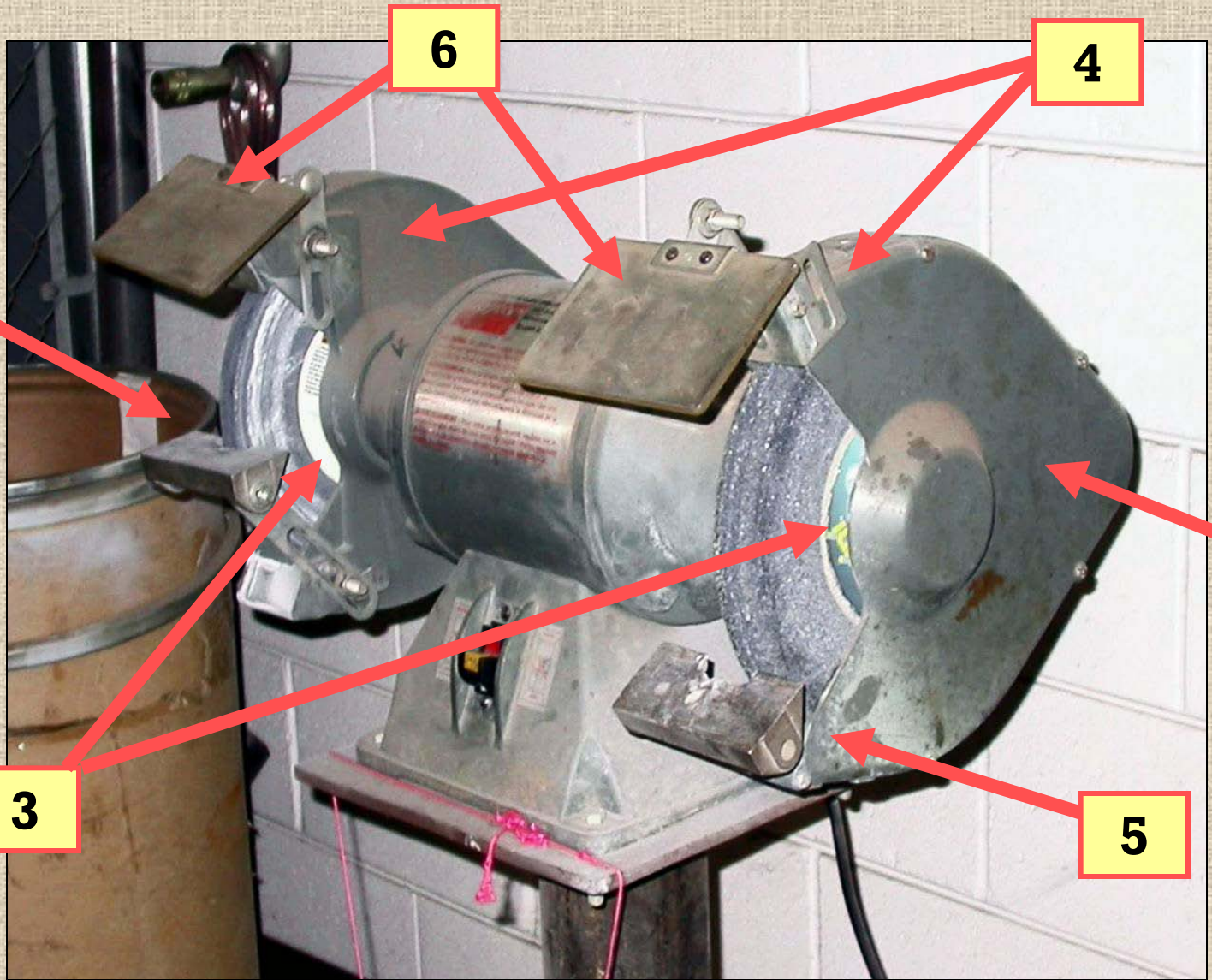
- Ring testing an abrasive wheel before installing it on a grinder is considered a best safety practice.



# Side Grinding

- Avoiding grinding on the side of an abrasive wheel is considered a best safety practice.







