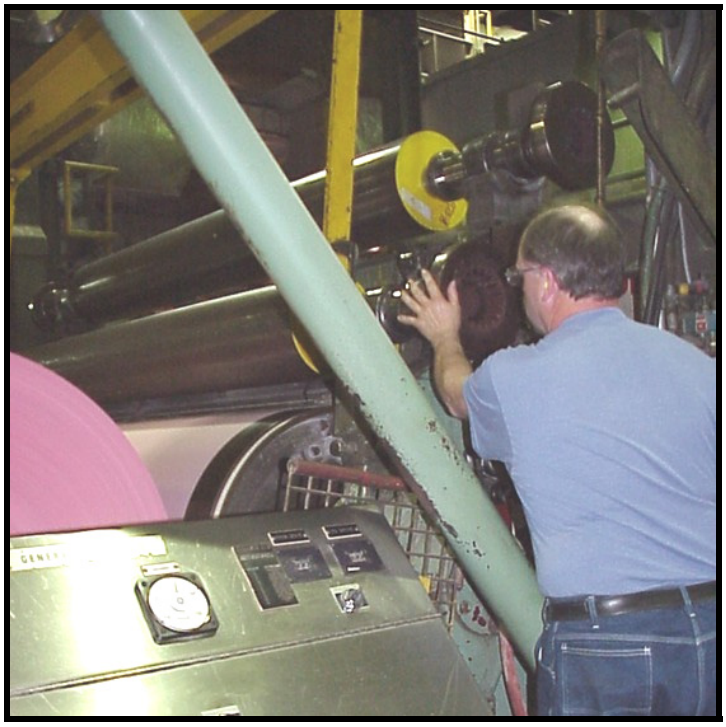
Paper Making Safeguarding Guide



Identifying Some Best Practices within the Paper Making Industry

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Table of Contents

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The illustrations, instructions, and principles contained in the material are general in scope and, to the best of our knowledge, current at the time of publication. There is no attempt to interpret any referenced codes, standards, or regulations. Please refer to the appropriate code-, standard-, or regulation-making authority for interpretation or clarification (e.g., US, European, Canadian, or ISO standards).

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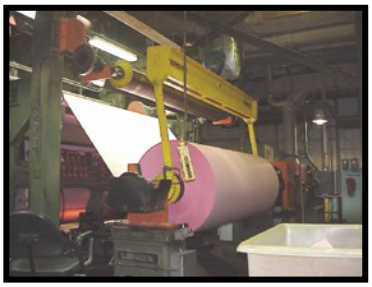
Approaches To Paper Making Safeguarding: General Principles

The paper machine and associated operations are hazardous due to their basic nature of high speed and pressure in-running rolls, elevated temperatures, wet and slippery conditions, and limited visibility areas. Add to these physical conditions the need to manually feed, adjust, and observe the paper marking process at many locations on the machine, often while the machine is running, and one can understand the difficulties encountered when attempting to design and provide safeguards.



Because of the numerous in-running roll nips and rotating machines, much of the following document will deal with safeguarding these hazards. Before addressing each section of the paper machine individually, it is important to summarize some general concepts of machine guarding that will be applied.

A primary objective of machine safety is to never allow personnel to enter or access a hazardous area while the machine is operating. At the same time, it must be recognized that wide variations in paper machine configurations exist, as does the need to provide access to each portion of the machine and its related power transmission equipment.

General Safeguarding Approaches

Hazards on your mill's paper machines should first be identified and priorities established for safeguarding, based on the severity of the exposure and likelihood of contact. A Job Safety Analysis (JSA) or other hazard identification method can help you systematically determine hazards, controls, and safe work procedures. Look at other factors as well, such as improving ergonomics and minimizing occupational health exposures.

Specific safeguarding should then be designed, constructed, and installed. Consensus standards have been referenced throughout this document whenever possible. Safeguarding must be feasible and appropriate, so that employees will not try to remove a guard that seems impractical. Some safeguards and retrofit kits may be available from the original equipment manufacturer. After installing safeguards, be sure to monitor their effectiveness to determine if modifications are necessary.

The three most recognized methods of safeguarding machinery are:

- Eliminating the Hazard
- Guarding of the Hazard
- Warning of the Hazard

Elimination of a hazard by design is the most preferable, but in many situations it is not feasible. The second approach of guarding the hazard is more commonly found in industry. Warning of the hazard is the third approach, but it does not prevent access to hazards such as in-running nip points. It is also possible to use a combination of guarding, warning signs, and safety colors to help increase the effectiveness of the safeguarding.

Additional Safety Considerations

There may be cases where it is not practical to completely guard a machine. In these situations, develop supplementary protection such as providing automatic feeding methods, hand tools, and personal protective equipment. This is in addition to employee training, good housekeeping, preventive maintenance, and checking other items such as lighting and floor conditions.

Also, it is highly probable that many good ideas and safeguarding designs will be developed, or already exist, to control each identified hazard. Share successful ideas with other departments and facilities. Learn from each other's mistakes and successes.

Safeguarding Methods

There are six different methods of safeguarding machines that will be illustrated here:

1. Fixed (structural barrier) guards
2. Interlocked guards and gates
3. Automatic safeguards
4. Safeguarding devices (presence sensing)
5. Safe distance
6. Safe location

Shields also offer some protection between the hazard and the exposed worker; however it is not a common application the paper making industry. This method offers little resistance- in some cases, it is the only barrier of protection as it offers incomplete isolation of the hazards, and still allows one (at will) to reach over, under, or around to overcome that protection. Therefore, shields will not be among those devices or safeguards examined here.

These methods are listed in descending order of preference. The first three methods (fixed, interlocked, automatic) describe guards that are physical enclosures or barriers that prevent entry of hands, fingers, or other parts of the body into a hazard by reaching through, over, under, or around the guard.

Guards should create no additional hazards between themselves and moving parts. They should utilize fasteners not easily removable by personnel, except for authorized individuals. Several types of guards are suitable depending on how and where they are used.

The latter three methods of safeguarding devices, safe distance, and safe location should be explored only when effective guards are not feasible- controlling access, not preventing it.

Refer to **Appendix F** for additional references, regulations, and standards that may apply to your operations.

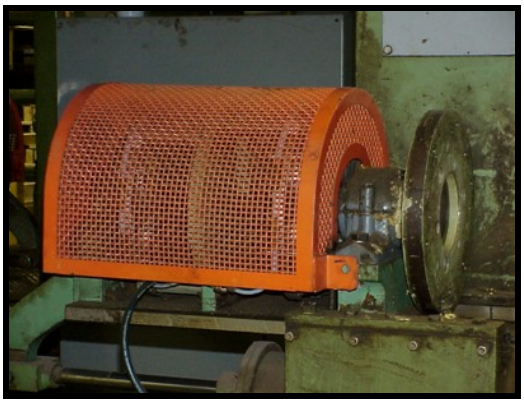


Figure 1. Fixed transmission enclosure guard.

Figure 2. Fixed coupling guard over drive shaft on embosser power transmission flywheel.

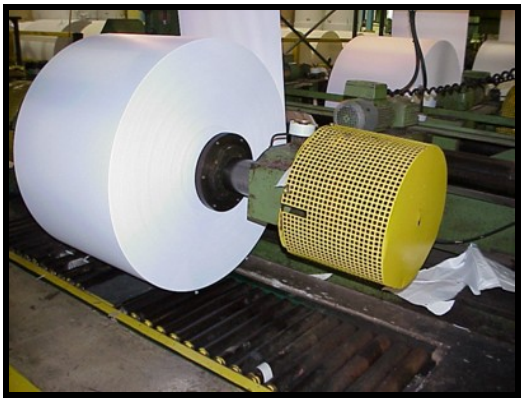


Figure 3. Fixed shaft coupling guard for roller winder

Safeguarding Examples

Fixed Guards

Fixed guards when properly designed, installed and maintained have the following characteristics:

- Considered preferable to other types.
- May be adjusted; once adjusted should remain fixed, and there should be no movement or detachment.
- Complete enclosure guards are preferable whenever possible. If they are not practical or significantly interfere with the safe operation of the machine, barrier guards such as bar, rod, or partial enclosures may be installed. Some barrier guards provide side protection and others may extend across the entire width of the roll nips.
- Some fixed guards are installed at a distance from the point of operation to allow for passage of materials or tools. A table of safe distances with permissible fixed guard opening sizes is contained in **Appendix A, Drawing A1** of this guide.
- Extension of lubrication fittings through the guard eliminate the need for operators to be in close proximity of machine hazards. See **Appendix A, Drawing A9**, for instance.

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More Fixed Guards

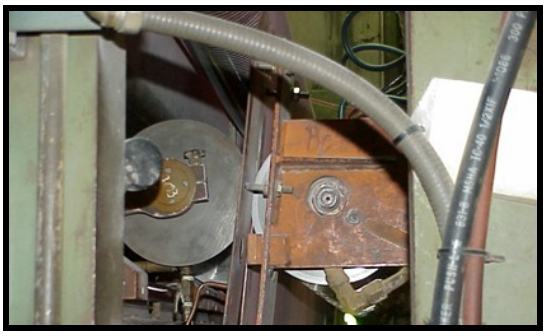

Figure 4. Fixed slitter guards inside re-winder.

Figure 5. Fixed barrier guard.

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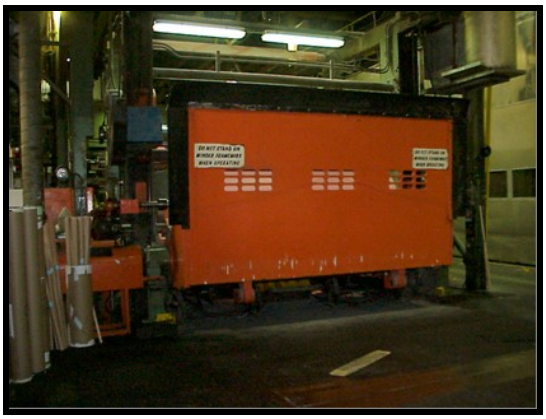
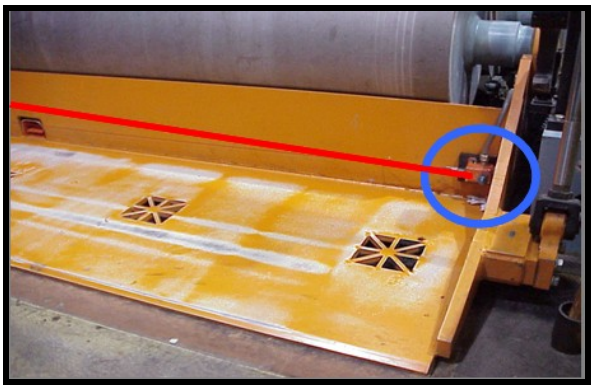


Figure 6. Interlocking guard on backend of re-winder, in the "up" position.



Figures 7 and 8 (below). Re-winder safety trip wire device.

Figure 8- Close up of interlocked trip wire at rewinder position.

Interlocking Guards and Gates

If a fixed guard cannot be used, the first alternative is an interlocking guard or gate. It prevents operation of the control(s) that start the machine in motion, until the guard or gate is in the closed position. When it is open and dangerous parts are exposed, the starting mechanism is inoperable and prevents the machine from running. When the machine is in motion, the guard or gate cannot be opened.

An effective interlocking guard or gate must meet three requirements:

- Guard the dangerous part(s) before the machine can be operated.
- Stay closed until the dangerous part(s) are at rest.
- Prevent operation of the machine if the interlocking device fails.

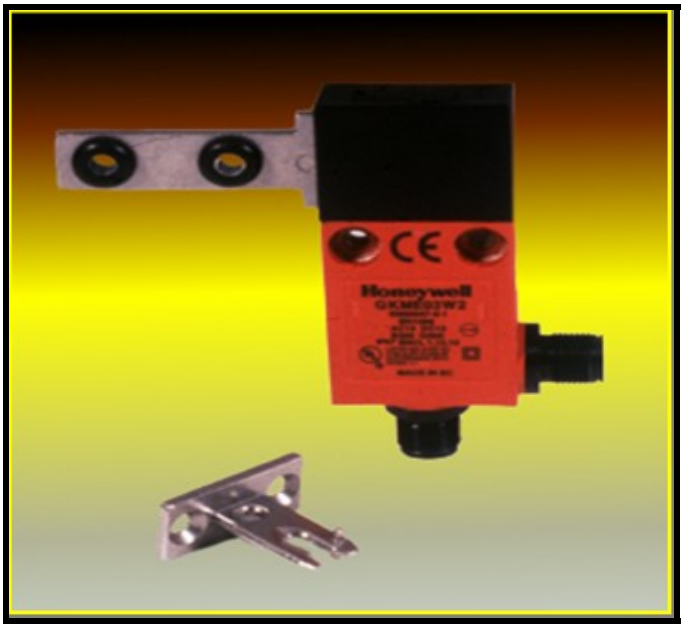


Figure 8A- Sample Interlock Device

Figure 9- Close up of presence sensing light beam located at rewinder position.

Figures 10. An example of a light curtain providing operator protection at the re-winder end where the end roll is awaiting the interlocked guard (orange) from raising into position. Note the red circle around the light beam transmitter and the red arrow pointing to the trip wire interlock device.

Safeguarding Devices

A safeguarding device may be used where effective guards cannot be installed. A safeguarding device provides protection by:

- Preventing and/or stopping normal motion of the power transmission source, if personnel inadvertently enter the hazardous area.

- Stopping the system in the event of inadvertent entry into the hazardous area.

Automatic threaders, tail cutters, and reel turn-up safety devices eliminate the need for the operator to be in close proximity to the machine hazards.

In selection and design of presence-sensing and emergency stop devices, it is imperative to consider the stopping time of the moving machinery hazards. Devices are appropriate only for equipment capable of instantaneous stopping or adequate braking distance.

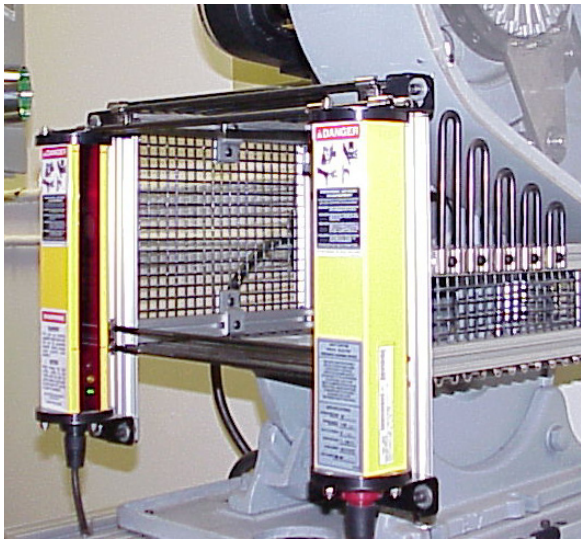


Figure 10A- Example Light Curtain on a Mechanical Power Press- Transmitter and Receiver

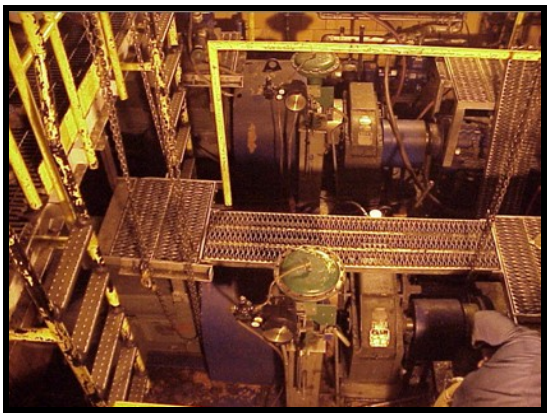


Figure 11. Guarding against access to machinery is accomplished by providing the catwalk at a safe distance from the machinery.

Safe Distance

Guarding may be accomplished by maintaining a safe distance between personnel and the hazardous equipment. This safe distance can be provided in the following ways:

- Provide a minimum vertical distance of 84” above the walking or working surface and the hazard.
- Provide a minimum horizontal distance of 42” between the person and the hazard. **See Appendix A, Drawing A1** for more details on guard design.

Where possible, sources of mechanical motion should be located within the framework and structure of the machine, equipment or system.

Figure 12. Illustrates safeguarding by location by using a fence enclosure to prevent access to the machine hazards.

Safe Location

Safeguarding by location can be accomplished by:

- Location in a room or similar enclosure.

- Permanent, substantial partitions or screens. Any gap openings in partitions or screens shall be of a size and location so that persons cannot come into contact with hazardous moving parts. **See Appendix A, Drawing A1** for more details.

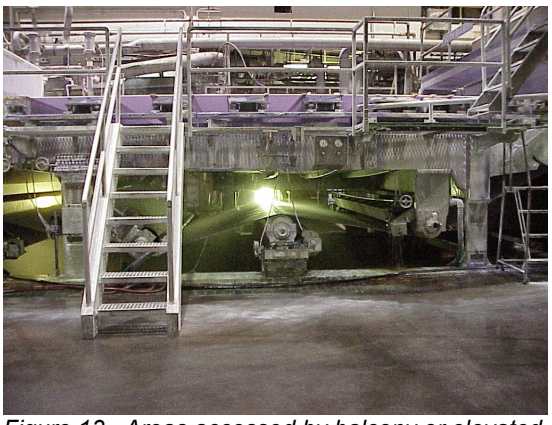
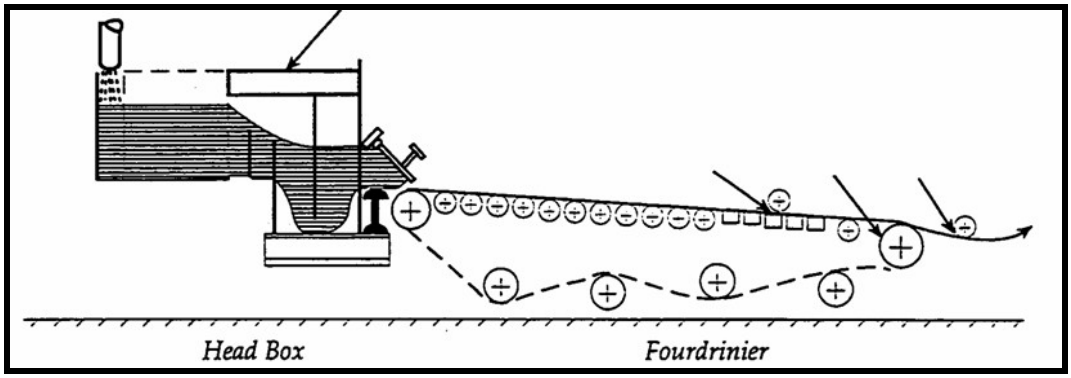


Figure 13. Areas accessed by balcony or elevated platform, restricted to trained workers. These areas are not normal workstations.

Head Box and Fourdrinier



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of the Head Box and Fourdrinier are hazardous footing due to the continuously wet environment and access to moving machine parts. The exposures mentioned in this section include:

Head Box

- Top Access: Platform and Ladder

Fourdrinier

- Nip Hazards: Wire Screen, Dandy Roll, Support and Tension Roll, Couch Roll, and Doctor Blades
- Walkways and Passageways: Wire and Pit, Trim Squirt, and Floors
- Rotating Hazards: Couplings, Shafts, and Shaft Ends

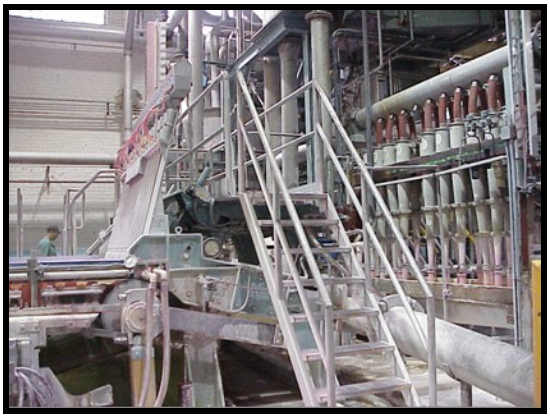


Figure 14. Head box platform.

Head Box - Top Access

Platform

Slip and fall hazards exist due to the wet environment. Since the operator must make head box adjustments, it is important to have slip-resistant catwalks or platforms of adequate width with top-rails, mid-rails, and toe-boards.

- Install an elevated catwalk across the head box that has a slip-resistant surface, such as an open grating design. An elevated catwalk should be equipped on both sides with standard railings top-rail; (42”), mid-rail (18”), and toe-board (4”). Install railings at the ends of catwalks or platforms that do not have stairs or ladders. Design catwalks to avoid interfering with operator adjustments on the head box. **See Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

Figure 15. Head box platform access ladder with handrail and slip-resistant surface.

Ladder

Slip and fall hazards may exist on the ladders leading up to catwalks and work platforms. The ladder should be slip-resistant, and have an adequate width, angle, and handrails.

- Install properly angled head box platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisleway, replace with permanent stairs installed perpendicular to the platform. **See Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

Figure 16. Front side view of the edge of the wire screen.

Fourdrinier - Nip Hazards

Wire Screen

Nip hazards exist where the wire screen contacts the rotating rolls on both the front and back sides of the fourdrinier.

- Install a fixed side barrier guard at each location where the wire screen contacts the rotating rolls to prevent fingers and hands from contacting the nips. See **Appendix A, Drawings A10 and A11** for additional information.

Or

- Install a standard railing to prevent access to the nip points and the side of the moving screen. It should have a mid and lower rail to prevent employees from accidentally slipping and falling into the pit. The railings should allow for washing machine components without having to remove fixed guards. They should be removed for machine maintenance, but should be in place during machine operation. See **Appendix B, Drawing B4** for additional information.

Figure 17. Nip hazard between roll and wire screen.

Dandy Roll

Nip hazards exist where the carrier rollers contact the ends of the rotating dandy roll.

- Install a fixed side barrier guard at each end of the dandy roll to prevent fingers and hands from contacting the nips, where the ends of the dandy roll contact the carrier rollers. See **Appendix A, Drawing A10 and A12** for additional information.

Or

- Install a fixed "hood" guard to enclose the entire dandy roll assembly. The functional purpose of this hood is to provide exhaust ventilation, along with enclosing the in-running nip hazards. **See Appendix A, Drawings A11 and A12** for additional information. When used in a dual role for ventilation, be certain that airflow exhaust values are not compromised.

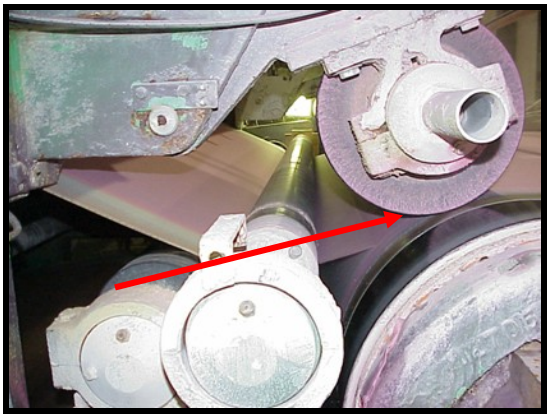


Figure 18. Nip hazard between support rolls and wire.

Figure 19. Nip hazard between tension rolls and wire.

Support and Tension Rolls

These rolls vary in number and location depending on the configuration of the fourdrinier section of paper machine. However, the points of contact between the wire screen and the support and tension rolls present a nip point hazard when it is accessible to personnel.

- Install fixed side barrier guards within the open framework of the fourdrinier to prevent placing hands or fingers into in-running nip points where wire belts contact support and tension rolls. Due to possible accumulation of pulp on guards installed in this area, the guard should be designed to easily shed pulp, be easily removed for cleaning, or be constructed of polycarbonate sheet. See **Appendix A, Drawings A10 and A12** for additional information.

Or

- Install railings, with appropriate mid and lower rails, to prevent reaching or falling into the nip hazards of wire belts contacting tension and support rolls and into the pit, but allow for washing machine components without having to remove fixed guards.

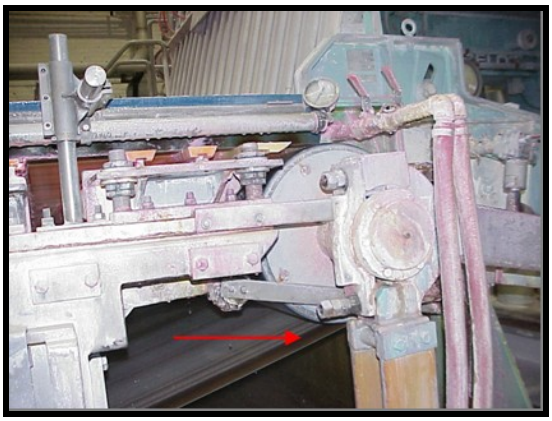


Figure 20. Nip hazard between breast roll and wire screen.

Support and Tension Rolls Cont.

Railings should be removable for machine maintenance, but should be in place during machine operation. See **Appendix B, Drawing B4** for additional information.

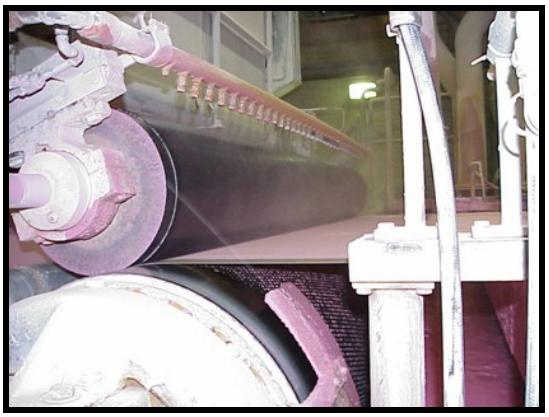


Figure 21. Nip hazard between couch roll and wire screen.

Couch Roll

A significant nip point hazard exists at the contact points, on both sides of the machine where the wire belt contacts the surface of the couch roll.

This area may be guarded by a fixed barrier or possibly by safe location, a railing, or fence that prevents physical contact with the couch roll nip point. It may be necessary to allow for access to adjust trim squirts located near the couch roll.

- Install a fixed side barrier guard that prevents hand and finger access to the in-running nip point on each end of the couch roll where the wire belt first comes into contact with the roll surface. See **Appendix A, Drawing A10 and A12** for additional information.

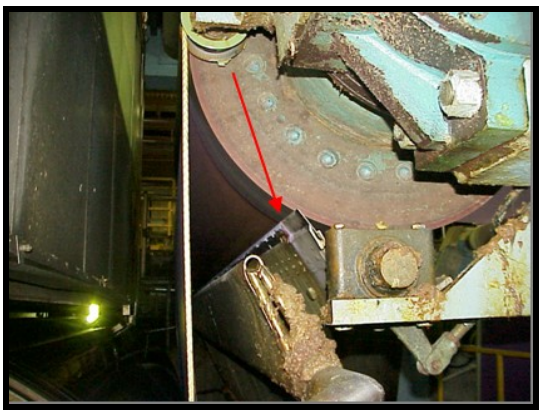


Figure 22. Doctor blade positioned on tension roll.

Doctor Blades

Doctor blades in general do not present in-running nip hazards as long as they are properly adjuster against the surface of the rotating rolls.

- Position the doctor blade directly against the surface of the rotating rolls. If a gap exists of more than 1/4” between the blade and roll, install a side barrier guard on each end to prevent access to the nip point. See **Appendix A, Drawings A10 and A12** for additional information.

