

American National Standard for Plastics Machinery

Requirements for the Manufacture, Care, and Use of Plastic Sheet Production Machinery

April 2, 2009

Draft 5.1

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Foreword

(This Foreword is not part of American National Standard ANSI/SPI B151.20)

This standard is a revision of American National Standard Requirements for the Manufacture, Care, and Use of Plastic Sheet Production Machinery, ANSI B151.20-1999. The standard was revised because:

- (1) Some paragraphs required modification for clarity and intent.
- (2) Additional explanatory material and illustrations were added.
- (4) Additional definitions were required.
- (5) Some paragraphs required modification and some paragraphs were added to conform more closely to change in technology

The project on requirements for the manufacture, care, and use of plastic sheet production machinery was initiated under the auspices of the Extrusion Section of the Machinery Division of the Society of the Plastics Industry, Inc (SPI).

SPI has long been concerned with operator safety on plastics processing equipment. Accordingly, the organization has established a standards development committee charged with the task of establishing necessary standards.

A standard treating the manufacture, care, and use of plastic sheet production machinery is complicated by the wide variety and sizes of machines manufactured and in use, and by the virtually infinite combinations of parts being produced, the production methods used, and the operating conditions existing in industry today.

The primary objective of this standard is to minimize hazards to personnel associated with machine activity by establishing requirements for the manufacture, care, and use of these machines.

To accomplish this objective, the committee decided to approach the problem of machine safety as follows;

The committee developed a list of hazards typical of Plastic Sheet Production Machinery and listed these in section 6 of this standard. For each hazard identified within the scope of the standard, the committee assessed the potential severity of injury related to the hazard, the frequency of exposure to the hazard, and possible avoidance. This process involved discussion among the committee, and resulted in the recommended preventive control measure included in sections 7 through 10 inclusive and additional Annex reference material. Compliance with this standard is considered to adequately control hazards identified in section 6. Other hazards not listed in section 6 that can occur with Plastic Sheet Production Machinery may require additional preventive controls not included in this standard.

To assist in the interpretation of these requirements, responsibilities have been assigned to the manufacturer, the remanufacturer, the modifier, and the employer.

Recognizing the impossibility of immediate updating of design and manufacturing methods, Sections 7 and 10 shall become effective one year after the approval date of this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Society of the Plastics Industry, Inc, 1667 K Street, NW, Washington, DC 20006

Consensus for this standard was achieved by use of the Canvass Method.

The following organizations recognized as having an interest in the standardization of extrusion were contacted prior to the approval of this standard. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

*****Will be added after balloting and public review of finalized document*****

The Extrusion Safety and Standards Development Committee of the Machinery Division, and the Safety Committee of the Molders Division of The Society of the Plastics Industry, Inc, which was responsible for this standard, had the following members:

John Rexford	HPM a Taylor's Company-Chairman
Brad Eisenbarth	American Maplan Corp.
James Provost	Davis-Standard, LLC
Jim Pilavdzic	Husky Injection Molding Systems
Ed Chorey	Milacron – Plastics Technologies Group, Inc.
Dennis Meckler	Bosch Rexroth
Mike Mithchell	Welex Incorporated
Tom Scheck	Eurotherm Inc.
Abdul Wahab	Coperion
Tom Limbrunner	Processing Technologies,, LLC

Secretariat to the Committee: W. Bishop - Executive Director, Machinery Division of the Society of the Plastics Industry

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Explanation of Standard Format

American National Standard ANSI/SPI B151.20 – Draft 200x uses a two-column format to provide both specific requirements and supporting information.

The left column, designated "Standard Requirements," is confined solely to these requirements.

The right column, designated "Explanatory Information," contains only information that is intended to clarify the standard. This column is not a part of the standard. Where supplementary illustrations are required, they are designated as "figures."

Operating rules (safe practices) are not included in either column unless they are of such a nature as to be vital safety requirements, equal in weight to other requirements, or guides to assist in compliance with the standard. The Annex includes common procedures practiced on plastics machinery. This is considered "Explanatory Information" and is supplementary to the standard.

