



**Safety Devices & Hazard  
Monitoring Best Practices**

# Prevention Through Better Design



## HazMon Best Practices:

Elevating Performance

Improving Safety

Reducing Risk

# OSHA Reports!

“Over the past 35 years, there have been more than 500 explosions in grain handling facilities across the United States that have killed more than 180 people and injured more than 675.”

*\*\*Have we improved? We can do better!!! How?*

# Overview

1. What is Required to be compliant?
2. What is Available?
3. What is a Typical Installation?
4. What are the Best Practices?

# OSHA & NFPA – Our View

Recommended Guidelines for Implementation of HazMon Systems in Grain Elevators						
NFPA 61 Guidelines						
		<div> <div></div> Red Box represents NFPA requirement (shall)           <div></div> Yellow Box represents OSHA requirement or recommendation           <div></div> Not required, but recommended - NFPA         </div>				
	Belt Conveyor	Inside Leg (20% inside building)		Outside Leg	Drag Conv	Screw Conveyor
Bearing Temp. at head & Tail (& knee pulley)	Required - Shall	Required - Shall		Desired Not required (recommended) Stop Machine and all machines feeding it Required	not required (recommended)	not required
Head pulley alignment	not required (recommended)	Required - Shall		Desired Not required (recommended) Stop Machine and all machines feeding it Required	NA	not required
Tail pulley alignment	not required (recommended)	Not Required - Recommended		Desired Not required (recommended) Stop Machine and all machines feeding it Required	NA	not required
Intermediate Idlers alignment	not required (recommended)	Not Required - Recommended		Desired Not required (recommended) Stop Machine and all machines feeding it Required	NA	not required
Motion: 10% slow-down	Desired Not required (recommended)	Required - Shall Alarm		Not required (recommended)	not required	not required
Motion: 20% slow-down	Desired Not required (recommended) Stop Machine and all machines feeding it Required	Required - Shall Stop Machine		Required - Shall (Stop machine)	Desired Not required (recommended) Stop Machine and all machines feeding it Required	Desired Not required (recommended) Stop Machine and all machines feeding it Required
Motor interlocks	N/A	Required - Shall Stop Machine		Required - Shall (Stop machine)	N/A	N/A
Plug Chute or High Level	Required - Shall (Stop machine)	Required - Shall Stop Machine		Required - Shall (Stop machine)	Required - Shall (Stop machine)	Required - Shall (Stop machine)
Flow from Leg w/o automatic overflow	Required - Shall (Stop machine)	Required - Shall Stop Machine		Required - Shall (Stop machine)	Required - Shall (Stop machine)	Required - Shall (Stop machine)

Class 2, Div. 1, Groups E, F & G vs. Class 2, Div. 2

Examples: Bucket Elevators, Belt Conveyors & Drag Conveyors

# What's Required

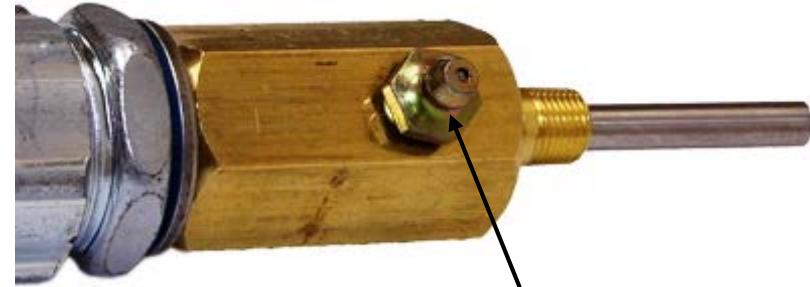
- Bearing temperature sensors
- Belt misalignment
- Shaft speed sensing
- Plug Chute
- Machinery control
  - Recommend: Automated Alarms & machine shut-downs

# Grain Elevators are Special Places

All electrical equipment must be rated and certified by a recognized testing laboratory Class II, Group G, Divisions 1 or 2

- Division 1 is an area where dust is present during operations
- Division 2 is an area where dust is intermittently present during operation
- The equipment must bear a “certification” label identifying it is suitable for area’s use (i.e. UL, FM, CSA, ETL, etc.)

# Bearing Temperature



Grease through assembly

- Sense grease temp. – earliest warning of a hot bearing
- Select water-proof sensors and mounts
- Use flex conduit – protect cables

**Warnings**  
**Alarms!!**



# Belt Misalignment Temperature vs. Touch



Warnings  
Alarms!!

Vs.

On/Off

R.O.R.

