

2016

# Perimeter Guarding

## White Paper

We published this white paper to help educate the marketplace on perimeter guarding and how it relates to improving workplace safety.



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## Perimeter Guarding

Perimeter Guarding is a barrier, also known as area guarding or safety guarding, used as a precautionary safety feature. This guarding is designed and built to be installed around manufacturing equipment. The purpose of the perimeter guarding is to protect employees from injury, protect machinery from damage, and to improve the overall workplace safety. Many factors go into proper machine guarding, but the most important factor to follow is OSHA guidelines. [OSHA](#) (Occupational Safety and Health Administration) is an agency of the [United States Department of Labor](#) that assures safe and healthy work conditions for working men and women by setting and enforcing standards. The standard [CR 1910.212](#)<sup>1</sup> defines safety as it relates to perimeter guarding.

OSHA will trust companies to take a proactive approach to following these guidelines, but will verify from time to time with plant walkthroughs. However if these standards are ignored, companies could be subject to fines. In the case of injury or death, companies will face costly fines and litigation due to neglect and/or carelessness.

## OSHA Understanding

Understanding and applying these OSHA standards is step one when designing a proper perimeter guarding system. These designs do vary based on the environment, types of equipment, hazardous locations, and machine operations, but ultimately result in the same outcome of improved plant safety. Some of the more common standards to be used when designing perimeter guarding set by OSHA are guard heights, distance guarding is elevated off the floor (also known as sweep distance), and panel selection all preventing reachability. The primary goal is to improve workplace safety, but the type of perimeter guarding system used will be determined by the customer's needs and environment.



## Material History / Summary

Improving safety dates back to the Industrial Revolution when workers were getting crushed by belts and pulleys, as well as chewed inch by inch in gears and screw conveyors. This first law requiring guarding of hazardous machines was passed in 1877<sup>2</sup>.

From this point on, companies used a number of material types to guard machines. Common materials used to build perimeter guarding are angle iron, T-Slotted aluminum extrusions, and welded tubular steel. Each material type has advantages and disadvantages of their own and against each type of material which have to be evaluated per application.

<sup>1</sup> [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9836](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9836)

<sup>2</sup> <https://www.dol.gov/dol/aboutdol/history/mono-regsafepart02.htm>

## Hybrid Guarding

A single solution can be evaluated, but doesn't always work for each application depending on the environment and the machine conditions. Hybrid guarding is also an option that should be evaluated. Applications may require a combination of hardguarding and electronic safety guarding used in access guarding locations. Together they can provide a safe work area for employees. A wide variety of options exist in improving plant safety

## Angle Iron

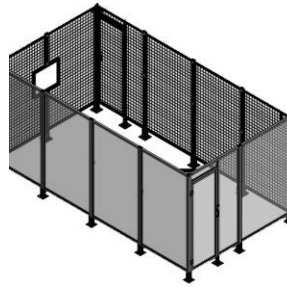
An old, yet still commonly used system is angle iron welded together. This is a very low cost, short life span, low aesthetic look method of perimeter guarding. However this is a system used to still protect workers from hazards offering at least a temporary fix instead of no fix at all. Typically the angle iron is a 1 inch x 1 inch angle stock made from either aluminum or cold-rolled steel, sometimes stainless steel depending on the application. This material can be purchased from most metal suppliers. Material is cut to size, mitered, notched, or overlapped at the corners, and welded together. This type of framing system still allows for panels to be attached either by tack welding wire mesh panels at each strand or fastening the panels with a bolt and packing plate method. This system generally does not have any plating on it due to the cost restrictions.



## T-Slotted Aluminum Extrusions

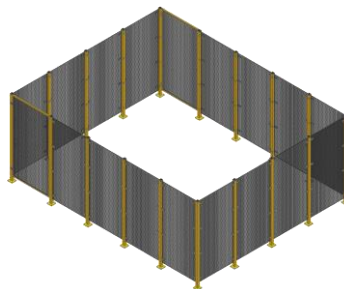
T-Slotted aluminum extrusions are used to build modular framing systems giving the ability to custom design the perimeter guarding around the application needs. This system has been around since the 1970s and has become the most popular method of perimeter guarding. There are a number of manufacturers of this type of system differing mainly from a service aspect, but all systems use the same methodology in respect to the material make-up. These extrusions are made from a high strength [6000 series alloy aluminum](#) designed with a continuous mounting slot in the profile. These profiles are extruded and are coated with a corrosion-resistant anodize finish. These extrusions are packaged and sent to manufacturers to be cut to custom sizes per customer requirements. T-Slotted aluminum extrusions are just one part of these systems, which are used for the framing structure. To create a hard-sided barrier, the appropriate panels such as polycarbonate or welded wire mesh need to be used based on the inherent hazards the perimeter guarding is being placed around. These panels can be placed in the modular T-Slot, surface mounted, or attached with quick removal options. Once the framing and panels are selected, then the rest of the modular framing system is constructed with various types of bolt-on fastening methods, mounting brackets, and miscellaneous accessories. Another advantage of using the T-Slotted aluminum extrusion product is the system can be designed as sub-sections. This allows the manufacturer to build panels making for a quicker install as well as provide the opportunity for quicker access to almost any part of the machine. If the machines, work cells, or floor

