



Gravel storage bin failure September 2014



Magnetite bin failure May 2014



Magnetite bin failure February 2013

STRUCTURAL HAZARDS – STEEL BINS

Steel storage bins can hold a large amount of material and if they fail, the consequences can be fatal. From 2012 to 2014, there have been 5 reported failures in the U.S. mining industry. Bin failures are often preventable with periodic inspection and maintenance. The following common deficiencies can lead to structural failure and bin collapse, placing miners at risk of fatal injuries caused by crushing, pinning and entrapment.

- **Failures of frame connection plates** – have been known to occur when they became excessively corroded. Shear plates (tabs) are commonly used for bins that are supported by an octagon-shaped frame. Preventive maintenance inspections of bins typically focus on the main beams in the frame, but may neglect the concealed critical shear tabs that connect the beams together.
- **Corrosion section loss of steel plates** – can result in thinning of the metal, which weakens the plates. Chipping hammers can be used to sound the metal and assess the general degree of corrosion. Ultrasonic thickness gauges should be used to determine the remaining thickness.
- **Wall openings** – as a result of either intentional holes cut into the sides of a bin, or unplanned holes as a result of corrosion or abrasion, will cause stress redistribution in the hopper and may cause an overload of the hopper to bin wall connection.
- **Lines of 100% corrosion loss** – near the suspended bottom can cause the bottom to fall off, releasing the entire bin contents. In some instances, lines of 100% corrosion in the upper bin wall will cause stress redistribution and can adversely affect the way in which the wall carries stress from the suspended hopper bottom and the contained material.
- **Deterioration of the suspended hopper to bin wall connection** – can cause failure at or near this critical connection. Deterioration can be a result of cracked welds, poor quality welds, corroded bolts, corrosion holes, lines of 100% corrosion, deterioration of the compression ring, or extensive section loss. Detailed inspection is important.
- **Abrasion damage** – from coarse materials discharging against the metal plates can cause thinning of plates, wear on bolts and welds, or create holes in the metal, resulting in a loss of strength.
- **Cracks** – may occur if bin plates or stiffeners are overstressed. Cracks reduce the load carrying ability of these structural components and a sudden failure can result.
- **Deterioration of structural support members** – such as columns, beams, and bracings is often a result of corrosion. Loss of thickness and capacity from corrosion can result in the failure one or more structural supports.
- **Impact damage** – to bin columns or lateral bracing can cause a steel column to bow or buckle. A buckled column can cause a bin to topple over. Likewise, equipment impact can cause damage to a concrete pedestal supporting a column.
- **Flow-related problems** – such as hang-ups, “ratholes,” and bridging of the product within the bin can lead to erratic and/or eccentric flow, and can overstress and damage bin components.
- **Buckling of the walls** – in tall bins the walls can buckle inward if the stored material flows off center. Likewise, if the stored material is able to bridge over the hopper outlet, then when the bridge collapses, the sudden downward force can cause buckling in the upper part of the bin.
- **Poor quality repairs and retrofits** – can reduce the strength of the structure. Hopper failures and fatalities have occurred as a result of poor workmanship. Certified welders should be used. A structural engineer experienced with steel bins should design and oversee repairs and retrofits to existing structures, and oversee reassembly of any used bin.
- **Lack of periodic inspection** – is often a contributing factor in bin failures. Without adequate inspections by a professional engineer knowledgeable in structural engineering, the above listed deficiencies often go unnoticed and can lead to failure.



Coarse refuse bin failure November 2012



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