Presence Sensing Devices

Balancing Safety & Productivity

Michigan Safety
“Credentials”

- Involved in Stamping, Press Brakes, Press Automation, Safety & Service of Controls  27+ years Experience
- Toured most North American Press Builders & Stampers
- Toured Asian, Middle Eastern & European Press Users & Builders
- Thousands of Successful “Safe” Installations Running
- Worked with manufacturers and OEMs-
  - Clearing - Niagara - Bliss, Piranha – Allsteel, Tennsmith, SEYI, LINK Systems
- Safety Committee for Precision Metalforming Association
- Speaker and Author of hundreds of safety presentations and articles
- SME Board of Directors
- PMA Safety Committee, co author of updated green book
Increasing productivity while maintaining safety

Safety = Productivity
- Cost of an accident
  - Lost Time
  - Hospitalization
  - Loss of confidence
    - Company
    - Management
    - Machinery

Consequences Of A Serious Injury 2008

- Loss of Earnings $1,755,000
- Hospitalization $96,000
- Ongoing Therapy $10,000
- Outpatient Treatment $90,000
- Cost Of Retraining $100,000
- Home Help $243,000
- Compensation For Pain & Suffering $80,000
Presence Sensing Devices

Applications & Operations

Improve SAFE Performance
LIGHT CURTAIN Basics

- Presence Sensing Device
  - Basic Components
    - Transmitter or Sender - Infrared LEDs
    - Receiver - Infrared Photocells
    - Relays - Output
    - Checking Circuit - Safety
PSD’s or LIGHT CURTAIN
- Purpose

- Presence Sensing Device Purpose
  - A Presence Sensing Device or Light Curtain serves several functions. First to assist in protecting the operator by sending an infrared beam across to detect the “Presence” of an individual in a hazardous location.
  - Second, it also protects non operators from entering a hazardous location by detecting their presence.
PSD’s or LIGHT CURTAIN
- How they work

- Operation
  - Infrared Light Curtains or PSD’s are a standard in the industry.
    - Infrared is used in order to reduce the interference from other light sources.
  - Power Levels are settable to reduce cross talk 3’, 6’, 12’, 24’, 50’
  - Synchronization Sequence - Prevent one beam as being seen as another (Sequencing- Beam 1, 2, 3, 4, 5, etc)
PSD’s or LIGHT CURTAIN
- Alignment and crosstalk

- Operation
  - Alignment
  - Power Setting
  - Crosstalk

TRANSMITTER POWER SWITCH SHOULD BE SET CORRECTLY FOR THE SCANNING DISTANCE. THIS WILL PROLONG THE LIFE OF THE UNIT AND REDUCE THE POSSIBILITY OF CROSSTALK TO OTHER LIGHT CURTAIN UNITS WHICH CAN RESULT IN NUISANCE STOP SIGNALS. SWITCH SETTINGS ARE AS FOLLOWS:

<table>
<thead>
<tr>
<th>DISTANCE</th>
<th>SWITCH &quot;ON&quot; SETTINGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0' TO 3'</td>
<td>NO SWITCHES</td>
</tr>
<tr>
<td>3' TO 6'</td>
<td>1</td>
</tr>
<tr>
<td>6' TO 12'</td>
<td>1,2</td>
</tr>
<tr>
<td>12' TO 24'</td>
<td>1,2,3</td>
</tr>
<tr>
<td>24' TO 50'</td>
<td>1,2,3,4</td>
</tr>
</tbody>
</table>

Top View of Machine 1
Top View of Machine 2
Top View of Machine 3

Black Max Receiver
Light Pulse Direction
Black Max Transmitter
**PSD’s or LIGHT CURTAIN**

- **Reflection**
  - Machinery
  - Part
  - Supports / Tables

- Baffles prevent interference
  - think of a spyglass
PSD’s or LIGHT CURTAIN
- Why PSD’s over guards

- Why choose Light Curtains over Guards
  - Guards are often left open or off
    - Often during critical manual setups
  - Guards make setup and changeover difficult
  - Guards are time consuming and limit productivity
PSD’s – Where to mount

- Safety Distance is based on stopping time
  - Can your hand get into the point of operation – Hazard, before the machine stops.
  - Required to do stopping time measurements regularly.
POINT OF OPERATION

- Guide Posts Can Be Pinch Points If The Separation Is Large Enough
- Stop Blocks Also
POINT OF OPERATION

- Press Brake Tools Can Vary

Point Of Operation

Stroke 1" Stroke 2" Stroke 3" Stroke 2"
Checking Stopping Time

- Press Set For Worst Case Scenario
  - Fastest Speed
  - Heaviest Die
  - 90 Degree Crank Angle

- Stop Time Meter
  - Set The Stop Time Actuator For The 90 Deg Point

- Brake Monitor with Display
  - Release the palm buttons at the 90 Degree Crank Angle.
**OSHA Formula**

\[ Ds = K \times Ts \]

- **Ds**: Minimum Safety Distance
- **K**: Constant Average Hand Speed (63 Inch / Sec)
- **Ts**: Stopping Time (Sec)