<p>1 Scope, Purpose, Application and Installation</p>	
<p>1.1 Scope</p> <p>The requirements of this standard shall apply to plastic sheet production machinery.</p> <p>Safety requirements of ancillary equipment used with plastic sheet production machinery are not covered by this standard.</p>	
<p>1.2 Purpose</p> <p>The purpose of this standard is to identify and address known hazards to personnel working on, or adjacent to, the plastic sheet production machinery.</p>	
<p>1.3 Application</p>	<p>E1.3 Application</p> <p>Inquiries with respect to the application of, or substantive requirements of this standard should be addressed to the Society of the Plastics Industry, Inc, 1667 K Street, NW, Washington, DC 20006.</p>
<p>1.3.1 New or Remanufactured Primary Sheet Production Machinery</p> <p>The requirements of this standard pertaining to manufacture shall apply to all new or remanufactured plastic sheet production machinery installed in the United States of America. Date of manufacture (month and year) shall be affixed permanently and legibly to the machine along with the name of the manufacturer or remanufacturer. Compliance shall be achieved within one year of the approval date of this standard.</p>	<p>E1.3.1 New or Remanufactured Primary Sheet Production Machinery</p> <p>Date of manufacture is understood to be the date the plastic sheet production machinery was complete and available for delivery to the employer.</p>
<p>1.3.2 Existing Installations</p> <p>The employer is responsible for bringing existing plastic sheet production machinery into compliance with the requirements of this standard within one year of the approval of this standard with the following exception:</p> <p>The 4 inch dimensions referred to in 7.3.1.8 shall be changed to 3 inches.</p>	<p>If modifications are required to achieve this reduced dimension, the employer is strongly urged to use 4 inches if at all possible.</p>
<p>1.3.3 All Installations</p> <p>An employer shall not operate plastic sheet production machinery or permit it to be operated unless it is in compliance with this standard. The use shall be in accordance with Section 9 of this standard and shall be effective on the approval date of this standard.</p>	

<p>2 Referenced American National Standards</p> <p>This standard is to be used with the following American National Standards.</p> <p>ANSI Z535.3-2006, Criteria for Safety Symbols</p> <p>ANSI Z535.4-2006, Product Safety Signs and Labels</p> <p>ANSI Z535.6-2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials</p> <p>ANSI/NFPA 79 -2007, Electrical Standard for Industrial Machinery</p> <p>ANSI Z97.1-2004, Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test</p> <p>ANSI/SPI B151.7 – 2009, Requirements for the Manufacture, Care, and Use of Extrusion Machinery</p>	<p>E2 Related Standards and Publications</p> <p>AN-137- Recommended Guideline for Safety Signs for Plastic Machinery and Related Equipment</p> <p>ANSI/ASSE Z244.1-2003- Control of Hazardous Energy- Lockout/Tagout and Alternative Methods</p> <p>AN-150 Arc Flash Hazards</p>
<p>3 Definitions</p>	
<p>3.1 Alarm. A visual or audible warning.</p>	
<p>3.2 Emergency Stop Device. A mechanism that, when actuated, stops all machine movement associated with the specific machine</p>	<p>E3.2 Emergency Stop Device. This mechanism may include but is not limited to a trip rod, cord, button, electronic device, etc.</p>
<p>3.3 Employer. Any person who contracts, hires, or is responsible for the personnel associated with the installation, set-up, operation and maintenance of plastic sheet production machinery.</p>	
<p>3.4 Guard. A physical barrier that prevents access to areas where known hazards exist.</p>	
<p>3.4.1 Guard, Fixed. A guard that is fixed in place and requires a tool for moving or removal.</p>	
<p>3.4.2 Guard, Movable. A guard which may be moved or removed without the use of tools. A movable guard requires an interlock(s).</p>	
<p>3.5 Hazard. A source of possible injury or damage to health.</p>	
<p>3.6 Instructions. Documentation for the installation, operation, care, maintenance, and safe use of the plastic sheet production machinery.</p>	<p>E3.6 Instructions. See ANSI Z535.6 – 2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.</p>
<p>3.7 Interlock. An arrangement whereby the operation of one control or mechanism allows or prevents the operation of another.</p>	
<p>3.8 Local Control. A control device located in full view of the component being controlled.</p>	<p>E3.8 Local Control. The operator must be able to see the hazard.</p>
<p>3.9 Lockout. The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.</p>	
<p>3.10 Maintenance Personnel. Individuals who by virtue of their training and skills are qualified to inspect,</p>	