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Doctor Blades Cont.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Mount an adequate number of mushroom shaped emergency stop switches on each side of the machine. See **Appendix C** for additional details

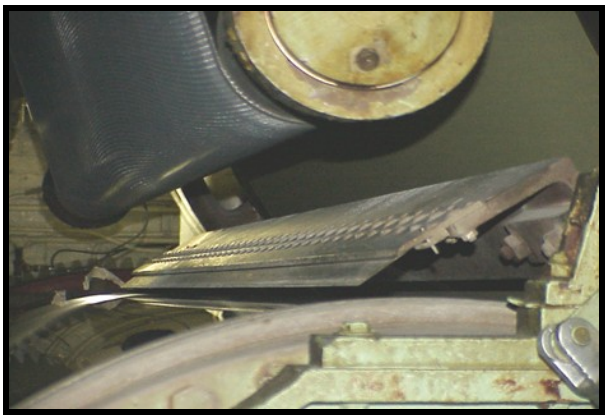

Figure 23. Doctor blade in open position

Figure 24. Machine frame openings along fourdrinier at elevated position, however, also needed where there is a potential for falls below (missing here).

Walkways and Passageways

Wire and Pit

There is a potential slip and fall hazard that may exist in the wire and pit area on both sides of the machine. If walkways or passageways are wet or slippery, an individual might slip and fall down between the machine frame into the pit.

- Install railings, with appropriate mid and lower rails to prevent falling into the pit. The railings should allow for washing machine components without having to remove fixed guards. They should be removable for machine maintenance, but should be in place during machine operation. The railing would also control access to moving machine hazards. See **Appendix B, Drawing B4** for additional information.

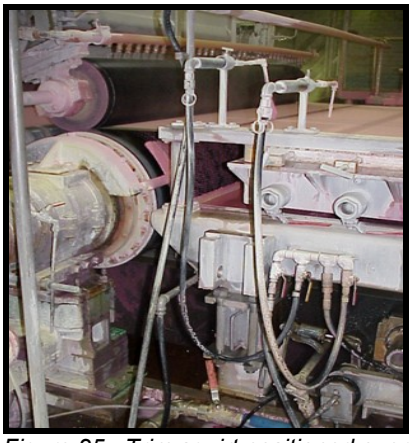

Figure 25. Trim squirt positioned over top of wire screen.

Trim Squirt

The trim squirt uses water to adjust the width of the paper. There is the potential for excess water to collect on the walkway and pose slip and fall hazards to paper machine and maintenance employees working in these areas.

- Provide adequate drainage to prevent excess water buildup on the walkway. It may be necessary to slightly angle the walkway to allow the water to flow towards the pit or nearby drains.

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Figure 26. Illustrates a typical wet end floor.

Floor Surfaces

The process of manufacturing paper uses large amounts of pulp, water, and other substances that may splash onto floors posing slip and fall hazards.

Since it is difficult to prevent splashes onto the floor in the wet end area, excellent housekeeping, well maintained slip-resistant floors, proper footwear, and safe work habits are essential.

- Provide a slip-resistant floor surface that has adequate drainage (floor drains, slight angles) and maintained on a regular basis. Whenever possible, it is preferable to use engineering controls such as barriers and precisely directed water to prevent unnecessary substances from splashing onto the floor. Additional information on engineering and administrative controls is contained in **Appendix B**.

Figure 27. Motor and shaft coupling guard for couch roll.

Rotating Hazards

Couplings

Protruding bolt heads, keys, screw threads, etc., on rotating couplings can catch loose clothing and hair or cut operator's skin.

- Install a *fixed* barrier guard to fully enclose and prevent access to each rotating coupling. See **Appendix A, Drawing A7** for additional information.

Or

- If a solid guard is not feasible, or if the amount of exposed shaft changes during machine cycles, then install an *automatically adjustable* barrier guard to fully enclose and prevent access. See Figure 27.

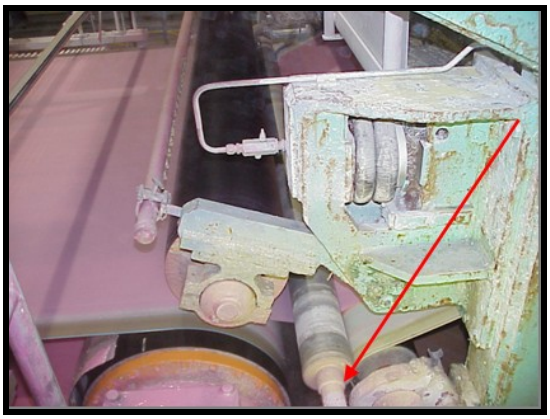


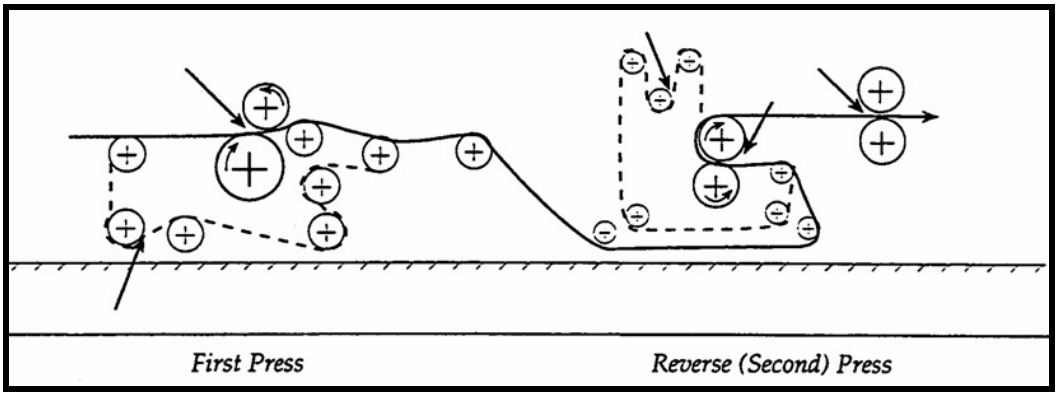
Figure 28. Dance roll shaft between fourdrinier and first press.

Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist.

- Install a fixed barrier guard over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4", any shaft end longer than 2" would need to be guarded to fully enclose and prevent access. Install guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Presses



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of the presses are from high pressure nips and hazardous footing due to inadequate, or debris blocked, footwalks, and crosswalks. The exposures mentioned in this section include:

Potential Safety Exposures

- Top Access: Platforms
- Nip Hazards: Felt Carrying Rolls, Press Rolls, Support & Tension Rolls, Doctor Blades, and Rope Sheaves
- Walkways & Passageways: Crossovers, Floors, and Broke Holes
- Rotating Hazards: Couplings, Shafts & Shaft Ends

Figure 29. Platform with railings and ladder, between fourdrinier and first press.

First, Second, Reverse and/or Smoothing Presses - Top Access

Platforms

Slip and fall hazards may exist on the ladders leading up to catwalks and work platforms due to the wet environment. The ladder should be slip-resistant, and have an adequate width, angle, and handrails.

Good housekeeping methods are needed to keep walkways and aisleways clean. Properly designed ladders and catwalks should be used to prevent slip, fall, and tripping hazards.

- Install an elevated catwalk that has a slip-resistant surface, such as an open grating design. It should be equipped on both sides with standard railings top-rail; (42”), mid-rail (18”) and toeboard (4”). Install railings at the ends of catwalks and platforms that do not have stairs or ladders.

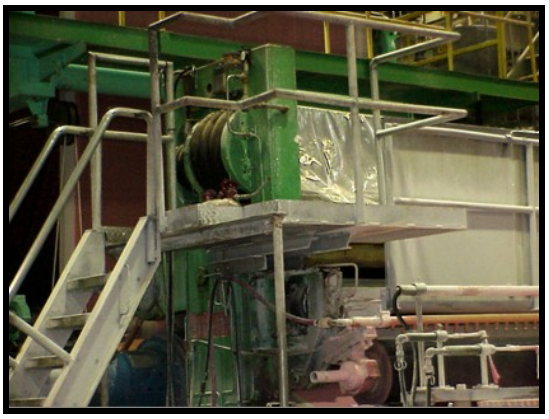


Figure 30. Platform between the couch roll and press rolls.

Platforms Cont.

The catwalk must be designed not to interfere with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisleway, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawing B2 and B3** for additional information on dimensions and construction features.

Figure 31. Nip hazard between carrier roll and felt.

Nip Hazards

Carrier and Tension Rolls

Nip hazards exist where the carrier and tension rolls contact the felt on both the front and back sides of the presses. (Carrier rolls are also commonly referred to as support rolls and felt rolls). Nip hazards also exist where carrier rolls contact each other.

For each workstation designated for control panel access, there must be emergency stopping capabilities, which can be quickly and easily accessed. Stopping control(s) should be interlocked with adequate braking action to stop machine motion as quick as possible. Safety delay interlocks or combination devices may be necessary to slow machine movement as quickly as practical. The devices must consist of push buttons for electric or fluid power (or electrically operated engine stops), pull cords or cables connected directly to the prime mover, control clutches, or other power control devices.

Figure 32. Nip hazard where two carrier rolls contact each other.

Carrier and Tension Rolls Cont.

- Install a fixed side barrier guard at each end of the carrier rolls (front and backside) to prevent fingers and hands from contacting the nips where the ends of the roll contact the felt. See **Appendix A, Drawings A10 and A12** for additional information.

Note: If the nip point is accessible from an adjacent crosswalk or passageway, install a full width nip barrier guard in addition to the side barrier guards. See **Appendix A, Drawing A4**.

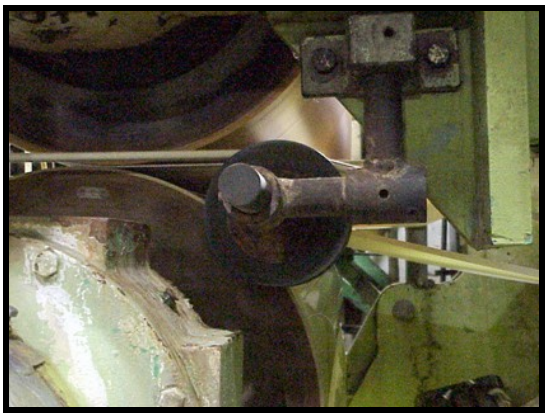


Figure 33. Nip between press rolls on first press.

Press Rolls

Nip hazards exist where the press rolls contact each other on both the front and back sides of the first, second, reverse, smoothing, marking, and embossing presses.

- Install a fixed side barrier guard at each end of the press rolls (front and backside) to prevent fingers and hands from contacting the nips where the felt contacts the roll. See **Appendix A, Drawings A10 and A12** for additional information.

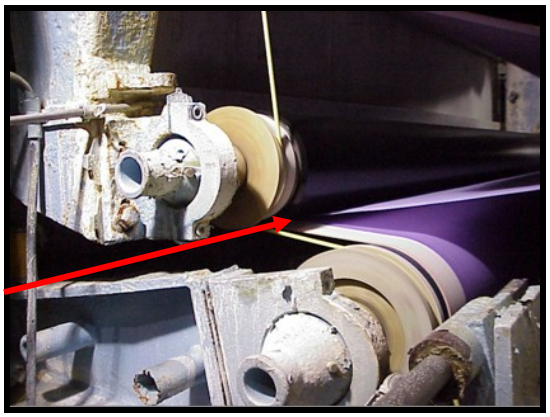


Figure 34. Rope sheave nip point.

Rope Sheaves

Nip points exist where the ropes contact the sheaves. Except for some rope sheaves that may need to be accessible for threading the machine, the others should be enclosed and guarded as much as possible to prevent individuals' fingers, hands, and clothing from being caught in the nip points.

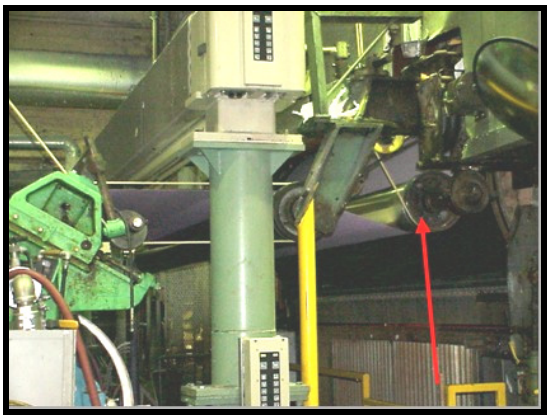


Figure 35. Nip point created by rope sheave.

- Enclose the rope sheaves so that the nip points are not accessible, except for a minimal number needed for machine threading.

- Extend the guard around the front and back edges of the sheave to provide additional protection, especially if adjacent to a machine crossover. Use a Lexan, Acrylic, or polycarbonate material to construct a guard that is strong with good visibility.

Figure 36. Partial guard for rope sheave (front view).

Rope Sheaves Cont.

- Evaluate the feasibility of installing a rope carrier or other threading safety devices on the paper machine, if none exist. See **Appendix A, Drawing A13**.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Mount an adequate number of mushroom shaped emergency stop switches on each side of the machine. Install safety trip wires across the width of accessible press nip points, if guards aren't feasible. See **Appendix C** for additional details.

Doctor Blades

Doctor blades in general do not present in-running nip hazards as long as they are properly adjusted against the surface of the rotating rolls. Figure 37 illustrates a doctor blade close to the roll, but in the open position.

- Position the doctor blade directly against the surface of the rotating rolls. If a gap exists of more than 1/4" between the blade and roll, install a side barrier guard on each end to prevent access to the nip point. See **Appendix A, Drawings A10 and A12** for additional information.

- Employees must avoid contact with sharp edges of the doctor blade while cleaning and replacing on the rolls.

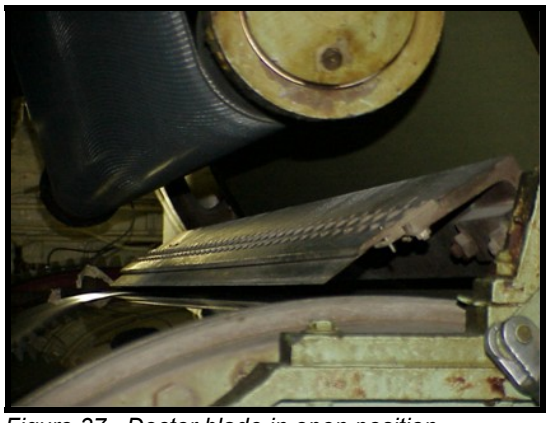


Figure 37. Doctor blade in open position

Figure 38. Crossover across platform with railings and ladder, between fourdrinier and first press.

Walkways and Passageways

Floors and Crossovers

The process of manufacturing paper uses large amounts of pulp, water, and other substances that may splash onto floors posing slip and fall hazards. Since it is difficult to prevent splashes onto the floor in the wet end area, excellent housekeeping, well maintained slip-resistant floors, proper footwear, and safe work habits are essential.

- Provide a slip-resistant floor surface that has adequate drainage (floor drains, slight angle) and maintain frequently. Whenever possible, it is preferable to use engineering controls such as barriers and precisely directed water jets to prevent unnecessary substances from splashing onto the floor.

Crossovers must be of adequate width, slip-resistant, and have proper handrails. Additional information on engineering and administrative controls is contained in **Appendix B**.

Figure 39. Broke hole with a rail guard.

Broke Holes

There is the potential for someone to accidentally slip and fall on the wet floor and fall into the broke hole.

- Install a railing to protect the broke hole, but allows the broke to be pushed into the floor opening. The opening between the bottom rail and the floor should not allow a foot or leg to pass through.

Or

- Construct an adequate removable walkway/cover to prevent falls into broke holes. Figure 39 illustrates a removable walkway/cover over a wire pit.

And

- Provide an audible alarm bell or visual flashing light [or other suitable warning] before dropping material through a broke hole where persons working below may be at risk.

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- When devices or feed conveyor systems for re-pulping are located beneath broke holes, special precautions must be used:

→ The broke hole opening must be reduced to the smallest practical dimension.

→ If the broke hole opening is large enough to permit a worker to fall through and is not guarded by standard guardrails, any employee pushing broke down the broke hole must wear a fall protection full body harness attached to a fall prevention lanyard, and

→ The lanyard provided with a D-ring attachment to a structural component capable of eliminating risk of falls into the re-pulping device, for example.

Figure 40. Example removable walkway-NOT in a Broke Hole configuration.

Rotating Hazards

Couplings

Protruding bolt heads, keys, screw threads, etc., on rotating couplings can catch loose clothing and hair or cut operator's skin.

- Install a *fixed* barrier guard to fully enclose and prevent access to each rotating coupling. See **Appendix A, Drawing A7** for additional information.

Or

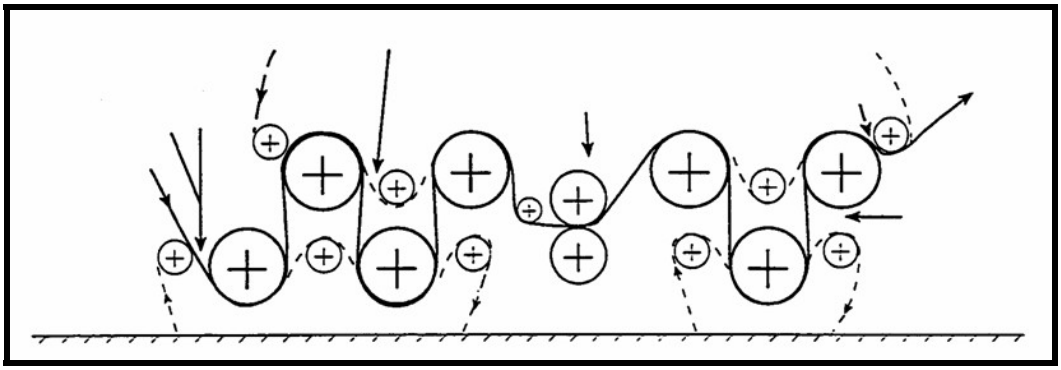
- If a solid guard is not feasible or if the amount of shaft that is exposed changes during machine cycles, install an *automatically adjustable* barrier guard to fully enclose and prevent access to each rotating coupling.

Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 illustrates a guarded shaft end.

- Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. For example, install a fixed barrier guard over exposed shaft ends (longer than 2") to fully enclose and prevent access. Install barrier guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Dryers



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of the dryers are from high pressure and temperature nips and rotating machine parts. The exposures mentioned in this section include:

- Nip Hazards: Take-Up Roll, Dryer Cans, Gears, and Rope Sheaves
- Walkways and Passageways: Floors, Crossovers, Broke Holes, and Platforms, Ladders, and Stairs
- Rotating Hazards: Couplings, Shafts, and Shaft Ends

Figure 41. Nip between felt and take-up roll.

Dryers - Nip Hazards

Take-Up Roll

Nip hazards exist where the felt contacts the take-up roll (Figure 41) and where the paper contacts the dryer cans (Figure 42). These exposures are on both the front and backside of the machine.

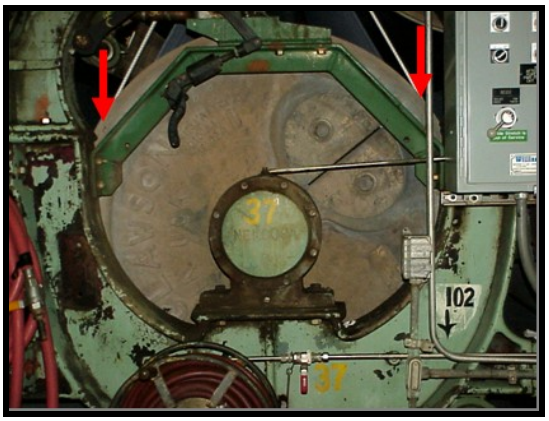


Figure 42. Nips between rope and dryer can.

Take-Up Roll Cont.

- Install a fixed side barrier guard at each end of the take-up rolls (front and backside) to prevent fingers and hands from contacting the nips where the felt contacts the roll. See **Appendix A, Drawings A10 and A12** for additional information.

Figure 43. Railing on front side of dryer to prevent direct access to nip points and will also serve to protect control panels.

Dryer Front side

- Install fixed side barrier guards to prevent placing hands and fingers into in-running nip points where paper contacts the dryer cans. See Figure 43 and **Appendix A, Drawings A10 and A12** for additional information.

Or

- Install railings, with appropriate mid and lower rails to prevent reaching into the dryer can nip points. See Figure 43 and **Appendix B, Drawing B4** for additional information.

Note: If the nip point is accessible from an adjacent crosswalk or passageway, install a full width nip barrier guard in addition to the side barrier guards and railings. See **Appendix A, Drawing A4**.

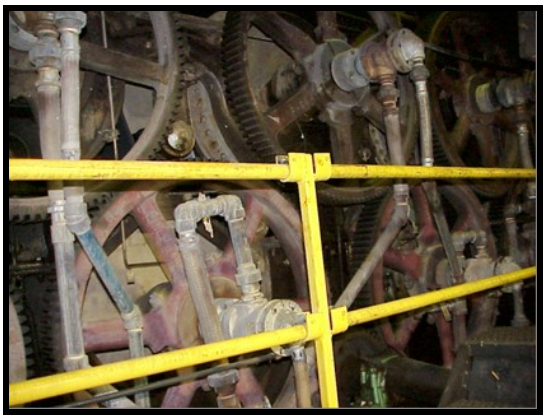


Figure 44. Nip points between rotating gears on backside of dryers. Note continuation of railing from previous figure.

Figure 45. Completely enclosed aluminum dryer shed.

Dryer Backside

There are nip points formed by rotating gears, rope sheaves, and paper contacting the dryer cans. It is normally easier to install complete backside enclosure barriers than to guard each individual nip point.

- Install complete barrier enclosures along the backside of the dryer to prevent fingers and hands from contacting the nip points. Depending upon the machine configuration and available room, the enclosures can be sliding, interlocked panels, or individually secured, locked panels. See Figures 44 and 45 and **Appendix A, Drawings A1 and A2** for additional information.

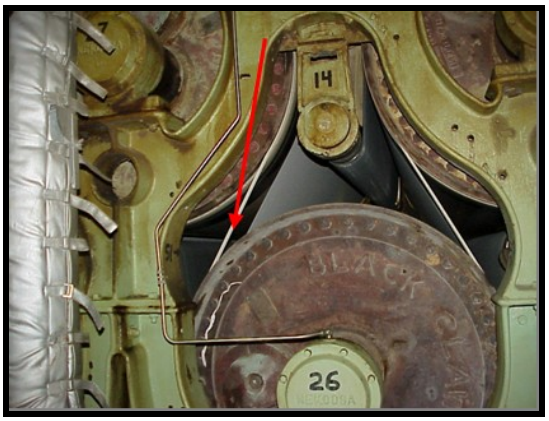


Figure 46. Nip point between threading rope and dryer can.

Rope Sheaves

Nip points exist where the ropes contact the dryer cans. Except for some nips that may need to be accessible for threading the machine, the others should be enclosed and guarded as much as possible to prevent individuals' fingers, hands, and clothing from being caught in the nip points.

- Guard the rope nip created by the contact point between the threading rope and dryer can. See Figures 34 - 36 in the Presses section.

The guard should be extended around the front and back edges of the nip point to provide additional protection, especially if the nips are adjacent to a machine crossover. Use Lexan, polycarbonate, or Acrylic material to construct a guard that is strong provides good visibility.

- Evaluate the feasibility of installing a rope carrier or other threading safety devices on the dryer, if none exist. Contact the paper machine manufacturer for information on rope carriers and threading safety devices.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Install an adequate number of mushroom shaped emergency stop switches on each side of the dryer. Install safety trip wires across the width of accessible dryer nip points, if guards are not feasible. See **Appendix C** for additional details.

Walkways and Passageways

Front side, Backside, and Crossovers

It is important in the dryer section to keep the floor clear of paper, work materials, tools, steam leaks, and condensation. Excellent housekeeping, well maintained slip-resistant floors, proper footwear, and safe work habits are essential to prevent slips and falls.

Whenever possible, it is preferable to use engineering controls to prevent steam leaks.

Preventive maintenance programs should include inspections of valves, hoses, and other components that may leak and pose slip and fall hazards.

Provide a slip-resistant floor surface that has adequate drainage and is maintained on a regular basis. Crossovers must be of adequate width, slip-resistant, and have proper handrails. Additional information on engineering and administrative controls is contained in **Appendix B**.

Figure 47. Guarded broke conveyor under the roller sections.

Broke Holes

There is the potential for someone to accidentally slip and fall on the wet floor and fall into the broke hole.

- Install a railing that will protect the broke hole, but will allow paper to return to the pit. The opening between the bottom rail and the floor should not allow a foot or leg to pass through.

Or

- Construct an adequate removable walkway/cover to prevent falls into broke holes.

- Install complete barrier guards to prevent access to the conveyor and broke hole.

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Figure 48. Backside upper dryer platform, railings, and ladder.

Platforms, Ladders, and Stairs

Look carefully at walking areas on floors and elevated workstations. Maintain slip-resistant catwalks and platforms of an adequate width with top rails, mid rails, and toeboards. Properly design ladders or stairs to access upper work platforms.

Keep walkways and aisleways clean and prevent slip, fall, and tripping hazards with consistent good housekeeping programs.

- Install an elevated catwalk that has a slip-resistant surface, such as an open grating design. It should be equipped on both sides with standard railings top-rail (42”), mid-rail (18”), and toeboard (4”). Install railings at the ends of catwalks and platforms that do not have stairs or ladders. Design and install the catwalk in such a way to avoid interference with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisle, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

Rotating Hazards

Couplings

Protruding bolt heads, keys, screw threads, etc., on rotating couplings can catch loose clothing and hair or cut operator’s skin. Figure 2 illustrates a coupling guard.

- Install a *fixed* barrier guard to fully enclose and prevent access to each rotating coupling. See **Appendix A, Drawing A7** for additional information.

Or

- Install a *self-adjusting* barrier guard to fully enclose and prevent access to each rotating coupling, if a solid guard is not feasible or if the amount of shaft that is exposed changes during machine cycles.

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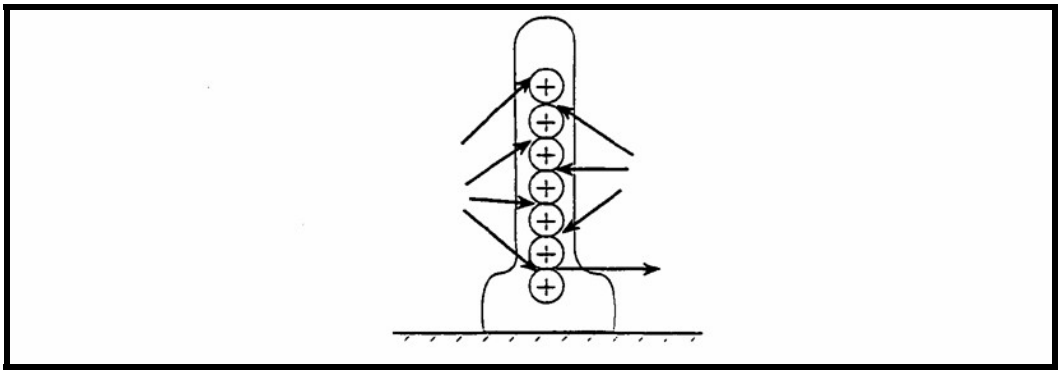
Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 on page 3 illustrates a guarded shaft end. The Figure 49 below is an unguarded shaft end-

Figure 49. An unguarded shaft end on a rewinder stanchion.

