

**OSC 12**  
Ohio Safety Congress & Expo

**WELL AT HOME. SAFE AT WORK.**

**Machine Safeguarding** Thursday 3/29/12  
New Standards and Products

Roger Harrison - Director of Training - Rockford Systems Inc.  
(800) 922-7533 extension 604 harrison@rockfordsystems.com

Part 1 #103 11:15am-12:15pm  
Part 2 #104 1:15pm-2:15pm

**Ohio** Bureau of Workers Compensation

**In most countries around the world:**

**Regulations:**  
legally mandatory - like OSHA Regulations

**Standards:**  
voluntary - like ANSI Standards are often used to obtain more current Best Safety Practices

**New ANSI Safety Standards since 2008:**  
ANSI GSR-2008 General Safety Requirements Common to ANSI B11 Machines  
ANSI B11.1-2009 Mechanical Power Press Safety  
ANSI B11.0-2010 Safety of Machinery and General Risk Assessment  
ANSI B11.9-2010 Safety Requirements for Grinding Machines  
ANSI B11.19-2010 Performance Criteria for Safeguarding (Methods)  
ANSI/NFPA79-2012 Electrical Standard for Industrial Machinery

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**ANSI B11 Safety Standards for Machine Tools**

ANSI GSR - 2008 General Safety for ANSI B11 Machines  
ANSI/NFPA 79 - 2012 Electrical Std. for Ind. Machinery  
B11.0 - 2010 Safety of Machinery - Risk Assessment  
B11.1 - 2009 Mechanical Power Press Safety  
B11.2 Hydraulic Power Presses  
B11.3 Power Press Brakes  
B11.4 Shears  
B11.5 Iron Workers  
B11.6 Lathes  
B11.7 Cold Headers and Formers  
B11.8 Drilling, Milling, and Boring  
B11.9 - 2010 Grinders - Abrasive Wheels  
B11.10 Sawing  
B11.11 Gear Cutting  
B11.12 Roll Forming and Roll Bending  
B11.13 Automatic Screw/Bar and Chucking

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(continued)

B11.14 Slitters (Now combined with B11.18)  
B11.15 Pipe, Tube, and Shape Bending  
B11.16 Metal Powder Compacting  
B11.17 Horizontal Hydraulic Extrusion Presses  
B11.18 Coil Processing (Slitting and Cut-to-Length)  
B11.19 - 2010 Safeguarding Criteria (Methods)  
B11.20 Integrated Manufacturing Systems  
B11.21 Machine Tools using Lasers  
B11.22 CNC Turning  
B11.23 Machining Centers  
B11.24 Transfer Machines

TR 1 - 2004 Ergonomics  
TR 2 - 1997 Mist Control  
TR 3 - 2000 Risk Assessment  
TR 4 - 2004 PLC/PES  
TR 5 - 2006 Noise Measurement  
TR 7 - 2007 Lean Manufacturing

American National Standards Institute

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**The American National Standards Institute (ANSI) does not write any Standards**

ANSI establishes procedures and accredits Standards development organizations (like RIA)  
If the written Standard meets their requirements, ANSI will then approve and publish the Standard

Newer Standards / Regulations tend to be **Performance Based**  
give end result - how to get there is up to you

Older Standards / Regulations tend to be **Specification Based**  
give very specific parameters of how to do

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ANSI B11.0 - 2010

American National Standard  
*Safety of Machinery - General Requirements and Risk Assessment*

Secretariat and Accredited Standards Developer:  
B11 Standards, Inc.  
4281 Tring Lane  
Langley, VA 20132, USA

APPROVED: 2 DECEMBER 2010  
American National Standards Institute

**ANSI**

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**Type A Standards:**  
aspects applicable to all types of machines

**Type B Standards:**  
B1 - ergonomics  
B2 - components and protective devices

**Type C Standards:**  
specific types or groups of machines

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**ANSI B11 Standards Instruct Employer:**

left side:  
shall . . . must . . . will . . .

right side:  
should . . . may . . .

**ANSI B11.19 - 2010 "Safeguarding Methods"**

- Guards
- Devices
- Distance
- Location
- Opening

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American National Standard for Machine Tools - Safeguarding When Referenced by Other B11 Machine Tool Safety Standards Performance Criteria for the Design, Construction, Care, and Operation

**Left side are Requirements**

**Right side is Informative**

**EXPLANATORY INFORMATION**

1. Scope, Purpose, and Application

1.1 Scope - When this standard is referenced by the other B11 Machine Tool safety standards, the requirements of this standard for the design, construction, care and operation of the safeguarding systems, safety devices, and methods shall apply.

The selection and application of the safeguarding means is provided in the representative B11 safety standards for the protection of the operator and shall take precedence over this standard.

1.2 Purpose - The purpose of this standard is to establish design and construction requirements for the design, construction, care, and operation of safeguarding means to protect operators and others from hazards.

This standard shall not apply to a particular machine tool unless it is referenced in one or more of the B11 Machine Tool safety standards.

When the other B11 standards provide specific user criteria for the design, construction, care, and operation of specific safeguarding, test methods, and safety devices.

1.3 Application - 1.3.1 Safeguarding - The requirements of this standard pertain to the requirements of

2.1 Scope, Purpose, and Application

2.1.1 Scope - The intent of this standard is to provide performance criteria for the design of safety devices, methods of safeguarding, and methods of work-recovery.

2.1.2 Purpose - The intent of this standard is to provide safeguarding for a particular application in order to meet the requirements of the other B11 standards. The requirements for the design of the safeguarding devices are provided in the representative B11 Machine Tool safety standards.

2.2 Purpose - The intent of this standard is to provide performance requirements of the design, construction, care, and operation of the safeguarding devices to meet the requirements of the other B11 standards. The intent of this standard is to provide the design of the safeguarding devices to meet the requirements of the other B11 standards.

2.3 Application - 2.3.1 Safeguarding - The requirements of this standard pertain to the requirements of

**Mechanical Power Press Safety**



**MPPS booklet**

1910.211 pages 4-6  
Glossary of Terms for Machine Guarding

1910.212 page 7  
General Requirements for All Machines

1910.217 pages 8-35  
Mechanical Power Presses

1910.219 pages 36-39  
Mechanical Power-Transmission Apparatus

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**Public Law 91 - 596  
91st Congress, S. 2193  
December 29, 1970**

**5 (a) (1) OSHA's General Duty Clause**  
EMPLOYERS to furnish a place of employment free from recognized hazards likely to cause death or serious physical harm to employees

**5 (b) EMPLOYEES shall comply with OSHA standards, rules, regulations, and orders applicable to his own actions and conduct**

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**SUBPART P - HAND AND PORTABLE POWERED TOOLS AND OTHER HAND-HELD EQUIPMENT**

1910.242 Hand and portable powered tools and equipment, general  
1910.243 Guarding of portable powered tools  
1910.244 Other portable tools and equipment

**SUBPART Q - WELDING, CUTTING, AND BRAZING**

1910.252 Welding, cutting and brazing

**SUBPART R - SPECIAL INDUSTRIES**

1910.261 Pulp, paper, and paperboard mills  
1910.262 Textiles  
1910.263 Bakery equipment  
1910.264 Laundry machinery and operations  
1910.265 Saw mills  
1910.266 Pulpwood logging  
1910.267 Agricultural operations  
1910.268 Telecommunications

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**Code of Federal Regulations OSHA Sub-Part O Machinery and Machine Safeguarding**

1910.211 Definitions [www.rockfordsystems.com](http://www.rockfordsystems.com)

1910.212 General requirements for all machines

1910.213 Woodworking machinery (ANSI 01.1)

1910.214 Cooperage machinery (barrel making)

1910.215 Abrasive wheel machinery ANSI B11.9  
ANSI B7.1

1910.216 Mills and calendars (rubber and plastics)

1910.217 Mechanical Power Presses (ANSI B11.1)

1910.218 Forging machines (presses and hammers)

1910.219 Mechanical power transmission apparatus

Vertical = specific  
Horizontal = general

**OSHA 1910.212 General requirements (a) (1)**

**protect operator & other employees in the machine area from hazards**

- point of operation
- ingoing nip points
- rotating parts
- flying chips & sparks



examples of safeguarding methods: barrier guards, two-hand actuators, electronic safety devices, etc.

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## 4.6 Safeguarding

6.1 General . . . Suppliers and users are required to perform risk assessment

4.2 Collaborative efforts . . . the supplier shall advise the user of residual risk . . .

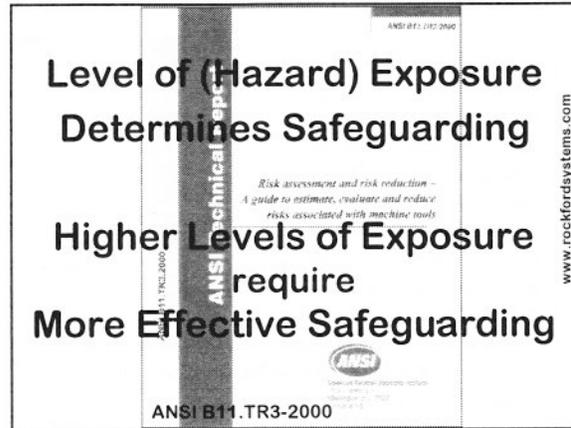
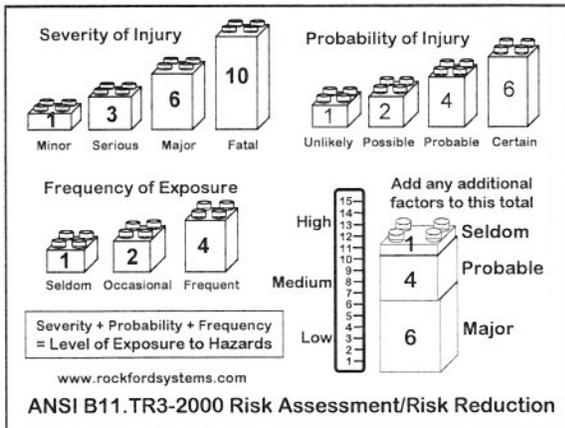
4.6 Safeguarding . . . The supplier shall provide safeguarding determined by risk assessment.

4.6 Safeguarding . . . The user shall ensure that additional safeguarding is provided and installed as determined by risk assessment.

during a  
**Risk Assessment / Hazard Analysis**

look for  
**EXPOSURE to a Recognized Hazard**  
(Immediate or impending exposure requires Guard-Device-Method)

and ways to  
**Reduce or Eliminate that Exposure**



## Residual Risk

remaining risk after protective measures have been taken

## Acceptable Risk

additional expenditure of resources will not result in significant advantages of increased safety.

