Safety Devices & Hazard Monitoring Best Practices
Prevention Through Better Design

**HazMon Best Practices:**
Elevating Performance  
Improving Safety  
Reducing Risk
“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

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

Examples: Bucket Elevators, Belt Conveyors & Drag Conveyors

<table>
<thead>
<tr>
<th>Inside Leg (20% Inside Building)</th>
<th>Outside Leg</th>
<th>Drag Conv</th>
<th>Screw Conveyor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bearing Temp. on head &amp; tail (5 line pulley)</strong></td>
<td>Required - Shall</td>
<td>Not required (recommended)</td>
<td>Not required (recommended)</td>
</tr>
<tr>
<td><strong>Head pulley alignment</strong></td>
<td>Not required (recommended)</td>
<td>Required - Shall</td>
<td>Not required (recommended)</td>
</tr>
<tr>
<td><strong>Tail pulley alignment</strong></td>
<td>Not required (recommended)</td>
<td>Not required - Recommended</td>
<td>Not required (recommended)</td>
</tr>
<tr>
<td><strong>Intermediate ladders alignment</strong></td>
<td>Not required (recommended)</td>
<td>Not required - Recommended</td>
<td>Not required (recommended)</td>
</tr>
<tr>
<td><strong>Motion: 20% slow-down</strong></td>
<td>Desired Not required (recommended), Stop Machine and all machines feeding it Required</td>
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<tr>
<td><strong>Motion: 20% slow-down</strong></td>
<td>Required - Shall Stop Machine</td>
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</tr>
<tr>
<td><strong>Motor Interlocks</strong></td>
<td>N/A</td>
<td>Required - Shall Stop Machine</td>
<td>Required - Shall Stop Machine</td>
</tr>
<tr>
<td><strong>Plug Chute or High Level</strong></td>
<td>Required - Shall Stop Machine</td>
<td>Required - Shall Stop Machine</td>
<td>Required - Shall Stop Machine</td>
</tr>
<tr>
<td><strong>Flow from Leg to automated equipment</strong></td>
<td>Required - Shall Stop Machine</td>
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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

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

Grease through assembly
Belt Misalignment
Temperature vs. Touch

• 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

- 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

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

<table>
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<tr>
<th>ISSUE 25</th>
<th>Assigned To Leg 3</th>
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<td>The knee pulley south bearing sensor does not change temperature when exposed to heat.</td>
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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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