- Install a fixed barrier guard over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4", any shaft end longer than 2" would need to be guarded to fully enclose and prevent access. Install barrier guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Calender



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures	
The primary exposures of the calendar is from the high speed in-running nips. The exposures mentioned in this section include:	• Nip Hazards: Calender Rolls, Static Electricity, Jumping-the-Stack • Walkways and Passageways: Platforms, Ladders and Stairs, Broke Holes, Steam, and Hydraulic Leaks • Rotating Hazards: Couplings, Shafts, and Shaft Ends

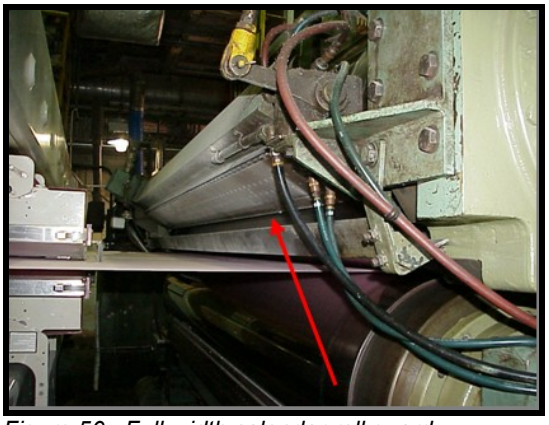


Figure 50. Full-width calendar roll guard.

Nip Hazards

Calender Roll

Full-width in-running nip hazards exist where the paper enters each set of rolls. Nip points also exist on the front and back sides where the rolls meet.

- Install a full-width barrier guard over the nip area of each in-running set of calendar rolls. See **Appendix A, Drawings A3 and A4**. The first drawing shows paper traveling over one roll before entering the nip. The second shows stock entering the nip from a central feeding position.

- Install fixed side barrier guards to prevent placing hands and fingers into in-running nip points where calendar rolls meet. See **Appendix A, Drawings A10 and A12** for additional information.

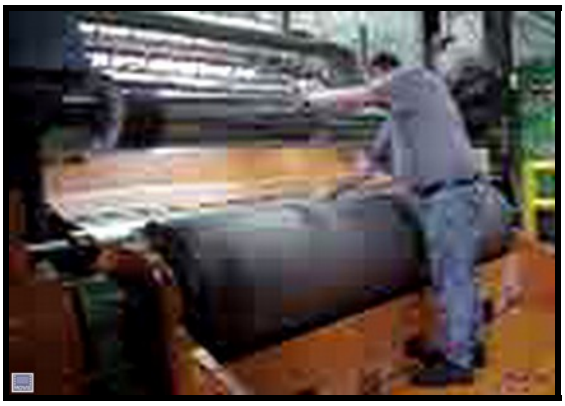


Figure 51. Begin threading the paper through the rewind area- a similar task with the calender operations.

Calender Roll Cont.

Threading the paper through the calender requires safe work procedures in order to prevent operators from becoming caught in the nip points.

- Evaluate the feasibility of installing an air winder or other threading safety device on the calender if none exist. Contact winder manufacturer for information on safety devices. Also see **Appendix A, Drawing A13**.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Install an adequate number of mushroom shaped emergency stop switches on each side of the calender. Install safety trip wires across the width of accessible calender nip points, if guards are not feasible. See **Appendix C** for additional details.

Static Electricity

Static electricity is generated by contact and separation of dissimilar material, such as paper traveling at a high speed through the calender stack. Flammable vapors, gases, or dust particles can be ignited by spark discharges. Operators may be injured because of an involuntary reaction caused by shock from a static spark.

- Evaluate and eliminate or reduce the potential of static electricity generation. See **Appendix D** for information on the use of static neutralizers, liquid treatments, bonding, grounding, and measurement equipment.

Figure 52. Upper calender platform, railings, and access steps.

Walkways and Passageways

Platforms, Ladders, and Stairs

It is important to have slip-resistant platforms of an adequate width with top-rails, mid-rails, and toeboards. Properly designed ladders or stairs should be used to access upper work platforms.

Good housekeeping methods are needed to keep walkways and aisleways clean and prevent slip, fall, and tripping hazards.

- Install an elevated platform that has a slip-resistant surface, such as an open grating design. It should be equipped on both sides with standard railings top-rail (42”), mid-rail (18”), and toeboard (4”). Provide railings at the ends of catwalks and platforms that do not have stairs or ladders. Design the catwalk so that it will not to interfere with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisleway, replace them with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

Broke Holes

There is the potential for someone to accidentally slip and fall on the floor and fall into the broke hole. Figure 39 and 47 illustrate methods of preventing access to broke holes.

- Install a railing that will protect the broke hole, but will allow paper to return to the pit. The opening between the bottom rail and the floor should not allow a foot or leg to pass through.

Or

- Construct an adequate removable walkway/cover to prevent falls into broke holes. Some broke holes use a removable walkway/cover to protect openings.

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Steam and Hydraulic Leaks

Since steam condensation, hydraulic leaks, and paper may pose slip and fall hazards in the calender area, preventive maintenance of equipment, excellent housekeeping, well maintained slip-resistant floors, proper footwear, and safe work habits are essential.

- Whenever possible, it is preferable to use engineering controls to prevent hydraulic and steam leaks. Preventative maintenance programs should include inspections of valves, hoses, and other components that may leak and pose slip and fall hazards.

- Provide a slip-resistant floor surface that has adequate drainage and maintained on a regular basis. Additional information on engineering and administrative controls is contained in **Appendix B**.

Rotating Hazards

Couplings

Protruding bolt heads, keys, screw threads, etc., on rotating couplings can catch loose clothing and hair or cut operator's skin. Figure 3 illustrates a coupling guard.

- Install a fixed barrier guard to fully enclose and prevent access to each rotating coupling. See **Appendix A, Drawing A7** for additional information. See Figures 2 and 5 for a similar arrangement.

Or

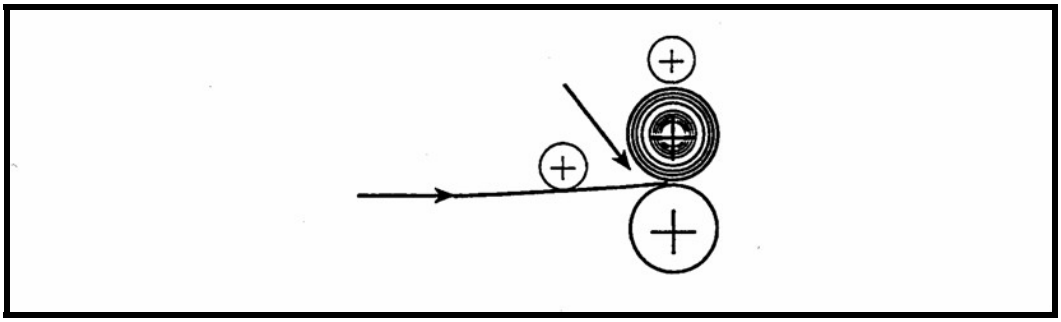
- Install an *automatically adjustable* barrier guard to fully enclose and prevent access to each rotating coupling, if a solid guard is not feasible or if the amount of shaft that is exposed changes during machine cycles. Note the trip wire and photoelectric presence sensing light beam in Figures 7, 9 - 10A.

Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 illustrates a guarded shaft end.

- Install a fixed barrier guard over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4", any shaft end longer than 2" would need to be guarded to fully enclose and prevent access. Install guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Winder and Paper Reel



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures	
The primary exposures of the winder and reel are from parts and nips, and from being struck by overhead cranes or reels. The exposures mentioned in this section include:	• Nip Hazards: Winder, Rider Roll, Static Electricity • Shear Hazards: Reel Handling System • Crushing Hazards: Roll Staging Area • Walkways and Passageways: Platforms, Ladders, and Stairs • Rotating Hazards: Reel & Roll Shaft Ends

Figure 53. Carrier roll nip and rotating shaft hazard.

Winder and Paper Reel - Nip Hazards

Winder

Nip hazards exist where the paper first contacts the rotating roll. The nip point extends across the entire width of the roll and is accessible from the front and rear sides of the winder.

- Install a fixed side barrier guard at each end of the winder roll (front and backside) to prevent fingers and hands from contacting the nips where the paper and roll contact. See **Appendix A, Drawings A10 and A12** for additional information.

Note: If the nip point is accessible from an adjacent crosswalk or passageway, install a full width nip barrier guard in addition to the side barrier guards. See **Appendix A, Drawing A4**.

Figure 54. Winder reel drum and spool nip hazard with stick used to cause sheet break.

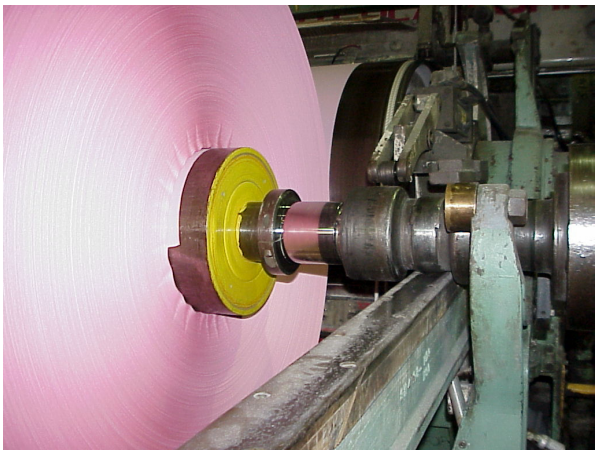


Figure 55. An unguarded shaft end on a rewinder stanchion

Drum and Spool

Nip hazards exist between the reel drum and reel spool. The nip point extends across the entire width of the drum and spool, and is accessible from the front and rear sides of the winder.

- Install a fixed side barrier guard or enclosure (see Figure 55) at each end of the reel drum and spool (front and backside) to prevent fingers and hands from contacting the nips where the drum and spool contact. See **Appendix A, Drawings A10 and A12** for additional information.

If the nip point is accessible from an adjacent crosswalk or passageway, a full width nip barrier guard should also be installed in addition to the side barrier guards. See **Appendix A, Drawing A4**.

- Evaluate the feasibility of installing threading safety devices on the winder and paper reel, if none exist. Contact winder manufacturer for information on threading safety devices. Also see **Appendix A, Drawing A13**.

If manual threading can not be eliminated, the winder and paper reel should be jogged or operated at a slower speed during threading procedures.

- There is the potential for someone to accidentally slip and fall into the paper reel broke hole (if so equipped).

Install a railing that will protect the broke hole, but will allow the paper to return to the slusher. Also evaluate use a self-propelled broke pusher to keep the employees a safe distance from the broke holes.

Figure 56. Example of how paper is manually threaded which is appropriate for some winders, when the rollers are advanced by foot control-inch mode.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Install an adequate number of mushroom shaped emergency stop switches on each side of the winder and paper reel. See **Appendix C** for additional details.

When equipping guards with interlock features with the drive mechanism, this will prevent the machine from running while the guard is not in place. Be cautious when interfaced electronic controls allow it to run at thread or jog/inch speed only for adjustment and start-up purposes while the guard is not in position.

Include a zero speed switch or locking device to prevent the guard removal while the roll is turning above thread or jog speed.

Static Electricity

Static electricity is generated by contact and separation of dissimilar material, such as paper traveling at a high speed through the winder and paper reel. Flammable vapors, gases, or dust particles can be ignited by spark discharges. Operators may be injured because of an involuntary reaction caused by shock from a static spark.

- Evaluate and eliminate or reduce the potential of static electricity generation. **Appendix D** discusses the use of static neutralizers, liquid treatments, bonding, grounding, and measurement equipment.

Figure 57. Reel shaft handling mechanism.

Shear Hazard

Reel Handling System

Shear hazards can exist where the reel shaft handling mechanism rotates into position to secure the reel shafts.

- Install a fixed side barrier or enclosure guards to prevent placing hands and fingers into the shear points in the reel handling mechanism. See **Appendix A, Drawings A1, A5, and A6** for additional information.

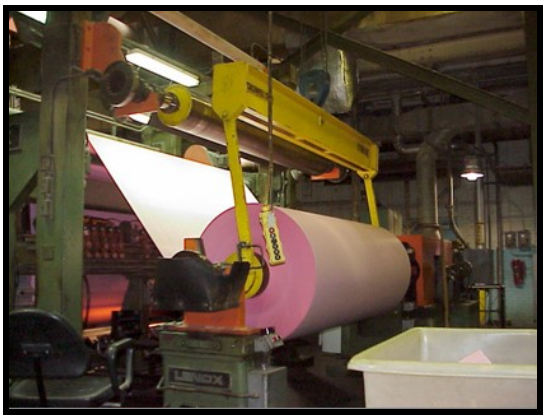


Figure 58. Overhead crane for moving reel to re-winder.

Figure 59. Staging area between winder and re-winder.

Crushing Hazards

Roll Staging Area

Examine and control crushing hazards when the rolls and shafts are moved with overhead cranes equipped with material handling devices. Employees may accidentally be crushed by a roll or shaft that moves or shifts weight suddenly. There is also the potential for accidentally crushing injuries between the roll or shaft and the frame of the machine.

- It is also important that workers lower the rolls in the staging area without inadvertently crushing their feet. Figure 58 illustrates an overhead crane used to move the roll and the placement of a shaft into the winder using a cradle attachment. Figure 59 illustrates the staging area between the winder and rewinder.

- Evaluate the material handling equipment and methods used to mechanically move the rolls and shafts onto and off of the winder and reel. The equipment should be properly installed and maintained and be capable of handling the anticipated load weights.

Provide adequate room to safely operate the equipment and to stage the rolls. Access to the staging area and equipment during roll and shaft handling should be for only authorized individuals.

- Evaluate installing mirrors or closed circuit camera systems to provide the operators with adequate vision of the front, back, and staging winder and paper reel areas. This would allow the operators to visually verify that all other individuals are clear of the equipment before starting the operation.

- Evaluate installing a warning alarm and time delay system to alert operators that the winder and paper reel will start within a predetermined time period. This will help warn anyone working on the machine to move out of hazardous areas before the equipment starts operating.

Walkways and Passageways

Platforms, Ladders, and Stairs

It is important to have slip-resistant platforms of adequate width with top-rails, mid-rails, and toeboards. Provide for properly designed ladder or stairs to access to upper work platforms.

- Keep walkways and aisleways clean and prevent slip and fall and tripping hazards with good housekeeping methods.

- Install an elevated platform that has a slip-resistant surface, such as an open grating design. Install on sides, standard railings top-rail; (42”), mid-rail, and toeboard (4”). Railings must be provided at the ends of catwalks and also for platforms that do not have stairs or ladders. Design the catwalk not to interfere with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisleway, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

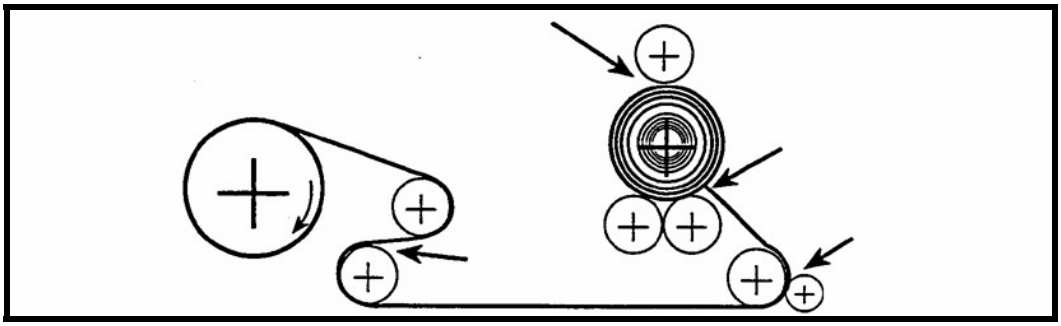
Rotating Hazards

Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator’s skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 illustrates a guarded shaft end.

- Install a fixed barrier guard over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4”, any shaft end longer than 2” would need to be guarded to fully enclose and prevent access. Install barrier guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Rewind



This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of the rewinder are from high speed nips and the potential to be struck by moving cranes, reels, or rolls. The exposures mentioned in this section include:

- Nip Hazards: Platen, Rider, Rewound Rolls and Drum, Threading, Tension Checks, Slitter Knives, Static Electricity
- Crushing Hazards: Roll Handling Systems, Crane Operation, Barrier Guard (Automatic)
- Walkways and Passageways: Platforms, Ladders, and Stairs
- Rotating Hazards: Reel & Roll Shaft Ends

Figure 60. Re-winder and roll stand with side barrier-roll removed

Nip Hazards

Platen, Rider, Rewound Rolls and Drum

Nip hazards exist on rewinders where platens, rider, rewound rolls, and drums rotate towards and contact each other. Due to the different designs and ages, each rewinder must be evaluated to determine the number and types of nip point hazards and the best methods of safeguarding them. The nip points may be accessible from the sides and/or from the infeed and outfeed areas. Figure 60 illustrates one type of rewinder and roll stand with side barrier guards.

Figure 61. Rewinder with safety trip wire inside tip-up.

Platen, Rider, Rewound Rolls and Drum (Cont.)

- Install fixed side barrier guards at each end of the rewinder (front and backside) to prevent fingers and hands from contacting the nips where the paper, platen, roll, and drum contact. See **Appendix A, Drawings A10 and A12** for additional information.

Note: If the nip point is accessible from an adjacent crosswalk or passageway, a full-width nip barrier guard and gate should also be installed in addition to the side barrier guards. Newer rewinders may be equipped with interlocked mechanically operated gates. See **Appendix A, Drawing A4**.

- Evaluate the existing emergency stop switches, trip wires, and related equipment. Install an adequate number of mushroom shaped emergency stop switches on each side of the winder and paper reel. See **Appendix C** for additional details.

Figure 62. Manual threading at job speed.

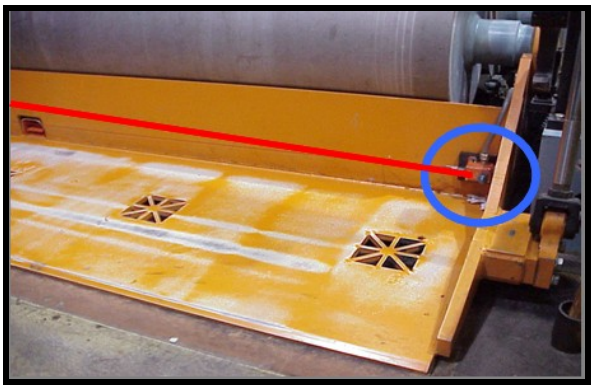


Figure 63. Highlight of interlocked trip wire connected to E Stop shutdown features when workers activate

Threading

Threading the rewinders and roll stands should require the operators to use a safety job to set-up the equipment and proper work procedures and to be aware of the position of co-workers. Refer to **Appendix A, Drawing A13**.

Use a safe method when starting paper into the nip of drum type reels or calender stacks accomplished by the use of feeder belts, carrier ropes, air carriage or other device or instrument:

- Use a rope carrying system wherever possible at points of transfer, or

- Sheaves should be spaced so that they do not create a nip point with each other and the sheave and its support should be capable of withstanding the speed and breaking strength of the rope for which they are intended.

Also, avoid feeding a stack with any hand held device which is capable of going through the nip.

- Evaluate the rewinder threading procedures to identify any practical methods of automatically or semi-automatically threading the paper. If manual threading cannot be eliminated, the rewinder should be jogged or operated at a slower speed during threading procedures.

Whenever feasible, the paper should be positioned and threaded with operators' hands as far away from the nip points as possible. Contact the rewinder manufacturer for information on threading devices.

- Evaluate installing mirrors or closed circuit camera systems to provide the operators with adequate vision of the front, back, and staging rewinder areas. This would allow the operators to visually verify that all other individuals are clear of the equipment before starting up.

- Evaluate installing a warning alarm and time delay system to alert operators that the rewinder will start within a predetermined time period. This will help warn anyone working on the machine to move out of hazardous areas before the equipment starts operating.

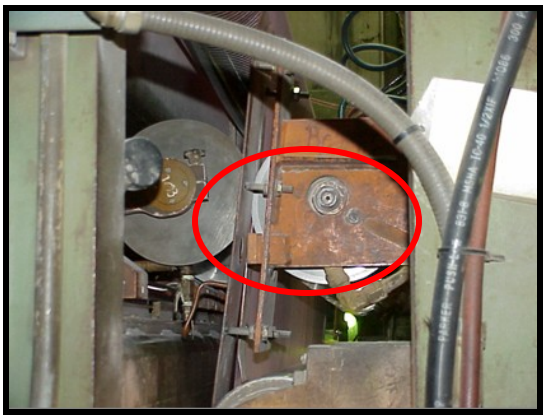


Figure 64. Re-winder guarded slitter knives inside roller housing.

Slitter Knives

Nip points exist between the slitter knives and the rewind platen. The sharp rotating knives also present cut hazards.

- Install individual slitter knife guards or a barrier guard/gate that does not allow access to the slitter area during rewinder operation. If a barrier guard or gate is used, install an interlock so that the rewinder cannot be operated without being in the closed position, interfaced with the emergency stopping limitations of the equipment. Note NFPA 79 for more details on emergency stopping provisions.

Static Electricity

Static electricity is generated by contact and separation of dissimilar material, such as paper traveling at a high speed through the rewinder. Flammable vapors, gases, or dust particles can be ignited by spark discharges. Operators may be injured because of an involuntary reaction caused by shock from a static spark.

- Evaluate and eliminate or reduce the potential of static electricity generation. **Appendix D** discusses the use of static neutralizers, liquid treatments, bonding, grounding, and measurement equipment.

Crushing Hazards

Removing Rolls From Rewinder

There are, in general, two types of equipment for rewinding paper. One uses a shaft and the other is shaftless. In the first type, with a shaft, crushing hazards may exist when the rolls and shafts are moved with overhead cranes. Employees may accidentally be crushed by a roll or shaft that moves or shifts weight suddenly. His or her hands may accidentally be crushed between the roll or shaft and the frame of the machine.

It is also important to lower the rolls in the staging area without inadvertently crushing their feet.

- Evaluate the material handling equipment and methods used to mechanically move the rolls and shafts onto and off of the rewinder. The equipment should be properly installed and maintained and be capable of handling the anticipated load weights.

Adequate room should be provided to safely operate the equipment and to stage the rolls. Access to the staging area and equipment during roll and shaft handling should be for only authorized individuals.

With the second, shaftless type, there is the potential that someone could be accidentally crushed by the automatically operating rewind barrier guard or by a moving roll of paper exiting the rewinder.

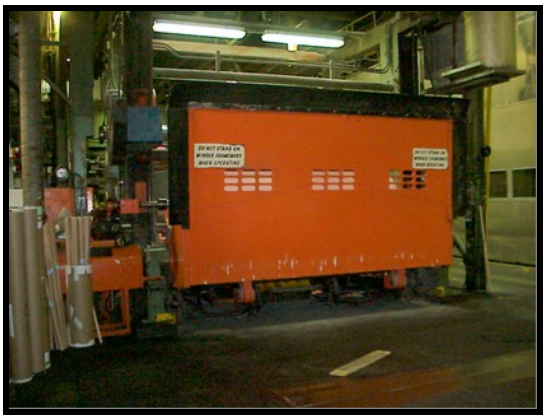


Figure 65. Rewind barrier that is automatically operated.

Removing Rolls from Rewinder Cont.

- Evaluate installing a warning alarm and time delay system to alert operators that the rewinder barrier will start opening and closing within a predetermined time period. This will help warn anyone working on the machine to move out of hazardous areas before the equipment starts operating.

Post prominent warning signs that use symbols, graphics, and/or multilingual words to inform individuals that the barrier is automatically operated.

Slip and Fall Hazards

Platforms, Ladders, and Stairs

It is important to have slip-resistant platforms of adequate width with top-rails, mid-rails, and toeboards. Design ladders or stairs to access upper work platforms.

Keep walkways and aisleways clean and prevent slip and fall and tripping hazards with good housekeeping methods.

- Install an elevated platform (if necessary) that has a slip-resistant surface, such as an open grating design. It should be equipped on both sides with standard railings; top-rail (42”), mid-rail (18”), and toeboard (4”). Install protective railings at the ends of catwalks or platforms that do not have stairs or ladders. Design the catwalk so that it will not interfere with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisle, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

Rotating Hazards

Shafts and Shaft Ends

Rotating shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 illustrates a guarded shaft end.

- Install a fixed barrier guard over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4", any shaft end longer than 2" would need to be guarded to fully enclose and prevent access. Install guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Basement

This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of the basement are from nips and uneven footing, caused by broke and other debris. The exposures mentioned in this section include:

- Access: Platforms, Ladders, and Stairs
- Nip Hazards: Carrier Rolls, Rope, and Sheaves
- Walkway and Passageways: Floors
- Rotating Hazards: Couplings, Shafts, and Shaft Ends

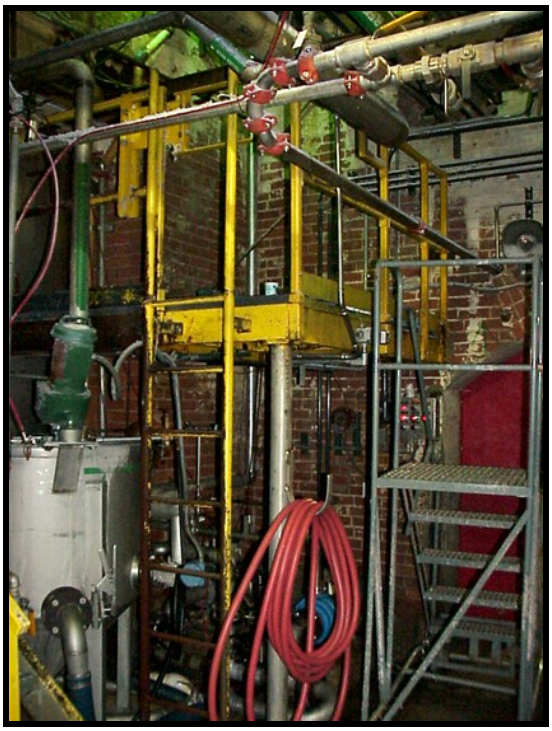


Figure 66. Platform, railings, and ladder.

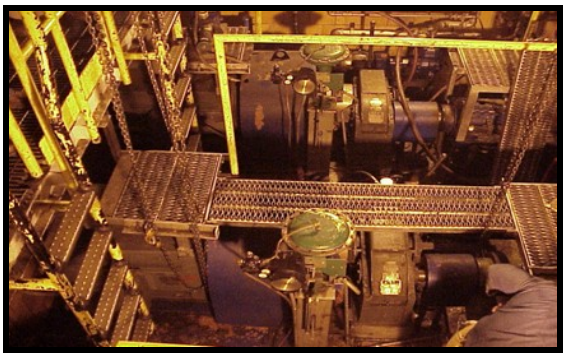


Figure 67. Equipment pit.

Access

Platforms, Ladder, and Stairs

Slip and fall hazards exist due to the wet basement environment. It is important to have slip-resistant platforms of adequate width with top rails, mid rails, and toeboards. Railings are also necessary to prevent individuals from accidentally falling down into areas (equipment pits) that are lower than the main walkway.
Good housekeeping methods are needed to keep walkways and aisleways clean and prevent slip/fall and tripping hazards.