plans change this type of product is easily expandable. This system does come with some drawbacks: premium pricing due to the customization capabilities; aluminum in general is more expensive than steel; not able to be used in food grade applications due to the caustic wash downs; not strong enough for all environments.



### **Steel Guarding System**

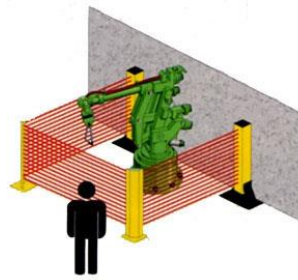
Another common type is a steel guarding system. This is a system made up of tubular steel posts, framed in wire mesh panels, and a floor mounting system. These systems are typically finished with a safety yellow paint or powder coat finish to provide high visibility of a hazardous area that is being protected. These systems are also manufactured by numerous suppliers. Each supplier of this type of steel guarding system has designed their own unique product line. When determining which system to use, evaluate your access needs to areas of machinery for maintenance and tooling changeovers as well as the environment conditions. The tradeoff is pricing over customization, but yet a quality system. Steel brings additional rigidity to the environment that T-Slotted Extrusions does not. Being made with tubular steel, the main framing must stay intact to provide the necessary rigidity, which makes for a simpler design. Straight runs and basic turns are ideal, which eliminates the customization ability. This does however make this type of system less expensive.



### **Electronic Access Guarding**

Hardguarding is not the only type of perimeter guarding. A number of electronic safety devices can be used to create access guarding. These devices consisting of safety light curtains, body curtains, safety laser scanners, and interlocking safety mats provide an “invisible fence” denying access to the machine or area. These products offer a wide range of heights and resolutions still allowing the ability to follow OSHA standards. However a key component in deciding which device to use is, does the machine instantly stop by a brake or does the machine ramp down? Stop time distance is a determining factor calculating the amount of time a machine takes to stop, which then determines how long access to the machine is restricted. This factor is used to narrow the type of electronic safety

devices that are permitted in a safe perimeter guarding application. Due to the vulnerability using these products because there is no physical restrictions to the machine, a risk assessment of the area is highly recommended.



## Panels

Panel selection is a critical element based on the OSHA standards and taking into account the machine operations relative to the present hazards. Common panels used in this type of perimeter guarding are clear polycarbonate, also known as Lexan, and welded wire mesh panels. Acrylic panels, also known as plexiglass, are sometimes mistakenly used in place of polycarbonate due to cost savings. Acrylic panels cannot be used in safety applications because it does not have any measurable impact resistance and could allow projectiles to be launched through the material<sup>4</sup>. Polycarbonate panels have a measurable impact resistance and should be used in applications where there would be projectiles<sup>3</sup>. Guarding that is placed close to the machine requires a solid panel to restrict any openings preventing reach through. Another common panel is a welded wire mesh panel with a PVC rubber coating. When considering welded wire mesh panels, the size opening allowance is determined by the distance the perimeter guarding is away from the hazard per OSHA standards. For example, a welded wire mesh panel with an opening of 1 inch x 1 inch regulations specifies the guarding must be placed 6 inches away from the hazard. For proper security when using welded wire mesh panels, mesh retainers should be used to tie the panels to the framing system. The color of the panel is not a regulation, but black is the most common color used. While safety yellow is important for awareness, it is a very hard color on an employee's eyes when looking through the panels to the machine, plus black colored panels hide dirt better in a manufacturing environment.