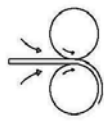
maintain, and repair plastic sheet production machinery.	
3.11 Manufacturer. Any person whose business is the manufacture of equipment covered in this standard for installation in the United States of America.	
3.12 Modification. For the purpose of this standard, any change to a product that affects the safety of personnel is considered a modification.	E3.12 Modification. Modification is intended to include adding, deleting, converting or altering the original product. This could affect such areas as control systems, ladders, enclosures, guards, etc., Anything that has been added, moved or removed, converted, or altered which effects the interface between the plastic sheet production machine and the personnel constitutes modification.
3.13 Modifier. Any person who performs a modification to a plastic sheet production machine.	
3.14 Nip, Counter Rotating. The point between two counter rotating rolls.	
3.15 Nip, Fixed Member. The point between a fixed member and a driven roll where the distance between the two is 4 inches or less.	
3.16 Nip, Primary. The first counter rotating nip the sheet goes through after leaving the die.	
3.17 Nip, Secondary. Any nip on the polishing roll stand after the primary nip.	E3.17 Nip, Secondary. There may be more than one secondary nip.
3.18 Nip, Web Generated. The contact point between a web surface and a rotating roll.	
3.19 Nip, Wedging. A fixed member nip where the distance between the fixed member and the surface of the roll decreases in the direction of rotation.	
3.20 Normal production. The utilization of the plastic sheet production machinery to perform its intended production function.	
3.21 Operator. An individual who has been trained and authorized by the employer to perform production work on the plastic sheet production machinery.	
3.22 Plastic. Any material processed by the plastic sheet production machinery.	
3.23 Pinch Point. Any point at which it is possible for a part of the body to be caught between a moving part and a fixed part or between two moving parts except nips.	
3.24 Polishing Roll Stand. A machine equipped with two or more metal rolls revolving in opposite directions and capable of nipping plastic melt used for heat transfer and/or sizing.	E3.24 Polishing Roll Stand. The machine may have additional capabilities such as polishing, embossing and laminating.
3.25 Presence Sensing Device. A device which is capable of detecting an intrusion into a specified area.	
3.26 Pull Roll Stand. A machine or a part thereof consisting of two nipping rolls that revolve in opposite direction and are used to pull the web after leaving the preceding equipment.	E3.26 Pull Roll Stand. A pull roll stand is also known as a draw roll.
3.27 Reach Point. The farthest point an operator is expected to be able to touch when outside of the machine or on a walkway. Areas that may only be reached by deliberately crawling into the machine or otherwise contorting the body are not considered within the reach point of the operator.	