Acceptable (tolerable) risk to one company may not be to another

### B11-2008 6.7 Achieving Acceptable Risk

- High Risk - only acceptable when all reasonable alternatives/options (protective measures) have been reviewed and deemed impracticable or infeasible
- Medium Risk - undesirable but permissible when all reasonable alternatives/options (protective measures) have been formally reviewed and accepted by relevant stakeholders
- Low Risk - usually acceptable
- Negligible Risk - acceptable

*Informative Note 2: Acceptable risk is fundamentally a business decision made by each supplier or user in the context of their own unique circumstances. The following structure is one example of a practical application of acceptable risk:*

## 6.6 Assess Residual Risk

Incentives to defeat or circumvent protective measures may include:

- protective measures prevent the task from being performed
- task was not identified and assessed for all hazards and risks
- protective measure slows down production
- protective measure interferes with user preferences
- protective measure is difficult or awkward to use
- additional personnel are needed to perform the task; operator resets safeguard while maintenance man inside the hazard area safeguards intended to protect only one person are used for more than one
- protective measure or its hazard not recognized as such by personnel
- protective measure not accepted as suitable, necessary, or appropriate

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ANSI B11.0 - 2010

## Annex A - Guide for the Risk Assessment Process Forming a Risk Assessment Team

Assessing risk requires the reasoned judgment and expertise of a team of individuals with a variety of experience. Team size should be proportional to system complexity and the degree of risk. Members should be people who:

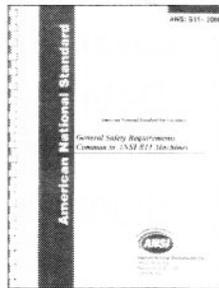
- can answer technical questions about machinery design and function
- have actual experience of how machinery is setup, operated, maintained
- have knowledge of machine processes and hardware and their limits
- have knowledge of incident history of this type of machinery
- have a good understanding of relevant safety regulations and standards
- are aware of specific safety issues associated with this type of machinery
- understand human factors and ergonomic issues regarding machinery

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ANSI B11.0 - 2010

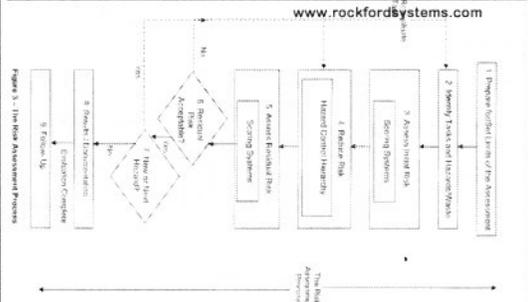
## General

“Safe” is the state of being protected from recognized hazards that are likely to cause serious physical harm. There is no such thing as being absolutely safe, that is, a complete absence of risk. In turn, there is no machine tool that is absolutely safe. All machines contain hazards, and some level of residual risk. However, the risk associated with those hazards should be reduced to an acceptable level.

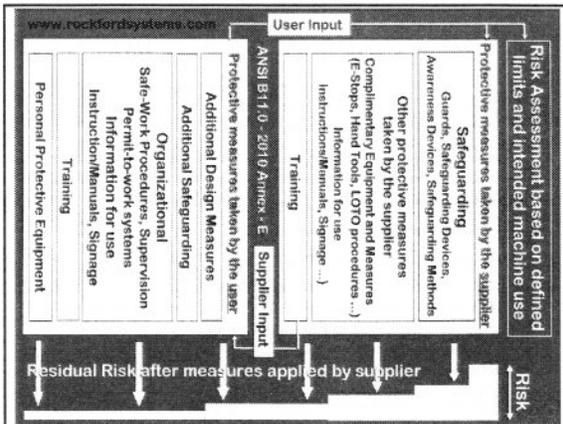


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Figure 3 - The Risk Assessment Process



B11-2008 GSR (General Safety Requirements)



## 5 concerns on any machine

**Safeguarding** - guard, device, method

**Controls** - control reliability

**Disconnect** and other LOTO devices

**Starter** - magnetic (drop-out protection)

**Covers** - rotating components covered to (7 feet - OSHA) from floor/working platform (8 feet - ANSI) (10 feet - European Stds.)

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## Light Curtain Presence Sensing Devices

Prevent initiation if sensing field is obstructed prior to cycle initiation

and

Stop hazardous motion if sensing field is obstructed after cycle initiation

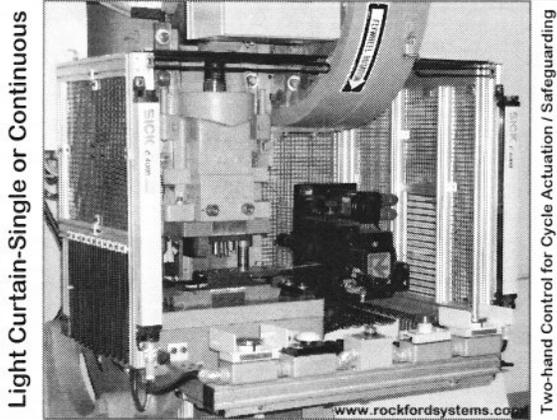
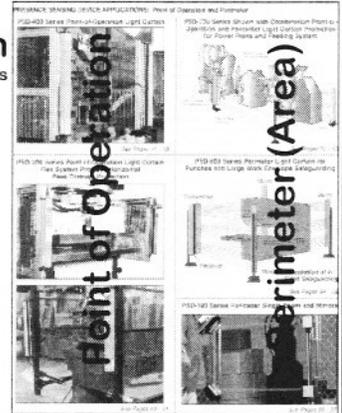
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## Light Curtain Presence Sensing Devices

can only be used on machines that can stop consistently and immediately anywhere in their stroke or cycle

without damaging: machine - tooling - work or creating another hazard

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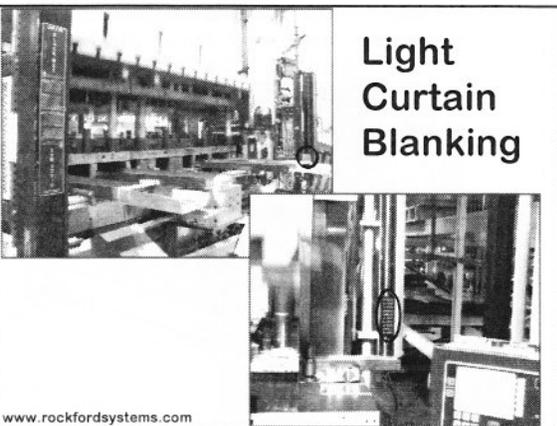
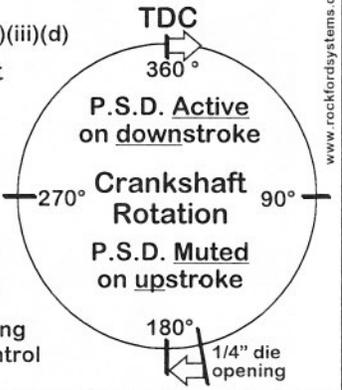
## Light Curtain Muting (c)(3)(iii)(d)

Bypasses output signal of P.S.D. on upstroke

Muting used for:

- 1) parts ejection
- 2) circuit checking
- 3) material feeding

Muting done in timing circuit of press control



Blankers increase Safety Distance

One Example

- Red: obstructed
- Amber: blanking
- Green: clear

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**8.5.3.8 MOS Identified ...**

LIGHT CURTAIN  
PHOTO-ELECTRIC  
PRESENCE SENSING DEVICE

THIS DEVICE MUST BE PROPERLY  
APPLIED, ADJUSTED (INCLUDING  
PROPER SAFETY DISTANCE),  
INSPECTED AND MAINTAINED IN  
ACCORDANCE TO THE APPROPRIATE  
OCCUPATIONAL SAFETY AND  
HEALTH ADMINISTRATION'S (OSHA)  
REGULATIONS, AMERICAN NATIONAL  
STANDARDS INSTITUTE'S (ANSI)  
STANDARDS AND OTHER  
RECOGNIZED SAFETY PRACTICES

**SPECIFICATIONS**

MAXIMUM HEIGHT	25
MINIMUM OBJECT SENSITIVITY	1.0 LB
FIELD OF COVERAGE	18 ft.
OPERATING RANGE	1 - 50 FT.
SERIAL NUMBER	AC079667
PART NUMBER	LBT-416

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**Don't Blank too many**

**WARNING**

**BLANKING**

This light curtain has both  
fixed and float blanking  
capability. This feature  
should not be used unless  
an object is in the blanked  
area. When using the  
blanking feature, the light  
curtain must be mounted at  
a greater safety distance.

**MUTING**

When muting (bypassing  
light curtain) during the  
nonhazardous portion of the  
machine cycle, **never** mute  
the light curtain until there is  
a 1/4" opening or less in the  
point of operation.

SEE INSTRUCTION MANUAL  
FOR DETAILS

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**Don't Mute too early**

**3-sided Light Curtain includes the coil feed**

Front-surface mirrors reduce range about 12%

Stainless-steel mirrors about 18% - shatterproof

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**2-sided Perimeter  
Light Curtain**

www.rockfordsystems.com

**Two Light  
Beams with  
corner mirrors  
for three-sided  
protection**

Railings  
protect the  
Light Beams  
and Mirrors

**"Two for One"  
Light Beams**

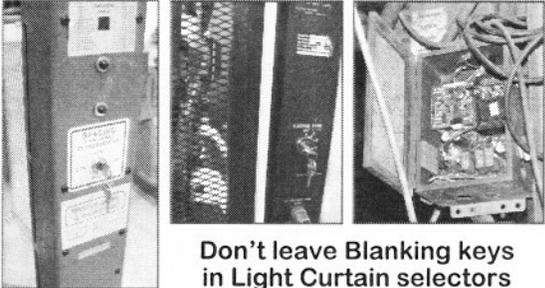
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**200' Range**

**Bottom rails prevent a hand from  
reaching under LC's "effective zone"**

No protection  
below this line

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**Don't leave Blanking keys in Light Curtain selectors**

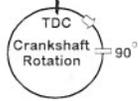
Unless all the key does is Reset the Light Curtain after being interrupted

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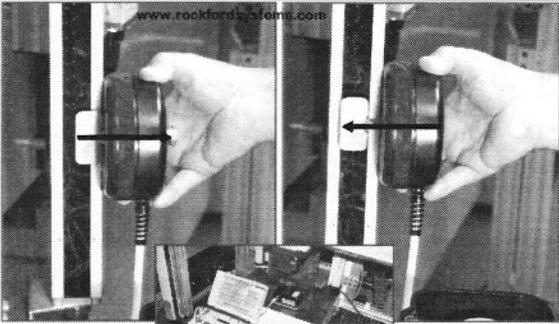
### OSHA Safety Distance Formula Light Curtains or 2 Hand Controls

Stopping Time in seconds at 90° crankshaft position  
x 63 inches per second (hand speed constant)  
= minimum safety distance in inches

**.200 x 63 = 12.6" Safety Distance**



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**STM FLAG NOT interrupting Light Curtain**

**STM FLAG interrupting Light Curtain**

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### ANSI B11.1 - 2009 E6.5.3 (16) Safety Distance for a Light Curtain Presence Sensing Device

**(.200 + .020 + .020) x 63 + 2.5 = 17.62"**

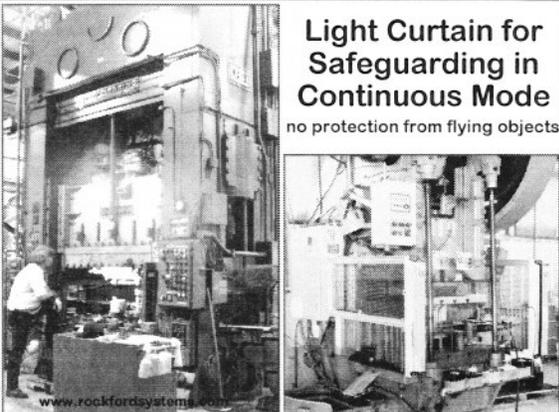
- $T_s$  press and  $T_c$  press control
- $T_l$  light curtain (tag or flag)
- $T_{bm}$  added for brake monitor
- K hand speed constant
- $D_{pf}$  penetration depth factor
- $D_s$  Minimum Safety Distance

**$D_s = K (T_s + T_c + T_l + T_{bm}) + D_{pf}$**

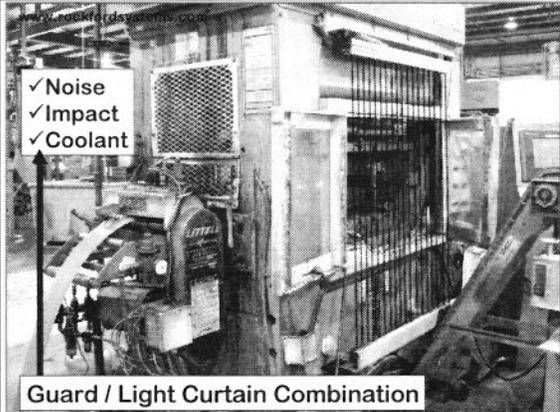
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### Light Curtain for Safeguarding in Continuous Mode

no protection from flying objects



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- ✓ Noise
- ✓ Impact
- ✓ Coolant

**Guard / Light Curtain Combination**

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## Light Curtain Pass-through Protection

If Operator can get in between LC sensing field and machine, more safeguarding is required:

- manual reset outside sensing field
- additional barrier guards
- additional light curtains
- safety mats or other devices
- operator(s) controls outside the sensing field of light curtain

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Vertical Light Curtain - Small MOS www.rockfordsystems.com

Horizontal Light Curtain - Large MOS

**MOS = Minimum Object Sensitivity differs for each make/model of Light Curtain**

## Function Testing Light Curtains

Function Test Checklist steps on this plastic-laminated quick-reference guide are generic. Refer to make model specific function test procedures from the manufacturer of your light curtain

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Light Curtain Test Rods Mounted near LC's

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Light Curtains should be only be installed, checked out, and maintained by a "Qualified Person" "a person or persons who, by possession of a recognized degree or certificate of professional training, or who, by extensive knowledge, training and experience, has successfully demonstrated the ability to solve problems relating to the subject matter and work." ANSI B30.2-1983

### Light Curtain "Function Testing" Procedure

ANSI B11.1-2001 8.3.1 Guards and devices must be checked ...