<sup>3</sup> <https://en.wikipedia.org/wiki/Polycarbonate>

<sup>4</sup> <https://en.wikipedia.org/wiki/Acrylic>

## Access Areas

The accessibility to each of these systems will vary based on the machines operations, tooling changeovers, and maintenance schedules. The T-Slotted aluminum extrusion and steel guarding systems provide more options for doors and removable panel sections whereas the angle iron systems will be more of a fixed system or smaller access panels due to the lack of material rigidity. Door designs and access panels are critical to the operation, but the OSHA standards still must be taken into account. Access areas must be restricted from “easy” access during machine operation, as well as the machine not having the ability to operate when these access areas are exposed, compromised, or bypassed. A general OSHA standard states it requires a minimum of a unique tool to be able to access an area such as various types of torx screws.



These types of restricted access work in low volume entrance areas such as long-run tooling changeovers and maintenance access. They can either be bolt-on panels or doors with locking door handles keeping the tools or keys from the machine operators. Areas that need to be accessed more frequently such as quick tooling set ups or machine changeovers and production part runs should be designed with access doors. These types of doors would not be locked or bolted as a standard. Some type of electronic safety device must be integrated with the machine control system to prevent restricted access while the machine is running to not be a hindrance to production.



## Electronic Safety Devices

Electronic safety device options can be overwhelming on the choices and decision making process based on the device functionality as it relates to the machine operation. Different types of the guarding would require the use of specific electronic devices. Types of electronic safety devices that can be used on access doors where the machine has a brake control are keyed interlocks, hinged interlocks, RFID switches, coded magnet switches, limit switches, enabling devices, and proximity switches. Types of electronic safety devices that can be used on access doors without machine breaks (machine ramps down to a stop) are solenoid locking switches and safety interlock handles. Types of electronic safety devices that can be used for access guarding are safety interlock mats, safety light curtains, body curtains, and safety laser scanners. In addition to that, two-hand controls, e-stop buttons, and

emergency stop rope pulls are a critical component as well depending on the type of equipment being guarded. By adding an electronic safety device, this turns a perimeter guard into a safe perimeter guard.



## Installation

Installing perimeter guarding is critical to plant safety. Perimeter guards are designed to be fastened in place and wired to appropriate sections of machine controls. Hardguarding generally has mounting feet at the bottom of the posts. The electronic safety devices are mounted to the hardguarding, and then wiring is routed to the proper control panel. Measuring off a fixed location and marking the floor or using a chalk line will ensure proper alignment of the guarding allowing the safety switches to make contact. Holes are drilled into the concrete or taps into a steel tread plate. Concrete anchors or bolts ranging from 3/8 inch to 1/2 inch are then used to fasten the mounting feet to the floor.



Depending on the rigidity of the perimeter guarding, additional mounting brackets/braces may need to be strategically placed in locations where the guarding can be fastened to the machine. Safety switches must be wired into the safety relays placed inside the machine control panel. The relays must then be terminated to the appropriate area that controls the hazard. To ensure proper installation of perimeter guarding, experienced contractors with the proper licensing and liability insurance should be used over general maintenance personnel. They must have a strong understanding of plant safety, as well as work in a safe manner themselves.

## Routine Maintenance

To ensure continual workplace safety for workers where perimeter guarding is installed, periodic checks should be added to a preventative maintenance schedule. Perimeter guarding is susceptible to abuse in most manufacturing environments including vibration, forklift damage, operator wear and tear, as well as possible part containment due



to part ejection from production machinery. During the preventative maintenance inspections, if product is found damaged compromising worker safety this material should be repaired or replaced immediately.

### **Applications**

Applications for perimeter guarding consists of cutting mechanisms, engraving devices, laser machines, extrusion presses, textile machinery, roll-forming machines, forming equipment, forging machines, broaching tools, boring machines, drilling equipment, grinders, corrugated machines, paper processing equipment, die-cast machinery, molding machines, stamping presses, robotic cells, pick and place units, bottling and packaging conveyors, and test instruments. Basically anywhere a product is made and people could be injured near a machine, perimeter guarding should be installed to keep people safe.

### **Keywords**

If it's determined you need assistance with perimeter guarding, use these keywords when searching for more information, suppliers, or support on perimeter guarding. Perimeter guarding, area guarding, hardguarding, safety guarding, barrier guarding, robot guarding, perimeter cage, work cell guarding, security cage, safety fencing.

## **Conclusion**

Ultimately the purpose of perimeter guarding is to save lives by improving plant safety. There are many theories, methods, and opinions on workplace safety. Following OSHA guidelines when building perimeter guarding around equipment is essential because the longevity of your plant, your people's wellbeing, and the success of your business are all on the line.