- Provides warning of an impending belt tracking issue
- Recommend: Hinged access door for visual inspections
- Temperature: Track and trend belt anomalies and history

# Shaft Speed Sensing



Warnings %

Alarms %

- Speed sensors mount on the tail pulley
- Free hanging sensors are most easily mounted
- Must alert operator at 90% of fully loaded belt speed
- Must stop the machine at 80% of fully loaded belt speed

# Shaft Speed Sensing

**Modern plants may use variable speed belts**

- Mount speed sensors on both head and tail pulleys
- Belt slow down is detected by difference in speed between head and tail pulley
- Operator is warned at 90% of current running speed
- Belt must stop at 80% of current running speed

# Plug Chute Detection



On

Off

Diaphragm Switch

# Operator Interface: Many Options Available

- Interface type depends on the complexity and automation at the plant
- Small country elevators with limited equipment and no automation typically use a standalone operator interface
- Larger fully automated facilities connect the hazard monitoring system directly to the factory automation system

***Best practice today requires the hazard monitoring system to stop the machinery in the event of a hazard***

# Small Plant Operator Interface

- Now available with graphical interface
- Can control multiple pieces of equipment
- Can sequence machinery shutdowns
- Affordable for the smallest of facilities





# Direct Connection to Factory Automation

- Systems can now directly interface with all factory automation systems using modern Ethernet connections
- Single point of viewing of all plant operations
- Direct integration provides seamless machinery control in the event of a hazard
- Enhanced data logging and machinery statistics available



CMC Communications module – direct connection to Plant's PLC Automation system

# How it is Installed *Really Matters*

- System must be impervious to water, especially in boot pits and outside
- Cabling system must be robust and fully protect both the sensors and backbone cables
- Cables must be securely tied down to prevent physical damage