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Light Curtain and Manual Gate protect Operator

Lexan Guarding keeps other people out of POO

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Light Curtain and Two-hand Control protect Operator

**Restart Interlock**  
manual reset  
located outside  
protected area  
in sight of hazard

**Two Single Light Beams  
24" M.O.S.**

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**Safety Distance for Light Curtain**

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**Two-Hand Actuators**  
used as a Safeguarding Device in the  
Single-Cycle (Mode) of Operation

- protection from unintended operation
- half-second maximum time between actuation
- anti-repeat (release and re-actuate)
- holding time for hazardous portion of cycle
- interrupted stroke protection
- each operator needs own set of actuators
- calculate safety distance from nearest POO hazard
- means to ensure safety distance

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**Capacitive Actuators mounted on swivels**

**Two-Hand Controls**

Ergonomic concern with highly repetitive use of 2-hand actuators

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**ANSI B11.1-2009 - LOTS of new Safety Block information**

**Interlocked Safety Block**

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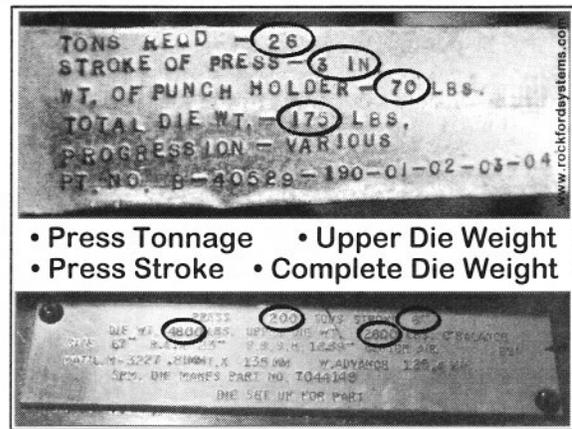
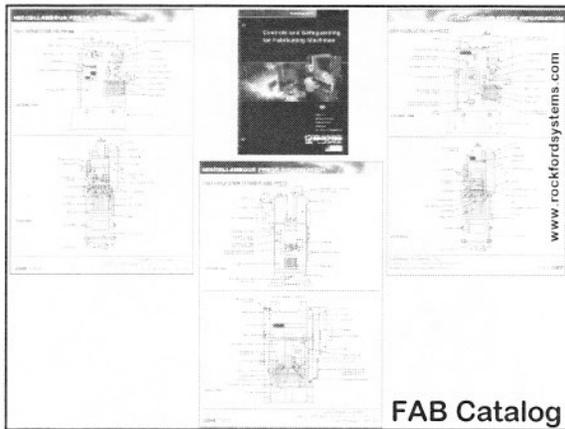
**OSHA 1910.217(e)(1)(i) Periodic + Regular Inspections for MPP**

**Sample Press Inspection Report**

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List Press Auxiliary Equipment here

**FAB Catalog** 254 255



- Press Tonnage
- Upper Die Weight
- Press Stroke
- Complete Die Weight

**Reporting Injuries**  
 on mechanical power presses  
 OSHA 1910.217(g)

**POINT OF OPERATION INJURIES**  
 requiring more than simple first aid

must be reported to  
 State or Federal OSHA  
 within 30 days of occurrence

MPPS page 35

**MINSTER**  
 Power Press  
**SAFETY MANUAL**

The Minster Machine Company  
 (419) 628-2331 Manual #805D  
 Minster, OH www.minster.com

**POWER**  
**SAFETY MANUAL**  
**PRESS**

National Safety Council  
 (800) 621-3433 #129760000  
 Roselle, IL www.nsc.org

**PSDI is allowed on Hydraulic Presses**

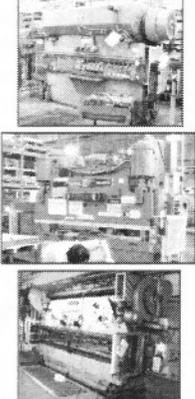
Follow the guidelines in ANSI B11.2 -1995

**Presence Sensing Device Initiation**  
 (using a light curtain for press cycle actuation)

**PSDI IS NOT PERMITTED**  
 on Mechanical Power Presses because  
 OSHA 1910.217 (h) requires 3rd Party certification  
 validation (no such 3rd party organization exists)

**PSDI PERMITTED on Hydraulic Presses**  
 because they are excluded from 1910.217 but  
 are covered under ANSI B11.2 - 1995 which  
 allows PSDI providing it is applied correctly

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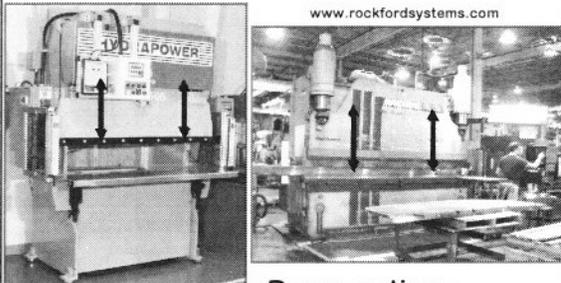
## Light Curtains

can be applied to any type of press Brake:

- Air Clutch
- Hydraulic
- Hydra-Mechanical
- Servo-Drive
- Mechanical Friction  
(requires new control system)

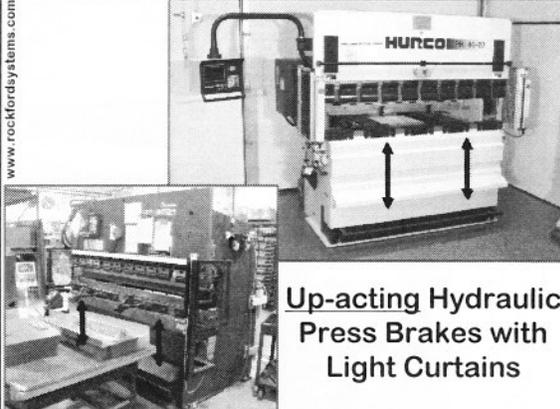
ANSI B11.3 – 2002 8.6.2

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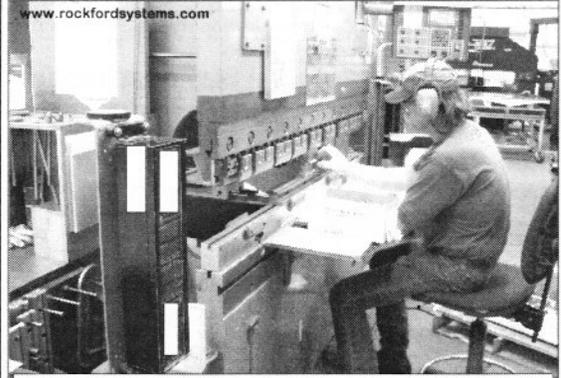
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## Down-acting Hydraulic Press Brakes with Light Curtains



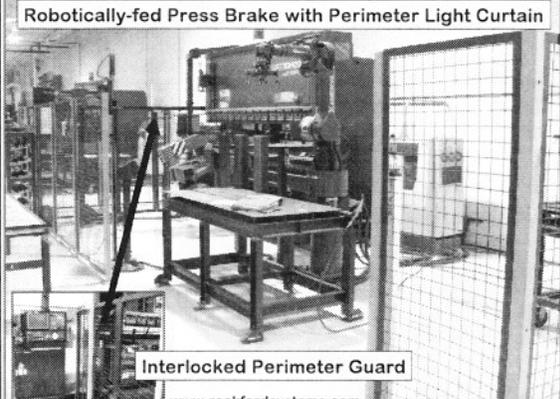
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## Up-acting Hydraulic Press Brakes with Light Curtains



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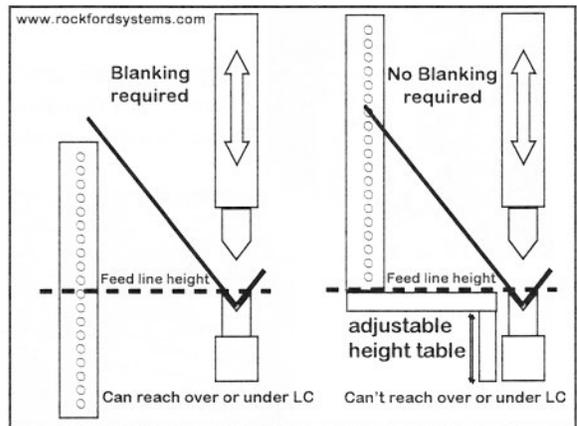
## Light Curtain - Press Brake bending operation



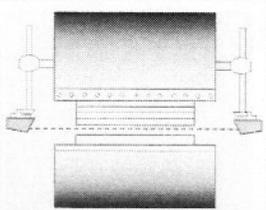
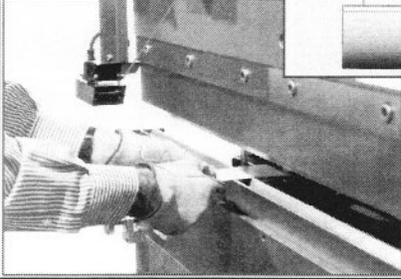
Robotically-fed Press Brake with Perimeter Light Curtain

Interlocked Perimeter Guard

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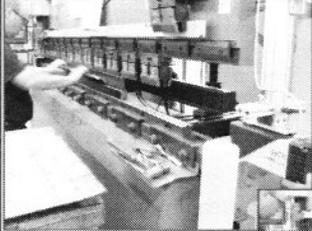


**LazerSafe**  
Safeguarding System  
ONLY FOR HYDRAULIC  
PRESS BRAKES

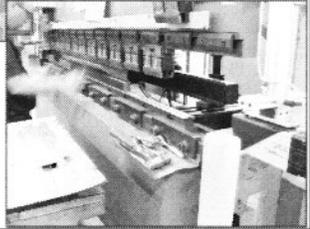



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**SICK V-4000**  
Laser Device  
allows for  
hand-holding  
small parts on  
HYDRAULIC PB's



**Light Curtain**  
would require  
**EXCESSIVE**  
**BLANKING**

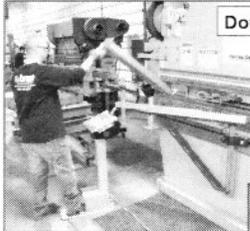
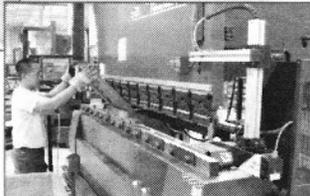


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**Down-acting Hydraulic Press Brake**

