Guarding Equipment: Keep It Simple

Hazards are ever-present in the steel plant environment, and a heightened awareness and emphasis on safety is a necessary priority for our industry. This monthly column, coordinated by members of the AIST Safety & Health Technology Committee, focuses on procedures and practices to promote a safe working environment for everyone.

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Comments are welcome. If you have questions about this topic or other safety issues, please contact safetyfirst@aist.org. Please include your full name, company name, mailing address and email in all correspondence.

Often when workers or managers are asked why guarding is needed on the job, the response is that either the Mining Safety and Health Administration (MSHA) or the Occupational Safety and Health Administration (OSHA) requires them to do so, or they were instructed to by a supervisor. This attitude needs to change; guarding equipment should be thought of as an extension of the equipment itself and a way to increase the safety of the worker and the productivity of the equipment.

Do You Have Time?

For the average person, the time needed to react to an unexpected sensation is about one second. The sayings "It happened so fast," "I didn't see it coming" or "There was no time for me to react" are heard far too often. In the time it takes for a person to react, an injury may have already occurred.

For example, a vehicle traveling at 60 mph can move 88 feet in one second. A 22-inch saw blade can rotate 50 times in one second. A heavy object can fall 16 feet in one second. A conveyor belt carrying tons of material can travel in the range of 0–15 feet in one second. An exhaust fan rotating at 800–1,200 rpm will complete 13–20 revolutions in one second.

When you decrease the time workers spend near moving equipment during repairs by separating the worker from the equipment, you can reduce the chance of accidents.

Changing the Variables

A typical conveyor belt travels about 600 feet per minute. This means the belt is moving at 10 feet per second. At this rate, the conveyor can draw in a worker's loose clothing, tools, hand, arm or more. A worker would be 10 feet into the pinch point before he/she can react.

Figure 1 shows many of the variables that can cause or be attributed to an accident. Adding a guard or barrier can help prevent an accident from happening according to any of the listed variables.

Even small motors can remove fingers or grab clothing, which can cause serious injuries. Any motor over 8 hp can haul a person through a small opening, with catastrophic results.

Emergency Pull Cords

Many workers use an emergency pull cord for protection against the rotating equipment behind a conveyor. The problem is that a conveyor carrying hundreds of tons of material traveling up to 900 feet per minute will not stop immediately when a pull cord is activated.

When an emergency pull cord is pulled, how long will it take the conveyor to stop completely? Will it stop in three, four or 10 seconds? That time could mean a traveling distance of 25–90 feet depending on length and load being carried. The pull cord will probably be activated while the accident is happening, which calls into question

Figure 1

A safety guard or barrier can protect against variables that can lead to injury.

of whether the pull cord can be adequate protection against rotating equipment.

Workers should be trained that the pull cord may not protect them from the rotating parts behind it. A company should know whether it is liable if a worker is injured by a rotating part behind a working pull cord. Regular, documented test procedures should be in place to make sure that all pull cords are working properly. Even if the worker is competent, the more time that is spent around unguarded or poorly guarded rotating equipment means there is a higher chance of that worker getting injured, no matter his or her level of competency.

Emergency pull cords do have an application in the workplace; however, there needs to be awareness and discussion about their effectiveness as a primary safety device.

Why Do We Need Guarding?

The most important reason to make a workplace safe is to make sure that at the end of a shift, employees are able to go home safely. Guarding is put in place to protect workers and separate them from moving machinery. This results in increasing safety while decreasing the chance of an accident. It is also the right thing to do, as it shows the workers that management cares about their safety and is willing to do the necessary things to keep them safe.

Guarding will also decrease liability from any possible accidents that may occur and is regulated by governing bodies. MSHA and OSHA have their own guarding requirements, which would not be in place unless something had happened to make them necessary.

Guards are meant to protect persons from inadvertent, careless, or accidental contact and deliberate or purposeful work-related actions. These include inspection, testing, cleaning, maintenance, troubleshooting, lubrication, adjustment and servicing. Guards are not meant to protect persons from deliberate or purposeful non-work-related actions, like horseplay.