<p>3.28 Rebuild. Restoring a portion of the plastic sheet production machinery to its original purpose, capacity, or function including compliance with Section 7 and 10 of this standard.</p>	<p>E3.28 Rebuild. Some change in original design may be required to comply with Section 7 and 10 of this standard.</p>
<p>3.29 Remanufacture. A substantial restoration of the plastic sheet production machinery.</p>	<p>E3.29 Remanufacture. Remanufacture typically consists of the following:</p> <ol style="list-style-type: none"> 1.) Complete dismantling of the plastic sheet production machinery. 2.) Cleaning and carefully inspecting all parts. 3.) Reworking worn parts to as new condition or replacing with new parts. 4.) Completely reconditioning or replacing power system components to meet applicable standards and guidelines. 5.) Thoroughly inspecting all electrical and control systems and replacing component/systems as required. 6.) Removing modifications which are not in conformance with Sections 7 and 10 of this standard and informing the employer of the removal.
<p>3.30 Remanufacturer. Any person whose business is the redesign and/or remanufacture of plastic sheet production machinery for installation in the United States of America.</p>	
<p>3.31 Repair. The restoration of a portion of the plastic sheet production machinery to original function using original design by replacement or reworking of worn or damaged parts.</p>	<p>E3.31 Repair. Repair may include such items as replacement or re-work of safety devices, drives, control meters, etc.</p>
<p>3.32 Safety Signs. A visual alerting sign, label, decal, placard, or other marking that advises the observer of the nature and degree of the potential hazard(s) that can cause injury or death and the required actions to avoid the hazard.</p>	<p>E3.32 Safety Signs. See AN-137 Safety Signs.</p>
<p>3.33 Servicing and/or maintenance. Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing equipment.</p>	<p>E3.33 Servicing and/or maintenance. These activities include lubricating, cleaning, adjusting, and unjamming of machines or equipment.</p>
<p>3.34 Set up. Any work performed to prepare the plastic sheet production machinery to perform its normal production.</p>	
<p>3.35 Setup Personnel. Individuals who are trained and authorized by the employer to prepare the plastic sheet production machinery.</p>	<p>E3.35 Setup Personnel. These activities include lubricating, cleaning, adjusting, and unjamming the machines or equipment.</p>
<p>3.36 Shall. The word "shall" is to be understood as denoting a mandatory requirement.</p>	
<p>3.37 Sheet. Plastic processed into a rectangular cross-section of various thicknesses.</p>	<p>E3.37 Sheet. Thin sheet is typically called film.</p>
<p>3.38 Sheet Production Machinery. A machine which receives molten plastic into the primary nip and processes it into finished sheet form.</p>	<p>E3.38 Sheet Production Machinery. Sheet production machinery normally includes polishing roll stand, conveyor (including slitting and trimming devices), pull roll stand(s), and other rolls.</p>
<p>3.39 Should. The word "should" is to be understood as denoting a recommendation.</p>	
<p>3.40 "S" Wrap. An "S" wrap is formed between two counter rotating rolls either touching or not, when the</p>	

web passes around the first roll, through the space between the two rolls, around the second roll, and continues. This is opposed to the web simply passing through the nip between the two rolls without wrapping either	
3.41 Tagout. The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.	
3.42 Traversing. The motion of a plastic sheet production machine from a non-production position to a production position and vice versa.	E3.42 Traversing. Traversing does not include plastic sheet production machinery motions inherent in production operation (i.e. oscillating and rotation).
3.43 Vapors. Gas or steam formed by processing plastic.	
3.44 Web. A sheet passed through the plastic sheet production machinery.	
4 Care—Responsibility for	
4.1 Instructions	
4.1.1 Manufacturer It shall be the responsibility of the manufacturer to furnish instructions with the plastic sheet production machinery.	E4.1.1 Manufacturer. See ANSI Z535.6 – 2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.
4.1.2 Modifier It shall be the responsibility of any person modifying plastic sheet production machinery to furnish instructions specific to the modification.	E4.1.2 Modifier. See ANSI Z535.6 – 2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.
4.1.3 Remanufacturer It shall be the responsibility of any person remanufacturing plastic sheet production machinery to furnish instructions with the remanufactured plastic sheet production machinery.	E4.1.3 Remanufacturer. See ANSI Z535.6 – 2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.
4.2 Training of Maintenance and/or Setup Personnel It shall be the responsibility of the employer to ensure the original and continuing competence of personnel caring for, setting up, inspecting, and maintaining plastic sheet production machinery.	
4.3 Inspection and Maintenance It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of plastic sheet production machinery to ensure that they are in safe operating condition and proper adjustment. At the minimum, the employer shall follow the	

inspection and maintenance instructions provided by the manufacturer.	
5 Manufacture, Remanufacture, Repair, Modification, and Rebuild	
5.1 Responsibility	
5.1.1 Manufacture The manufacture of new plastic sheet production machinery shall be in accordance with Sections 7 and 10 of this standard.	
5.1.2 Remanufacture The remanufacture of plastic sheet production machinery shall be in conformance with Sections 7 and 10 of this standard.	
5.1.3 Modification The modification made to existing plastic sheet production machinery shall be in accordance with section 7 and 10 of this standard that apply to the modification. Any modification shall not reduce the level of safety existing on the plastic sheet production machinery at the time of manufacture or remanufacture.	E5.1.3 Modification For the purpose of this standard, bringing plastic sheet production machinery into conformance with the requirements of Section 7 is considered a modification.
5.1.4 Repair Repair shall not reduce the level of safety of the plastic sheet production machinery.	E5.1.4 Repair The intent of this section is to ensure that repairs are done properly with equivalent or better components.
5.1.5 Rebuild Rebuild of any portion of existing plastic sheet production machinery shall be in accordance with Section 7 and Section 10 of this standard. Rebuild shall not reduce the level of safety of the plastic sheet production machinery.	

