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THE SCIENCE OF SAFETY:

The ABC's of Industrial Barriers

WHITE PAPER

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THE SCIENCE OF SAFETY

Industrial facilities are inherently dangerous and use a variety of barriers to protect people, products and property. In some instances, these barriers may simply separate pedestrian traffic from other internal vehicle traffic. In other facilities, barriers may be employed to keep people away from automated processes and machinery or to protect employees against falls. Barriers may also be used to protect production equipment and/or the building itself from vehicle damage. In all cases, barriers play an important role in helping facilities operate safely and efficiently. An appropriate safety barrier should only be selected after evaluating the application criteria.

Rite-Hite Dok-Guardian Safety Barrier

In heavy equipment operation zones, safety barriers also are frequently used (and for good reason). Roughly 34,900 people are seriously injured and 85 killed every year in forklift-related incidents across the U.S., according to OSHA. The barriers used in these applications are designed to absorb the energy of a vehicle impact, protecting plant personnel from potentially life-threatening injuries. Barriers are often applied at the edge of loading docks to protect pedestrians from accidentally stepping off, as well as forklift and other vehicle operators from inadvertently rolling over the edge. Safety barriers can also be applied to protect sensitive equipment or structural elements in a facility, saving repair costs and downtime.

TYPES OF BARRIERS

One of the simplest forms of safety measures are yellow lines painted on facility floors to designate pedestrian walkways. Although walkways are common in industrial facilities, they are increasingly being augmented with physical barriers. These barriers add a vertical visual component and create a physical barricade between pedestrians and potential hazards, enhancing safety. According to a report from the National Safety Council, workplace injuries accounted for nearly $206 billion in 2013.

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Rite-Hite SpanGuard Safety Barrier

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DANGERS ABOVE THE PLANT FLOOR

In mezzanine and elevated work platform applications, safety barriers can be implemented near edges where loading and unloading take place. This safety precaution can help prevent falls, which is a major issue every year – there were nearly 697 fatalities due to workplace falls to a lower level in 2016, according to a report from the Bureau of Labor Statistics.

HOW BARRIERS WORK: DEFLECTION

Barriers absorb an impact by distributing the impact energy into the materials that comprise the barrier. As the barrier absorbs energy, the materials that comprise it elongate and the barrier deflects. There are two components to barrier deflection. During the impact, the barrier deforms elastically to the point at which energy reaches equilibrium. After most impacts, the barrier returns to its original position. After a severe impact, the barrier may sustain permanent deformation. Before installing a barrier, the user must consider the maximum elastic deflection to ensure adequate protection of personnel and equipment.

Barriers absorb the kinetic energy of an impact by distributing the impact energy into the materials that comprise the barrier.

CONSIDERATIONS

There are several considerations facility managers should keep in mind when contemplating safety barriers applications:

- What are the maximum gross loads and speeds of the material handling equipment expected to impact the barriers?
- Is there sufficient space to allow the barrier to sustain maximum deflection when impacted?
- Is repair or replacement acceptable after a barrier impact creates permanent deformation?
- Are barriers permanently installed or do they need to be removed on a regular basis?

The impact rating of a barrier is often difficult to define. Although OSHA's regulation 1910.29 (fall protection systems criteria) defines requirements for pedestrian guardrail systems, it does not address barriers designed to stop heavier loads than the 200-lb. standard it uses.

Many manufacturers rate industrial barriers based on their ability to stop an impact of 10,000 lbs. at 4 mph – which has been an industry standard for more than 30 years. However, while this rating provides a meaningful reference for a specific load at a specific speed, it fails to define several key variables:

- How is the barrier's performance affected as the mass of the impacting vehicle increases?
- How is the barrier's performance affected as the impacting vehicle's speed increases?
- How severely was the barrier damaged by the impact? Is replacement necessary?
- How much did the barrier deflect during impact? Did it stop the load soon enough to prevent injury or damage?