Figure 2

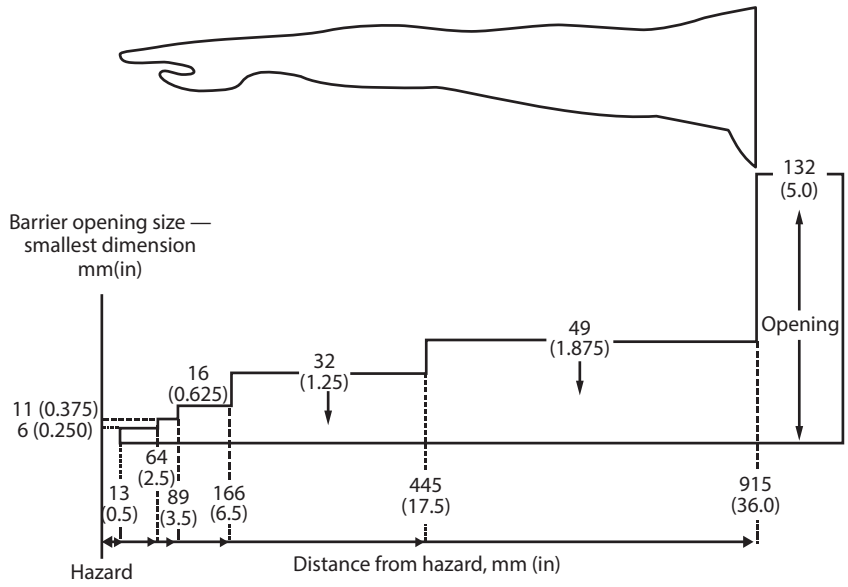


Chart illustrating how to measure a pinch point.

Setting the Guarding Policy

When establishing a guarding policy, utilize the current MSHA or OSHA guarding standards. It should be implemented by the owner or management in collaboration with the workers and the joint health and safety committee.

A good tool to use for standardization of your guarding policy is the "American National Standards Institute (ANSI) B11 – Safety Series Standards for

Machine Tools." This guideline was developed to determine guarding mounting distances based on the maximum opening sizes in the guarding. It ensures that any body part that can fit through the mesh will not be able to contact the rotating or moving component inside. All personnel should be involved in the planning and implementation process so everyone understands why the guarding is necessary.

Identifying Danger Areas — Using a safety gauge can help determine the distance from a hazard. Figure 2 describes how a pinch point is measured and how the barrier opening size affects the distance from the hazard. The goal is to keep all objects away from exposed rotating parts, where the object can be pulled in and damaged. These parts include shafts, drums or return rollers. The in-running pinch point plus the entire exposed area of the rotating or moving component can be considered the danger area. Even the exposed area of the component, if burred or if there is buildup or wear, can create an entirely separate hazard.

A worker should not be able to reach in or around any moving components. A safety gauge (Figure 3) will give a clear indication as to whether or not the guarding is adequate and meets requirements, or if insufficient guarding needs to be replaced.

Figure 4 illustrates a pinch point on a conveyor belt, and Figure 5 depicts what would be considered the "danger zone" surrounding the same conveyor belt.

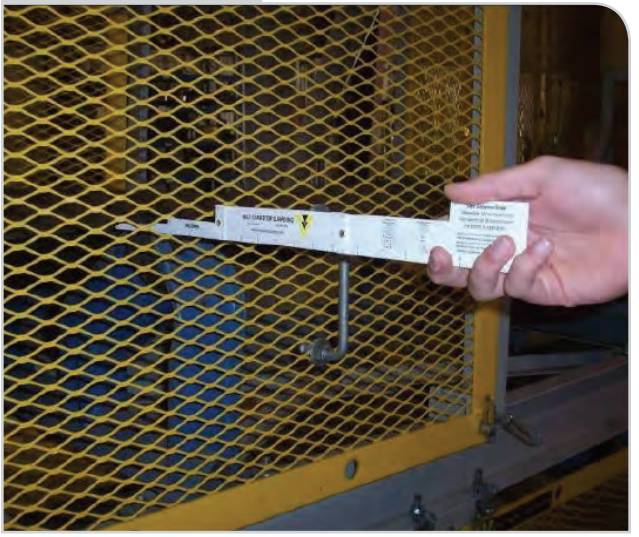
How Danger Areas Can Change Over Time — Much like the environment, danger areas can change over time due to various condition and element changes. For example, a return roller could get worn and have a hole in the can or pick up other material, which would cause the entire return roller to become the danger area. The lagging on a pulley starts to loosen from the steel can, or the can is able to wear through. Figure 6 depicts examples of danger zones that can be affected over time.