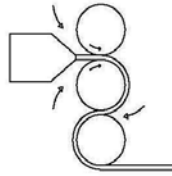
Hazards and Areas of Danger



COUNTER
ROTATING
NIP



FIXED
MEMBER
NIP



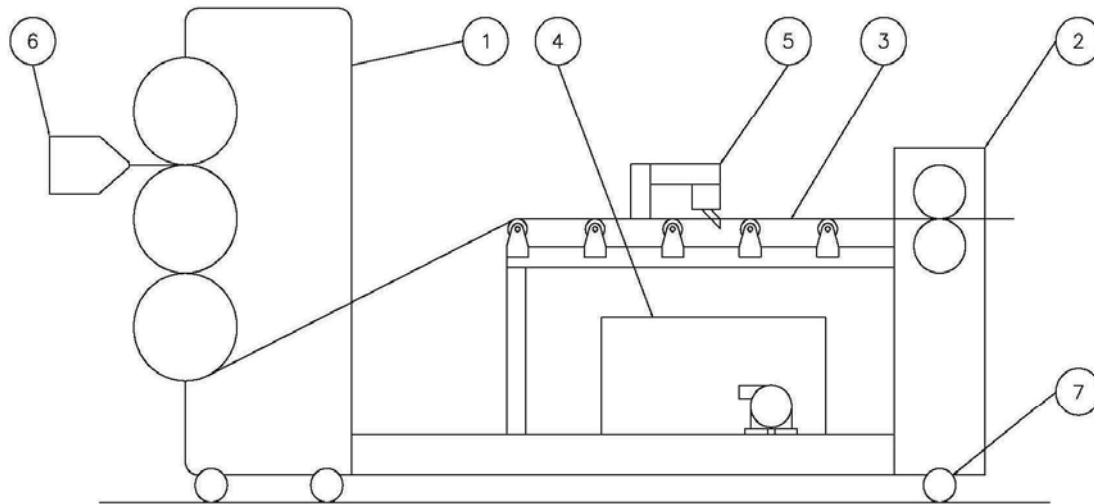
PRIMARY &
SECONDARY
NIP



WEB
GENERATED
NIP



WEDGING
NIP



- | | |
|--------------------------------|-------|
| 1. POLISHING ROLL STAND | 6.1.1 |
| 2. PULL ROLL STAND | 6.1.2 |
| 3. CONVEYOR | 6.1.3 |
| 4. HEAT TRANSFER SYSTEM | 6.1.4 |
| 5. SLITTER | 6.1.4 |
| 6. DIE | 6.1.5 |
| 7. WHEELS AND MACHINE MOVEMENT | 6.1.6 |

<p>6.1 Specific machine areas where hazards exist</p> <p>Refer to Figures 1 and 2</p> <ol style="list-style-type: none"> 1. Polishing Roll Stand 2. Pull Roll stand 3. Heat Transfer System 4. Slitter 5. Die 6. Wheels and machine movement 	
<p>6.1.1 Polishing Roll Stand</p>	<p>E6.1.1 Polishing Roll Stand See Figures 1 and 2 area 1</p>
<p>6.1.1.1 Mechanical hazards Crushing, shearing and/or entanglement hazards caused by the movement of:</p> <ul style="list-style-type: none"> •Rolls and shaft extensions •Roll arms/Cylinders •Belts and sheaves •Gears and sprockets •Couplings •Roll gaps/Dead stops 	
<p>6.1.1.2 Thermal Hazards Burns due to operating temperature of:</p> <ul style="list-style-type: none"> •Rolls •Hoses •Rotary Unions •Web •Motor •Reducer 	
<p>6.1.2 Pull Roll Stand</p>	<p>E6.1.2 Pull Roll Stand See Figures 1 and 2 area 2</p>
<p>6.1.2.1 Mechanical Hazards Crushing, shearing, and/or entanglement hazards caused by movement of:</p> <ul style="list-style-type: none"> •Rolls and shaft extensions •Couplings •Cylinders 	
<p>6.1.2.2 Thermal Hazards Burns due to operating temperature of:</p> <ul style="list-style-type: none"> •Web •Rolls •Motor •Reducer 	
<p>6.1.3 Heat Transfer System</p>	<p>E6.1.3 Heat Transfer System See Figures 1 and 2 area 3.</p>
<p>6.1.3.1 Mechanical hazards Shearing, impact, and/or entanglement hazards due to</p>	