- Standard mode
- Box mode
- Back-gauge mode

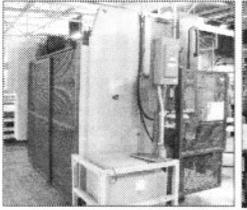
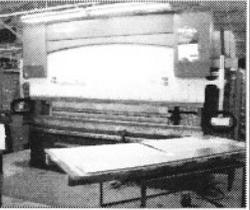
**“Box Mode”**  
for parts  
with tall  
side-legs

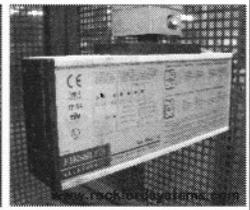



**Up-Acting Hydraulic Press Brake**

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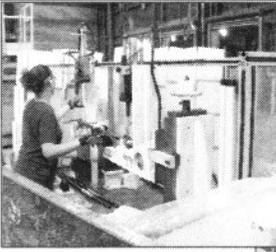
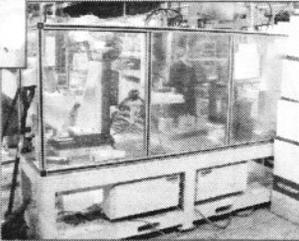
**Hydraulic Press Brake with Fiesler  
P.O.O. Laser Safeguarding Device**



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**Light Curtain and  
Two-hand Control  
Sides/Back Guarded**

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**Manual Gate and  
Two-hand Control**



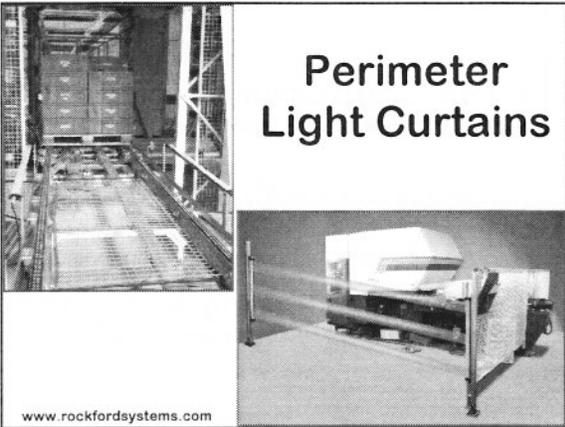
**Light Curtain and  
a Manual Gate**



**Light Curtain and  
Two-hand Control**

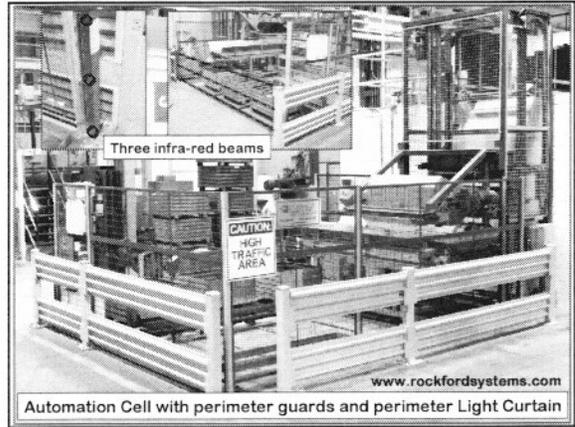


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## Perimeter Light Curtains

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Automation Cell with perimeter guards and perimeter Light Curtain



## Mount LC 3<sup>rd</sup> Boxes at accessible height

LC on Automated Drilling



Inaccessible 3<sup>rd</sup> Boxes for LC's

Is POO access still possible?

## Presence Sensing Safeguarding Devices

PSSD's

- Safety Light Curtains / Screens
- Single and Multiple Safety Beams
- Safety Mat Systems
- Area Scanning Systems Area Laser Scanners
- Radio Frequency (capacitance)
- Drop Probe (Ring Drop) devices

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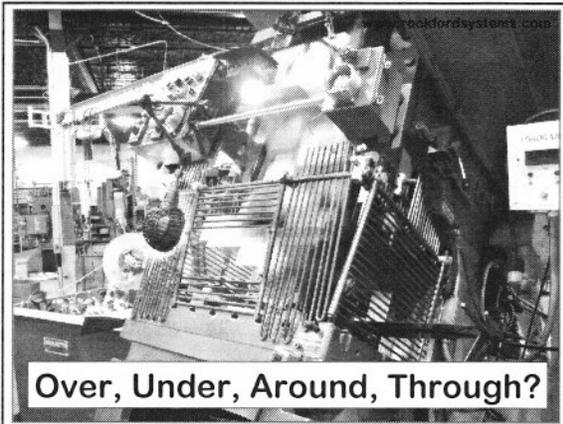
## Point of Operation Guard Requirements

OSHA 1910.217(c)(2) and ANSI B11.1-2009(8)(5)

- can't reach through, over, under, around
- meets Table 0-10 for openings and distances
- no pinch points between guard & moving parts
- good visibility into the point of operation
- fasteners not readily removable (tool required)
- \*materials strong enough to protect people
- \*free from sharp edges that could injure people

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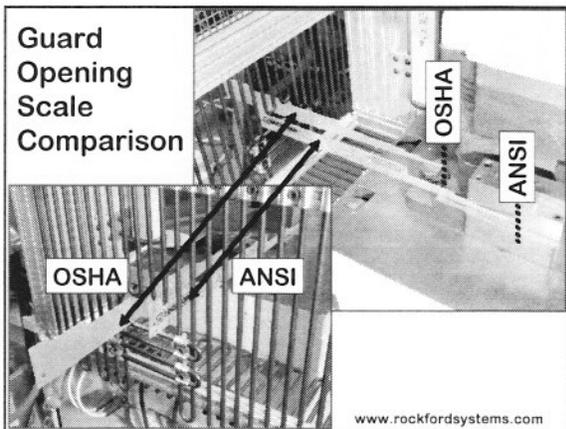
MPPS pages 26-28



**OSHA Guard Opening Scale – 1948**  
 Liberty Mutual and ANSI Standard writing committee

**ANSI Guard Opening Scale – 1996**  
 Liberty Mutual and ANSI Standard writing committee

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**Function Testing**  
 Point of operation Guard

**2 Reasons to "Function-test" Guard Interlocks:**

- 1) to make sure the interlock **WORKS**
- 2) to make sure it has **NOT** been **CHEATED**

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7.9.2.1 When tasks such as start-up, set-up, repair, adjustment or maintenance require removing, disabling, bypassing, suspending one or more safeguards, alternative protective measures shall be required. Only properly trained and authorized personnel shall be allowed access to a hazard area. The bypass process shall be documented and shall include specific procedures and appropriate training of personnel . . . safeguards shall be restored . . . prior to resumption of normal operation.

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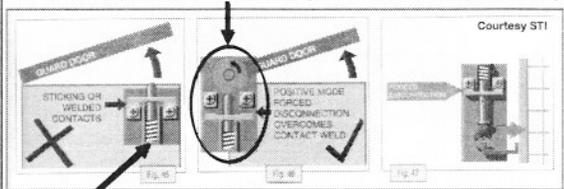
ANSI B11.0 - 2010

**Newer Guard Interlock Switches**  
**KEY** geometry makes it difficult to defeat  
**KEY** forces a make/break of electrical contacts

These types of fasteners are an easy way to cheat the interlock

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Contact Block and Cam are securely enclosed to avoid tampering



This one depends only upon a spring (if spring breaks - fails to safe condition)

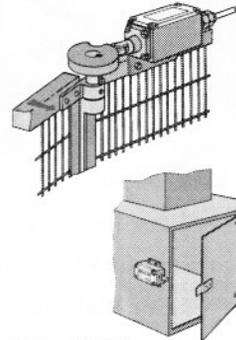
These two have forced disconnection (if spring breaks - fails to safe condition)

**“Positive Mode Guarding”** ensures that the interlock switch contacts are physically pulled apart or **“Force Disconnected”** by the movement of the guard

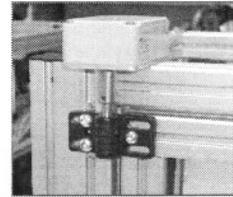
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GOOD: Forces contacts apart when guard is opened

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Direct Hinged Mounting



Door Interlock requires positive acting switch

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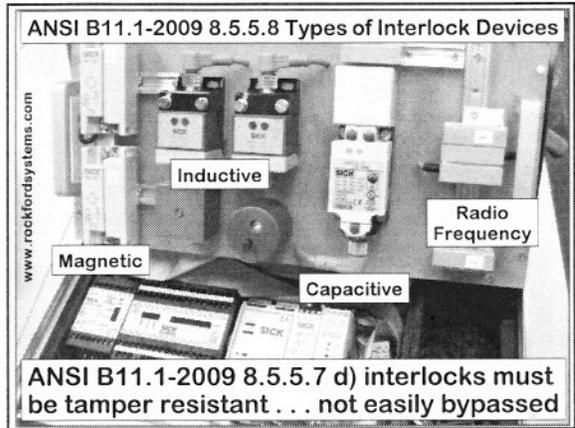
BAD: Depends on a spring to open contacts when guard is opened



Yellow or Red

Safety Interlocks

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ANSI B11.1-2009 8.5.5.8 Types of Interlock Devices

ANSI B11.1-2009 8.5.5.7 d) interlocks must be tamper resistant . . . not easily bypassed

### Guard Interlock Safety Switches:

- Tongue:** tongue (key-shaped) actuator must be inserted and removed for switch operation
- Hinge:** mounted on hinge pin of guard door and uses opening motion of door to actuate
- Latching:** locks guard door closed and delays it's opening until hazardous machine motion is complete (run-down) before interlock opens
- Non-contact:** no physical contact required to actuate these capacitive or magnetic switches; sometimes “coded” to decrease tampering
- Position (limit switch):** linear or rotary cam operated in a positive mode often used on sliding guards
- Trapped Key:** control or power interlocks which require a specific sequence of de-energization

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Rockwell Automation - Allen Bradley Safebook 3 - 2009

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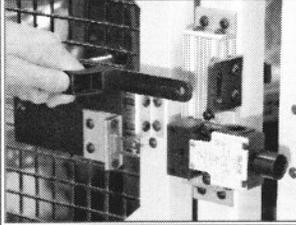
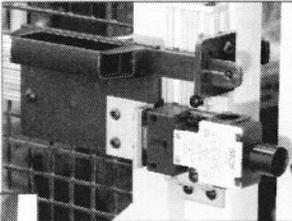
### EN 954-1 Safety Related Parts of Control Systems

<b>Category B</b>	safety-related parts of machine and safeguards – components withstand environment	} PREVENTION of faults
<b>Category 1</b>	well tried safety components and principles	
<b>Category 2</b>	components monitored before machine start-up and periodically	
<b>Category 3</b>	dual/monitored system of critical components – single fault does not lead to loss of safety function	
<b>Category 4</b>	dual/monitored system with all foreseeable faults detected	} DETECTION of faults

Mets  
Grd Int  
IR-LC

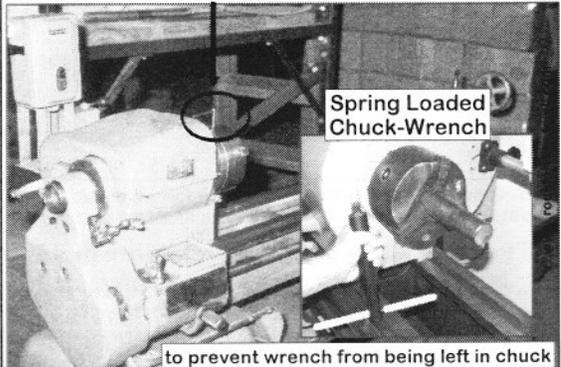
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### Risk Assessment for Interlock Reliability

- Minor Risk - Cat. 1
- Serious Risk - Cat. 2
- Major Risk - Cat. 3
- Fatal Risk - Cat. 3