- OSHA is LAW. In Michigan its MI OSHA
- OSHA Can Adopt Any Applicable Standard to prove feasibility
- Other Additional Points of Safety are Covered in General Duty / Safety, etc.
ANSI Formula

\[Ds = K (Ts + Tc + Tr + Tbm) + Dpf\]

Ds - Minimum Safety Distance

K - Constant Average Hand Speed (63 Inch / Sec)
Ts - Stopping Time (Sec)
Tc - Machine Control Time (Sec)
Tr - Response Time (Sec) - Light Curtains
Tbm - Brake Monitor Setting Less Ts (Sec)
Dpf - Depth of Penetration (Inch) - Light Curtains

- More Comprehensive Than OSHA
Figure 3.6: Horizontally mounted remote segment Black Max units to detect a person inside the main sensing field.
- PSD’s Remote Segments

- Remote Segments or Horizontal Light Curtains
  - Remote Segments or Horizontal Lights are required if someone can stand between the light and the hazard.
  - Since Stopping Time dictates the vertical lights distance, you have to prevent someone from standing between the light and the hazard since some lights reset when the light is cleared the horizontal segment detects the presence of an operator inside that area
POINT OF OPERATION

Die Is Closest To The Operator
e.g. 4” From The End Of The Bolster

Worst Die Scenario
POINT OF OPERATION

Remote
Length Is
Based On
Dies Size &
Point of
Operation

Point Of Operation

Point Of Operation

Point Of Operation

Point Of Operation

Point Of Operation

\[ Ds = 63\times (Tc + Tr + Ts + Tbm) + Dpf \]
ANSI Formula

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Dpf - Depth of Penetration (Inch) - Light Curtains

Larger the gap the further back the lights must be moved
**ANSI SAFETY DISTANCE**

**NOT APPROVED FOR DISTRIBUTION**

\[ D_s = K \times (T_s + T_c + T_r + T_{bm}) + D_{pf} \]

- **Ds**: Minimum Safety Distance
- **K**: Constant Average Hand Speed (63 inch / Sec)
- **Ts**: Stopping Time (Sec)
- **Tc**: Machine Control Response Time (Sec)
- **Tr**: Response Time (Sec) - Light Curtains
- **Tbm**: Brake Monitor Time Setting (Less Ts) (Sec)
- **Dpf**: Depth of Penetration (Inch) - Light Curtains

**Calculator:**

- **# Consecutive Blanks Used, Include Floating Blank (0-6)**: 0.95
- **Nearest Point Of Operation - Inside Of The End Of The Bolster**: 1 Blank or Float = 1.7" Add .75 Each additional

**Object Sensitivity**

- **Black Max - No Blankin**: .95"

**Factors:**

- **K**: 63.000 63" / Sec - Constant
- **Ts**: 0.100 80 SPM Gap = .200 / 40 SPM SS = .320
- **Tc**: 0.005 501 or 5000 = .005 Sec
- **Tr**: 0.024 Link Lites = .024 Sec - Longest, .0125 Shortest
- **Tbm**: 0.030 (Brake Mon Setting - Ts) or 10% Of Ts
- **Dpf**: 3.230 3.4 x Object Sensitivity

**Ds**

- Minimum Safety Distance (From the nearest point of operation): 13.247
- Adjusted Safety Distance, Based On Point of Operation: 13.247
- Remote Light Curtain Suggested: 12
LIGHT CURTAIN
DEPTH OF PENETRATION

- Black Max Standard Light
  - Dpf = 3.4 x Obj Sensitivity - 0.275
  - No Blank Object Sensitivity = 0.95” (.75 Beam Spacing)
  - 1 Blank or Floating - Object Sensitivity = 1.7”

Do Not Use!
Instead Use

47 Years
1972-2019
Control Reliability - PSD’s are only as good as the control into which they are wired

- Control Reliability
  - Not just redundancy
  - Checking and Verification and lock out when a failure is detected.
  - New standards are also taking into account risk assessment and as such are addressing using different modules to prevent common failure rates. Diversely Redundant.

Diagram:
- CLUTCH/BRAKE VALVE
- LOGIC SYSTEM 1
- LOGIC SYSTEM 2
- COMPARISON
- A CONTROL INPUTS B
Mutting Versus Blanking

- **Mutting**
  - Mutting means to disable the light curtains electronically.
  - Mutting is used on the upstroke of presses and press brakes.
  - Mutting typically starts at ¼” above contact with the material and continues until the top of the stroke.
LIGHT CURTAIN

Parts

¼ Inch
Pinch Point
Light Curtains - Blanks

- Beam Blanking

“More Beams You Blank - The Further Back You Need To Be”
Object Sensitivity

Dpf = 3.4" x Object Sensitivity - 0.275"

Black Max Lights
LIGHT CURTAIN
Light Curtain Blanking

Usage
Application
Blanking -- Impact on Safety Distance
LIGHT CURTAIN

- Blanking Routing
  - Start with No Blanks
  - Blank only when mandatory
  - Never blank to allow your hands to be in the lights
Black Max Blanking

