# TECH BRIEF

## Critical Design Elements for Maximizing the Life of Under Press Steel Belt Conveyors

***Engineers and plant managers looking to get the most out of their conveyors can work to mitigate the effects of impact force on the conveyor. There are several solutions that can be put in place to get the most life out of the conveyor.***

Stamping companies have relied on steel belt conveyors to automate scrap handling since the industrial revolution. As press technology has expanded to meet the changing demands of customers in the automotive, aerospace, defense, and construction equipment sectors, the reliability and robust nature of the steel belt conveyor design remains one of the most efficient methods for the transfer of flat metal stamping scrap.

The increased demands on stampers to achieve tighter tolerances using a wider range of materials coupled with 24/7 run times means that equipment purchases normally made as second nature now need to be evaluated for dependability and longevity under extreme operating conditions. Failure of an in-floor conveyor means unplanned press down time, increased maintenance labor hours, safety concerns, and potentially missed shipments. The design of the steel belt conveyor for a given application is a critical component to maximum asset utilization and decreased costs by avoiding conveyor wear and unplanned downtime.

### The Effects of Force on a Steel Belt Conveyor

The structural and functional design of a press is focused on the operating process and the quality of the output—how and where the scrap is collected and disposed of is typically not part of the design process. This reality can pose challenges when stamping operations purchase conveyors for moving their scrap.

When stamping scrap is discharged from the press it can fall from 36 inches up to more than 10 ft. The impact of this drop can be significant on the conveyor belt reducing the reliability and increasing maintenance requirements. To illustrate the of the impact of this drop on the conveyor belt we can use the following real-world application example:

| Scrap Dimensions | Weight | Height of Fall | Lbs. of Force |
|---|---|---|---|
| 5" x 5" x 3/16" | 1.2 lbs. | 48" | 460* |

*Based on 1/8" deflection

To understand the implications of the scrap falling on the conveyor belt, we can use a typical formula for "Impact Force of a Falling

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Object." While there are other application specific variables that can be added to this calculation, the basic equation will help us to see the exponential impact of force by filling in the data using the example in the chart above.

## Impact of Force from a Falling Object

The dynamic energy in a falling object at the impact moment can be expressed as:

$$E = F_w h$$
$$= m g h \quad (4)$$

Where:

$F_w$ = force due to gravity - weight (N, lbf)

g = acceleration of gravity (9.81 m/s2, 32.17405 ft/s2)

h = falling height (m)

S = the distance it take the object to stop

The equation can be combined with the equation of work:

$$F = m\, g\, h/s \quad (5)$$

*source: http://www.engineeringtoolbox.com/impact-force-d_1780.html*

Using the information and calculation above, the impact of a piece weighing 1.2 lbs. can have 460 lbs. of force on the conveyor belt. "Ouch!"

This high force is surprising until you understand the force of impact is dependent on the distance it takes to stop a moving object. In this calculation the conveyor belt is assumed to deflect 1/8" under impact. Repetitive high force impacts of this type explain the potential for premature conveyor failure.

To illustrate the calculation, consider the effect of an air bag in an automobile. In a crash test simulation without an air bag, a crash dummy hits the windshield with high force. The addition of the air bag reduces the effects of the force because the air bag lengthens the stopping time and distance and absorbs a portion of the generated force.

## Solutions that Extend Conveyor Life

Engineers and plant managers looking to get the most out of their conveyors can work to reduce the effects of impact force on the conveyor. There are several solutions that can be put in place to get the most life out of the conveyor. One approach is to slow the scrap down with chute. The other method is to design the belt more resistant to impact of the scrap.

1. The simplest, and most effective solutions to avoiding the negative effects of impact is to design the chutes between the press and the conveyor to absorb some of the impact of the scrap. The chute can be constructed out of steel thicker than the scrap and out of abrasion resistant (AR) steel, that can hold up to the repeated impact of the scrap. Slowing the scrap down reduces the impact on the conveyor. Many times, the area of the chute that is worn can be replaced—repair costs for a chute are much lower than for a conveyor belt.