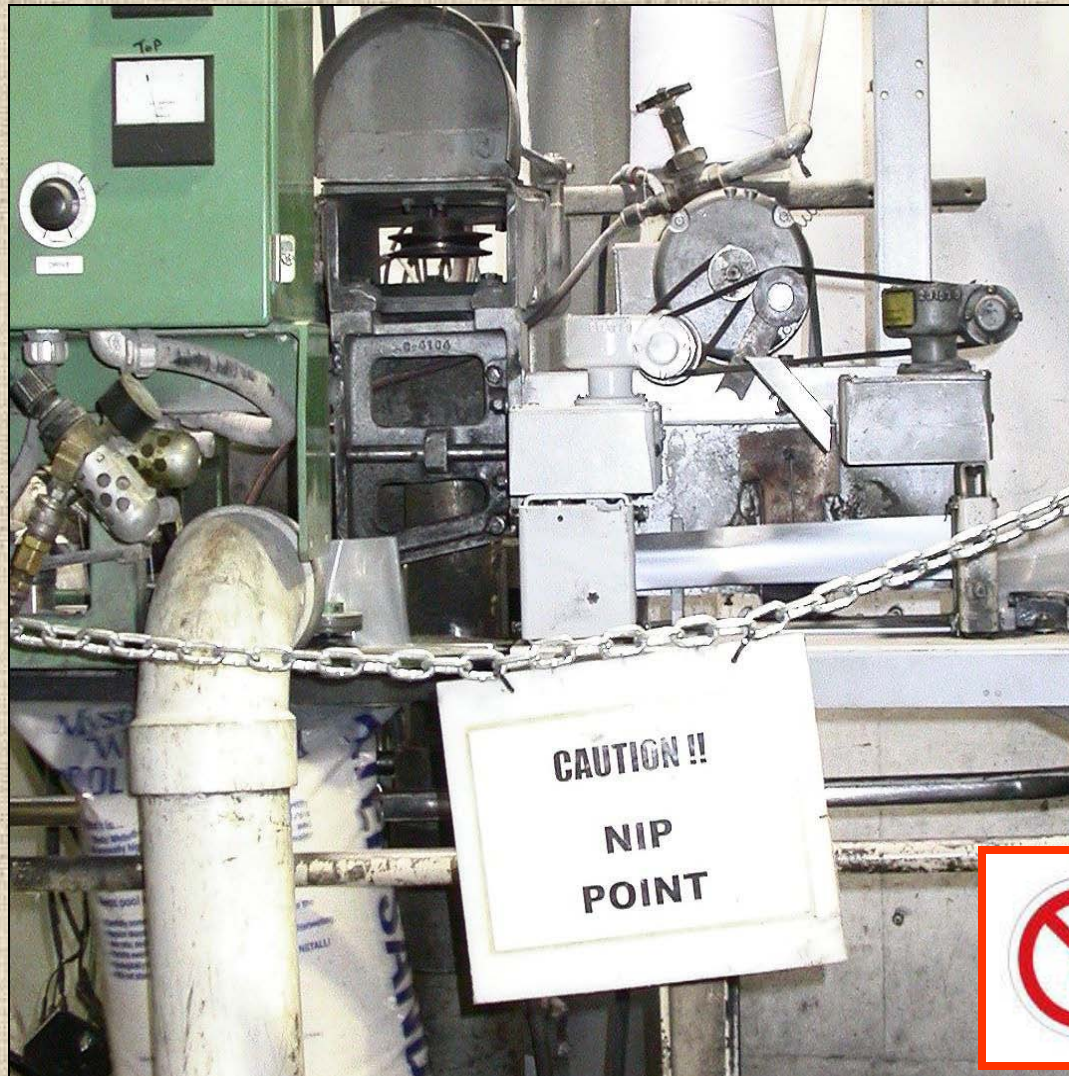
# **Safety defects**

## **30 C.F.R. §§ 56/57.14100**

- (b) Defects on any equipment, machinery and tools that affect safety shall be corrected in a timely manner to prevent the creation of a hazard to persons.
- (c) When defects make continued operation hazardous to persons, the defective items, including self-propelled mobile equipment, shall be taken out of service and placed in a designated area posted for that purpose, or a tag or other effective method of marking that defective item shall be used to prohibit further use until the defects are corrected.