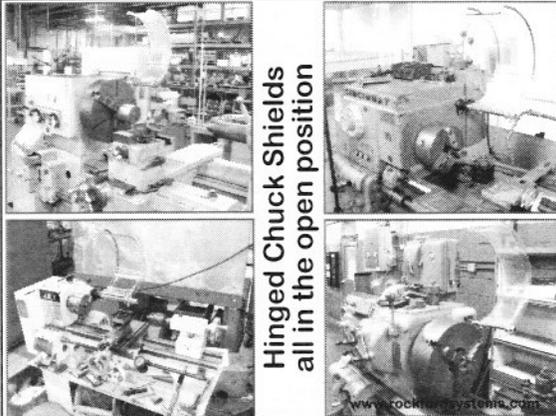
### #1 Hazard - starting lathe with key in chuck



Spring Loaded Chuck-Wrench

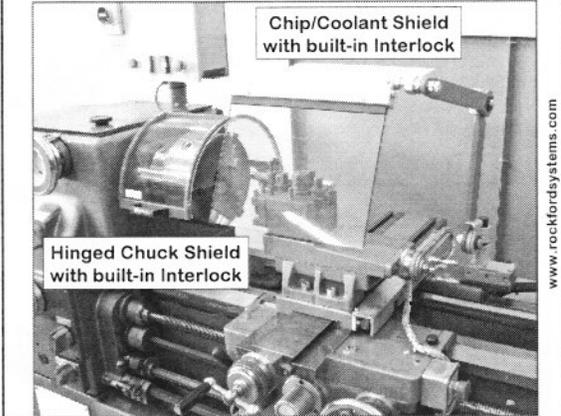
to prevent wrench from being left in chuck

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Hinged Chuck Shields all in the open position

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Chip/Coolant Shield with built-in Interlock

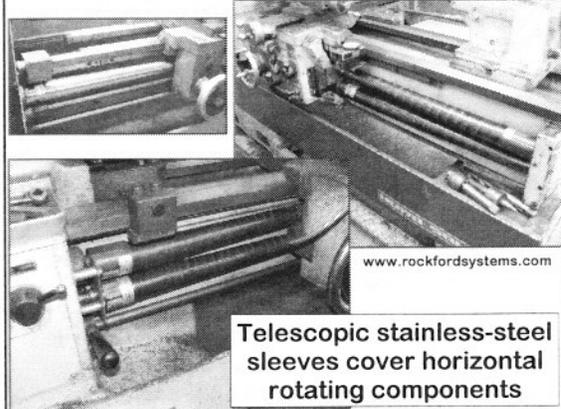
Hinged Chuck Shield with built-in Interlock

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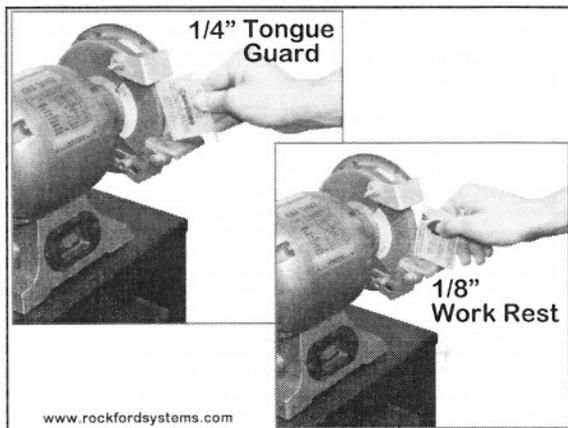
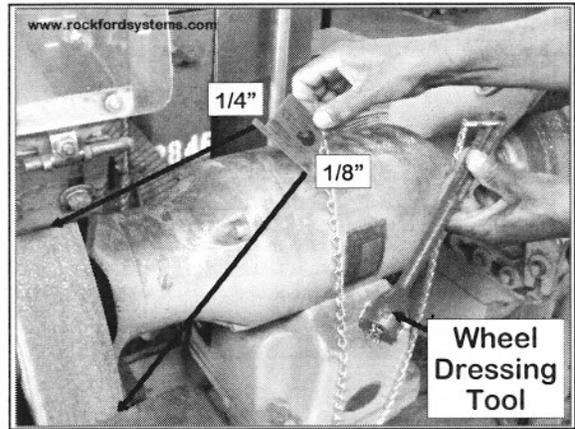
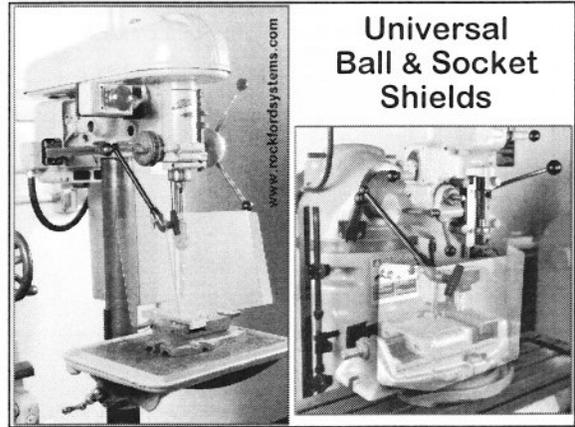
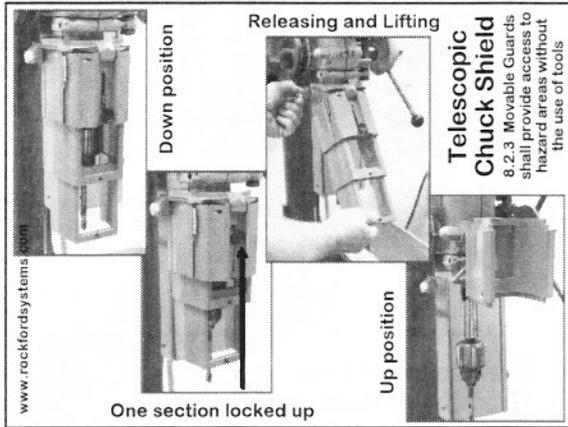
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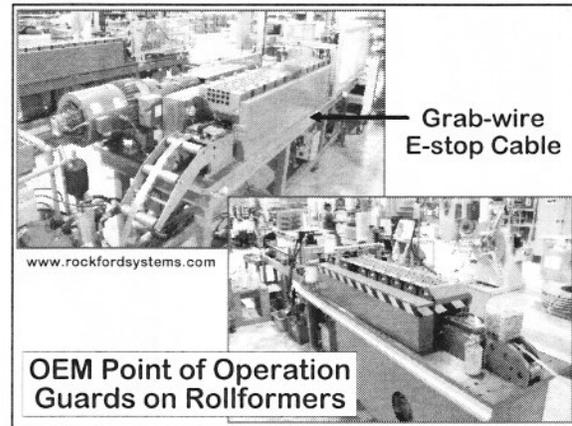
### Shields with built-in Interlocks



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### Telescopic stainless-steel sleeves cover horizontal rotating components





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**American National Standard  
ANSI B11.19 - 2010**

**Performance Criteria for Safeguarding**

OSHA 1910.212 General Requirements for All Machines  
OSHA 1910.219 Mechanical Power Transmission Apparatus  
NFPA 79 2007 Electrical Standard for Industrial Machinery

Point of Operation Safeguarding: Guards (all types),  
Devices (all types), Distance (Safe holding), Operator  
location, Safe Opening

**Safeguarding Applications and Attributes**  
ANSI B11.19-2010 Annex F has bullet points on each

- Shields
- Fixed Guard
- Interlocked Guard
- Adjustable Guard
- Type "A" Movable Barrier
- Type "B" Movable Barrier
- Presence Sensing Devices
- Single Trip Device
- Restraint Device
- Drop-Probe Device
- Two-Hand Control Device
- Two-Hand Trip Device
- Single Control Device
- Awareness Barriers
- Awareness Signals
- Awareness Signs
- Safe Distance
- Safe Holding
- Safe Opening
- Safe Work Procedures

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**ANSI B11.19 - 2010**  
**Performance Criteria for Safeguarding**  
**13 Inspection and Maintenance of Safeguarding**

The user shall document the safeguarding. www.rockfordsystems.com

The user shall provide maintenance instructions, recommendations, and procedures to maintenance personnel for all safeguarding used to protect individuals from the hazards associated with the machine.

The user shall ensure that the safeguarding is maintained and inspected, and shall ensure the initial training and the continued competency of personnel responsible for the maintenance and inspection of the safeguarding.

Following any maintenance to the safeguarding, the user shall ensure that the safeguarding performs as intended.

When the safeguarding is removed or disabled for maintenance, alternate safeguarding shall be provided to protect maintenance or operating personnel, or other individuals. See ANSI Z244.1 (Control of hazardous energy)

**ANSI B11.19-2010 Performance Criteria for Safeguarding**  
**E13 Inspection and Maintenance of Safeguarding**

The documentation of the safeguarding should at minimum, include the following where applicable:

- safety distance calculations
- control schematics
- software program
- records of periodic maintenance checks

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The user (who can be the machine supplier that provides or modifies the safeguarding, the integrator of the safeguarding, or the user of the machine) should consider the safeguarding supplier's instructions and recommendations in determining the maintenance program.

The user should determine the period between inspections based on the use of the safeguarding and the safeguarding supplier's recommendations.

Examples of criteria and procedures include but are not limited to verification:

- of the safety distance
- that all safeguarding is in place and functioning correctly
- that complimentary equipment is functioning correctly (e.g. emergency stops)

Alternate safeguarding or lockout/tagout procedures may be required.  
See 29 CFR 1910.147 and 29 CFR 1910.133(b)(2) for further information.

## ANSI B11.19 - 2010 Performance Criteria for Safeguarding 14 Training on the Use of Safeguarding

The user shall ensure that an appropriate training program is developed for operators, helpers, maintenance personnel, supervisors and other individuals who may be exposed to the hazards of the machine.

The user shall ensure that individuals listed above are trained based on the program developed.

For those individuals trained above, the user shall verify their understanding and provide for their continued competency.

Individuals listed above shall be responsible for following the training and safety procedures provided by the user in the maintenance and use of safeguarding.

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## ANSI B11.19-2010 Performance Criteria for Safeguarding E14 Training on the Use of Safeguarding

The user should take into account the safeguarding supplier's instructions, specifications, recommendations, etc., when developing a training program.

**Training should include, but not be limited to:**

- types of safeguarding www.rockfordsystems.com
- capabilities/options of safeguarding
- description of safeguarding for specific application and hazard
- function of the safeguarding
- proper installation and operation of the safeguarding
- functional testing of the safeguarding
- limitations of the safeguarding
- abnormal or unexpected operation of the safeguarding

## ANSI B11.19 - 2010 6.5 Perimeter Safeguarding

e.g. perimeter guarding with interlocked gate/door, or electro-optical PSD's; light curtain, laser scanner

... used in areas containing single or multiple hazards not individually safeguarded ... designed to stop/prevent hazardous motion while an individual is in the safeguarded area ... If pass-through is possible, supplementary safeguarding is required ... Requires manual reset before hazardous motion can occur (not just closing an interlocked door or clearing a sensing field)

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## Safeguarding of Personnel & Equipment

- Welding robot cells
- Automatic assembly machines
- Packaging machines
- Tire Manufacturing
- Forklifts, Towmotors, Lift Trucks
- Tube-bending machines
- Press/bolster guarding
- Automatic Storage & Retrieval Systems (ASRS)
- Complex material handling processes
- Shrink-wrap machines
- Palletizing robots
- Carton-making machines
- Automatically Guided Vehicles (AGV's)
- General safety mat replacement

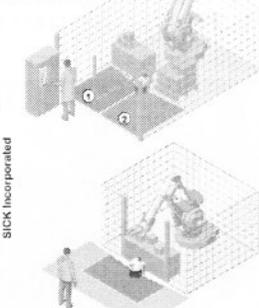


Area Laser Scanner

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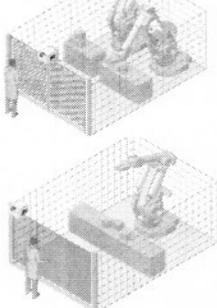
SICK Incorporated