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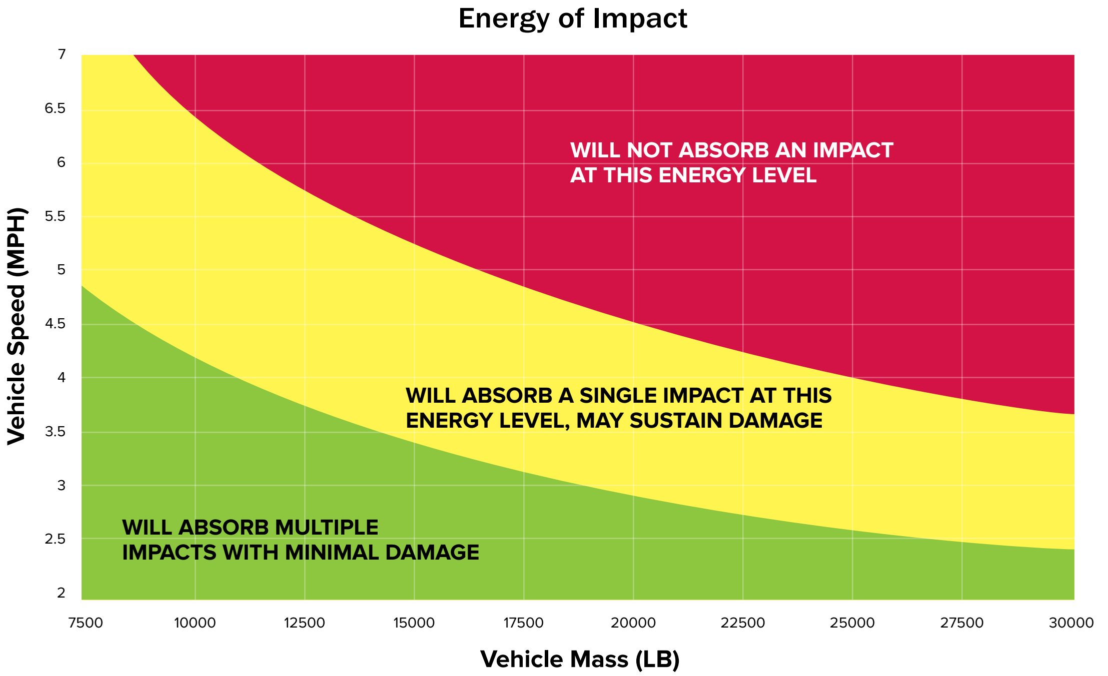

BARRIER LOAD AND SPEED TEST (BLAST)

Rite-Hite has developed a test methodology to quantify specific application variables and determine barrier ratings in terms of total kinetic energy absorption, instead of a specific mass and speed.

$KE = \frac{1}{2}mv^2$
(where m=mass [weight] and v=velocity),

It is centered on the formula for kinetic energy ($KE = \frac{1}{2}mv^2$, where m=mass [weight] and v=velocity), which takes into account both the weight and speed of the impacting object. Expressing the impact rating in terms of energy allows the user to understand the effects of various speeds and weights and determine a more appropriate barrier for their application than would be possible with a single speed and mass rating. At the top of the page is an example of a kinetic energy chart for a Rite-Hite safety barrier.

The chart separates the barrier's impact rating into three different areas. The green area shows testing where the barrier wasn't damaged and it is capable of being impacted again. The yellow area shows where the barrier stopped the impact load, but potentially sustained damage and would possibly need repair or replacement. The red area shows where the impact energy exceeds the barrier's maximum rating. In these cases, the impact cannot be fully absorbed and the barrier would not be able to stop the load – indicating that this barrier should not be used for this application.

Kinetic energy ($KE = \frac{1}{2}mv^2$) is proportional to the mass and to the square of the velocity. Because of the squared velocity term (v^2), changes in the velocity component have a greater effect on kinetic energy than changes in the mass (weight).

THE BOTTOM LINE

Installing safety barriers is a cost effective, yet important investment that can help prevent accidents, injuries and damage to products or equipment. Before selecting barriers to invest in, it is important to consider all of the application requirements. Once these site-specific variables are determined and understood, a user can select the best barrier(s) to meet their safety and protection needs.

[1] https://ohsonline.com/Articles/2013/09/01/Death-by-Forklift-is-Really-the-PITs.aspx
[2] http://www.nsc.org/Membership%20Site%20Document%20Library/2015%20Injury%20Facts/NSC_InjuryFacts2015Ed.pdf
[3] https://www.bls.gov/news.release/cfoi.t02.htm

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