# Administrative Controls Are Not Guards





# Well Maintained?

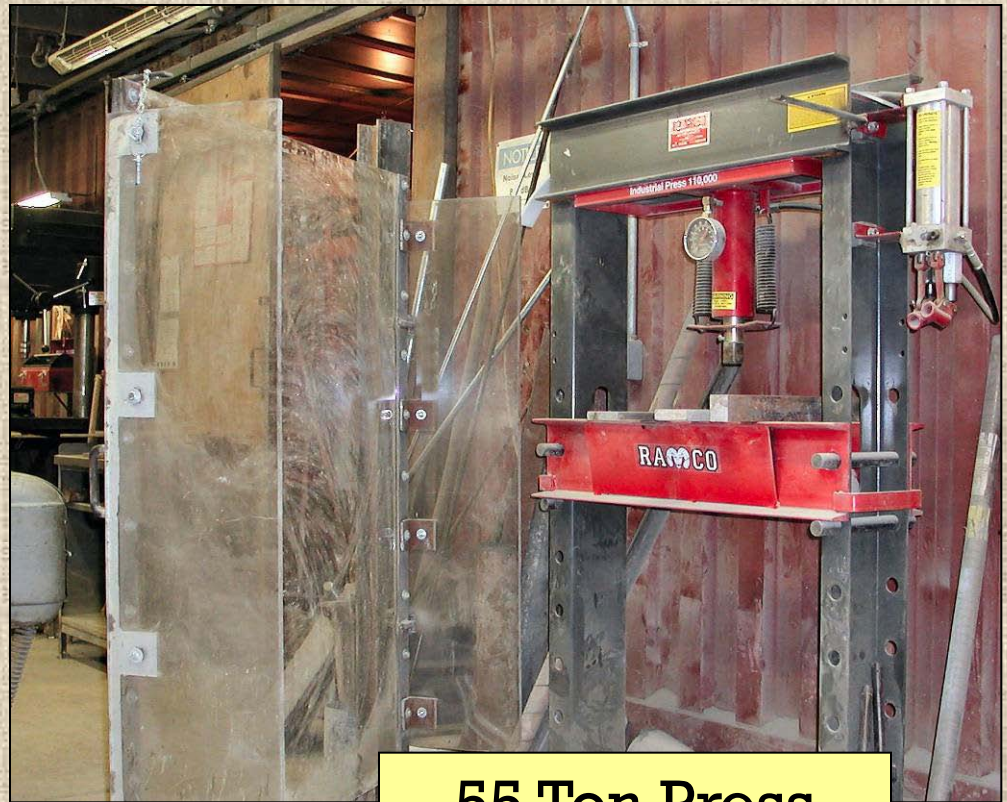




# Ejected Materials - Presses



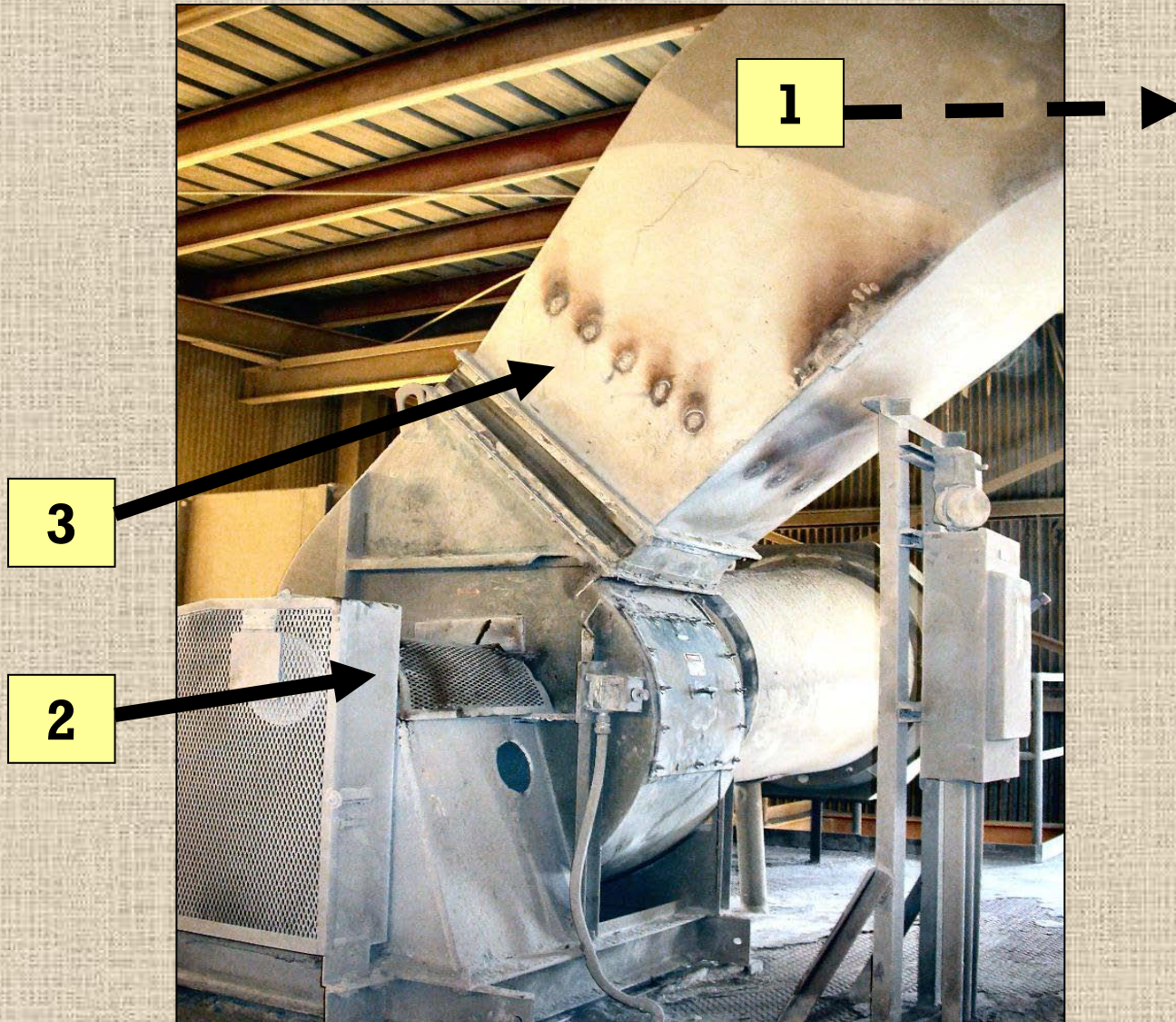
100 Ton Press



55 Ton Press



# Ejected Materials - Fans





# Screens & Metal Grids



2

1

3