**Area Guarding:**  
2 Safety and 2 Warning Zones,  
horizontal mounting



**Area Guarding:**  
1 Safety and 1 Warning  
Zone, horizontal mounting

**Access Guarding:**  
2 Safety Zones, vertical mounting,  
using contour-as-reference

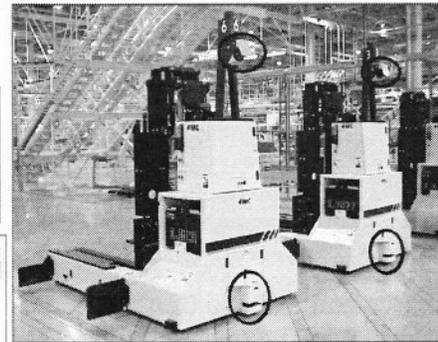


**Access Guarding:**  
1 Safety Zone, vertical mounting,  
using contour-as-reference

SICK Incorporated

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## Area Laser Scanners on AGV's



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**Area Laser Scanners**

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**Two Area Laser Scanners in opposite corners  
Each one covers half of the Welding Cell**

**Area Laser Scanners**  
ALS is a PSSD

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**Area Laser Scanner**  
Laser Class 1  
IEC 1496 Type 3  
IEC 61508 SIL 2

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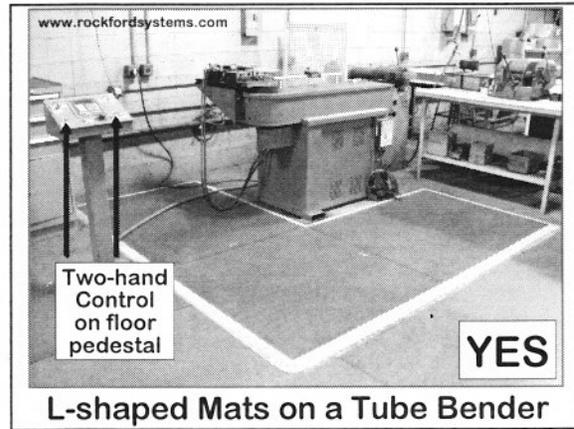
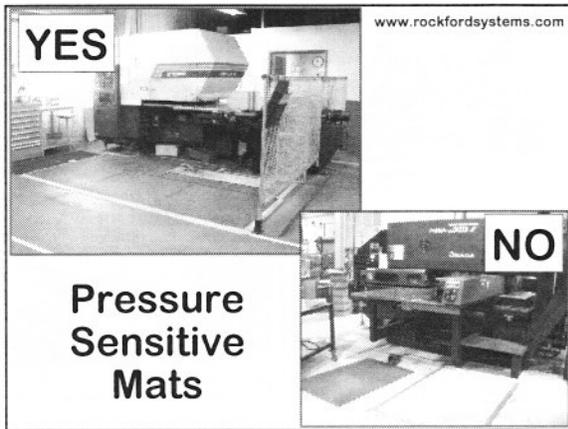
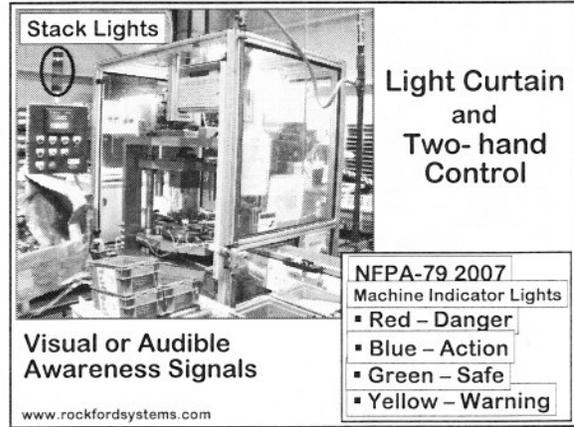
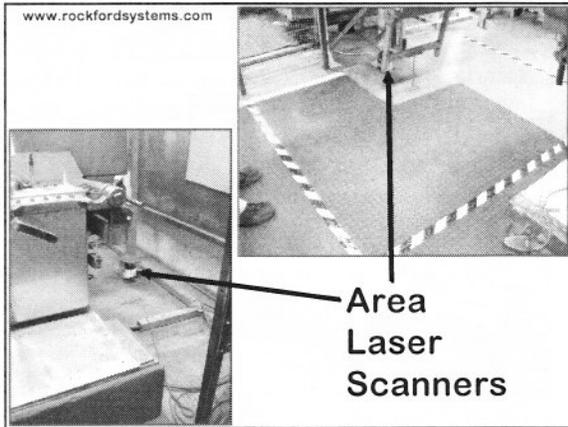
**Horizontal Tube Bender  
with Area Laser Scanner**

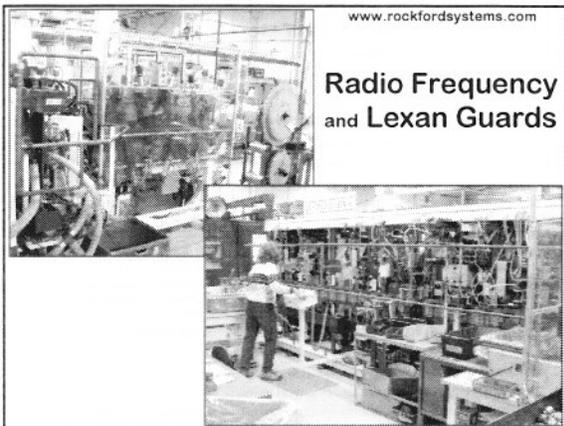
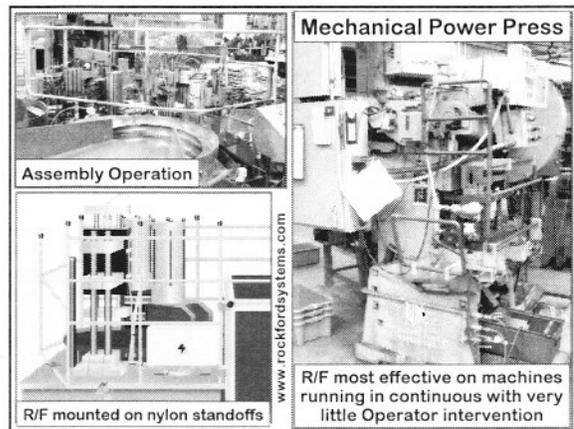
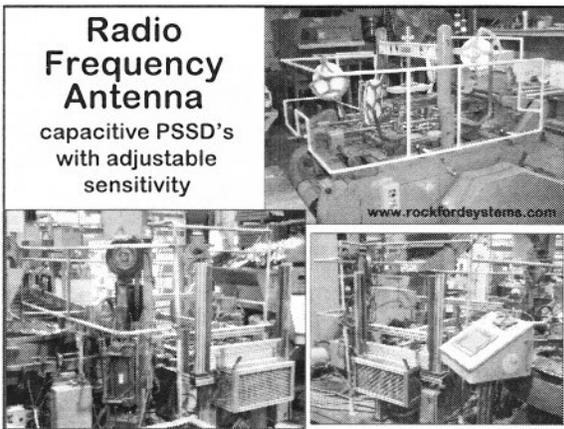
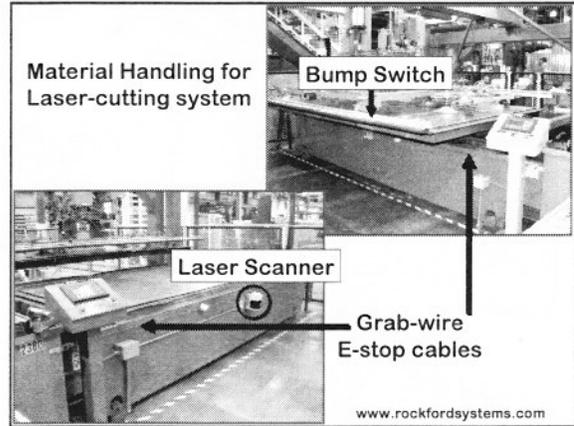
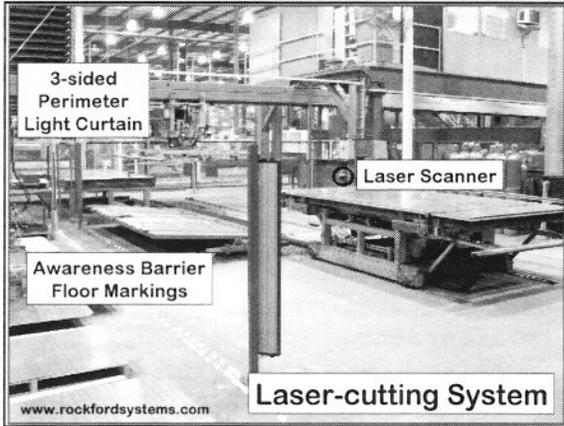
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**Area Laser Scanners**

**ALS**      **Pick and Place**





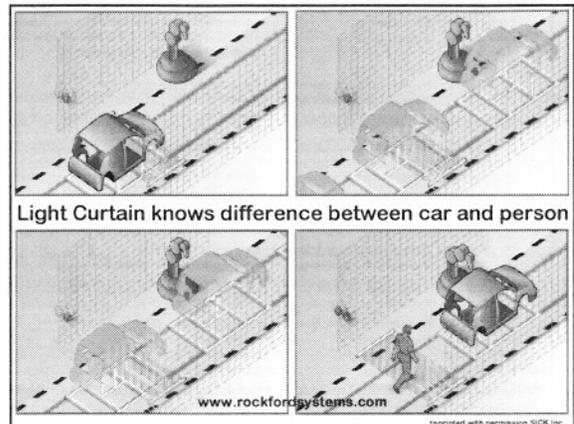
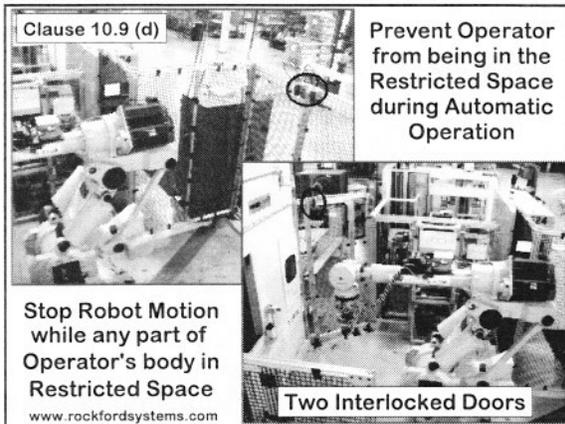
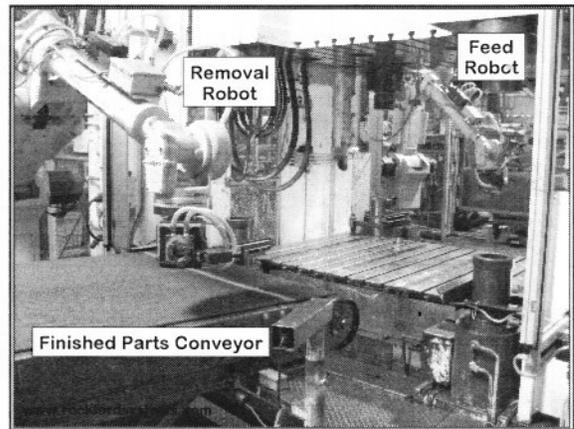
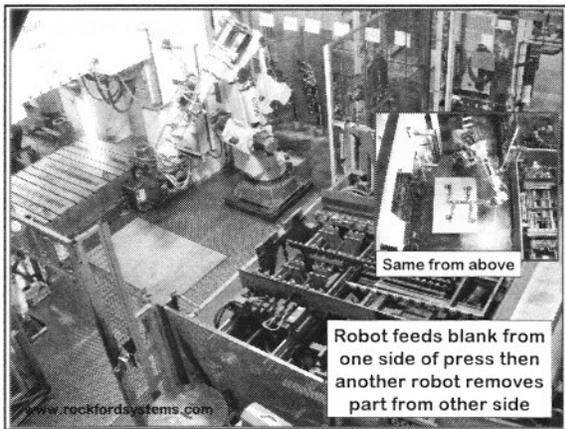
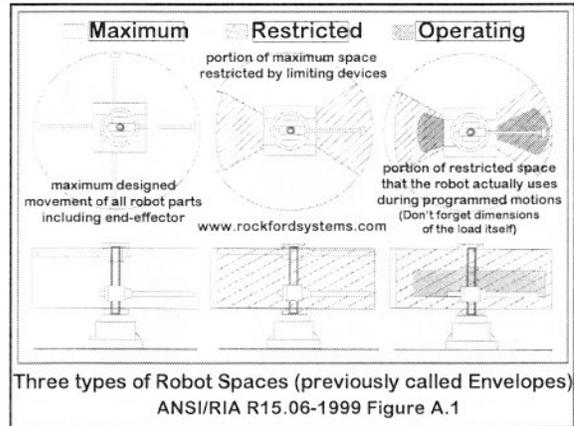
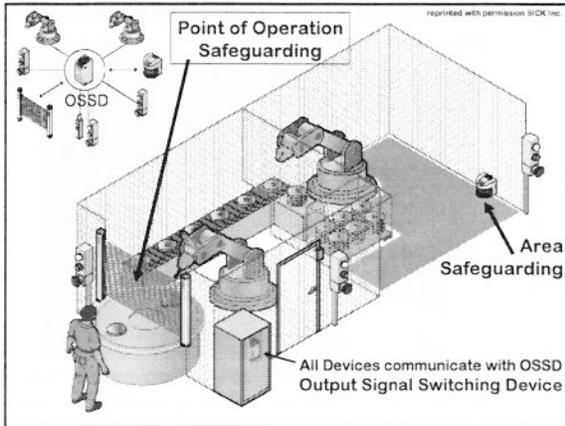
**“Drop-Probe” Devices**  
**“Ring-drop” Devices**  
**“Halo” Devices**  
 ANSI B11.19 - 2010 8.7  
 Also see ANSI B154.1-1995  
**Rivet Setting Equipment**