<p>movement of:</p> <ul style="list-style-type: none"> • Pump motor coupling. • Overpressurized coolant. • Fan blades. 	
<p>6.1.3.2 Thermal hazards Burns due to contact with:</p> <ul style="list-style-type: none"> • Overheated coolant. • Motor. • System components. 	
<p>6.1.4 Slitter</p>	<p>E6.1.4 Slitter See Figures 1 and 2 area 4.</p>
<p>6.1.4.1 Mechanical hazards. Puncture, shearing, and/or entanglement hazards due to:</p> <ul style="list-style-type: none"> • Blades. • Blade holder. 	
<p>6.1.4.2 Thermal hazards Burns due to contact with hot knife(s).</p>	
<p>6.1.5 Die Hazards associated with the die are not covered in this standard.</p>	<p>E6.1.5 Die See Figures 1 and 2 area 5.</p>
<p>6.1.6 Wheels and machine movement</p>	<p>E6.1.6 Wheels and machine movement See Figures 1 and 2 area 6.</p>
<p>6.1.6.1 Mechanical hazards Crushing, shearing, and/or entanglement hazards due to movement of:</p> <ul style="list-style-type: none"> • Wheels. • Plastic sheet production machinery. 	
<p>6.2 Other Hazards</p>	
<p>6.2.1 Electrical Hazards Electric shock or burns due to contact with live conductive parts and/or arc flash.</p>	
<p>6.2.2 Vapors Certain processing conditions and/or plastics can cause hazardous fumes or vapors.</p>	
<p>6.2.3 Platforms Falling hazards associated with elevated platforms.</p>	
<p>7 Safety Requirements and/or methods</p>	
<p>7.1 General Guarding</p> <p>Guards and/or other safety measure(s) shall be provided where hazards exist. Movable guards shall be interlocked to stop hazardous motion exposed by moving or removing the guard.</p> <p>Fixed guards shall require fasteners to attach guard in place and tools to install or to remove the fasteners.</p> <p>Reach over safety distances shall be in accordance with table 3 of Figure 3 unless otherwise specified.</p>	<p>E7.1 General Guarding</p> <p>Examples of some types of fasteners that should not be used are:</p> <ul style="list-style-type: none"> • slotted head screws • wing nuts • magnets • latches and hasps • hooks and eyes.

Reach through opening shall be in accordance with table 4 of Figure 4.