Things to Consider When Building a Guard or Guarding an Area

There are several important factors to selecting a guarding solution:

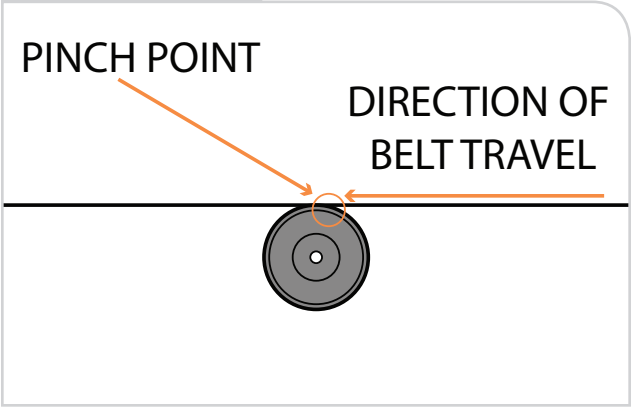
Ease of Maintenance and Cleanup — Make sure the guards are maintenance- and cleanup-friendly. A guard that is hard to maintain or clean can cause

Figure 3



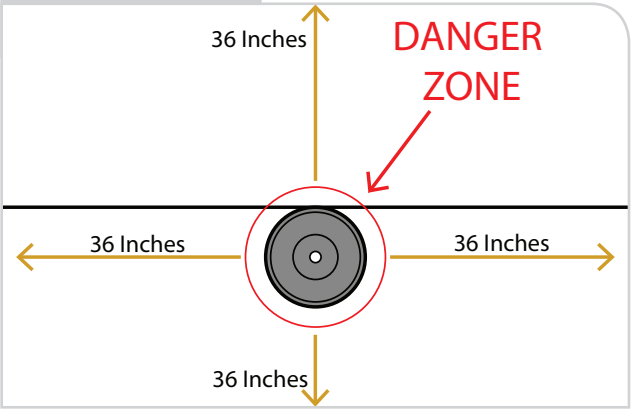
A safety gauge can measure distance to a pinch point.

Figure 4



Location of a pinch point on a conveyor belt.

Figure 5



The danger zone for a conveyor belt.

Figure 6

Examples of danger zones that can be affected by changes over time.

major problems later if the workers have a difficult time performing their duties.

Special Requirements for the Area Being Guarded — Things such as lubrication, vibration analysis, heat analysis, speed sensing, overheating concerns, corrosive areas and flammable areas all need to be taken into consideration before selecting a guarding solution.

Ergonomics — A well-designed guard should not weigh more than 50 lbs. and should not require more than one person to remove or install it.

Simplicity — The guard should be designed to fit into place easily with minimal thought or effort; simplicity is an important factor when dealing with a wide variety of workers who may come in contact with the guard.

Ability to Withstand Normal Operational Forces — Guarding does not need to be able to withstand catastrophic failures, like if a shaft breaks or a wheel flies off, but it should be able to endure everyday forces; for example, if an employee puts his/her weight on the guard, it should be able to support him/her.

A Quality Fastening System — A fastening system is required to ensure the guard remains securely in place while the machine is being operated. A wedge clamp is a very simple option, as it is never removed so the guard always has a place to latch back on to. Figure 7 depicts how a wedge clamp works. As an alternative, a tie wrap can be used to comply with MSHA standards that require a tool to remove.

Visibility — The guarding solution should be easily recognizable. One way to heighten guard visibility is to paint the guards a color that will stand out from the equipment. If colors are standardized, the employees will recognize which color means danger. Safety yellow is the most common color used to identify guarding.

Adjustability and Ease of Inspection — The guards should be able to be adjusted without the loss of protection and without modifications to the guard itself. They should also be able to allow for inspection without removal, or the company should have a policy in place to ensure the guard is never removed while the equipment is in operation.

Safety — The design, material and construction of the guard should enhance the

Figure 7

A wedge clamp fully opened (left), partially opened, (center) and closed (right).

equipment it protects against, not create further hazards. Guards should be free of burrs, sharp edges and pinch points. Hand railings, for example, are often used where guarding should be. However, hand railings can be breached easily and are not adequate protection to limit access to a pinch point.

Training

Training on a guarding system should involve instruction, discussion and hands-on training. Specific training is a crucial part of any effective guarding system and should warn all workers, management and supervisors about the potential dangers that exist. A training program should be updated regularly to ensure the materials are current and relevant.

Conclusion

Guarding equipment should be an essential element of worker safety. When choosing a guarding solution, keep it simple; the less complicated the guard is, the easier it will be to access the equipment and perform maintenance. Standardized guarding will create uniformity and familiarity for those working around it. Training should also take place to ensure that personnel understand why the guarding is in place and why it is critical to keep the guards in place. Finally, ensure that workers do not come in contact with any rotating or moving machinery.

Acknowledgments

The author would like to thank Karen Vandergeest and the entire staff at Belt Conveyor Guarding.

References

1. *Safety Series Standards for Machine Tools,* American National Standards Institute (ANSI), 2013.
2. *Guarding Regulations*, Mining Safety and Health Administration (MSHA), 2013. ✦