Mechanically verifies the absence of  
 hand or fingers in Point of Operation

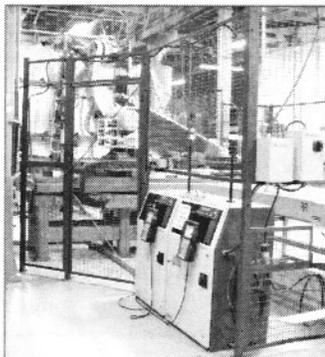
Riveters, Spot Welders, Staplers, Stakers  
 Eyeletters, Terminators, Dinkers, Clickers

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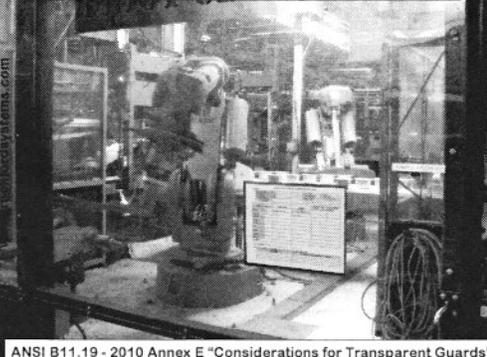
CURRENTLY 12 inch sweep and 60 inch height (ANSI/RIA)  
WILL SOON BE 6 inch (.15m) sweep, 72 inch (1.8m) height (CSA)



Perimeter Guard on a Robot Cell

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Polycarbonate "Vision Panels"



Perimeter Guard on Robot Cell

ANSI B11.19 - 2010 Annex E "Considerations for Transparent Guards"

**ANSI B11.0 - 2010 General Requirements and Risk Assessment 7.9.2.2 - Visibility**  
Guards, safeguarding devices, awareness devices, and safeguarding methods shall not cause undue obstruction to the view of the production process.

*Informative Note: Polycarbonate or other plastic materials often used for viewing panels may be subject to loss of mechanical strength due to the operating environment. The speed and amount of degradation of polycarbonates is dependent upon the environment, the lubricants, metal removal fluids, etc, and the conditions of use. Further, such degradation is not always visible.*

Also see ANSI B11.19 - 2010 Annex B "Considerations for Transparent Guards"

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**! DANGER**

Do not operate this machine until you read and understand the following safety precautions.

Never operate this machine unless you have read these safety warnings and have received and understood all operating instructions.

Never place any part of your body in the die area.

Never place any part of your body where it can be struck or crushed by part movement.

Never operate this machine without the use of a guard or safety device that will prevent contact with moving parts.

Always use hand tools for loading and unloading material from the point of operation or any other hazardous part of the machine.

Never work on this machine unless power is off, tagged out or well-secured and all energy sources are used safely and all energy electrical, air, hydraulic, etc., are in a safe state.

**Closing Ram and Die**  
Will result in loss of limbs or bodily injury if placed in machine.  
**Never place your hands or any part of your body in this machine.**



**Pictograms**

DO NOT REMOVE OR COVER THIS SIGN. SEE BACK FOR MOUNTING.

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**Danger and Warning Signs**



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**Conveyor Hazards Include:**

- In-running nip points
- Shear, pinch, crush points
- Rotating parts
- Power Transmission
- Counterweights
- Material dropping or falling
- Long hair, loose clothing getting caught
- Servicing or maintenance without proper lockout

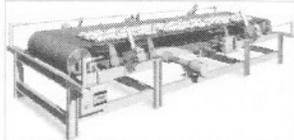


Overhead Conveyor 2000' long with multiple drives

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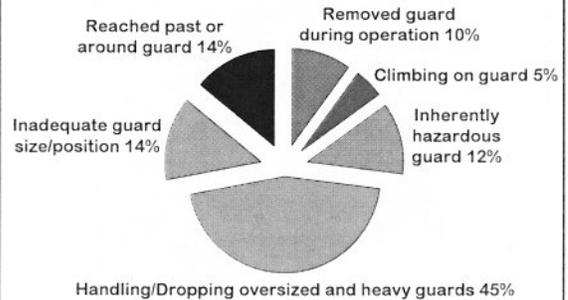
# Conveyor Safety

- 5(a)(1) General Duty Clause
- 1910.212 General Requirements for All Machines
- 1910.219 Mechanical Power Transmission
- 1910.147 Lockout/Tagout
- ANSI B20.1 Safety for Conveyors/Related Equipment
- Specialty Industries also contain some requirements
- 1910.218 Foundries
- 1910.261 Pulp/Paper
- 1910.263 Bakeries



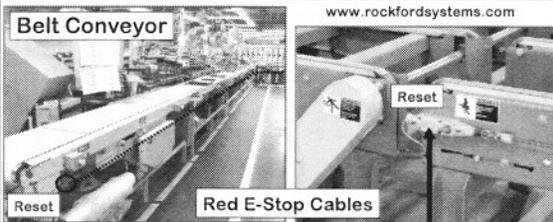
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## Injuries Related to Equipment Guarding



Source MSHA

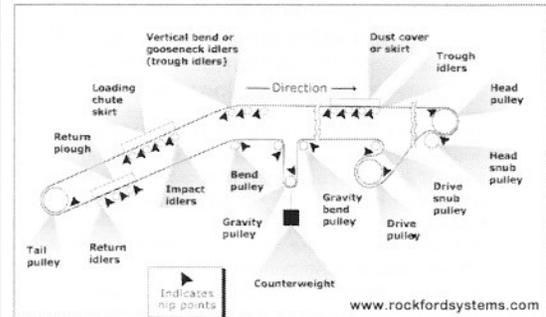
### Belt Conveyor



ANSI B20.1-2006 5.11.2 (1)  
Conveyors that start up automatically require an Audible or Visual Warning Device that can be clearly seen or heard at all points that people may be present

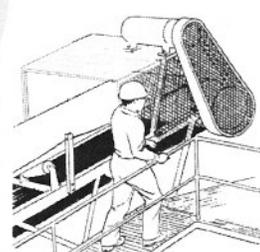
ANSI B20.1-2006 5.11.4  
Manual reset or start at the location where the Emergency Stop was initiated required to resume operation

## Belt Conveyor – Nip Points





**OSHA 1910.219**  
Covers for rotating components up to 7' OSHA or 8' ANSI



**MPTA**

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### Package Conveyors

### Bulk Handling Conveyors

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These and others are free downloads; cemanet.org  
Conveyor Equipment Manufacturers Association



These and others are free downloads; cemanet.org  
Conveyor Equipment Manufacturers Association



These and others are free downloads; cemanet.org  
Conveyor Equipment Manufacturers Association

Conveyors are covered by OSHA 29 CFR SubPart O in 1910.212 General Requirements for all machines and 1910.219 Mechanical Power Transmission Apparatus Safety Standard for Conveyors and Related Equipment ANSI/ASME B20.1-2006 **Main One**

Specifications for Welded Steel Conveyor Pulleys with Compression Type Hubs ANSI B105.1-1983

Terms and Conveyor Definitions ANSI/CEMA 402-1985

Unit Handling Conveyors - **Belt Conveyors** ANSI/CEMA 402-1985

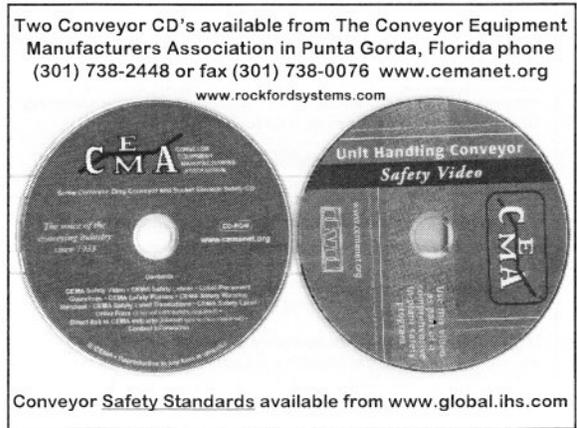
Unit Handling Conveyors - Belt Driven Live Roller Conveyors ANSI/CEMA 403-1985

Unit Handling Conveyors - Chain Driven Live Roller Conveyors ANSI/CEMA 404-1985

Unit Handling Conveyors - Roller Conveyor Non-powered ANSI/CEMA 401-1985

Unit Handling Conveyors - Slat Conveyors Live Roller Conveyors ANSI/CEMA 405-1985

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**Article 119.7 Electrical Safety Program**  
**(A) General.**

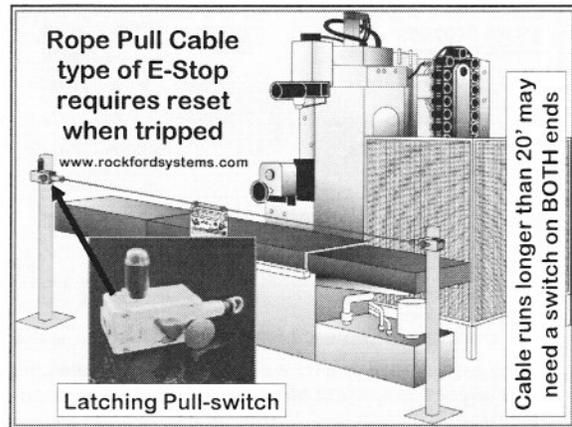
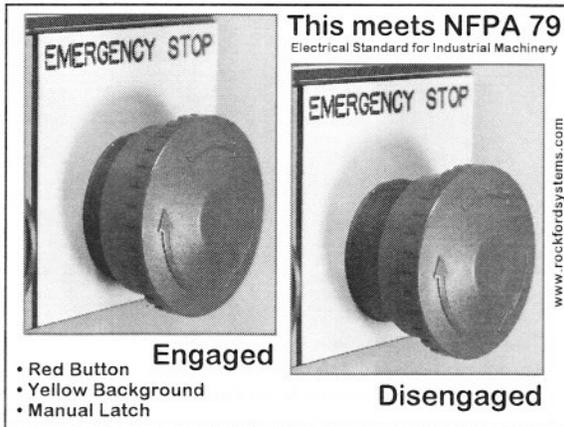
The employer shall implement and document an overall electrical safety program that directs activity appropriate for the voltage, energy level, and circuit conditions.