- Install an elevated platform (if necessary) that has a slip-resistant surface, such as an open grating design. It should be equipped on both sides with standard railings; top rail (42”), mid rail (18”), and toeboard (4”). Install railings at the ends of platforms that do not have stairs or ladders. Design the catwalk so that it does not interfere with operator adjustments. See **Appendix B, Drawings B1 and B4** for additional information on dimensions and construction features.

- Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisleway, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2, B3 and B5 – B8** for additional information on dimensions and construction features.

Platforms, Ladder, and Stairs Cont.

- Install standard railings; top rail (42”), mid rail (18”), and toe board (4”) around equipment pits that are 4 feet or more lower than walkway. Railings should also be installed, if the height difference is less than 4 feet and if there is the potential for serious employee slip and fall injuries.

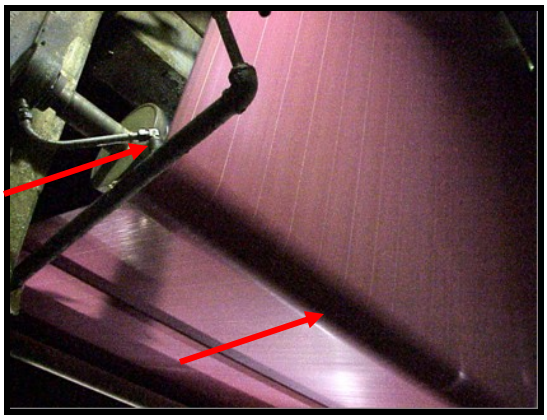


Figure 68. Dryer felt carrier nip hazards- basement.

Figure 69. Dryer felt carrier partial guard- above.

Nip Hazards

Carrier Rolls

Nip hazards exist where the felt contacts the dryer carrier rolls in the basement area. The nip points may be located at different heights ranging from near floor level to above shoulder height.

- Install a fixed side barrier guard at each end of the dryer felt roll to prevent fingers and hands from contacting the nips where the felt and roll contact. Here there are **two sources of contact**- the inrunning nip AND the roller coupling on each side. See **Appendix A, Drawings A10 and A12** for additional information.

Note: If the nip point is accessible from an adjacent crosswalk or passageway, install a full width nip barrier guard in addition to the side barrier guards. See **Appendix A, Drawing A4**.

Rope Sheaves

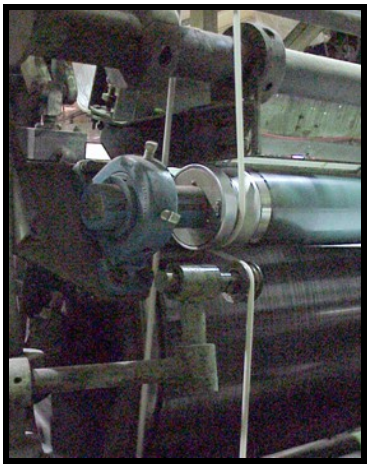


Figure 70. Exposed nip points- rope/ sheaves.

Nip points exist where the ropes contact the sheaves and where there are counter-weights for felt adjustments. These should be enclosed and guarded to protect tool operators working in this area from getting their fingers, hands, clothing, or hair caught in the nips.

- Enclose the rope sheaves so that the nip points are not accessible. See Figure 36 as an example of a ‘partial’ fixed barrier enclosure- akin to a shield. For other guarding alternatives, see figures contained in the 'Presses' section.

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Rope Sheaves Cont.

- Evaluate the existing emergency stop switches, trip wires, and related equipment accessible from the basement area. An adequate number of emergency stops should be available, visibly and easily accessible. See **Appendix C** for additional details.

Figure 71. Typical basement with wet floor.

Walkways and Passageways

Floors

The process of manufacturing paper uses large amounts of pulp, water, and other substances that may splash onto floors posing slip and fall hazards.

Since it is difficult to prevent splashes onto the floor in the basement area, good housekeeping, well maintained slip-resistant floors, proper footwear, and safe work habits are essential.

- Provide a slip-resistant floor surface that has adequate drainage (floor drains, slight angle) and maintained on a regular basis. Whenever possible, it is preferable to use engineering controls such as barriers, and precisely directed water jets to prevent unnecessary substances from splashing onto the floor. Information on engineering and administrative controls is contained in **Appendix B, Slip and Fall Prevention Methods**.

Rotating

Couplings

Protruding bolt heads, keys, screw threads, etc., on rotating couplings can catch loose clothing and hair or cut operator's skin. Figure 2 illustrates a coupling guard.

- Install a fixed barrier guard to fully enclose and prevent access to each rotating coupling.

See **Appendix A, Drawing A7** for additional information.

or

- Install a flexible barrier guard to fully enclose and prevent access to each rotating coupling if a solid guard is not feasible, or if the amount of shaft that is exposed changes during machine cycles.

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Rotating

Shafts and Shaft Ends

Rotating shafts and shaft ends can catch loose clothing and hair or cut the operator's skin. The hazard is further increased if protruding bolt heads, keys, screw threads, etc., exist. Figure 3 illustrates a guarded shaft end.

- Install a *fixed* barrier over exposed shaft ends whose length is more than half the diameter of the shaft. Per OSHA 1910.219 (C) (4) (i), projecting shaft ends present a smooth edge and shall not… project more than .5 the diameter of the shaft unless guarded by non-rotating caps or sleeves. As an example, if the shaft diameter were 4", any shaft end longer than 2" needs to be guarded to fully enclose and prevent access. Install suitable protective guards over exposed shafts that are rotating at a high speed or have protruding bolt heads, keys, screw threads, etc. See **Appendix A, Drawing A8** for additional information.

Roll Wrap

This section contains alternative recommendations for each exposure. The configuration of the specific paper machine may determine which recommendations may be feasible for implementation or modification.

Potential Safety Exposures

The primary exposures of roll wrap occur from nip points, burn contact with hot adhesive platens, and potential crushing contact with closing platens or paper rolls as they enter and exit the wrap deck area. The exposures mentioned in this section include:

- Access: Platforms, Ladders, and Stairs
- Contact Hazards: Rolls, Cradle , and Platens
- Walkways on Deck Floors
- Rotating Hazards: Couplings, Shafts, and Shaft Ends

Figure 72. Roll Wrap Cradle

Machine Contact Hazards

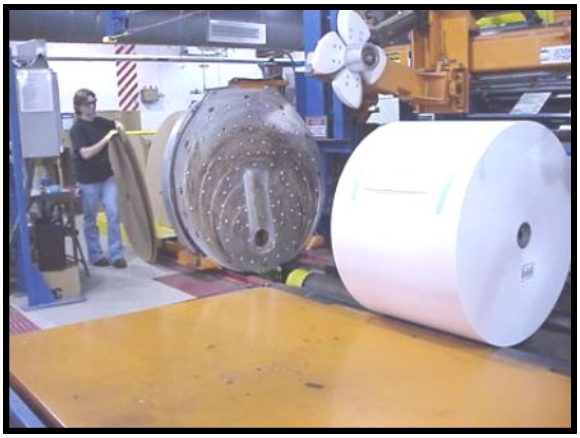
- Contact with Cradle In-Feed- Activated by operator on upstairs platform. Pit area and cradle enclosed with structural barricade/fence. Prohibit access “in, under, and around” the point of operation where cradles transport rolls from lower to upper deck with robotic-like precision and movement. See Figure12 for complete enclosure and **Appendix A, Drawings A1, A2, and A12.**

Figure 73. Partial Perimeter Fencing around Roll Cradle awaiting lift to upper deck wrap area.

- Fall and Cradle Contact Risk- Avoid entry into roll pits. Do not climb over or under railings protecting roll movement from the lower to upper decks.

Cradle lifts roll to upper platform and then roll is ejected and rolled into the roll wrap area

Figure 74. Roll Wrap- Cradle in "Up" Position.



- Wrap and Roll- Operators must stand clear of closing platens during cycle where adhesive covers clamp to roll ends. Process occurs on both sides of the area between the hot platens, where the roll moves to the wrapping area. Supplies are on one side and the labels and control panel are on the other.

Figure 75. Roll Wrap- Hot Platens Awaiting Compression

- Wear heat resistant gloves on roll wrap deck, as burns are a serious exposure if operators come into contact with the hot platens.
- Emergency stopping capability is accessible by the prominent location of the overhead trip cord. This feature must override all other controls that supply energy and movement to this machine.
- Protective hand-wear is essential for this task. Gloves should be of a non-stick surface so labels will not adhere to glove surface. See Figure 79.

Figure 76. NOTE- Overhead trip cord for E-Stop. Also note heat resistant hand wear for this task when working with adhesive surface.

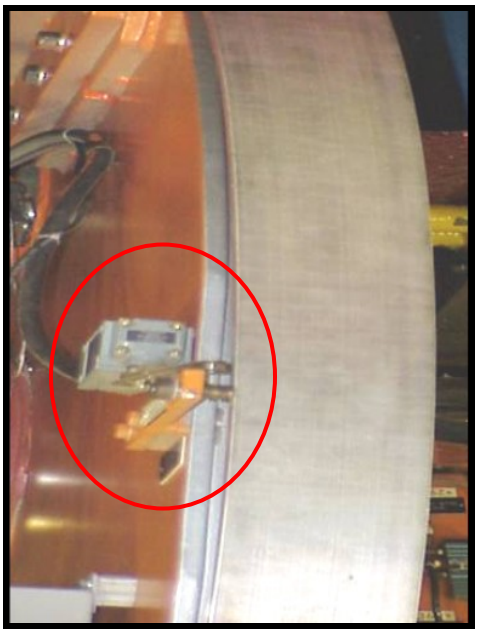


Figure 77

- Use emergency stop trip cables overhead and E-stop (RED) (see Figure 76) buttons to cease motion to the roll process when inside the wrap sequence. Note the connection to the interlock shutoff device (see Figure 83) capable in some applications of separating the platens as well as inputting an emergency shutdown signal to cease motion (Figure 77). In this case, the platens have been equipped with a 'pressure sensitive' surface that, when touched, sends a stop signal to the machine and ceases machine motion.

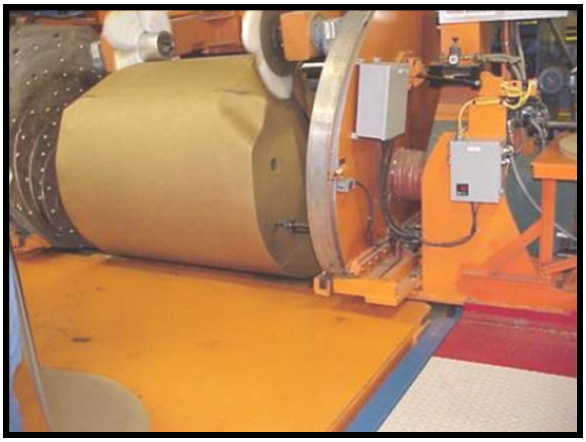


Figure 78. Roll Wrap- Crimping Edges before Labels

- Paperboard "circles" are placed inside the hot platens and held by a metal probe while the ends of the roll cover paper are depressed. Then, the paper circle is manually placed on the hot platens. The operator withdraws, sequences the closure of the platens and steps away from the machine movement (Figures 78)

Figure 79. Roll Wrap- Label placement

- Finished Roll Wrap- Once complete, the label is applied manually; the finished rolls automatically 'roll' laterally down the deck, and rest on a push deck, before moving onto the slat conveyor

Figure 80.Robotic Roll "Flipper" in Vertical Position

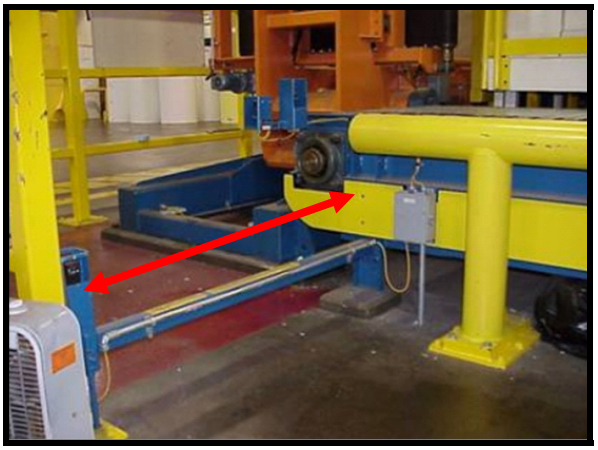


*Figure 81. **RED** arrow simulates light curtain controlling access to **RED** floor danger zone*

Figure 82.Robotic roll flipper returning to vertical position after rolls have been transferred to slat conveyor.

- Contact with Robotic Roll "Flipper"- Light curtain protects roll placement to avoid potential access to moving rolls and 'robot' workspace. Employee access is possible under the barrier railing. A light curtain gives some additional protection near the end of the slat conveyor to avoid encroachment on the finish conveyor where packaged rolls rest awaiting storage and staging (Figure 80 -82).

Figure 83. - E-Stop on Roll Wrap Deck

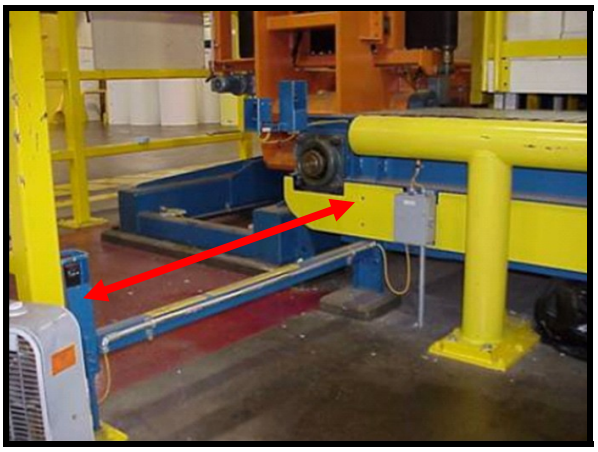


Figure 84. - Danger Zone- Encroachment area where Light Curtain (red arrow) protects workers from entering roll flipper

Figure 85.-Staging Area where finished rolls await pickup with forklift. Note marked aisles.

Emergency Stop Capabilities- Provides for quick access at edge of platform between the tilting table and the cradle at roll wrap. Precautions include assurance that all operators and employees understand the extent of machine movement that this protects- here it is only the conveyor movement, not the platen sequence- an independent function for a different set of risk. Note that per NFPA 79, emergency stop devices must be prominent **RED** in color, mounted in an area near the hazards to minimize risk BEFORE contact, and provided with a reset function that will not allow the machine to automatically begin movement when the start cycle is re-initiated (see Figure #83 and **Appendix C**)

- Walking Working Surfaces- Note the **RED** flooring located inside the protected zone where the horizontal rolls are hoisted 90 degrees with this CNC feature, transferring the finished rolls vertically and another 90 degree lateral turn to place them on the conveyor to the right (**BLUE** structure within the **YELLOW** barricades- see Figures #84 and 85), where they proceed down-line to await PIT transport to shipping.

- Presence Sensing Devices- Figure 84 shows the **RED** floor area protected from worker encroachment, signified by the **RED** arrow where the light curtain interfaces with the tilt table (flipper) movement to prohibit entry when the tilt mechanism is cycling. This is an essential feature to allow the machine to recognize a worker in the danger zone to effectively cease machine movement and disallow restart until the operator has reset the machine in a 'production' mode. Structural barricades also limit PIT access and aisles well marked for isolating pedestrian travel from hazardous areas (See Figure 85).

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Converting Operations

Potential Safety Exposures

Primary risk of injury here occur from nip points, contact with moving machine parts and rotating hazards, and falls from elevated work platforms. Further details covered in this section include:

- Access: Platforms, Ladders, and Stairs
- Contact Hazards: Rolls, Machine Gears and Belt Drives
- Walkways on Floors
- Machine Hazards: Chain Drives, Interlocked Access and Moving Parts

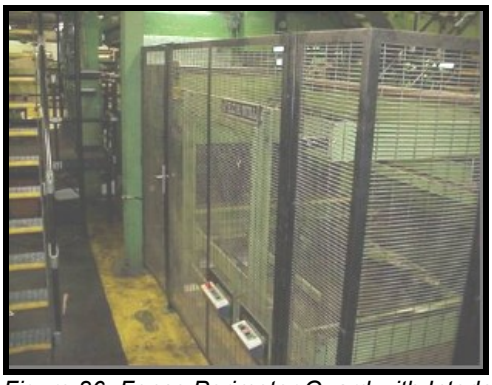


Figure 86- Fence Perimeter Guard with Interlock on Sheeter

Figure 87- Lexan Guard with Interlock

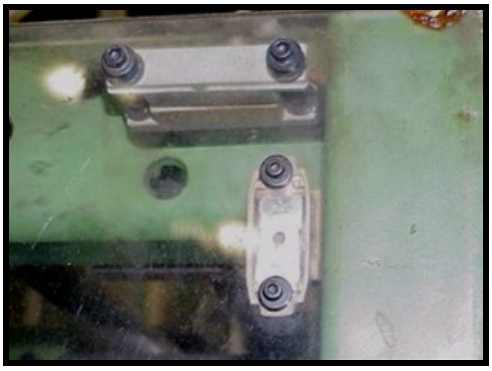


Figure 88- Close up of Lexan interlock device

Machine Contact Hazards

- Fixed 'fence' perimeter safeguard enclosing moving parts on sheeter. Interlocked device requires key to open gate and enter- will automatically cease machine movement when opened. For equipment not capable of stopping immediately upon opening an interlocked barrier, combination interlock mechanisms can protect the user by disengaging machine actuators, but delaying entry by withholding gates in the closed condition until all machine movement is ceased.

- Carton Packer- Lexan or polycarbonate gate protects users and bystanders from access into moving machine parts on this carton packer machine. Barriers must cover accessible moving parts when in closed position. When interlocked, the machine movement ceases promptly when opened (Figure 88).

Figure 88- Warning Strobe on Box Machine

Figure 89- Adjustable Lexan barrier guard on boxmaking machine- has readily removable fasteners.

Figure 90- Exposed Chain Drive on Side of Lidder Control Station

- Warning strobe or light indicates that machine is 'down' and under repair or surveillance. Because some portions of machine are not within normal vision or in immediate control of the operator, these warning lights are a prudent control to help inform others nearby that lockout/tagout protocol may be pending and that conditions require special precautions.

- Boxmaking Machine- Adjustable Lexan barrier provided to protect entry into hazardous moving parts and point of operation risks. Side with common access to aisle needs interlock device to assure barrier is in place when machine is in production mode.

- Lidder Control Station- Polycarbonate/Lexan guard should extend around open sides to prevent access to the chain drive. Some barrier guards may need additional scrutiny to be certain they protect entry from all points. Again, to help assure use, most barrier safeguards are interlocked with the machine operation, when capable of stopping before the worker can gain entry, with a suitable interlock device. NOTE- Interlocks augmenting a barrier guard must not be bypassed except where alternate procedures or devices provide a level of safety equivalent to that provided by the interlock. Interlocks are 'bypassed' anytime the designed control strategy is disconnected by means including, but not limited to, a temporary wiring change, physical interference or a temporary software change.

Figure 91- Lidder Station partially exposes workers to unprotected moving machine parts

Figure 92- Embossing Die storage area- only 4.5' but still requires fall prevention measures

Figure 93- Removable Crossover Walkway

- Lidder Station- The lid positioner offers an uncontrolled machine moving part that can be protected with the use of an electronic PSD (Presence Sensing Device) – a light curtain, for example, or an interlocked gate or barrier guard (Figure 91 and Figure 8A).

Refer to Appendix A for Drawings A2, A5, and A6 for power transmission and fixed barriers to protect various moving machine parts.

Elevated Walking Surfaces

- Elevated Walking Surfaces- Platform where embossing dies are stored .has no perimeter fall protection. Per OSHA 1910.23 (b) (ii), "every wall opening from which there is a drop of move than 4' shall be guarded," even temporary wall opening here suitable for upper level storage off the floor. Although persons need to access this area with an overhead hoist, a suitable railing and midrail is necessary at all other times to avoid the risk of falls to the floor level. See **Appendix B, Drawings B2, B4 and B6-B8.**

  - Install properly angled platform access ladders that have a slip-resistant surface, such as an open grating design. They should be equipped with standard handrails on both sides of the ladders. If the ladders extend too far into the main aisle, replace with permanent stairs installed perpendicular to the platform. See **Appendix B, Drawings B2 and B3** for additional information on dimensions and construction features.

Beater Room and Baling/Compacting

Potential Safety Exposures

Primary injury risk of injury in the beater room and from compacting operations occur from crushing in the compactor, falls into the beater vat and elevated work levels, nip points from contact with moving machine parts and rotating hazards. Common hazards covered include:

- Access: Platforms and Elevated Surfaces, and Wet Floors
- Contact Hazards: Rolls, Machine Gears, Beater Augers, and Belt Drives
- Confined Space: Potential Oxygen Limitation, Engulfment
- Material Handling; Manual Movement of Broke on Slab Cradle

Figure 94- Broke Chutes in Converting

Figure 95- Bailer in Basement

*Figure 96- E-Stop in **RED** circle*

Beater Room and Baling/Compacting

- Chutes from Converting Floor- Bins taken to balers or dumped into beaters. Dust accumulation and waste paper makes for slippery floors in some areas. Also, excessive paper debris buildup near electrical wires and fixtures create fire risk.

- Baler controls have 'dead man' features that require manual pressure sustained for complete baler cycling. When pressure is released, baler stops. Avoid bystanders from 'helping' to be certain they are clear of machine movement. Perform planned 'lockout/tagout' protocol on balers, as with other machines, when service or paper 'jams' require work on machine functions and operation. Refer to Figures 95 and 96).

- Testing safety devices- Brakes, backstops, anti-runaway devices, overload releases, emergency stops, and other safety devices must be inspected and tested frequently to ensure that all are operative and maintained in good working condition. Maintain discrepancy reports to inform supervisors that machines are disabled until corrected. Refer to **Appendix C**.

Figure 97. - Protective Railing on Baler at Operator Position

- Protective barriers- Structural yellow fence around operator station to prohibit access to baler when in motion- note however, this has no interlock mechanism or presence-sensing device to shut down the machine cycle if the operator leaves that position. The 'dead man' feature on the controls helps provide a 'hostage' affect.

Figure 98- Bales Awaiting Wires to be Cut on Conveyor

- When clipping wires off bale and pushing paper into broke holes or beaters, employees run the risk of falling into the conveyor and into the hopper below. The inclined and raised conveyor surface here makes it less likely for worker 'falls' into the beater vat, however; there may be situations where additional perimeter protection is necessary.

Figure 99. - Cradle holding slabbed paper for Beater

Figure 100. - Beater with Toe Board, Mid Rail, and Top Rail to serve as fall prevention

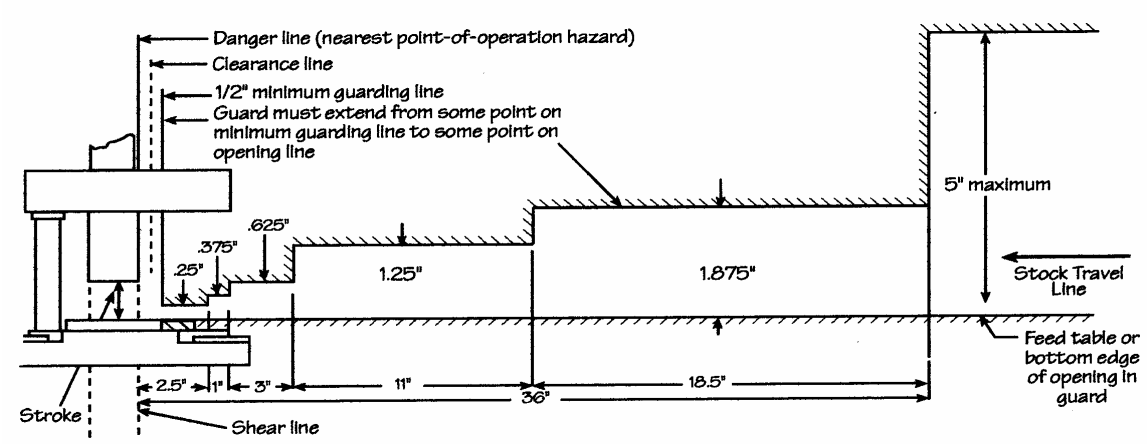
- Cradle for slabbed paper located at beater vat entry. Forklift partially raises/tips cradle, then employee's drag, push/pull paper into beaters often creating a serious risk of slips and falls, in addition to the manual material-handling task to manipulate the heavy paper. When pulling broke off the cradle nearby the beater vats, workers should assure that appropriate railing protection is in place or that suitable fall prevention harness and lanyards are effectively used. See Figure Appendix E, Figure E3).

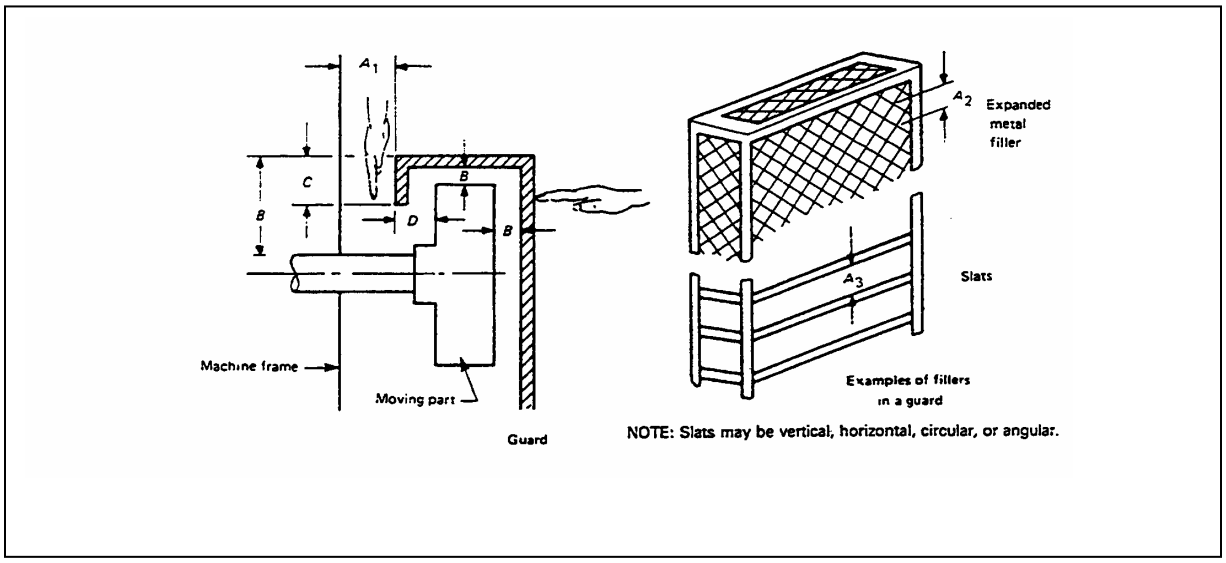
- Fall Protection- Use guardrails 42 inches high around beaters when tub tops are less than 42 inches from the floor. Install guardrails per the requirements in OSHA 1910 Subpart D, Walking-Working Surfaces. A guardrail of standard height must be installed when the top edge of vessels or tubs is less than standard height guardrails above the floor or operator's platform. If necessary for the protection of the person feeding equipment, provide an intermediate guardrail (see Figure 100 and **Appendix B, Drawing B4**).