## Example of a robust waterproof cable





# How it is Installed *Really Matters*

- All system components must be water and dust tight

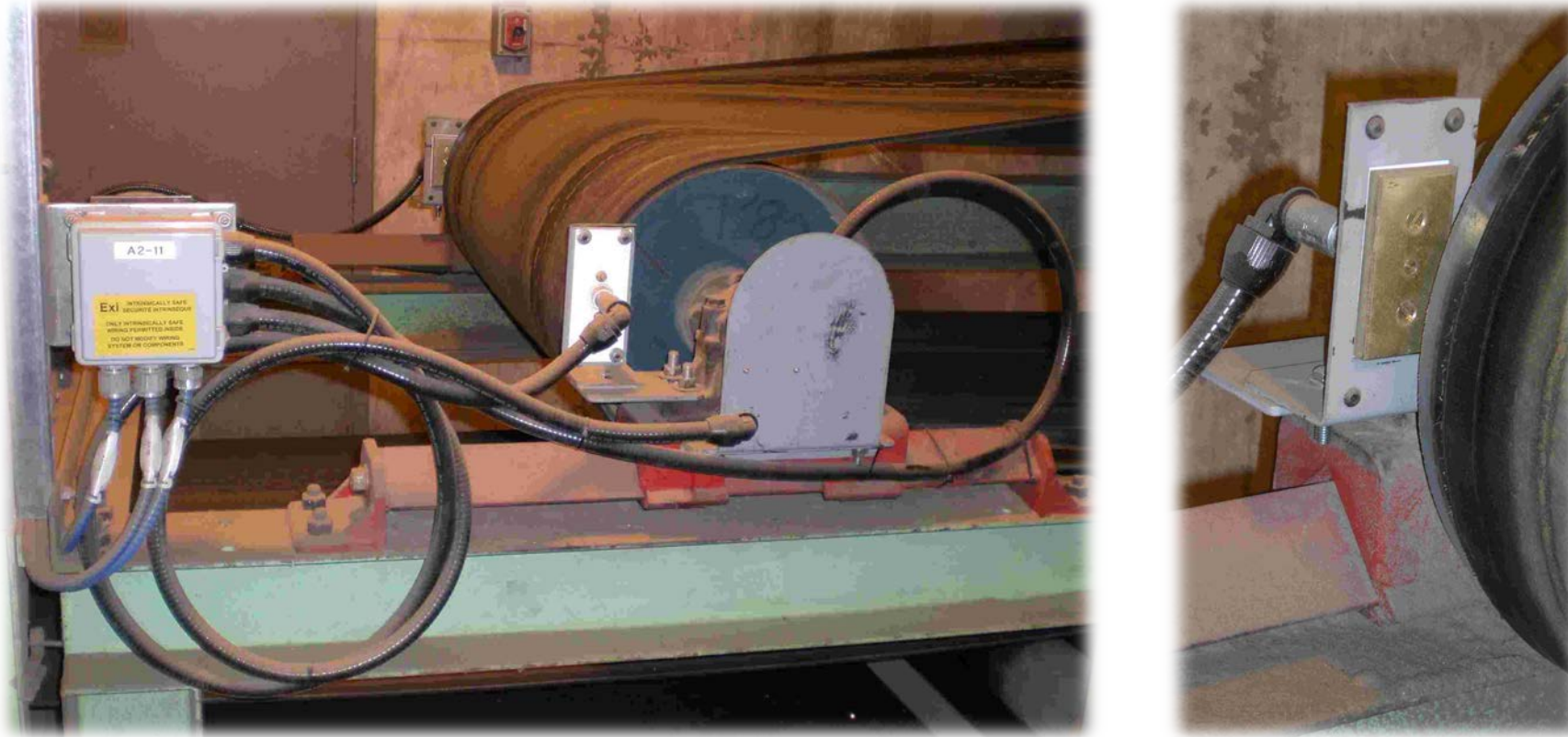


Example of a watertight junction box

# High Quality Installations



# Typical Installations



Rugged & Reliable Belt Misalignment



# Typical Installations



Wireless as an option (where wires are impractical)

- Mobile Trippers
- Ship Loading conveyors
- Not recommended for plant-wide CSD systems

# Buy a System, Not a Collection of Parts

- A system will provide all of the parts required:
  - Sensors
  - Mounting hardware
  - Junction Boxes
  - Hardware
  - Wiring components
- A system will provide consistent installations from plant to plant, reducing training and installation risks

***We have a HazMon system & Sensors....  
I'm fully protected, right???***



# System Validations/Audits

## Testing is a Must!!!

- Verify after installation and at least once a year:
  - Every sensor is operational
  - Sensors are displayed correctly on the graphical interface
  - Alarms operate at the correct trip points
  - Machinery stops when required
  - Test every point
  - Use a simulator if available so you do not disturb the system
- Misalignment sensors should be physically inspected at 3 month intervals
- Use a checklist
- Have a written process and follow it!
  - Be certain your staff & installers follow this procedure!!!!



# Real World Examples – Safety Issues discovered during Audits



Touch Switch is “gummed” with grain dust. Will not compress and alarm operators

- No notification provided – **Major Safety Hazard**



# Real World Examples – Safety Issues discovered during Audits

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## ISSUE 25

Assigned To Leg 3

The knee pulley south bearing sensor does not change temperature when exposed to heat.

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## ISSUE 26

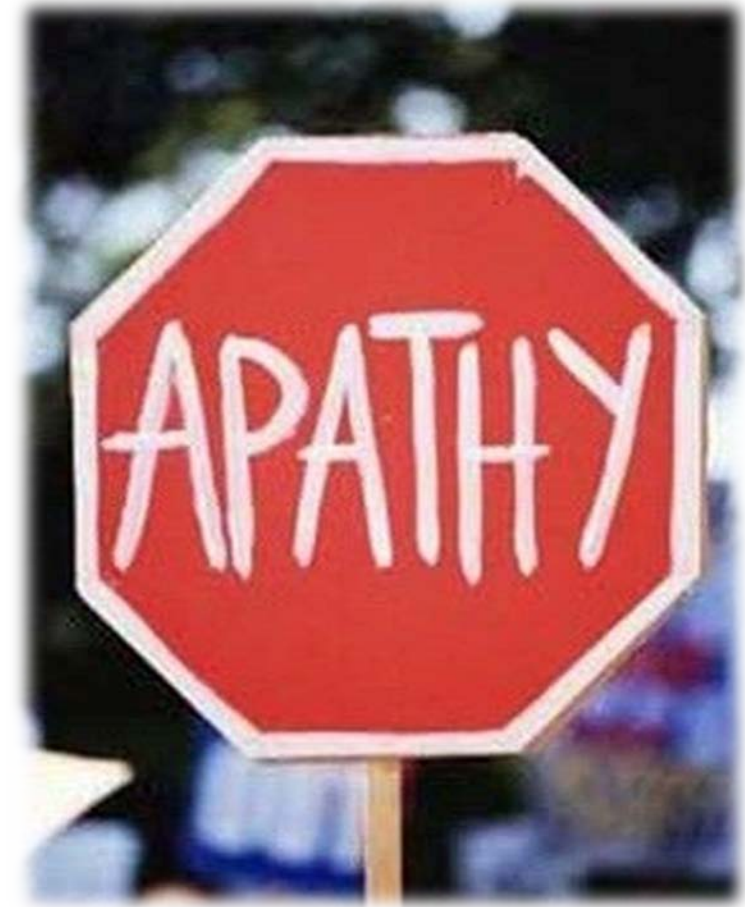
Assigned To Leg 3

The knee pulley north bearing sensor does not change temperature when exposed to heat.

No notification provided – **Major Safety Hazard**

# What is Stopping Us?

- Ineffective Company Policy
- Operator Apathy
- Lack of Accountability
- Low Dependability
- Repeated Bypassing
- Lacking documented validation process
  - All sites should have a paper trail



# Q & A

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