# Screen Mesh - Opening Sizes

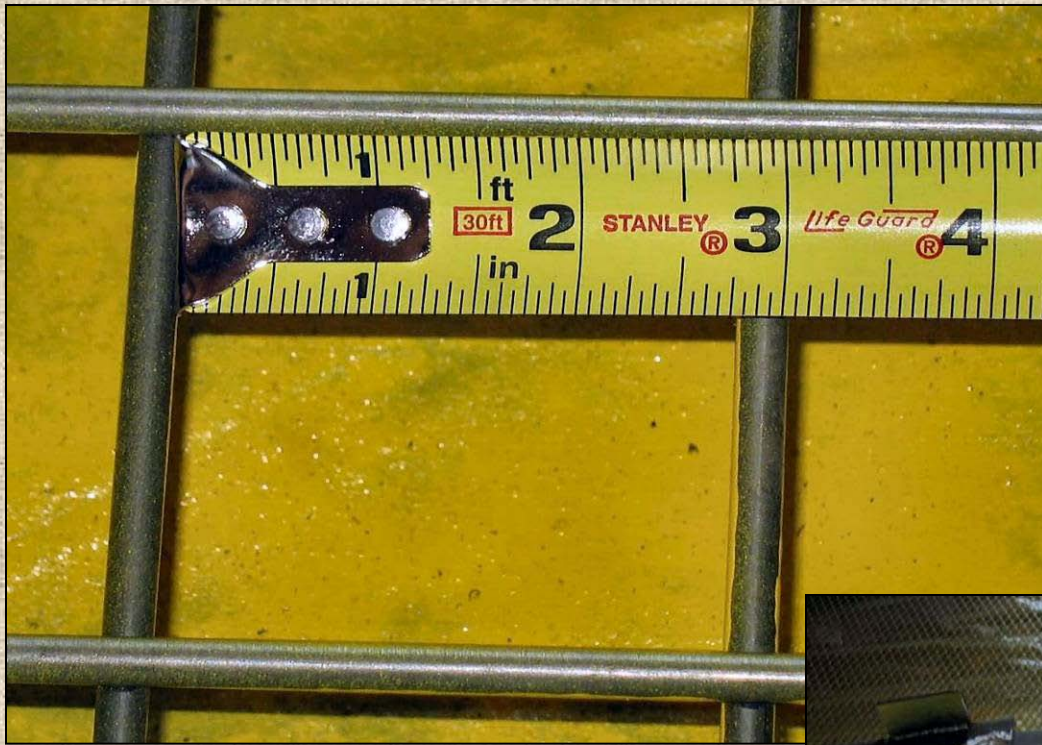




# Opening Size





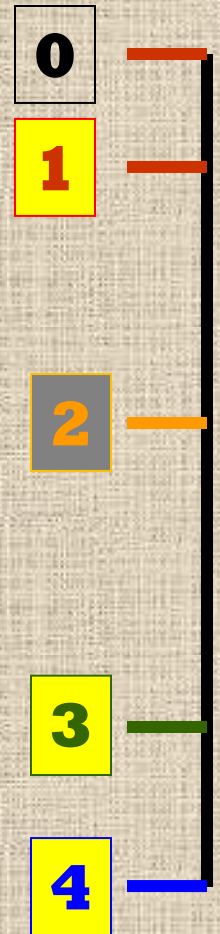


# Opening Size





# Risk Management Achieves Guarding Compliance







**We Can Build  
Better Guards**

**Aim High !!**

**Go Beyond Compliance**