- Confined Space Entry- Entering the beaters to remove broken pallets requires proper CSE protocol. Refer to Appendix E and F for appropriate standards and guidance.

Appendix A
Safeguarding Methods

Drawing A1. Guard Distance vs. Opening Size (First of Three Pages)





This diagram shows the recommended safe openings between the bottom edge of a fixed or adjustable barrier guard and feed table at various distances from the nearest point of operation (or shear) hazard. The dimensions are used in the design, installation, adjustment, and use of guards for feeding of material, visibility slots, part/scrap or material ejection, use of stock gauges, and other necessary openings, common in the paper processing industry. NOTE that the clearance line provided in the first diagram above marks the distance required to prevent contact between the guard and moving parts. The minimum guarding line marks the distance between the infeed side of the guard and the danger line.

Drawing A1. - Guard Distance vs. Opening Size- (Second of Three Pages))

TABLE 1

RECOMMENDED MINIMUM DISTANCE AS A FUNCTION OF GAP SIZE (INCHES)

Known Gap Size	*Recommended Minimum Distance*
0.000 – 0.250	≥ 0.5
0.251 – 0.375	≥ 2.5
0.376 – 0.625	≥ 3.5
0.626 – 1.250	≥ 6.5
1.251 – 1.875	≥ 17.5
1.876 – 5.000	≥ 36.0

Greater than 5.000 inch gap not allowed

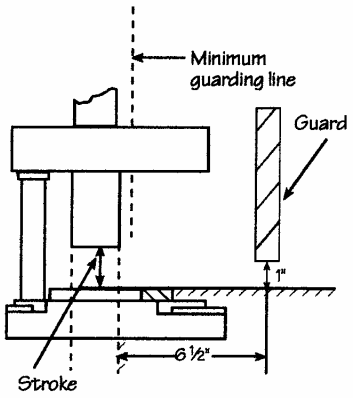
TABLE 2

RECOMMENDED MAXIMUM GAP SIZE AS A FUNCTION OF KNOWN DISTANCE (INCHES)

Known Distance	*Recommended Maximum Gap Size*
0.5 – 2.49	≤ 0.250
2.5 – 3.49	≤ 0.375
3.5 – 6.49	≤ 0.625
6.5 – 17.49	≤ 1.250
17.5 – 35.9	≤ 1.875
≥ 36.0	≤ 5.000

Less than 0.5 inch distance not allowed

Suppose it is necessary to provide a 1" opening between the bottom of a guard and the top of the feed table so that material can be fed into the press. The chart at right shows that a guard with a 1" feed zone opening should be positioned at least 6½" from the point-of-operation (shear point).



Note: remainder of guard (sides, top) not shown for clarity reasons.

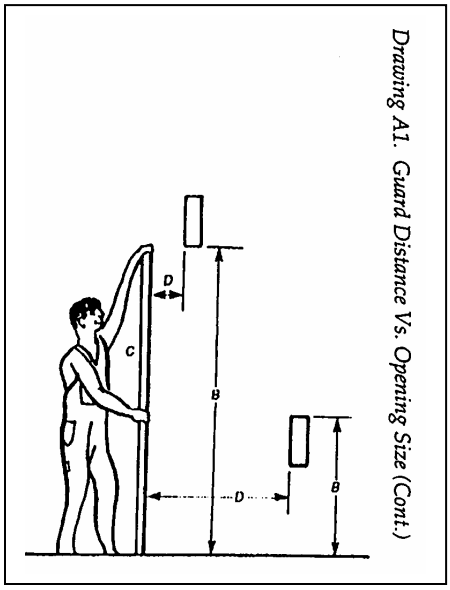
NOTE- The previous step gauge safe opening figures and values represent summary findings from Liberty Mutual in a study completed in 1993. Although more conservative values and distance requirements than OSHA's Table O-10 (Subpart O), these values are being adopted by ANSI B11 series standards in each new revision after 2000. The newest B11 standard developed with this new set of values is ANSI B11.19-2003; Performance Criteria for Safeguarding Machine Tools.

Drawing A1. Guard Distance vs. Opening Size (Final of Three Pages- A1.)

NOTE: This table is adapted from ISO 4254/1-1985, where the values stated are SI units and regarded as the primary units. All conversions to U.S. customary units round to the nearest inch.

**All values in mm/in.*

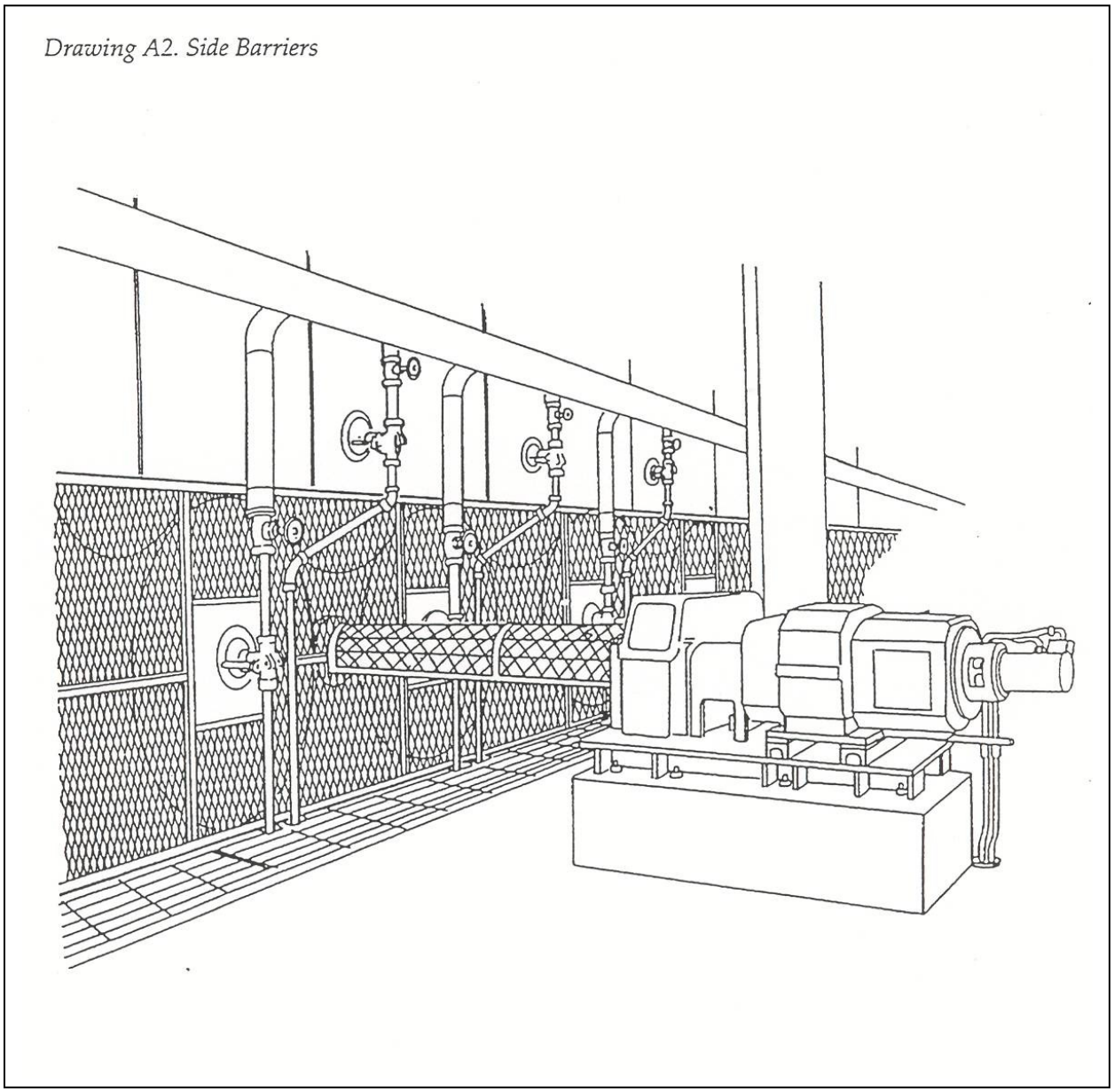
	C*							
	2440/96	2200/86	2000/78	1800/71	1600/63	1400/55	1200/48	1000/40
B*	D*							
2440/96	0	100/4	100/4	100/4	100/4	100/4	100/4	100/4
2200/86		250/10	360/14	400/16	500/20	500/20	600/24	600/24
2000/78			360/14	500/20	600/24	700/28	900/36	1100/43
1800/71				600/24	900/36	900/36	1000/40	1100/43
1600/63				500/20	900/36	900/36	1000/40	1300/51
1400/55				100/4	800/32	900/36	1000/40	1300/51
1200/48					500/20	900/36	1000/40	1400/55
1000/40					300/12	900/36	1000/40	1400/55
800/32						600/24	900/36	1300/51
600/24							500/20	1200/48
400/16							300/12	1200/48
200/8							200/8	1100/43



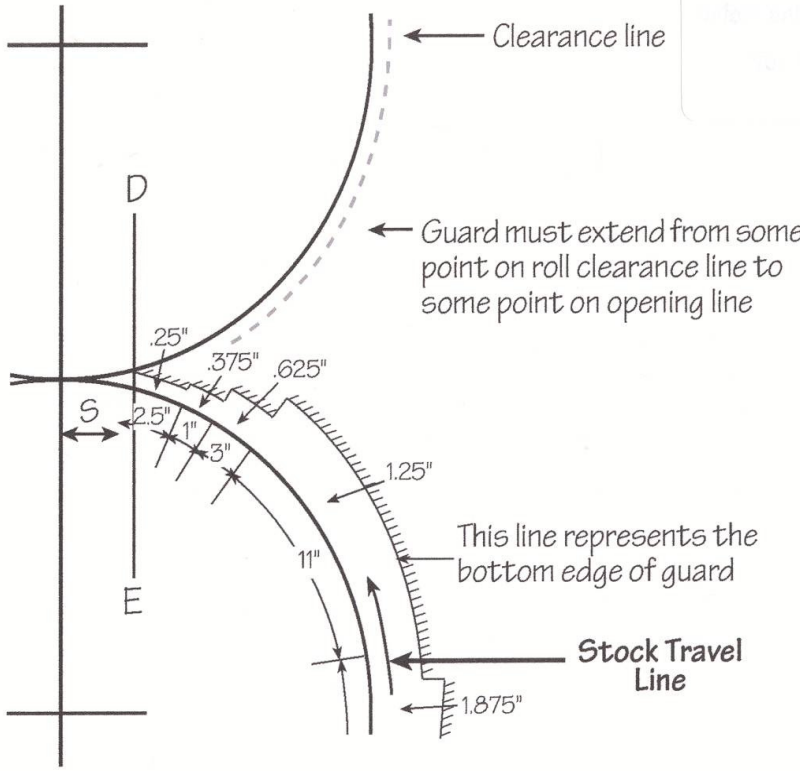
Drawing A1. Guard Distance Vs. Opening Size (Cont.)

"B" is the vertical distance to the hazard - see drawing.
"C" is the vertical height of the barrier.
"D" is the horizontal distance to the hazard.

Drawing A2. Side Barriers



Drawing A3. Guarding In-Running Rolls



This diagram shows the recommended safe openings on an in-running roll nip where stock travels over one roll before entering the nip.

The various openings are such that for average size hands, they do no t permit operator's fingers to reach nip point even though guard contact is on back of fingers, hand, or forearm.

Because the nip zone area varies in size and shape, it is necessary to reestablish a definite procedure for determining a point from which to develop dimensions for locating a guard.

STEP 1 - Outline of nip zone should be drawn full scale. Draw clearance line for top roll. If more than 1/4" clearance is required, the top edge of guard should be located in accordance with safe opening layout.

STEP 2 - Use scale to determine where there is a 1/4" space between roll surfaces on stock travel line. Draw radius line (DE) distance between line (DE) and clearance line of rolls is (S) distance on chart measured on roll.

STEP 3 - From line (DE), begin layout on roll with stock travel of safe opening dimensions as shown in drawing. Layout can be made on roll surface with 1/2" divider steps. Outline guard section - (one edge touching clearance line and other touching safe opening layout at proper point to give required opening.) Determine necessary dimensions for properly locating guard from the final layout. Width of guard will be determined in addition to locating dimensions.

CAUTION:

When installing guards with openings over 1/4", operators should test to make certain the guard is effective before rolls are operated. Check also for stability of mounting and rigidity of construction.

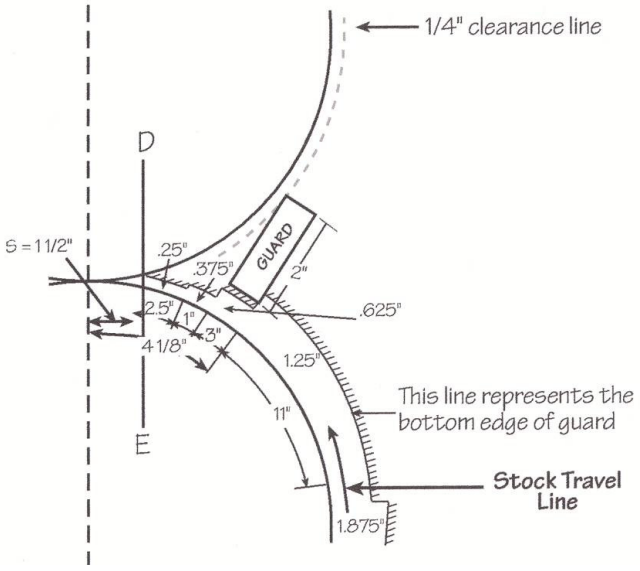
Drawing A3. Guarding In-Running Rolls (Cont.)

EXAMPLE

It is necessary to provide a ½" opening under a guard so that material can be fed to a set of 16" diameter rolls.

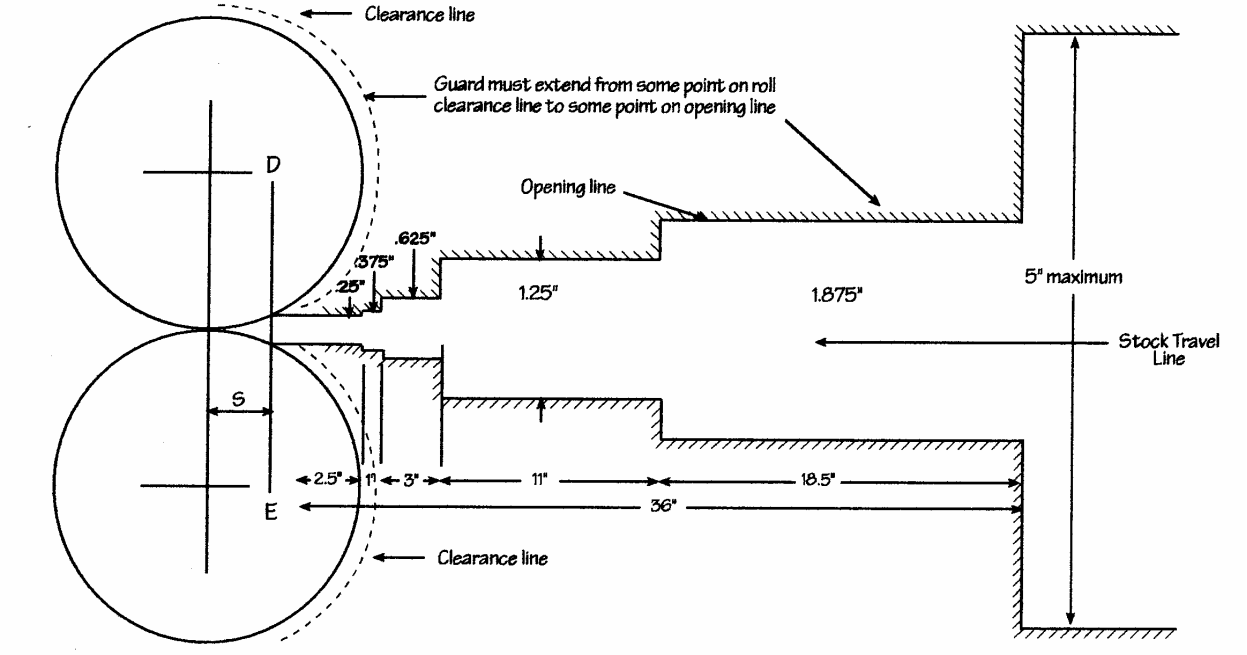
The point where there is a ¼" space between the surface of the two rolls (measured on a radius line of bottom roll) is 1½" from the center of the rolls. This provides the line DE from which to lay out the safe opening dimensions. The nearest point that ½" is acceptable is 3½" from line DE or 5" from the center of the rolls measured on the surface of the bottom roll.

In this case, a ¼" clearance on the top roll was selected. When the guard section (⅜" thick) was positioned on the layout, it was possible to determine the guard width which is 2".



Drawing A4. Guard Distance vs. Opening Size - Central Feeding

- This diagram shows the recommended safe openings for in-running rolls requiring a central feed zone.
- The various openings are such that for average size hands, they don't permit the operator's fingers to reach the nip point even when the guard contacts the back of fingers, hand, or forearm.



Because the nip zone area varies in size and shape, it is necessary to establish a definite procedure for determining a point from which to develop dimensions for locating a guard.

STEP 1 - Outline of nip zone should be drawn full scale with stock travel line accurately indicated in layout. Draw clearance line for both rolls. If more than 1/4" clearance is required between edges of guard and rolls, the edges of guard should be located in accordance with safe opening layout.

STEP 2 - Use scale to determine where there is a 1/4" space between roll surfaces on stock travel line. Draw vertical line (DE). (Distance between line (DE) and clearance line of rolls is *S* distance on chart.)

STEP 3 - From line (DE), begin layout of dimensions shown above centered on travel line. Outline guard sections giving required opening between sections. (One edge of each section will touch clearance line *A*. The other will touch safe opening line *B* at proper point to give required opening.) Determine necessary dimensions for properly locating guard from this final layout. Width of guard sections will be determined in addition to locating dimensions.

CAUTION:

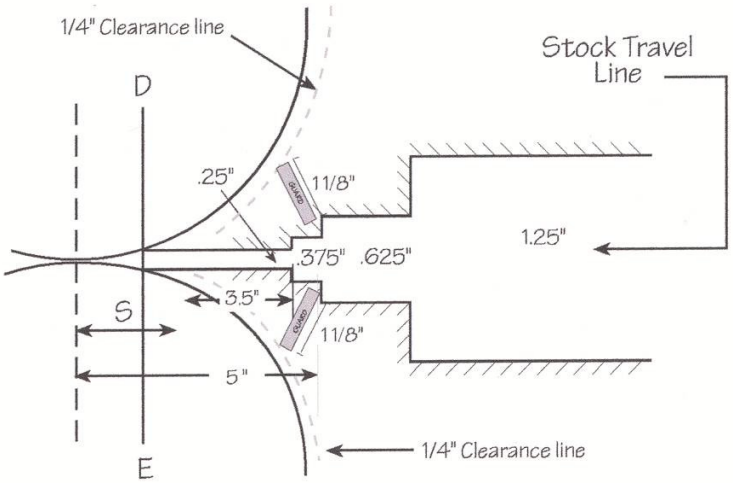
When installing guards with openings over 1/4", careful test to make certain the guard is effective before rolls are operated. Regularly check for guard mount stability and rigidity of construction.

EXAMPLE

It is necessary to provide a ½" opening between guards so that material can be fed to a set of 16" diameter rolls.

The point where there is a ¼" space between the surface of the two rolls (measured on a radius line of bottom roll) is 1½" from the center of the rolls. This provides the line DE from which to lay out the safe opening dimensions. The nearest point that ½" is acceptable is 3½" from line DE or 5" from the center of the rolls measured on the surface of the bottom roll.

In this case, a ¼" clearance on the top roll was selected. When the guard section (⅜" thick) was positioned on the layout, it was possible to determine the guard width which is 1⅛".

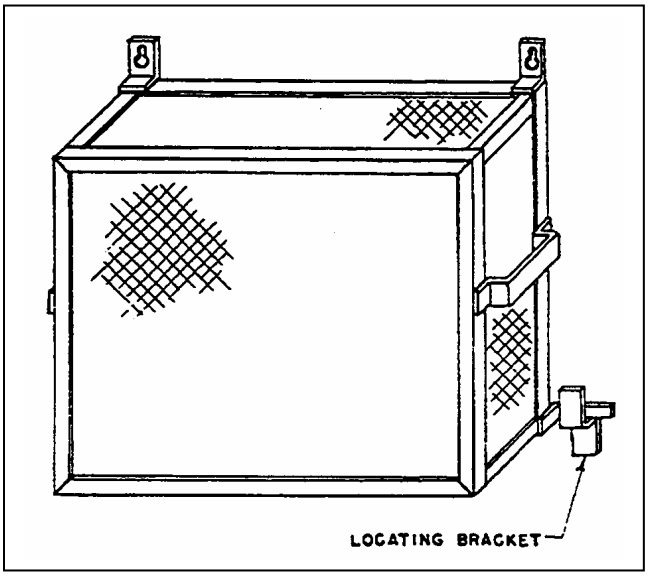


Drawing A5. Power Transmission Guards

FIG. 1

Keyhole type attachment for guard suspended on machine frame.

Used when frequent removing of entire guard is necessary.



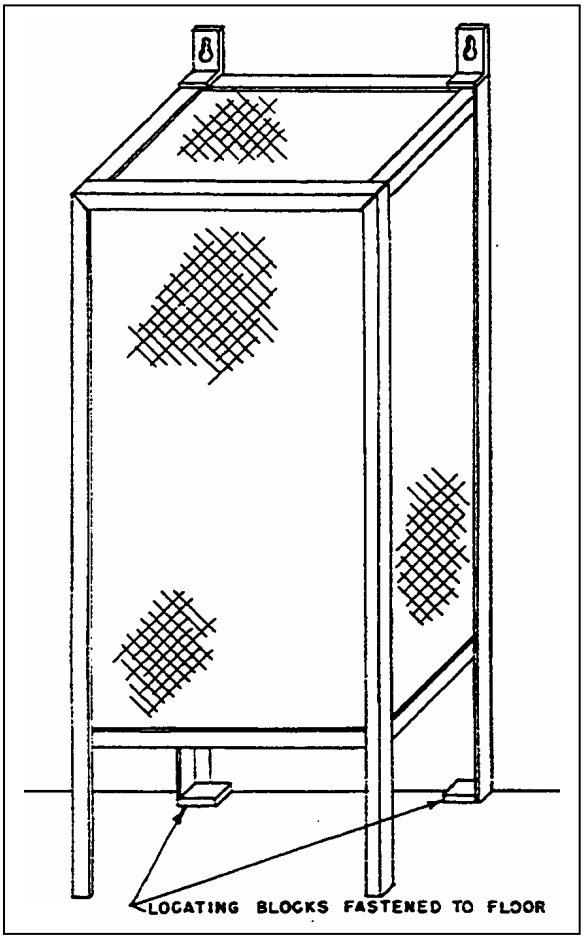


FIG. 2

Keyhole type attachment with location blocks on floor, used to hold guard in place.

Drawing A5. Power Transmission Guards (Cont.)

FIG. 3

Floor mounted guard.

Special sockets for mounting guards on floor are available commercially.

When no exposure exists near floor level, maximum open space should facilitate easy cleaning access.

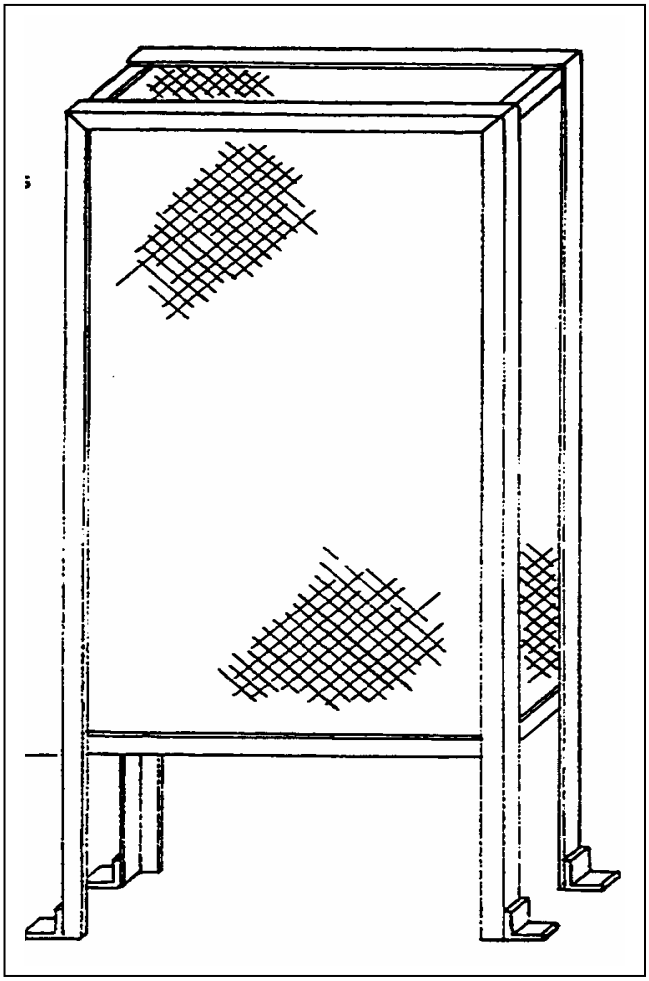
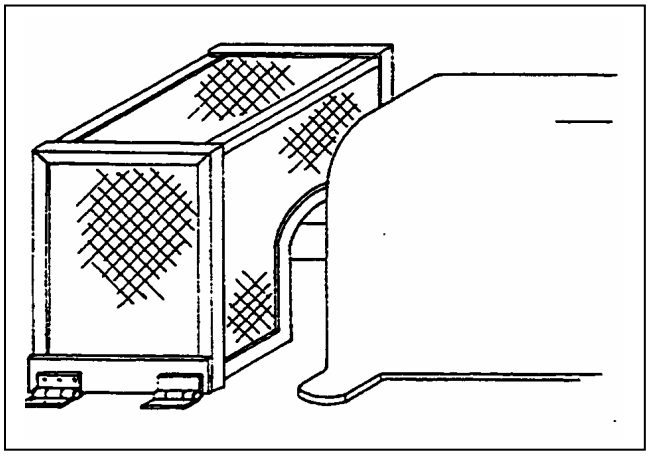


FIG. 4

Guard hinged on floor over power transmission. Equipment located near floor level.



