Inspections Tasks Add Business Value

Darrin Clark, Reliability Specialist

ArcelorMittal
Agenda

• Inspections Defined
• Business Value Defined
• How Do Inspections Add Value?
• Getting Full Value From Inspections
• How ArcelorMittal Is Approaching Inspections
Inspections Defined

• Inspection
  – a checking or testing of an individual against established standards
  – the act of examining something closely
  – a strict or prying examination

“An activity seeking evidence that a failure has occurred or is in the process of occurring”
Business Value Defined

• Value
  – regard highly; think much of
  – The property or aggregate properties of a thing by which it is rendered useful or desirable
  – relative worth, utility, or importance

“The extent to which an object or activity contributes in a positive way to a business goal”
How do inspections add value?

- Early indication of an impending failure
- Opportunity to make repair before failure occurs
- Expend resources only when necessary
- Reduce spares inventory, call outs, overtime

“Allow us to avoid the consequences of failure”
Consequences

- Safety
- Environmental
- Throughput
- Quality
- Customer Service
- Operating Cost
- Hidden
To Avoid Consequence

- Identify evidence of a failure that is likely to occur
- Proper frequency to allow time to plan, schedule and execute repair
- Over time, cost less than the failure
- Have properly defined severity levels
- Have defined corrective actions
- Results effectively communicated to asset owner(s)
- Must get done, and be reacted to
The P – F Interval diagram illustrates the relationship between asset condition and time. It shows:

- **Initial Capability**: The starting point of the asset's capability.
- **Potential Failure Point**: Where the asset begins to show signs of failure.
- **Functional Failure Point**: The point where the asset's functionality is lost.
- **Minimum Required Capability**: The lowest level of capability required for the asset to function safely.

The diagram highlights the time period between the initial capability and the minimum required capability, which is crucial for maintenance planning and decision-making.
Failure Modes

• Identify evidence of a failure that is likely to occur

• Failure Mode – Any event that causes a failed state
  – Age
  – Random
  – Infant Mortality
  – Human Error
Failure Mode – Car Tire Worn

• Likely to occur on rear tires?
• Likely to occur on front tires?
• Likely to occur on spare tire?
Task Frequency

- Proper frequency to allow time to plan, schedule and execute repair before consequence.

<table>
<thead>
<tr>
<th>ASSET CONDITION</th>
<th>Minimum required capability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Month</td>
</tr>
<tr>
<td></td>
<td>3 Months</td>
</tr>
</tbody>
</table>

Diagram showing the relationship between potential failure point (P) and functional failure point (F), with time intervals of 1 month and 3 months.
Cost

• Over time the cost of the inspection must less then the cost of the failure

• Total Cost of Inspection
  – Cost of inspection x Frequency x MTBF
  – EX. $100 x 12 months x 10 years = $12,000

• Cost of Failure
  – Cost of Repair + Downtime (or other consequence)
  – EX. $3000 + $5000 = $8,000
Cost

• When Safety/Environmental Consequences are likely, cost is not a factor
• Safety/Environmental Consequences require a reduction of risk to a tolerable level
Severity Levels

• Have properly defined severity levels

Tread Depth Example

**ASSET CONDITION**

- **NORMAL**
- **WARNING**
- **ALARM**
- **CRITICAL**

**TIME**

- Initial Capability
- Potential Failure Point
- Functional Failure Point
- Minimum required capability

**ASSET CONDITION**

- 1/2”
- 3/16”
- 1/8”
- 1/16”
Corrective Action

• Have defined corrective actions
• All stakeholders must agree on the corrective action that will be taken when a non-normal condition is found
• Corrective tasks must restore the asset to its original capacity
Inspection Results

• Results effectively communicated to asset owner(s)
• Must be presented in a clear, understandable way
• Responsibility for receiving and acting on findings must be clearly defined
• Appropriate technology must support reporting and follow-up on detected exceptions
• Must be tracked to mitigation
Program Administration

• Must get done, and be reacted to
• Routine inspection tasks must be resourced and properly prioritized
• Average of 400 failure modes per $1M in RAV in the process of failing
• Proper attention must be paid to anomalies detected
• Un-inspected points and ignored results = no avoidance of Consequences = no VALUE
How ArcelorMittal Is Approaching Inspections

The following slides provide examples of how ArcelorMittal USA Flat Carbon is obtaining maximum business value from Inspection Tasks
Each Inspection point is mapped to an identified Failure Mode.
Failure Mode: J-hook Rivets fatigue

- BCF E: CHARGING CRANE M/HOOK ASSY

<table>
<thead>
<tr>
<th>FF interval:</th>
<th>Frequency:</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.00 months</td>
<td>1 quarter</td>
</tr>
</tbody>
</table>

- Maintenance group: IH-3SP BCF Maintenance
- Trade: IH - Contractor

- Technology: Radiography
- Inspection Tools: (None)
- Operating cond.: Must be shut down
- Duration of task: 2.00 hours
Each inspection point is evaluated for proper "Worth Doing" criteria.
Severity levels (states) are defined based on the effect of the failure as it progresses from Potential Failure to Functional Failure.

### States

<table>
<thead>
<tr>
<th>Value</th>
<th>Alarm?</th>
<th>Alarm Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal - No cracks in weld</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any hairline crack on welds</td>
<td></td>
<td>Warning</td>
</tr>
<tr>
<td>&gt; 1/32&quot; but &lt; 1/16&quot; wide crack in weld</td>
<td></td>
<td>Alarm</td>
</tr>
<tr>
<td>&gt; 1/16&quot; wide crack in weld</td>
<td></td>
<td>Critical</td>
</tr>
</tbody>
</table>

Default to normal allowed

Default state: Normal - No cracks in weld
Each inspection point has a defined, pre-planned corrective task that can be generated by alarm acknowledgement.
Results are captured in Reliability System and alarms monitored by Equipment Specialists.
Inspection points assembled into routes and Work Orders automatically generated to perform inspection tasks. Compliance to the schedule is tracked. Follow-Up activities are tracked.
Darrin Clark, Reliability Specialist

Questions?
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Thank you!