Source: Littlefuse www.rockfordsystems.com

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**NPPA 79**  
**Electrical Standard**  
**for Industrial Machinery**  
**2012 Edition**

**Main Power Disconnects - Motor Starters**  
**Voltages - Grounds - E-stops - and more**  
**Category 1 Stop Controls**  
**Category 2 Stop Controls**  
**Category 3 Stop Controls**



**ANSI B11.19 - 2010 3.83 STOP definitions**

**Controlled Stop:** The stopping of machine motion while retaining power to the machine actuators during the stopping process. Also referred to as a Category 1 or 2 stop.

**Emergency Stop:** The stopping of a machine, manually initiated, for emergency purposes.

**Normal Stop:** The stopping of a machine, initiated by the control system, at the completion of a cycle.

**Protective Stop:** The stopping of a machine, initiated by safeguarding for safeguarding purposes.

**Uncontrolled Stop:** The stopping of machine motion by removing power to the machine actuators, all brakes or other mechanical stopping devices being activated. Also referred to as a Category 0 stop.

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**ANSI B11.19-2010 10.4 Safe Location**

Individuals should be made aware of the nature and location of the hazards through the use of awareness device(s) in vicinity of the hazard

- Inadvertent access from a walking or working surface to the hazard shall be prevented by:
  - vertical distance of sufficient height
  - horizontal distance
  - combination of vertical and horizontal distance
- Access to the recognized hazard shall be limited by locating the hazard:
  - in a room, vault, or similar enclosure
  - behind permanent, substantial partitions fencing/railing or screens . . .

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**ANSI B11.19-2010 8.8 Single Control Safeguarding Device**

**One-hand Trip or One-hand Control or Foot-Switch must be protected from unintended / inadvertent actuation**

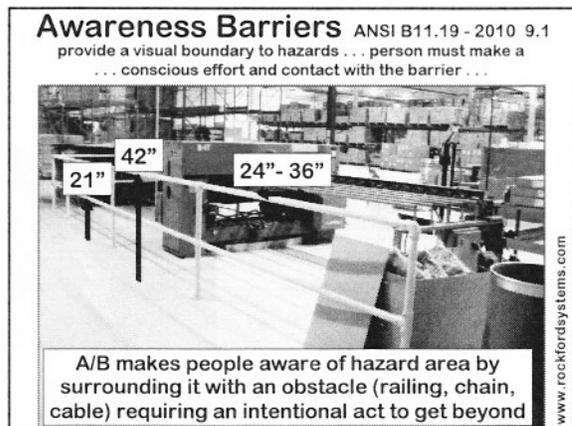
If more than one operator, each one shall have an individual device. Selection of the single control safeguarding device shall be capable of being supervised. Each device selected shall be concurrently operated and require release and reactivation of all single devices before another machine cycle can be initiated. There must be an indication for each Operator that single device is selected or de-selected.

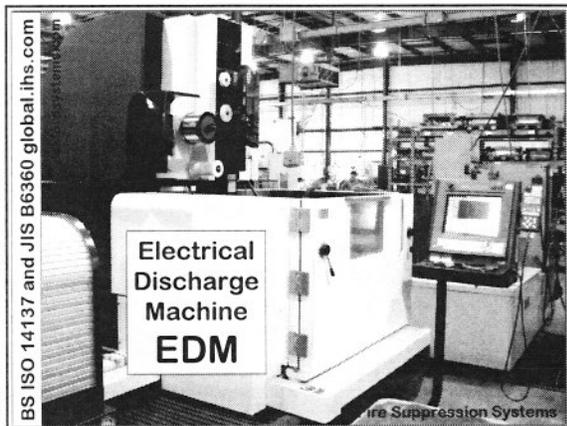
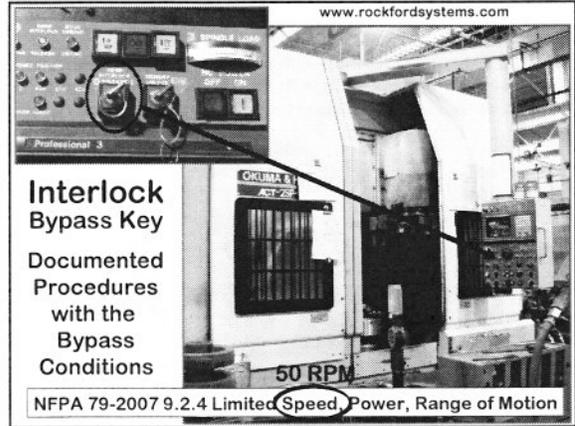
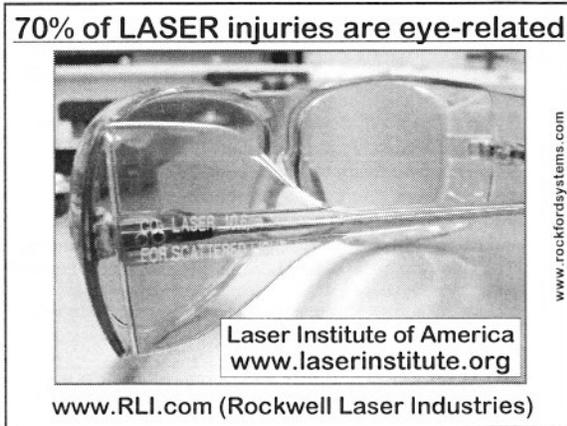
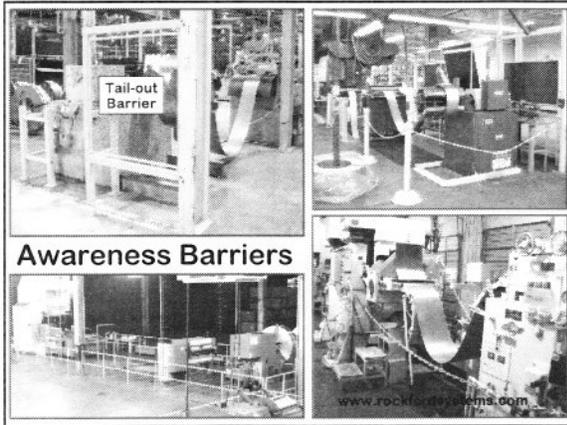
Devices must meet Performance of Safety-related Function.

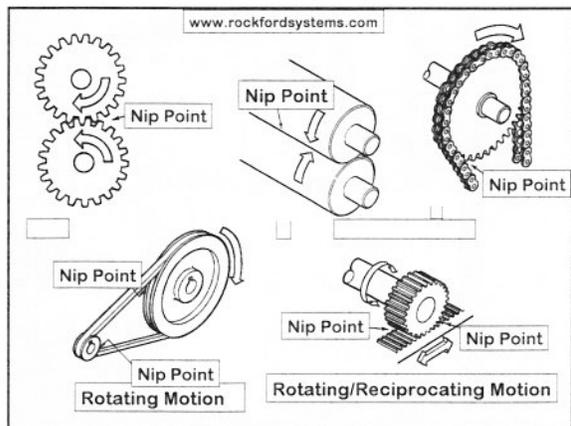
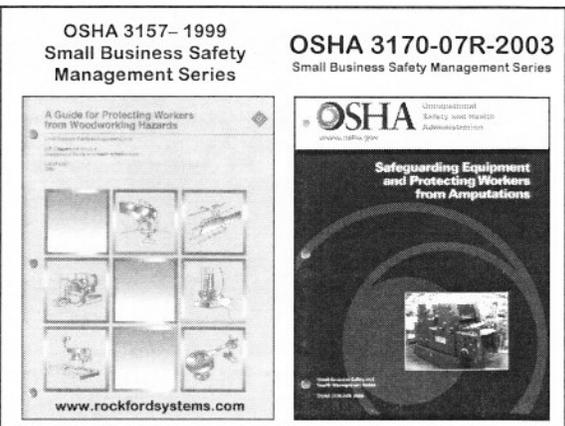
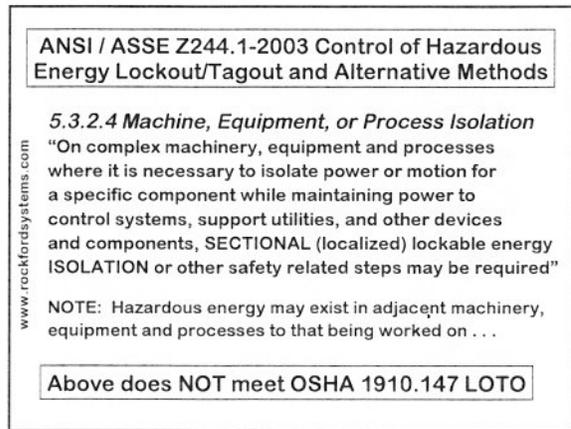
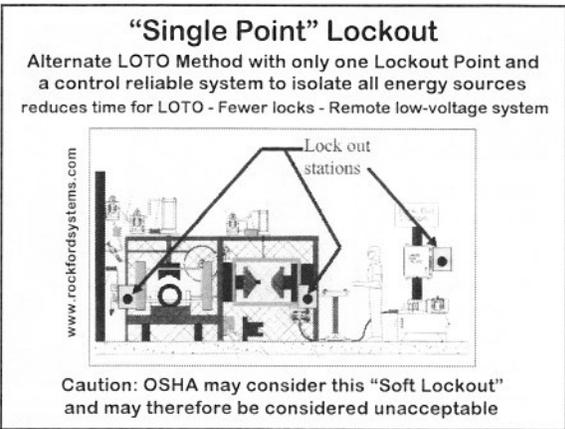
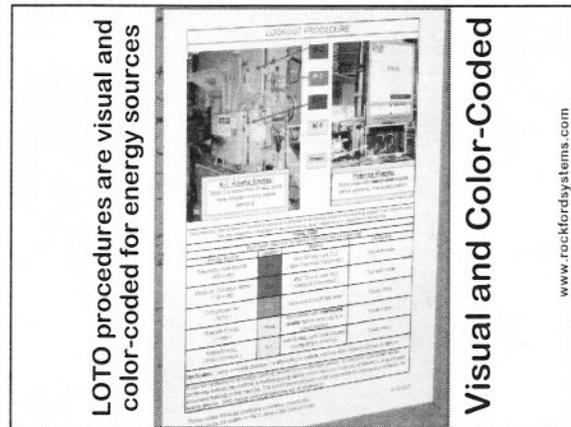
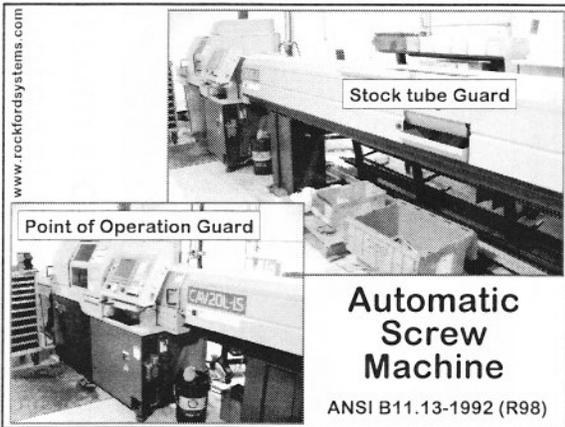
**Safety Distance**

- speed of approach of the individual
- total response time of the device (from supplier)
- response time of the interface
- response time of the control system
- time it takes machine to stop hazardous motion
- safeguarding device's depth penetration factor

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**OSC 12**