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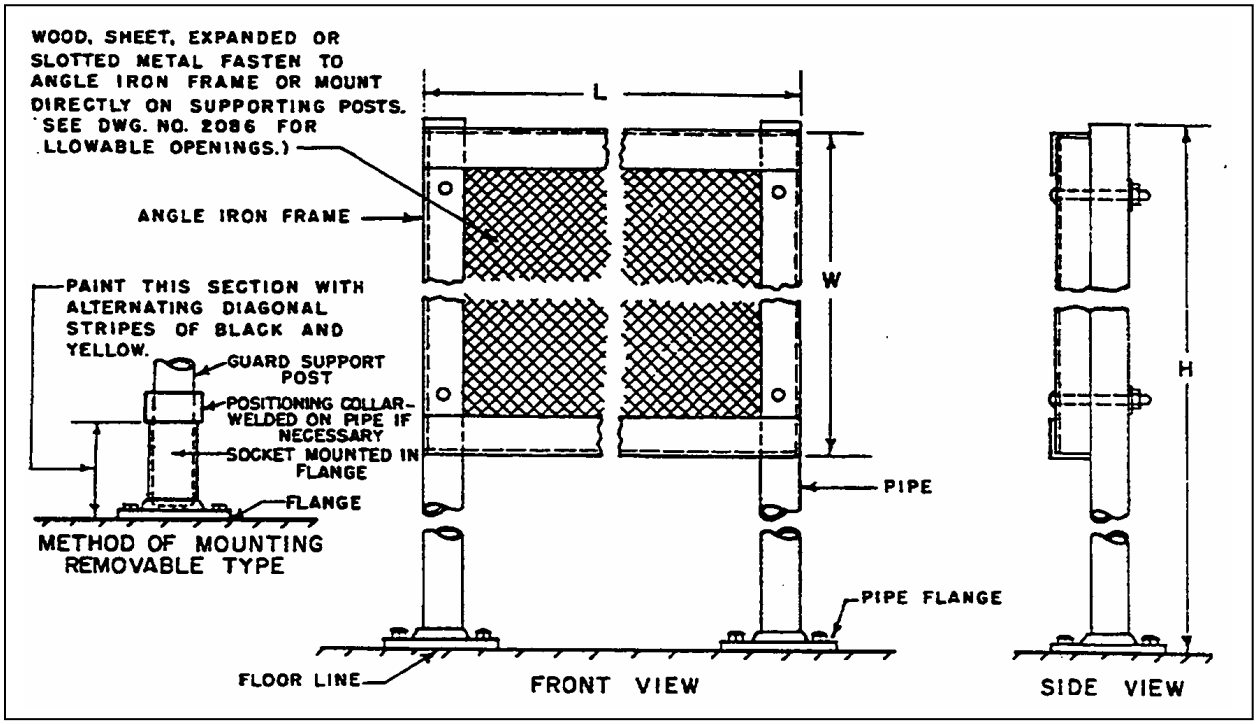
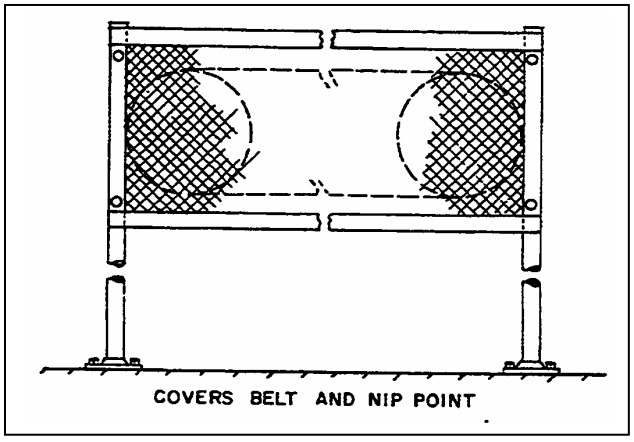
Drawing A6. Floor Mounted Barricades



NOTE:

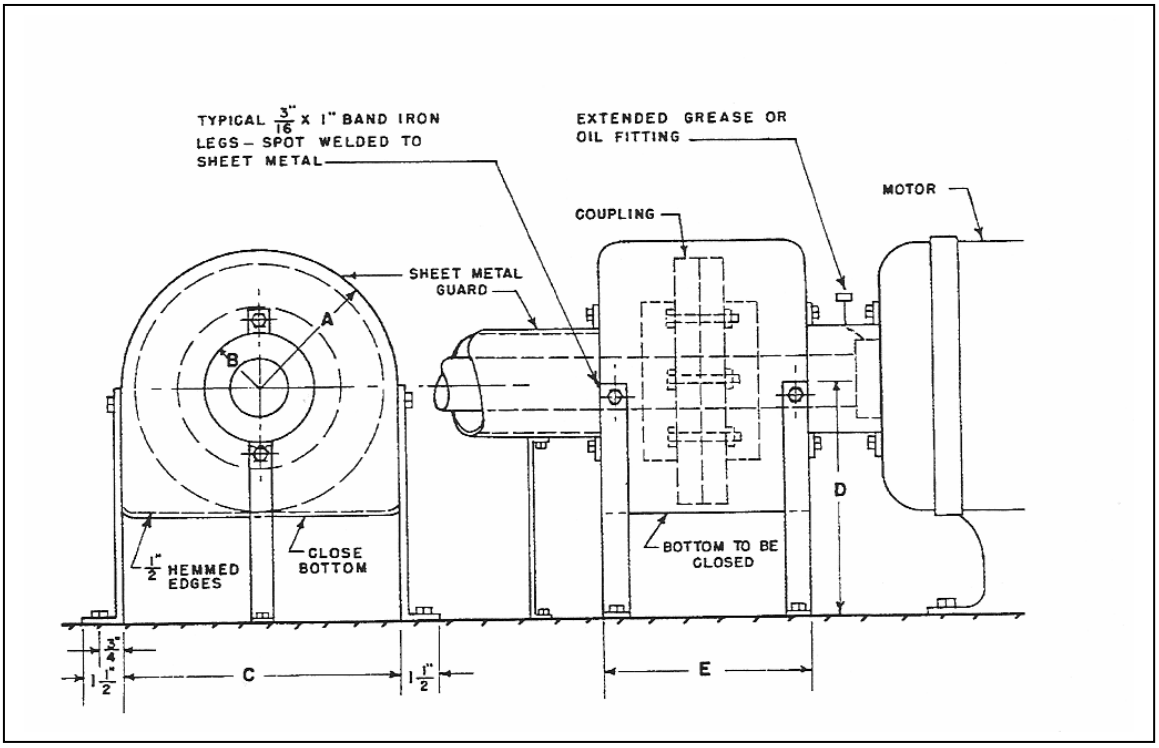
The *H, W.* and *L* measurements must be developed in accordance with the type of exposure.



NOTE:

On in-running belt and pulley exposures that cannot be provided with complete enclosures or nip point guards, a barricade type shield protects against falling or reaching into moving machine parts: top, bottom, or side plates can be added to shield for more complete coverage of the exposure.

Drawing A7. Coupling and Shaft Guard



NOTES:

Maximum clear openings to be 1/4". Select all lettered dimensions to suit application.

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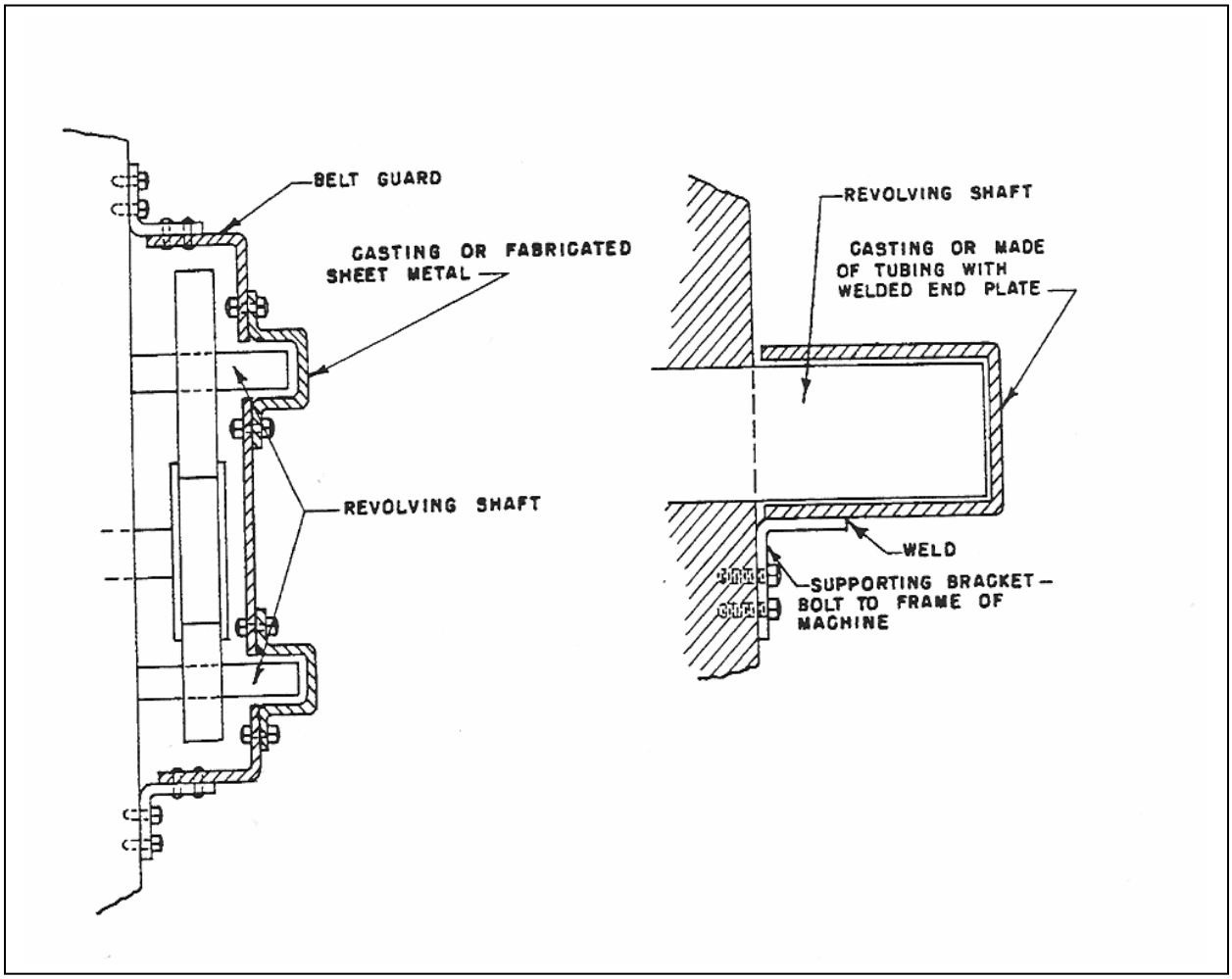
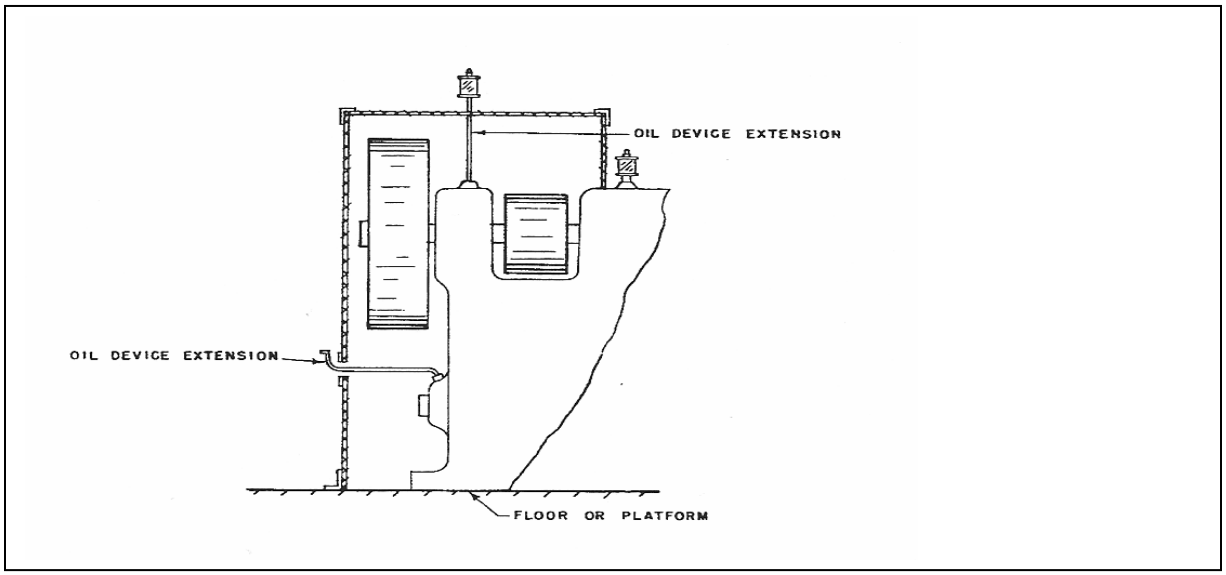
Drawing A8. Shaft End Guard

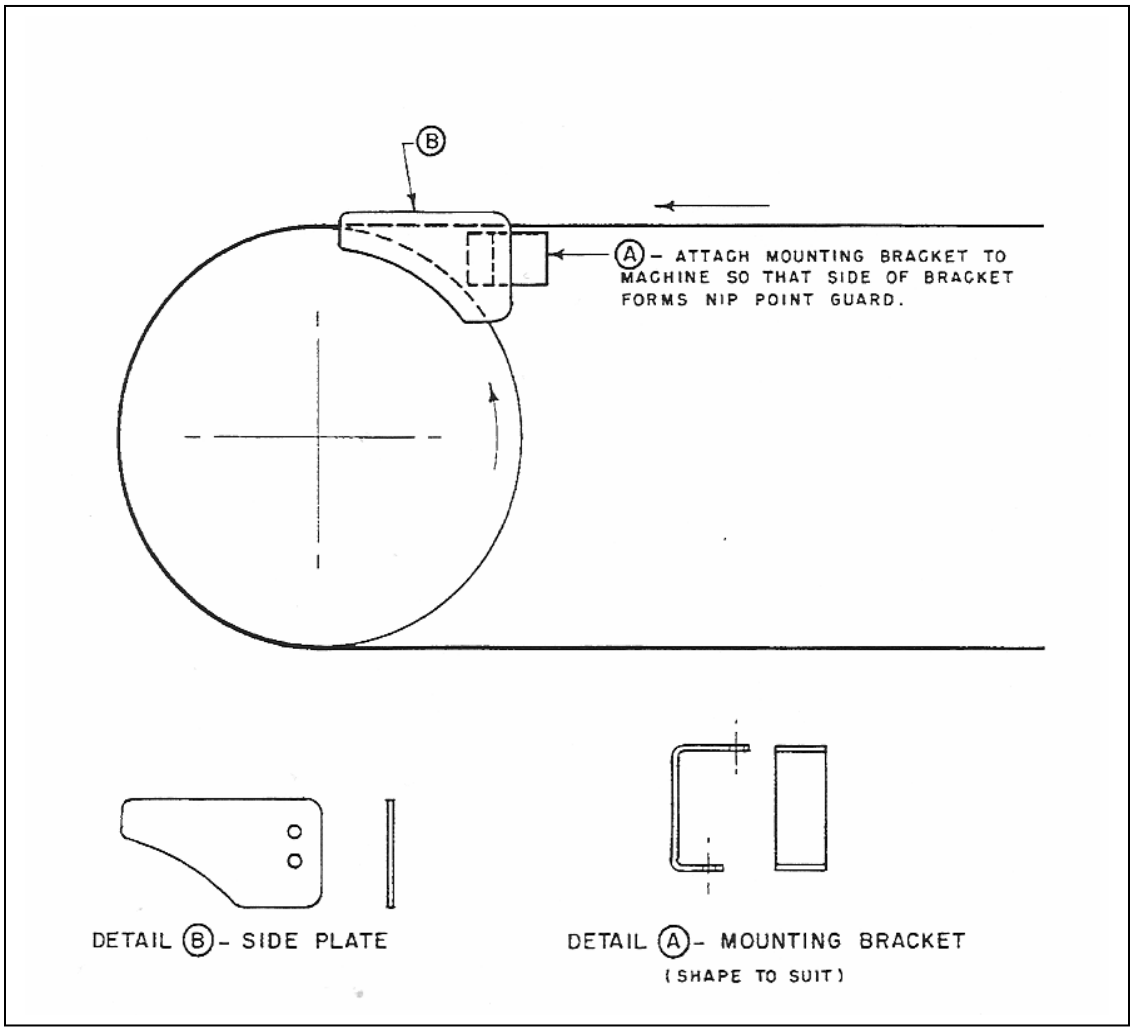


Drawing A9. Lubrication Extensions



- Extensions for lubricating devices (automatic oilers, oil cups, grease fittings, etc.) eliminates necessity for removal of guard.
- Such devices can be located outside guard by use of small pipe tubing, flexible metal hose, etc., shaped to reach points within guard requiring lubrication.
- Centralized pressure lubrication systems and extended oiling devices are available commercially.

Drawing A10-1. Side Nip Point Guarding



- Thickness of stock and other measurements to suit. (*A)* and (*B)* must be rigid to prevent vibration.

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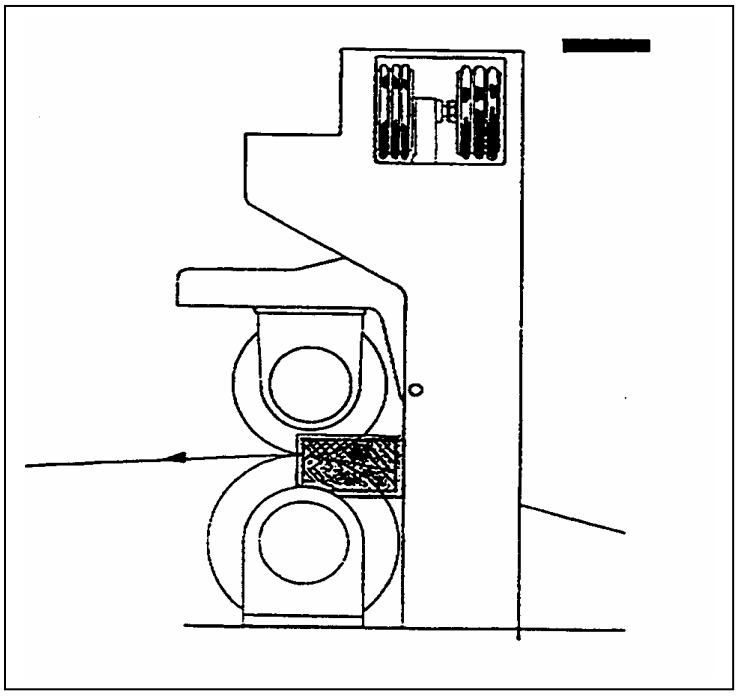
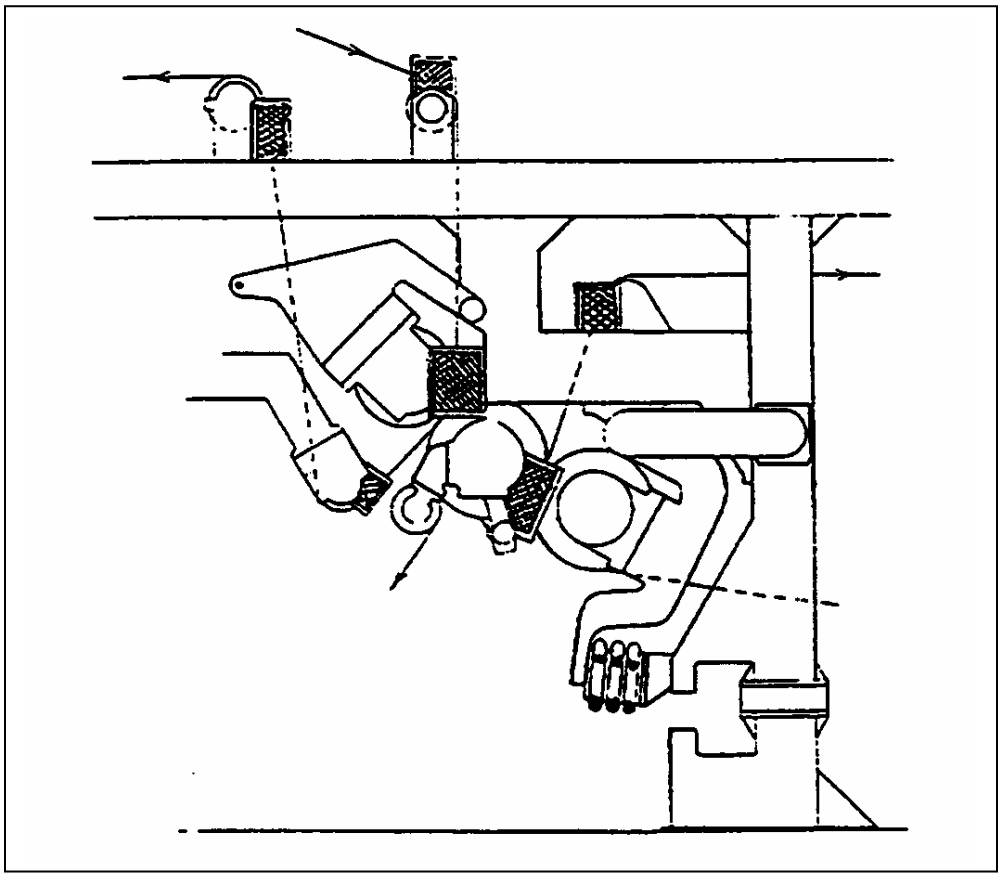
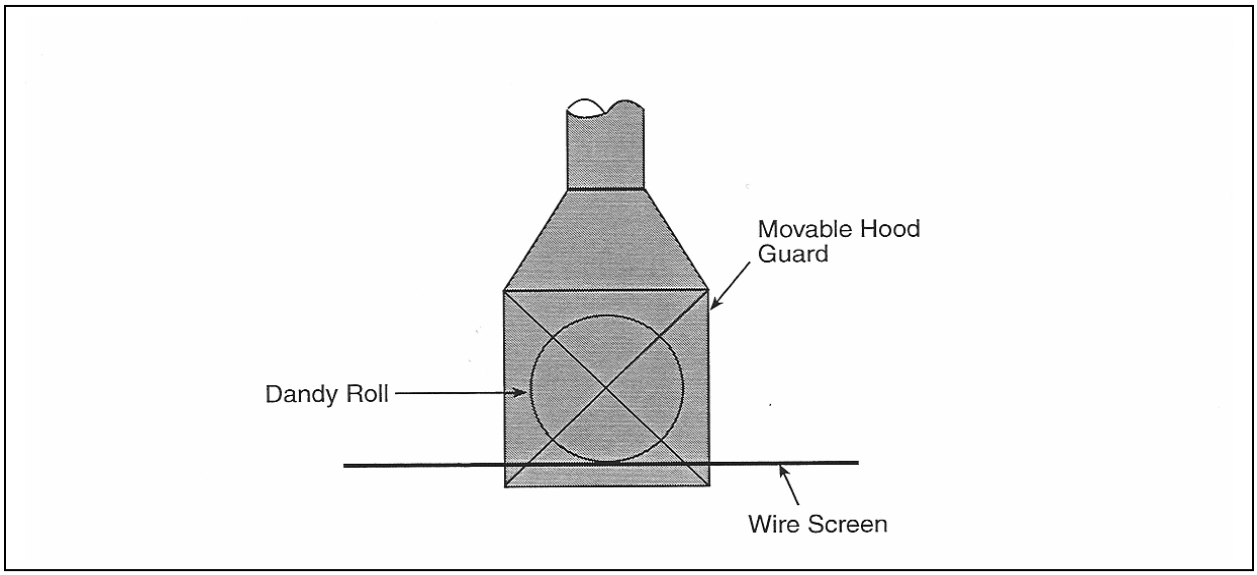
Drawing A10-2. Side Nip Point Guarding (Cont.)



Drawing A10-3. Side Nip Point Guarding (Cont.)



Drawing A11. Ventilation Hood Guard



Install a fixed “hood” guard to enclose the entire dandy roll assembly. The functional purpose of this hood is to provide exhaust ventilation, along with enclosing the in-running nip hazards. When used in a dual role for ventilation, be certain that airflow exhaust values are not compromised.

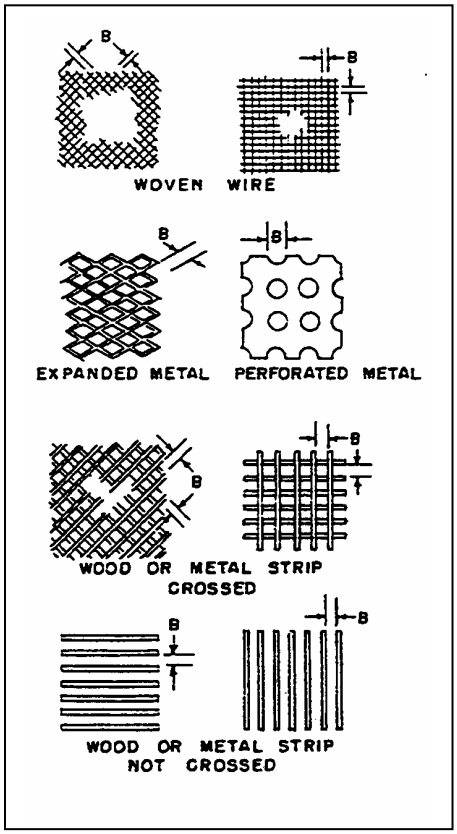
Drawing A12. Guard Construction

If guards are made of wire mesh, wood, perforated or expanded metal, crossed strips or bars of wood or metal, etc., the width or diameter of the holes should not exceed 2". If parallel strips or bars of wood or metal are used, the space between them should not exceed 1". There should be no openings more than 1/2" in width or diameter within 4" of any gear, belt, pulley, flywheel, or other dangerous moving part. Wood slats should be smooth and free from splinters and the holes in perforated or expanded metal should be free from sharp cutting edges. Any panel, which measures more than 42" in both width and length, should be substantially supported across its narrowest dimension at intervals of not more than 42".