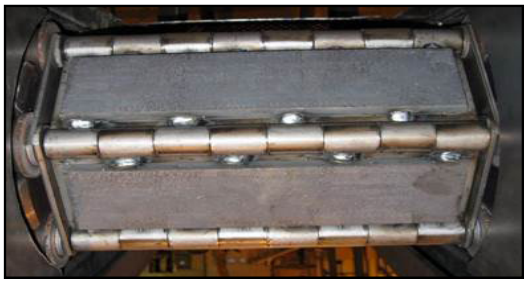

Image of 2-1/2"pitch steel belt conveyor with reinforced impact plate.

2. A good general guide line for steel belt conveyors is to avoid using a belt hinge that is thinner than the scrap it is carrying. So, if the scrap is 3/16" thick, you would want to avoid using a 2-1/2" pitch or 4" pitch conveyor with 1/8" thick hinges. A 6" pitch conveyor with 3/16" thick hinges would be used instead.

3. If the scrap is thicker and is falling a substantial distance then is possible to upgrade the belt and conveyor frame. Options include:

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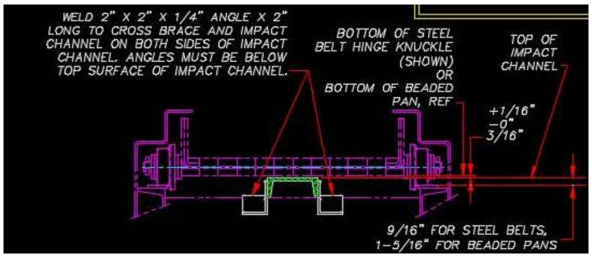
a. **An impact plate.** These plates are welded directly to the top hinge of the steel belt. The impact plates are usually thick enough to protect the hinge of the belt.

b. **Load bars and load shoes** (see CAD drawing below). The load bar is a steel channel that is part of the frame that runs right below the hinge. Load shoes are welded to the bottom of the belt. The clearance between the load shoe and load back is small, but enough to let the belt move. When a heavy load is applied to the belt, the load shoe hits the load bar and the force is transferred to the frame rather than the belt having to carry the entire load.

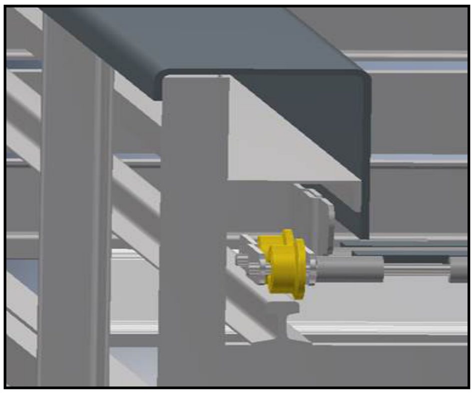



Placement of load shoes preventing the effects of impact force.

4. Scrap bouncing off a press chute tends to deflect everywhere, causing a lot of damage to a conveyor if it gets into the side wings and rollers of the belt. To lessen the frequency of this happening there are a few design elements that can prevent this damage and potential conveyor failure.

   a. The first is wing guards. The guards extend the skirt down to partially cover the wings of the conveyor.

   b. The second design option is to leave 4-6" of space from the edge of the chute feeding the conveyor and the wing guard of the conveyor. The gap creates a funnel that pushes the material toward the center of the conveyor.



3D view of protective wing guard. The extended guard helps to prevent scrap metal from getting stuck in the wings.

## Conclusion

Understanding the impact of force from metal scrap falling from a press on to a steel belt conveyor is important to know during the design and quotation phase of a new conveyor purchase. There are some core design elements that can be built into a specific steel belt conveyor that will not only reduce the effects of force, but also improve material flow. Both elements will reduce unplanned downtime and maintenance costs, and will help to keep your focus on press output.

## About PRAB

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