Remove All Blanks Prior To Setting Up A New Job
PSD Blanking

Blanking

- Blanking means to ignore one or more segments which may be obstructed by a table or scrap conveyor.
- Blanking does not mean that you can ignore this secondary hazard you may now have by compromising the full range of the light curtain, nor should you blank to allow your hands to gain access.
PSD’s - Why PSD’s over Restraints or Pullbacks

- Restraints and Pullbacks require adjust by the operator and setup person. This person is completely responsible to make sure they are set properly.
- Pullbacks can get hooked and pull the operator into the die.
- Limit motion and can prevent the operator from getting out of the way of fork trucks, etc.
- Only protects the operator
- Operators “Lean” on these items
Pull Backs & Restraints

Restraints

Pull Backs
Are Laser Sensors considered PSD’s

- Lasers Safety Device - Press Brakes
  - Laser Sensors on press brakes are not the same as PSDs since the light curtains set up a safety distance and factor in hand speed, etc.
  - Lasers do not prevent machine operation if you are in the hazard.
  - 2 or 3 laser system attaches to Ram.
  - Has slow mode which continues to allow the machine to run even after it sees an obstruction by depressing the pedal again.
Increasing productivity while maintaining safety

- Safety = Productivity
  - Improving safety and productivity requires a close examination of your process
  - Attached are some tools to achieve both
Alternate Devices
Supports and Magnetic Base

Left Hand Model

Right Hand Model
Alternate Devices
Magnetic Supports- Die Attach

- Safety = Productivity
  - Magnets can hold the part so an operator doesn’t have to hold them during the fabrication process
Alternate Devices

Magnetic Backgage Fingers
Using Mirrors

- Safety = Productivity
  - Mirrors Allows up to 4 sides of the machine to be covered by the same lights
  - If you blank a beam it’s blanked all the way around
  - Some signal loss occurs
Controls

Safety & Production

- Controls
  - Stop Cycle Mode on Press Brakes
    - $\frac{1}{4}''$ is the acceptable height by OSHA to allow the lights to be muted.
    - Depending on the control there are various ways that enact the $\frac{1}{4}''$ Stop Cycle Mode.
    - Stop cycle allows the ram to start down and stop at $\frac{1}{4}''$ without releasing the footswitch. This allows you to then insert the part at this point.
    - Most utilize the same source as the muting control is triggered from (Limit switch, timer adjust, control output programmed)
Increase Manufacturing

- Safety = Productivity
  - Using stop cycle mode allows for the ram to stop at $\frac{1}{4}"$ and then insert the part.
  - At $\frac{1}{4}"$ above pinch point the lights are muted therefore the part doesn’t interfere with the lights.
- **PSD’s Perimeter Guard**

- Perimeter Light Curtain Guards
  - Perimeter Lights have a bigger beam spacing since they are typically further away from the point of operation.
  - They do not reset when you pass through the sensor, and therefore require you to reset the lights using a manual keyswitch.
Are Laser scanners considered PSD’s

- **Lasers Scanners**
  - Laser Scanners are not Presence sensing devices in the typical way.
  - Area Scanners used to scan are typically not categorized as the primary safety device which means you should be using another safety measure as the primary. These are typically used in a similar fashion as a safety mat. With the same limitation of reaching over.
  - The same formulas don’t apply for Light Curtains and Laser Scanners since you can reach over scanner.
Under, Over, Around & Through

Mesh Aperture
Safe Zone has a mesh aperture of 22mm x 22mm which allows the fence to be located right up to 120mm from the hazard.

Height and Distances
- Safe Zone has a panel height of 2000mm.
- Hazards between 2000mm and 2200mm above ground require a safety distance of 350mm.
- Hazards between 2200mm and 2400mm above ground require a safety distance of 100mm.

Clearances
Safe Zone provides a clearance of 200mm between the bottom of the panel and ground level for cleaning purposes. Where a hazard is located in the lower areas of the machine, the potential to reach under and around must be considered. Custom panels or the fence location can ensure correct safety distances.
Why Not Light Curtains?

- When are light curtains not the best option
  - Full Revolution Machine
  - Fully guarded operations requiring no operator involvement and dedicated machines with no tooling changeover.
  - Machines without electronic controls (Pneumatic machines)
Maintenance and Ts - Stopping Time

- Items That Impact Stopping Time
  - Velocity
    - Press Speed
  - Engagement
    - Clutch Pressure- Air
    - Brake Pressure- Spring
    - Clutch & Brake - Friction Disc
      - Brake Design Type, Quality, & Wear
      - Clutch Design Type, Quality & Wear
  - Weight
    - Counterbalance Pressure and Setting
    - Slide Weight
    - Die Weight
Thank You!!

Questions?

- Your Time Is Very Important, Thank You
- Thanks to all of you who made this training possible.
- Free 3 Day OSHA training [www.linkelectric.com](http://www.linkelectric.com)

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