NOTE:

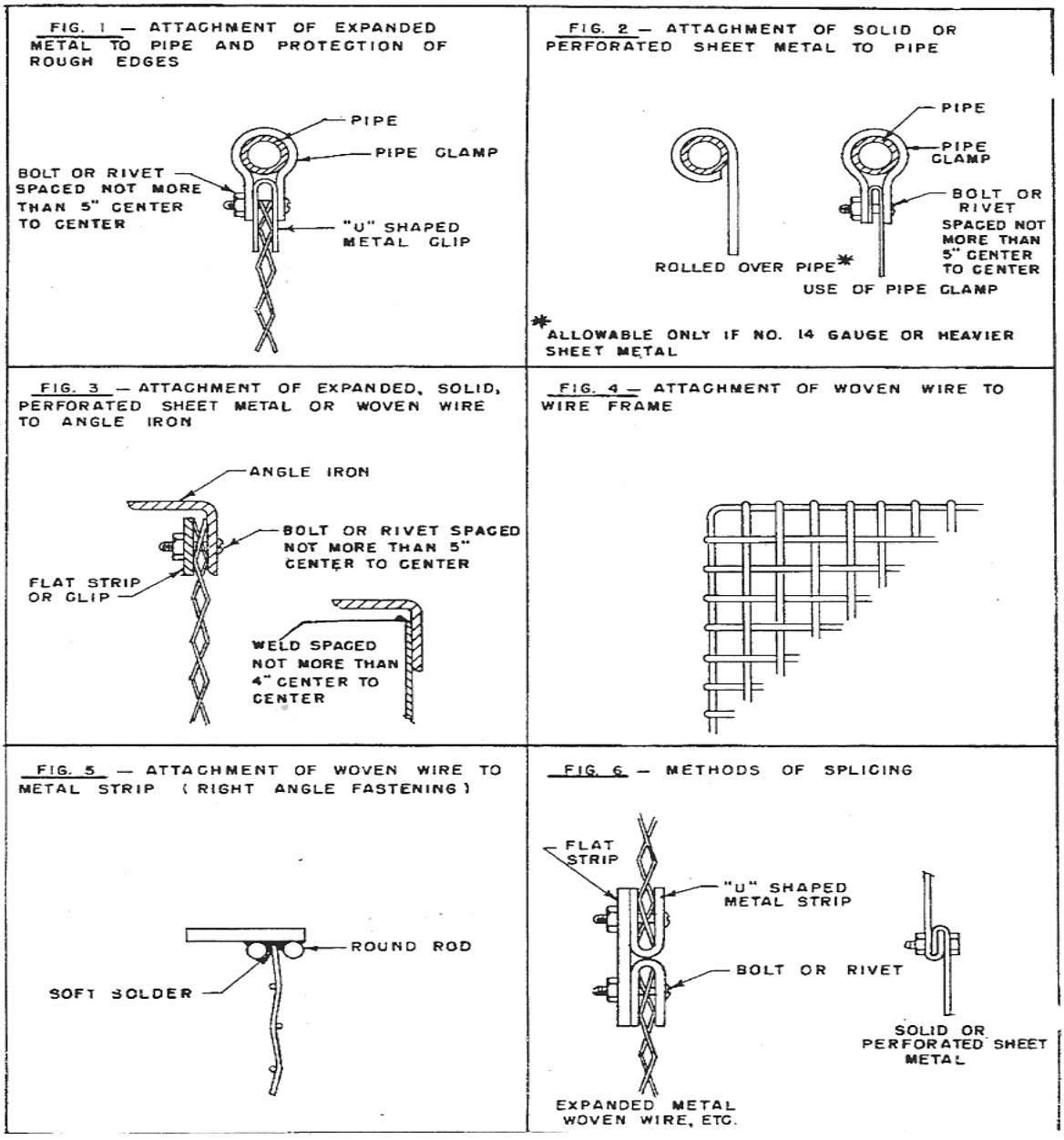
If the material of which the guard is constructed has openings wider than 1/2", it should be covered at all points within 4" of belts, etc., with wire mesh work or sheet metal or some other suitable material having no openings wider than 1/2". If the hole is diamond shaped, the width shall be measured along one side of the opening. If the hole is oblong, the greatest dimension should not exceed that specified above for "width."

Local ordinances or state codes may vary from these figures. In this case, comply with local requirements. Wood guards should be used only where the presence of fumes or where manufacturing conditions would cause a rapid deterioration of metal guards.

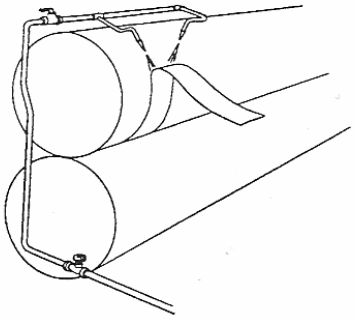


MATERIAL	CLEARANCE FROM MOVING PARTS AT ALL POINTS	LARGEST MESH OR OPENING ALLOWABLE	MINIMUM GAUGE (U.S. STAND.) OR THICKNESS
WOVEN WIRE	INCHES UNDER 2 2-4 UNDER 4 4-15	INCHES 3/8 1/2 1/2 2	 NO. 16 NO. 16 NO. 16 NO. 12
EXPANDED METAL	UNDER 4 4-15	1/2 2	NO. 18 NO. 13
PERFORATED METAL	UNDER 4 4-15	1/2 2	NO. 20 NO. 14
SHEET METAL	UNDER 4 4-15		NO. 22 NO. 22
WOOD OR METAL STRIP CROSSED	UNDER 4 4-15	3/8 2	WOOD 3/4 METAL NO. 16 WOOD 3/4 METAL NO. 16
WOOD OR METAL STRIP NOT CROSSED	UNDER 4 4-15	1/2 WIDTH 1 WIDTH	WOOD 3/4 METAL NO. 16 WOOD 3/4 METAL NO. 16

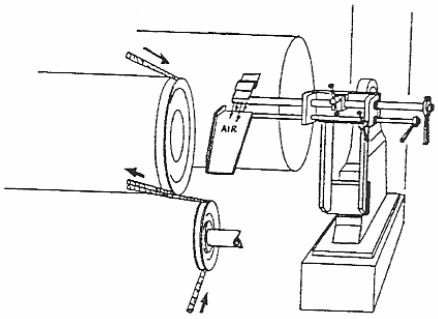
Drawing A12. Guard Construction (Cont.)



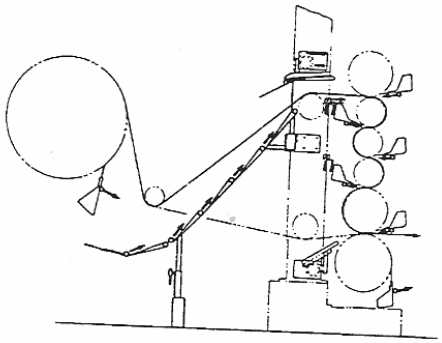
Drawing A13. Air Threaders

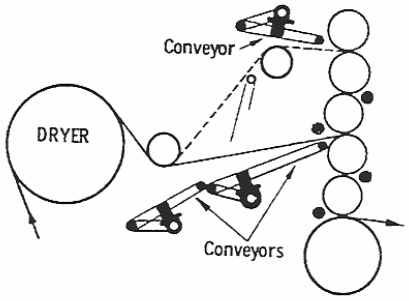


Remotely operated air jets



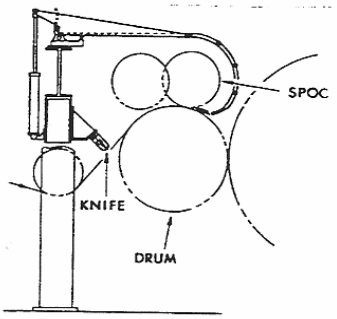
Remotely operated threading doctor to feed tail into rope nip or air chute



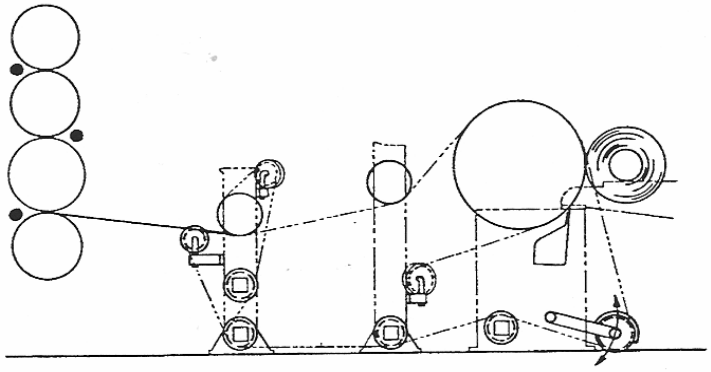


Calendar air chutes or threading conveyors to thread lightweight sheets and ropes to thread heavy board grades

Drawing A13. Air Threaders (Cont.)



Remotely operated air or tape turn up devices on reel



Rope, tape, and air systems for feeding tail to reel drum

Appendix B
Slip and Fall Prevention Methods

Preventing Slips and Falls

The process of manufacturing paper uses large amounts of pulp, water, and other substances that may splash onto floors posing slip and fall hazards. Regardless of where and how falls occur and which injuries are sustained, two-thirds of all falls can be traced to slip-resistance problems with floor surfaces. Preventing falls requires an understanding of how they occur and what measures can be taken to eliminate or control potential hazards.

Why Do People Fall?

To reduce the risk of falls, it is important that existing hazards are corrected immediately and that safe physical and mechanical facilities - including adequate lighting - are installed. For all jobs, safety pre-planning should take place so that potential hazards can be identified and controlled. Pre-planning should include instituting preventive maintenance procedures, practicing safe work methods, and providing adequate instruction, training, and supervision for employees.

Slips

The following list of precautions can help prevent some of the more common slip hazards:

Floor Maintenance

- Eliminate sources of leaks by repairing problems where they originate.
- Maintain floors appropriately to keep walking surfaces clean and use slip-resistant floor coatings.
- Clean up spills immediately and don't leave a spill unattended while looking for cleaning supplies. Post caution signs to warn people of slippery surface conditions.
- Keep liquids from spattering, splashing, or dripping by using controls such as splashguards, drip pans, and drains.
- Install adequate drainage (floor drains, slight angle).
- Repair or replace smooth or worn flooring.

Slip-Resistant Flooring Materials

- Install materials such as metal, abrasive, neoprene, or duckboard substances on floors to make them skid-resistant.
- Locate floor mats at equipment operators' stations to provide traction.
- Salt or sand icy surfaces promptly at building entrances or exits and on all outdoor walkways.

Employee Education

- Train employees to use caution when walking within certain areas. NEVER allow running..
- Make sure that employees wear proper footwear with slip-resistant soles and heels.
- Place warning signs and mirrors at sharply angled or intersecting passageways.

Trips

Here are some preventive measures that can be implemented to help people avoid tripping:

Maintenance/Housekeeping

- Maintain well-defined aisles and passageways.
- Encourage employees to keep work areas clean and free of debris.
- Install adequate waste receptacles.
- Provide sufficient area lighting.
- Store air hoses and extension cords off of floors.
- Repair breaks, cracks, and other floor defects promptly.
- Eliminate needless fixed obstructions.
- Store materials properly and keep walkways clear.
- Supply dolly trucks or toolboxes for maintenance employees.

Equipment Failure

When major pieces of equipment need to be repaired, employees attempting to work on them may accidentally slip and fall. Preventive measures include proper design, construction, installation, inspection, maintenance, and use of physical and mechanical equipment, including items such as:

- Stairs, steps, ramps, railings, and machine platforms
- Scaffolds and all overhead structures, such as flooring and catwalks
- Rigging equipment.
- Power and hand trucks
- Ladders and stepladders
- Proper hand tools

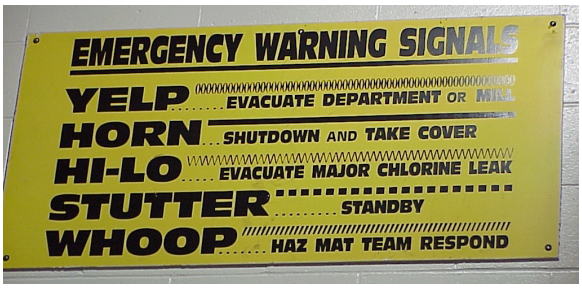
Sudden Motions

Unexpected noise, sudden starting of equipment, horseplay, running, and jumping are all factors that can cause falls. Sudden motions tend to startle people and throw them off balance. Therefore, it's a good idea to warn employees in advance that unusual noises may occur. Familiarize the workforce with audible and visual alarms that have various messages and demand specific procedures, sometimes in an emergency- ranging from PIT backup alarms to facility sirens that involve evacuation. Use teamwork and coordination to prevent the unexpected starting of machinery.

Inattention

Daydreaming, distraction, or preoccupation probably is a factor in most falls. That's why it is important to implement educational programs for employees that emphasize safety messages such as: "Keep alert," "Watch where you're going," and "Never read and walk at the same time."

Installing warning signs and signals in areas where falling hazards exist and painting unavoidable tripping hazards in contrasting colors also will help prevent falls. Most important of all, stress employee alertness. Warnings and alerts can also signify danger and require special procedures. For example, in the figure below, different audible alarms mean different things. Note the provisions for hearing impaired and for various types of emergencies.



Unsafe Practices

Many falls are the result of people performing tasks or behaving in unsafe manners. Controlling other people's behavior is difficult, but the following are some suggestions that can help:

- Instruct employees to keep their weight evenly balanced on both feet and approach all stairs or steps squarely - not diagonally.
- Direct employees to avoid running or hurrying, especially around corners, up and down stairs, on ladders, etc.
- Educate employees not to carry materials in ways that obstruct their views of walkway surfaces. Instead, encourage them to use material handling aids and make additional trips, if necessary.
- Emphasize the importance of keeping work shoes in good condition.
- Train employees to brace their feet and bodies before pushing or pulling on objects that may give way suddenly, such as machinery, drawer handles, and hand tools.
- Advise employees to consult medical advice if they tend to fall repeatedly with no other evident cause.
- Train employees how to use ladders and stepladders properly and to not use objects such as chairs, desks, boxes, as substitutes for ladders.

In general, safe work methods are determined by planning in advance how a job or task should be handled and by past accident experience. Fall prevention requires that safety practices should be clearly defined, communicated to all employees through instruction and training, and consistently reinforced by example and supervision.

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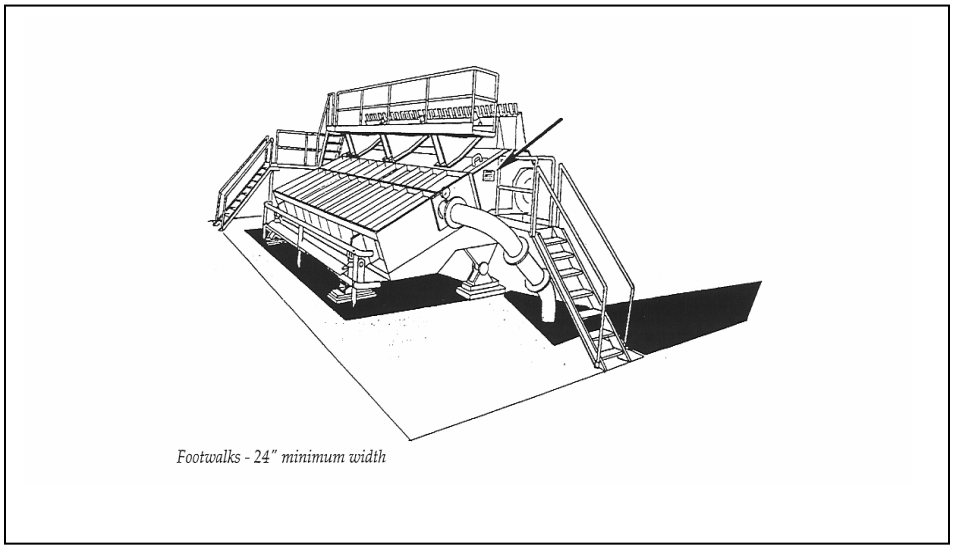
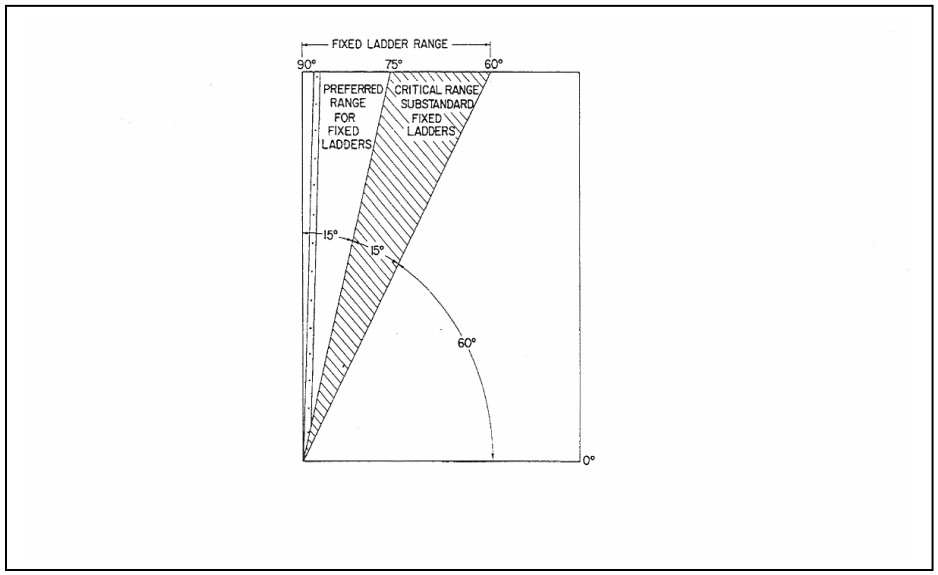
Drawing B1. Work Platform

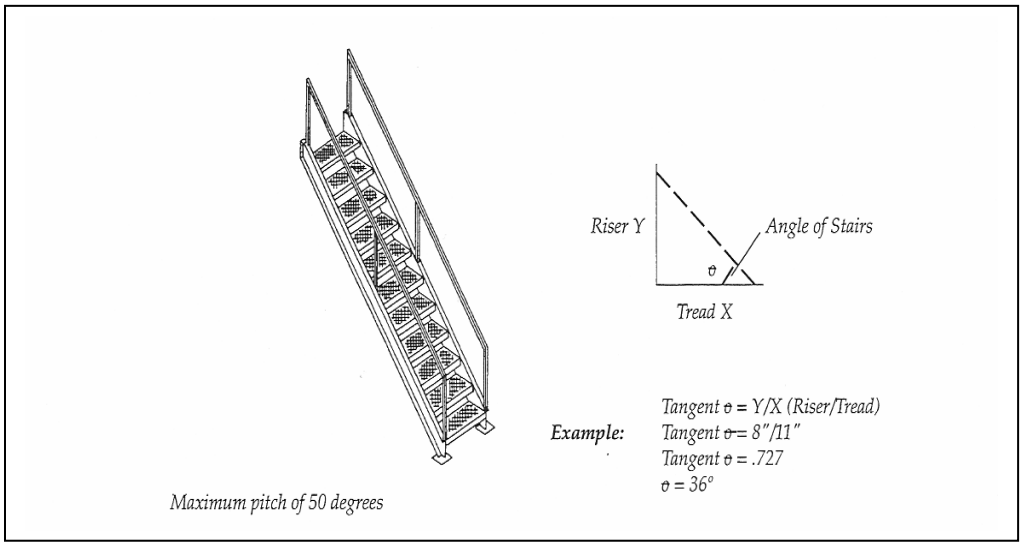


Drawing B2. Pitch of Fixed Ladders

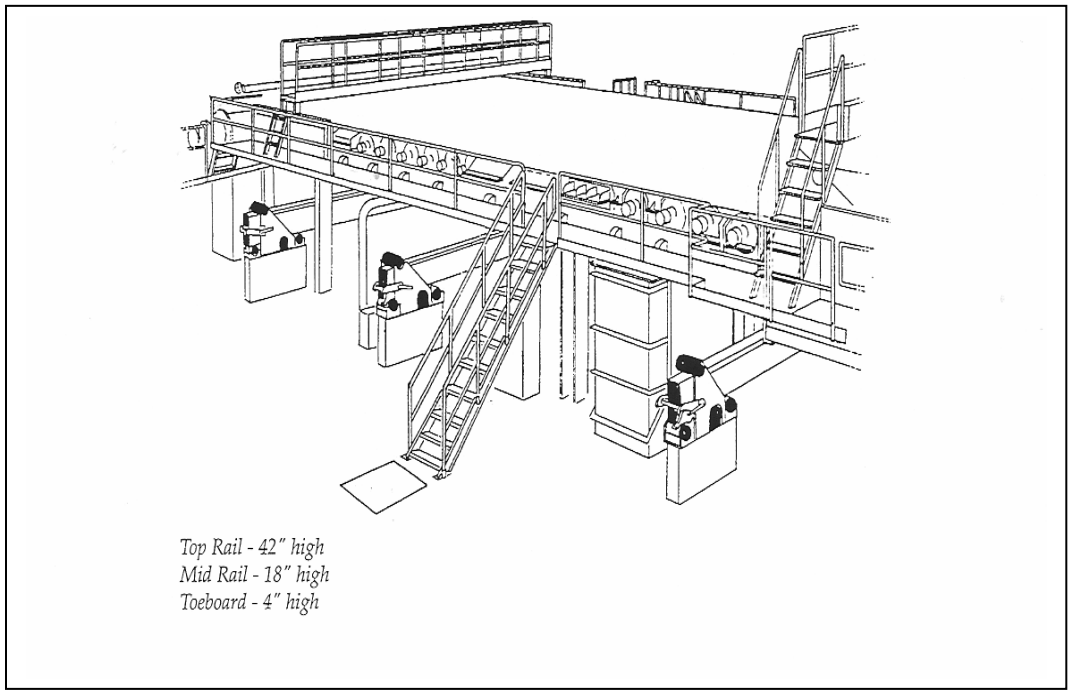


Optimum placement values and angles for ladder fixed ladder positions.

Drawing B3. Stairs

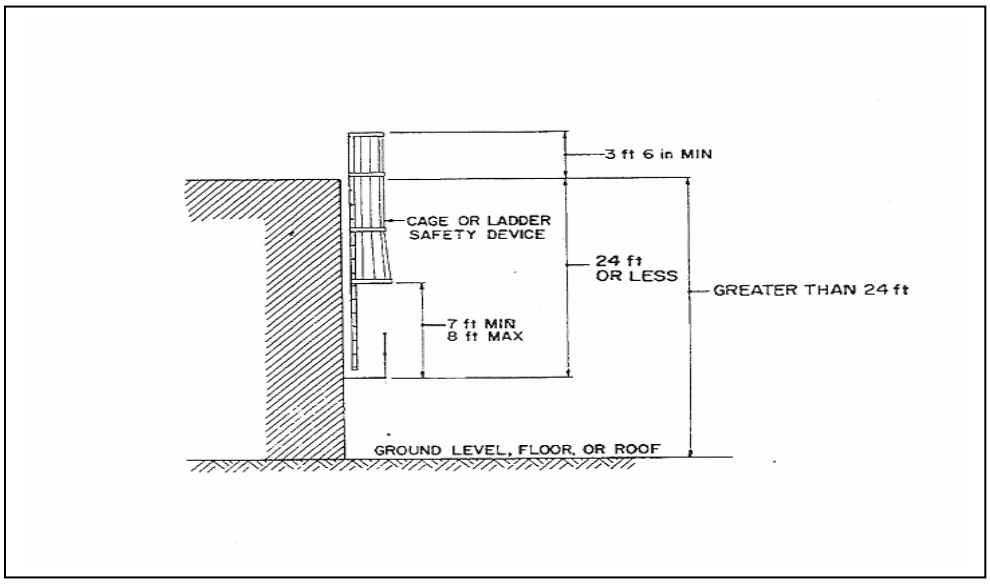


Drawing B4. Railings

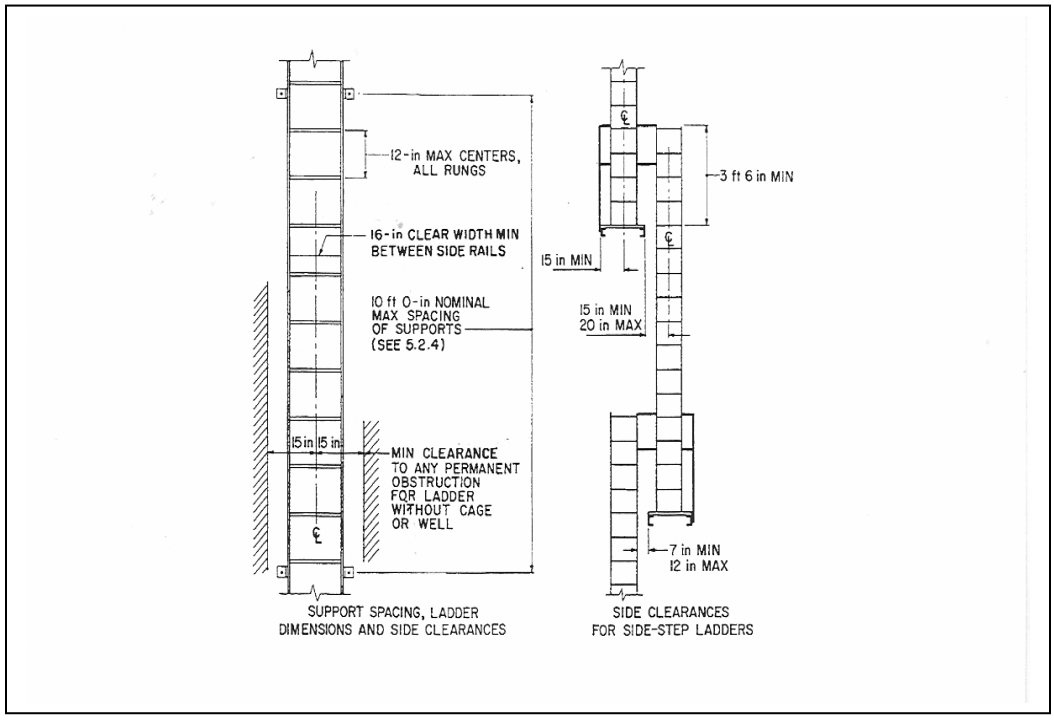


Example shown of a crossover of the press rollers where there are significant fall hazards into moving machine parts- a constant threat. Note the railings on elevated walkways and stair access. NOTE also that there are substantial nip points and entanglement risks from press rolls accessed from portions of the catwalk area that need suitable guarding.

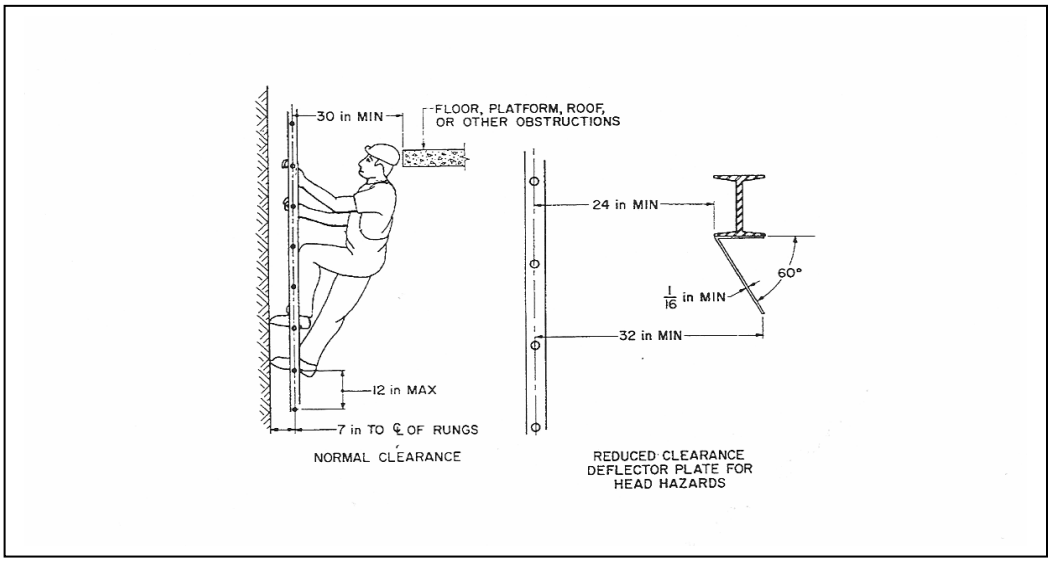
Drawing B5. Ladder Cage / Safety Device



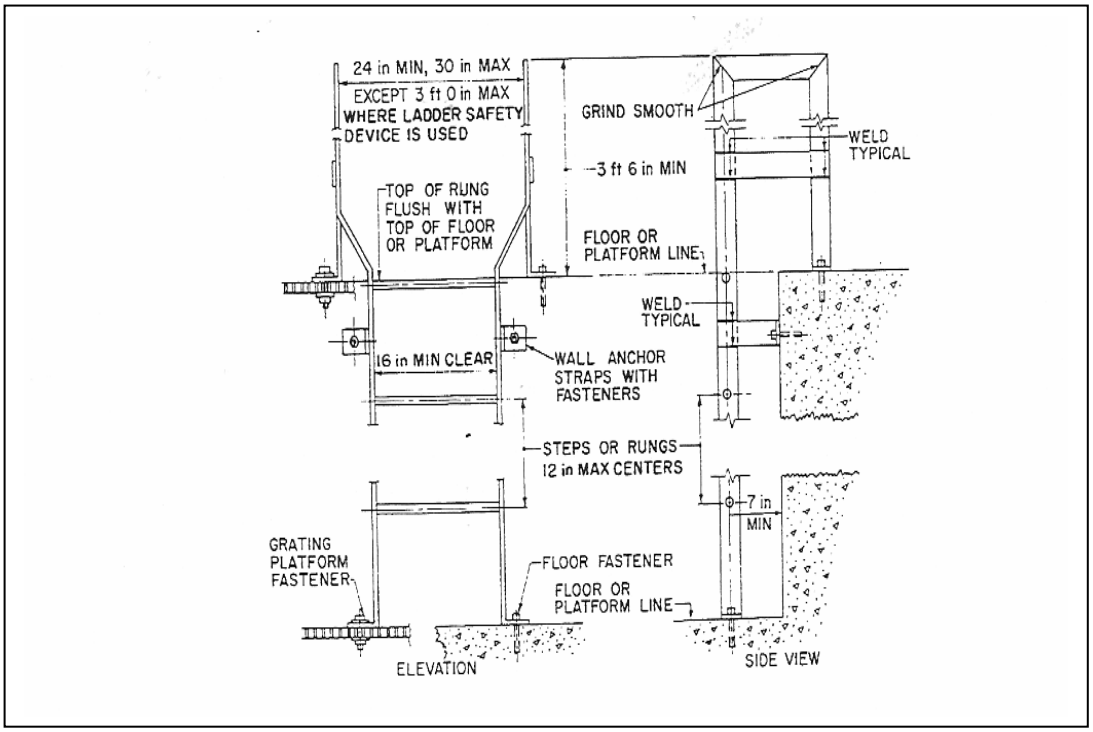
Drawing B6. Ladder Dimensions / Clearances



Drawing B7. Minimum Ladder Clearances



Drawing B8. Ladder Termination



Appendix C
Machine Controls

Machine Controls

The safety of machine operators and maintenance personnel can be improved by the proper design, installation, use, and maintenance of machine controls. All new installations should meet applicable Federal, State, and local codes and regulations such as the National Electrical Code (NFPA 70E and NFPA 79 are two of the governing codes for machine control layout and features).

All control, emergency, and power devices should be clearly and permanently identified. Information on color coding and labeling is included later in this Appendix. Locate controls so that they are readily accessible and not easily struck or damaged.

All motor starters should be of the magnetic design so that motors will not automatically restart after an interruption of power. They should only restart after the operator manually reactivates the start controls.

"Jog" or "Inch" control circuits should be designed so that they prevent the accidental operation of the "run" or "automatic" mode of operation. Start controls should be guarded or protected to minimize accidental operation. Safety guard interlocks should be operational and not bypassed.

Warning alarm and time delay systems should be used to alert operators that certain machine components such as the dryer, calender, and winder would start within a predetermined time period. This will help warn anyone working on the machine to move out of the hazardous areas before the equipment starts to operate.

Emergency stops, trip wires, and related equipment should be installed where appropriate and required by standards and regulations. An emergency stop control should be provided for each operator control station and should be readily distinguishable from all other operating controls. Additional emergency stops are needed along both sides of the paper machine to allow operators to stop the equipment in the case of an emergency. Mushroom emergency stop controls are preferable and should be installed on equipment or during control panel replacement situations.

It is important to test machine controls on a regular basis to ensure proper operation. Operators should be aware of control locations, proper use, inspection, and testing requirements.

The following figure illustrates an example of a common machine control panel:

Figure C1. A Sample machine control panel.

Safety Colors

The next two pages in this section refer to consensus guidance in ANSI Z535.1-.4 standards on signs and labels. Color-coding can help operators select proper machine controls, locate safety equipment, understand signs, identify piping systems, avoid physical hazards, and generally work more safely. Before using specific colors, check all applicable standards and regulations to determine additional requirements. Consistent uses of safety colors can help reduce human error, thereby, contributing to a safer work environment.

Use red to identify:

- STOP or OFF controls on machinery
- Emergency stop switches or bars
- Exit signs
- Flammable-liquid containers
- Fire protection equipment and piping systems

Use orange to identify:

- Dangerous parts of machinery
- Energized equipment that may cut, crush, shock, or injure
- The inside of guards and enclosure doors identifying unguarded hazards
- Edges of exposed parts such as gears, pulleys, or cutting devices

Use black to identify:

- START or ON controls on machinery
- Traffic or housekeeping markings (in combination with white or yellow)

Use yellow to identify:

- Physical hazards that might cause individuals to trip, fall, strike against something, stumble, or get caught or pinched
- Emergency return controls on machinery
- Traffic or housekeeping indicators such as aisle markings
- Storage cabinets and containers for flammable, explosive, or corrosive materials
- Pipelines transporting hazardous materials
- Material handling equipment such as lift trucks or cranes
- Radiation hazards (in combination with black stripes or checkerboard pattern)

Use GREEN to identify:

- START or ON controls on machinery
- First aid kits and dispensary
- Safety showers
- Stretchers
- Safety bulletin boards
- Gas masks
- Safe pipeline identification
- Emergency egress routes

Use BLUE to identify:

- Pipelines that carry protective materials such as inerting gases
- Information safety signs or bulletin boards

Signs and Symbols

On safety signs, using the proper signal words and colors along with international safety symbol helps to ensure that the message will be understood despite language or literacy barriers.

Signal Word: "DANGER" *Indicates a hazard with imminent danger of death or serious injury* - White letters on a red oval field with a white border on a black rectangular field.

Message/Symbol: Black or red on a white background.

Signal Word: "WARNING" *Indicates a potential hazard that could result in death or serious injury* - Black letters in an orange truncated diamond on a black rectangular field.
Message/Symbol: Black on an orange background.

Signal Word: "CAUTION" *Indicates a hazard that may potentially result in minor or moderate injury* - Yellow letters on a black rectangular field.

Message/Symbol: Black on a yellow background.

Signal Word: "NOTICE" *Indicates a statement of company policy that relates to safety or property protection* - White letters on a blue rectangular field.

Message/Symbol: Blue or black on a white background.

Signal Word: "SAFETY FIRST," "BE CAREFUL," etc. *Indicates safe work practices, proper safety procedures, or location of safety equipment* - White letters on a green rectangular field.

Message/Symbol: Green or black on a white background.

Regulations and Standards

Many local, state, and federal regulatory agencies have standards regarding the use of colors to identify various hazards. ANSI has specific 'consensus' guidelines for shades of colors that should be used. Refer to the current applicable standards for further details. These standards may include, but not limited to:

- American National Standards Institute
ANSI A13.1; Z535.1; Z535.2; Z535.3; Z535.4; Z535.5

- National Fire Protection Association
NFPA 30; 70E; 79; 101; 170

- Occupational Safety and Health Administration
OSHA 1910.144; 1910.145; 1910.261

Appendix D
Static Electricity Control

Static electricity is generated by contact and separation of dissimilar material, such as paper traveling at a high speed through the calender stack, winder/paper reel, and the rewinder. The following lists some of the problems that can be caused by static electricity:

- Machine operators may be injured because of an involuntary reaction caused by a static spark's shock (such as accidentally reaching into a nip point, contacting a hot surface, etc.)
- Ignition of flammable vapors, gases, or dust particles
- Product contamination with attracted dust and dirt particles
- Lower quality of laminations or coatings
- Misfeeding of paper and paper jams
- Reduced machine speeds
- Higher scrap rate
- Damage to electronic machine controls and measuring equipment
- Excessive downtime of the process

Preventing static electricity is an important component of an effective safety program. It also can improve efficiency, productivity, and quality of the products. There are a number of methods for measuring and preventing or minimizing the generation of static electricity.

Static Meters

Handheld or stationary meters are available to take spot or continuous static electricity measurements. They are helpful for determining sources of static buildup and proper grounding of bagging/unbagging operations and dry particle piping/duct systems. Some models can be connected to chart recorders for documenting and evaluating ongoing measurements.

Static Control Bars

Static control bars can be installed to prevent static charges from accumulating on paper, laminating, and coating products. Depending upon the machine location where they are installed, different designs may be used. One type uses passive induction bars that are considered better than tinsel or carbon brushes.

Another design uses a static control bar that is connected to a DC power supply that allows emission of static neutralizing ions to eliminate static charges. One variation of this design includes a self-cleaning air assist system. This is useful if space restrictions do not allow the bar to be mounted close to the paper.

Ionizing Air Guns/Nozzles/Pins

These types of air guns/nozzles can be installed at the end of existing airlines to neutralize static charges. They allow compressed air to be applied from a handheld gun or permanently mounted nozzle to rapidly neutralize static charges and remove dust particles from product surfaces. Pairs of electrode pins can be installed in air sources, especially if there is not enough room to install a larger static bar.

Portable/Stationary Ionizers

Portable or stationary ionizers can be used to provide a constant flow of neutralizing ions to eliminate static in various work areas. Many models have adjustable blower speeds and some have heaters. These units are useful both in production equipment areas and in inspection/packaging areas.

Static Control Liquid Solutions

These types of liquid solutions can be applied to work surfaces, floors, tools, conveyors, clothing, and other materials. They can be applied as a spray, wipe, dip, or transfer method (roller coatings, etc.). A majority of the solutions are nontoxic, nonflammable (NFPA-56A), nonstaining, biodegradable, and meet MIL-B-81705 requirements.

Static Control Program Effectiveness

In order to effectively control static electricity, the following program elements should be established:

- Identify actual and potential static sources
- Evaluate and implement appropriate control methods
- Determine control effectiveness and modify methods if necessary
- Train employees regarding the hazards and prevention of static electricity, control methods on applicable equipment. Consider additional risk with chemical use, if any.
- Maintain equipment in proper condition

*Some Static Electricity Control Equipment Suppliers

By Stat- USA
1971, Western Avenue,
Box 1115
Albany, NY, 12203

By Stat- Canada
2630, Sabourin street
Saint-Laurent (Quebec)
CANADA H4S 1M2
(800) 361-6777
(514) 333-8880
http://www.bystat.com/frames.asp

Electro Statics, Inc.
352 D Godshall Drive, Harleysville, PA 19438-2017
Tel: (215) 513-0850 FAX: (215) 513-0855
http://www.electrostatics.com/index.html

NRD LLC
2937 Alt Blvd.
PO Box 310
Grand Island, New York 14072-0310
1-800-525-8076 - Toll-free within the USA
1-716-773-7634 - Outside the USA
Fax: 1-716-773-774
http://www.nrdstaticcontrol.com/ContactUs.asp

Static Technologies Corporation, 61 Pleasant Street, Randolph, MA 02368
Tel: (781) 961-7220 Fax: (781) 961-1858
http://www.static-tech.com/index2.html

Tantec Inc.
630 Estes Avenue
Schaumburg, IL 60193
Phone: 847-524-5506
Fax: 847-524-6956
http://tantecusa.com/maincontrol.htm

***Not all- inclusive and none specifically endorsed.**

Appendix E
Confined Space Entry

Figure E1. Open Stairwell to Basement

Confined Space Entry- Permit & Non-Permit

- Follow written plans identifying spaces and configurations where work is performed by normal operations and maintenance of which fit the OSHA 1910.146 definitions. Note- Some spaces may be considered 'non- permit required spaces' but need careful scrutiny before forming that conclusion (Figure E1).

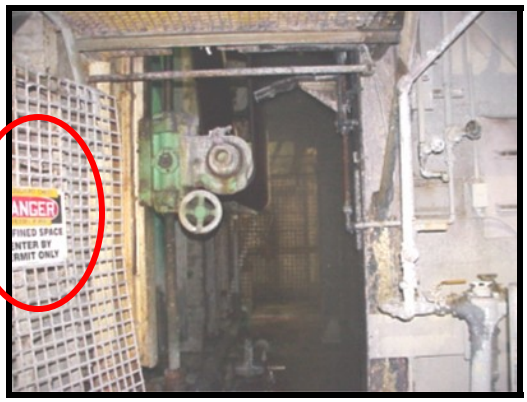


Figure E2. - Basement Area

- Carefully examine the risk when hot work is performed within these spaces. Consider posting fire watches and plan for appropriate ventilation in areas where atmosphere contaminants are likely when welding or grinding.
- Prepare for attendants for confined space work and for trained rescue provisions.

Figure E3. - Beater Room and Vat with Fall Protection Anchorage Point on Overhead Hoist Beam

- Provide for fall protection with overhead fall arrest harnesses and anchorage points (lanyards attached to overhead girder) when working in the open beater vats. Also, examine atmosphere before entry to assure optimum breathing levels of oxygen are present and that other toxins are not present, consistent with your CSE permit required plan.
- Provide regular training for authorized entrants and attendants to assure all understand risks and implement suitable controls (e.g., atmospheric analysis for permit-required spaces, PPE, rescue provisions, communication, etc.). Depth of beater vat creates confined space (about 8 feet deep) to clean out or if pallet breaks and worker must remove wood from beater.

Figure E4- Beater Vat- Note Railing Protection

- When workers must enter the beaters, make sure all control devices are locked and tagged **BEFORE** entry. Follow the lockout tagout requirements in 1910.147 and compare best practices within ANSI Z244.1.

Figure E5- Sample Sign Identifying CSE Permit

- Post signs and warnings around the area when work performed in a confined space and remove only when all is complete, including tool removal, and plan elements are verified.

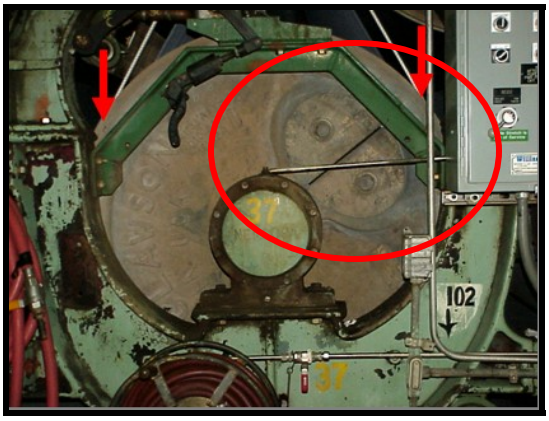


Figure E6- Dryer Can Entry Point for Cleaning; a Major Confined Space Risk

- Dryer cans have special and significant 'permit requirements' for Confined Space. Cleaning operations, when conducted, demand special protocol using ANSIZ117.1 and OSHA 1910.146 guidance. Be certain that your procedures contemplate ALL present, residual, and planned work and contents when preparing workers in this practice.

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Appendix F
Paper Making Safety Standards- Some Sources

SAFETY TOPIC/TERMS	US REQUIREMENTS (They may refer to other standards)	EUROPEAN REQUIREMENTS - Closest Standards listed (NOTE that these are NO all inclusive and may refer to other standards) SEE END OF CHART FOR STANDARD NAMES
Actuating Controls	OSHA 1910.261, .212, ANSI B11.19	EN 574, IEC 60204, IEC 61508, IEC 60621
Adjustable Barrier Guards	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Anti-Restart Protection	NFPA 79, NEC	EN 1037, IEC 60204, IEC 61508
Automatic Movable Barrier Device	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Awareness Barriers	OSHA 1910.261, .212, ANSI B11.19	EN 292
Awareness Signal or Device	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 457, EN 981, IEC 61508, IEC 60621
Barrier	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Brake	NFPA 79	IEC 60204
Broke Holes	OSHA 1910.261	EN 292
Catwalks / Crossovers	OSHA 1910.23, .261 = 24" minimum width	EN 292
Color Coding	ANSI Z 535.1	IEC 60204, ISO 3864
Communication Systems	OSHA 1910.261, ANSI B11.19	EN 292, IEC 61508, IEC 61511
Concurrent	NFPA 79, ANSI B11.19	IEC 60204, IEC 61131
Confined Spaces	OSHA 1910.146	EN 292
Control Reliability	NFPA 79, ANSI B11.19, NEC, , ANSI TR4 and TR6	EN 954, EN 1037, EN 60204, IEC 61131, IEC 61508, IEC 61511, ANSI TR4 and TR6
Control System	NFPA 79, ANSI B11.19, NEC, , ANSI TR4 and TR6	EN 954, EN 1037, EN 60204, IEC 61131, IEC 61511, IEC 60621
Conveyors	ANSI/ASME B20.1	BS 5667
Cutters / Doctor Blades	OSHA 1910.261	EN 292
Electrical Wiring Methods	NEC, OSHA 1910.301-.399, NFPA 79	EN 60204, IEC 61508, IEC 60621
Equipment, Auxiliary	OSHA 1910.261, NFPA 79, NEC	EN 60204, IEC 61511
Ergonomics	OSHA General Duty Clause, ANSI B11 TR 1	EN 547, EN 614, EN 894, EN 981
Fall Protection	OSHA 1910.261	EN 361
Fire Detection / Protection / Pressure Vessels	NFPA, OSHA 1910.160, .164	EN 286, EN 1127
Fixed Barrier Guard	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854

SAFETY TOPIC/TERMS	US REQUIREMENTS (They may refer to other standards)	EUROPEAN REQUIREMENTS - Closest Standards listed (NOTE that these are NOT all inclusive and may refer to other standards) SEE END OF CHART FOR STANDARD
Gates	ANSI B11.19	EN 292, EN 547, EN 811
General Machine Safety	OSHA 1910.211, .212, .261	EN 292, EN 1010, EN 1034, EN 1050
Guard	OSHA 1910.261, .212, ANSI B11.19	EN 292, EN 294, EN 349, EN 547, EN 811, EN 953, EN 999, ISO 13854
Hand Control	OSHA 1910.212, ANSI B11.19, NFPA 79	EN 574, IEC 60204, IEC 61508, IEC 60621
Hand Tools	OSHA 1910.164, ANSI B11 TR1	EN 292, EN 614
Heat / Hot Surfaces / Pipes	OSHA 1910.261	EN 563
Interlock	OSHA 1910.212, ANSI B11.19, NFPA 79	EN 1088, IEC 61508, IEC 61511, IEC 60621
Interlocked Barrier Guard	OSHA 1910.212, ANSI B11.19, NFPA 79	EN 1088, IEC 61508, IEC 61511, IEC 60621
Jog / Speeds	OSHA 1910.212, ANSI B11.19, NFPA 79	IEC 60204, IEC 61131, IEC 60621
Labeling/Symbols	OSHA 1910.212, ANSI B11.19, ANSI Z535.3	ISO 3461, ISO 7000
Ladders	OSHA 1910.27	EN 292
Lighting	OSHA 1910 (several sections) & ANSI/IES	EN 1837
Lockout/Tagout of Power Sources	OSHA 1910.147 - Means to shut-off, lockout/tagout & release residual pressure	EN 982, EN 983, EN 1037, IEC 61511
Lubrication	OSHA 1910.164	EN 292
Manuals/Diagrams: Set-up, Operation, Maintenance, Training	OSHA 1910.261, .212, ANSI B11.19	EN 1010, EN 1034, IEC 61511
Material Handling Methods & Equipment	OSHA 1910.261 & General Duty Clause	EN 292, EN 614, RIA 15.06
Mirrors / Cameras	ANSI B11.19	EN 292
Movable Barrier Guard	OSHA 1910.212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Nip Points	OSHA 1910.212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Noise Levels & Hearing Protection	OSHA 1910.95	EN 24869, ISO 11201
Operator Controls	OSHA 1910.212, ANSI B11.19, NFPA 79	EN 574, IEC 60204, IEC 61511, IEC 61508, IEC 60621
Personal Protective Equipment	OSHA 1910.132	Numerous: EN 132 - EN 24869
Point of Operation	OSHA 1910.212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854

SAFETY TOPIC/TERMS	US REQUIREMENTS (They may refer to other standards)	EUROPEAN REQUIREMENTS - Closest Standards listed (NOTE that these are NOT all inclusive and may refer to other standards) SEE END OF CHART FOR STANDARD
Point of Operation	OSHA 1910.212, ANSI B11.19	EN 292, EN 294, EN 349, EN 953, ISO 13854
Power Transmission Apparatus	ANSI/ASME B15.1 (adapted from ISO 4254/1) - guard 8' or less from floor or work platform; OSHA 1910.219 - guard 7' or less from floor or work platform	EN 292, EN 1050
Presence-Sensing Devices - Electro-Optical & RF	ANSI B11.19, NFPA 79	IEC 61496, EN 954, EN 1037, EN 60204, IEC 61131, IEC 61508, IEC 61511
Pressure Sensitive Protective Devices (mats, etc.)	ANSI B11.19, NFPA 79	EN 1760
Quality Control - Thickness Gauges - radioactive sources, etc.	OSHA 1910.97, .1096	EN 12198
Railings	OSHA 1910.23 - Open-sided platform / floor 4' or higher: Top rail = 42" (200 lbs. capacity), mid rail, toeboard = 4" high	EN 292
Risk Assessment	ANSI B11 TR3, ANSI/RIA 15.06, HAZOP, FEMA, Fault Tree or similar	EN 1050
Safe Distance	ANSI/ASME B15.1 (adapted from ISO 4254/1), ANSI B11.19 (straight line openings)	EN 292, EN 294 (allows irregular openings), EN 349, EN 953, EN 999, ISO 13854
Safe Location	ANSI/ASME B15.1 (adapted from ISO 4254/1), ANSI B11.19	EN 292, EN 294 (allows irregular openings), EN 349, EN 953, EN 999, ISO 13854
Safe Opening	ANSI/ASME B15.1 (adapted from ISO 4254/1), ANSI B11.19 (straight line openings)	EN 292, EN 294 (allows irregular openings), EN 349, EN 953, EN 999, ISO 13854
Safe Position of Controls	OSHA 1910.261, .212, ANSI B11.19, NFPA 79	EN 574, EN 894, IEC/EN 60204, EN 954, EN 1037, IEC 61131, IEC 61508, IEC 61511
Safety Signs	ANSI Z 535.1 through Z535.4, OSHA	ISO 3864
Set-Up / Threading	OSHA 1910.261	EN 292, EN 1010, EN 1034, EN 1050
Shafts / Couplings	OSHA 1910.219 - guard if shaft end is longer than 1/2 of shaft diameter	EN 292, EN 1050
Shall	OSHA/ANSI - Mandatory requirement	EN 292, EN 1010, EN 1034, EN 1050
Should	OSHA/ANSI - Recommendation	EN 292, EN 1010, EN 1034, EN 1050
Stairs	OSHA 1910.24, .261 = 22" minimum width - see standard for angles, tread rise & runs	EN 292
Start-Up Time Delay / Alarms	OSHA 1910.261, NFPA 79, NEC, ANSI/ASME B20.1	EN 457, IEC 60204, IEC 60621, IEC 61508
Static Electricity	NFPA, NEC	EN 1127
Stop Controls - Emergency / Master / Trip Wires	NFPA 79 - Hard Wired : Category 0 or 1	EN 418, EN 60204, IEC 61508
Stop Controls - Normal	NFPA 79 - Category 0, 1 or 2	EN 418, EN 60204, IEC 61508, IEC 61511, IEC 60621
Symbols	ANSI Z 535.3	ISO 3461, ISO 7000
Two Hand Controls	OSHA 1910.261, .212, ANSI B11.19, NFPA 79	EN 574, IEC 60204, IEC 61508, IEC 60621
Trim Squirts	OSHA 1910.261	EN 1034
Ventilation / Industrial Hygiene	OSHA 1910.106, .261, .1200	EN 132, EN 626, EN 1093, EN 12198, EN 24869, ISO 11201
Walking Surfaces / Floor Drains	OSHA 1910.22, .23	EN 292

Appendix F
Paper Making Safety Standards- Some Sources

All IEC standards referred in this section and this document are from the “International Electrotechnical Commission,” a European domiciled standards setting agency.

EUROPEAN STANDARD	NAME OR TITLE OF STANDARD
BS 5667	LIVE ROLLER CONVEYOR SPECS.
EN 132	RESPIRATORY PROTECTIVE DEVICES
EN 286	UNFIRED PRESSURE VESSELS
EN 292	SAFETY OF MACHINERY
EN 294	SAFETY DISTANCES - UPPER LIMBS
EN 349	MINIMUM GAPS TO AVOID CRUSHING
EN 361	FALL PERSONAL PROTECTIVE EQUIP.
EN 418	EMERGENCY STOPS
EN 457	AUDITORY DANGER SIGNALS
EN 547	SAFE WHOLE BODY ACCESS
EN 563	HOT SURFACES - SAFETY
EN 574	TWO HAND CONTROLS - SAFETY
EN 614	ERGONOMIC DESIGN - MACHINERY
EN 626	REDUCE HAZARDOUS SUBSTANCES
EN 811	SAFETY DISTANCES - LOWER LIMBS
EN 894	ERGONOMIC DISPLAY/CONTROLS
EN 953	FIXED & MOVABLE GUARDS
EN 954	CONTROL SYSTEM SAFETY
EN 981	AUDITORY/VISUAL SIGNALS
EN 982	HYDRAULIC POWER SAFETY
EN 983	PNEUMATIC POWER SAFETY
EN 999	HAND/ARM SPEED SAFETY
EN 1010	SAFE DESIGN - PRINTING/PAPER/ CONVERTING MACHINES
EN 1034	SAFETY - PAPER MAKING/FINISHING MACHINES
EN 1037	PREVENT UNEXPECTED START-UP OF MACHINERY
EN 1050	MACHINERY RISK ASSESSMENT
EN 1088	INTERLOCKING DEVICES
EN 1093	AIRBORNE HAZARDOUS SUBSTANCES
EN 1127	EXPLOSION PREVENTION
EN 1760	PRESSURE SENSITIVE DEVICES/MATS
EN 1837	LIGHTING OF MACHINES - SAFETY
EN 12198	RADIATION EMITTED BY MACHINERY
EN 24869	METHOD OF MEASUREMENT
IEC 61508	Generic ELECTRICAL CONTROL SYSTEMS

Appendix F
Paper Making Safety Standards- Some Sources

EUROPEAN STANDARD	NAME OR TITLE OF STANDARD
IEC 61511	Process ELECTRICAL CONTROL SYSTEMS
IEC 60621	MACHINERY ELECTRICAL CONTROL SYSTEMS
IEC 60204	MACHINERY - ELECTRICAL EQUIPMENT SAFETY
IEC 61131	PROGRAMMABLE CONTROLLERS
IEC 61496	ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT
ISO 3461	SYMBOLS
ISO 3864	SAFETY COLORS & SIGNS
ISO 7000	EQUIPMENT GRAPHICAL SYMBOLS
ISO 11201	EQUIPMENT NOISE CONTROL
ISO 13854	MINIMUM GAPS TO AVOID CRUSHING
ISO 13849	MACHINERY CONTROL SYSTEMS- ALL TECHNOLOGIES

INTERNET STANDARDS SITE:	http://global.ihs.com