Table 3 - Safety Distance, Reach Over Protective Structure

Height of Danger Zone (a)		Height of fixed barrier or protective structure (b)																	
		mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in		
		1000	39.37	1200	47.24	1400	55.12	1600	62.99	1800	70.87	2000	78.74	2200	86.61	2400	94.49	2500	98.43
		Horizontal distance to danger zone (c)																	
		mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
2500	98.43	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
2400	94.49	100	3.94	100	3.94	100	3.94	100	3.94	100	3.94	100	3.94	100	3.94	100	3.94	----	----
2200	86.61	600	23.62	600	23.62	500	19.69	500	19.69	400	15.75	350	13.78	250	9.84	----	----	----	----
2000	78.74	1100	43.31	900	35.43	700	27.56	600	23.62	500	19.69	350	13.78	----	----	----	----	----	----
1800	70.87	1100	43.31	1000	39.37	900	35.43	900	35.43	600	23.62	----	----	----	----	----	----	----	----
1600	62.99	1300	51.18	1000	39.37	900	35.43	900	35.43	500	19.69	----	----	----	----	----	----	----	----
1400	55.12	1300	51.18	1000	39.37	900	35.43	800	31.50	100	3.94	----	----	----	----	----	----	----	----
1200	47.24	1400	55.12	1000	39.37	900	35.43	500	19.69	----	----	----	----	----	----	----	----	----	----
1000	39.37	1400	55.12	1000	39.37	900	35.43	300	11.81	----	----	----	----	----	----	----	----	----	----
800	31.50	1300	51.18	900	35.43	600	23.62	----	----	----	----	----	----	----	----	----	----	----	----
600	23.62	1200	47.24	500	19.69	----	----	----	----	----	----	----	----	----	----	----	----	----	----
400	15.75	1200	47.24	300	11.81	----	----	----	----	----	----	----	----	----	----	----	----	----	----
200	7.87	1100	43.31	200	7.87	----	----	----	----	----	----	----	----	----	----	----	----	----	----
0	0.00	1100	43.31	200	7.87	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Barriers less than 1000mm (39 inches) in height are not included because they do not sufficiently restrict movement of the body. There shall be no interpolation of the values of this table. Consequently, when the known values of tables a, b, or c are between two values, the values to be used are those which provide the higher level of safety.

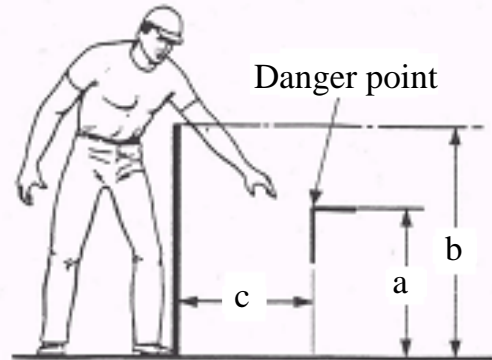


Figure 3 – Reach over protective structure

Table 4- Safety distance, Reach through opening

The following table gives the safety distance for regular openings. The dimensions of opening “e” correspond to the side of a square opening, the diameter of a round opening and the narrowest dimension of a slot opening. For opening > 120 mm (4.724 inch) table 3 shall be used.

Opening “e”		Safety Distance “Sr”					
		Slot		Square		Round	
(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)
$e \leq 4$	$e \leq 0.157$	≥ 2	≥ 0.079	≥ 2	$\geq .079$	≥ 2	$\geq .079$
$4 < e \leq 6$	$0.157 < e \leq 0.236$	≥ 10	≥ 0.394	≥ 5	$\geq .197$	≥ 5	$\geq .197$
$6 < e \leq 8$	$0.236 < e \leq 0.315$	≥ 20	≥ 0.787	≥ 15	$\geq .591$	≥ 5	$\geq .197$
$8 < e \leq 10$	$0.315 < e \leq 0.394$	≥ 80	≥ 3.150	≥ 25	$\geq .984$	≥ 20	$\geq .787$
$10 < e \leq 12$	$0.394 < e \leq 0.472$	≥ 100	≥ 3.937	≥ 80	≥ 3.150	≥ 80	≥ 3.150
$12 < e \leq 20$	$0.472 < e \leq 0.787$	≥ 120	≥ 4.724	≥ 120	≥ 4.724	≥ 120	≥ 4.724
$20 < e \leq 30$	$0.787 < e \leq 1.181$	≥ 850 (1)	≥ 33.465 (1)	≥ 120	≥ 4.724	≥ 120	≥ 4.724
$30 < e \leq 40$	$1.181 < e \leq 1.575$	≥ 850	≥ 33.465	≥ 200	≥ 7.874	≥ 120	≥ 4.724
$40 < e \leq 120$	$1.575 < e \leq 4.724$	≥ 850	≥ 33.465	≥ 850	≥ 33.465	≥ 850	≥ 33.465

(1) If the length of the slot opening is ≤ 65 mm (2.56 inch) the thumb will act as stop and the safety distance can be reduced to 200 mm (7.87 inch).

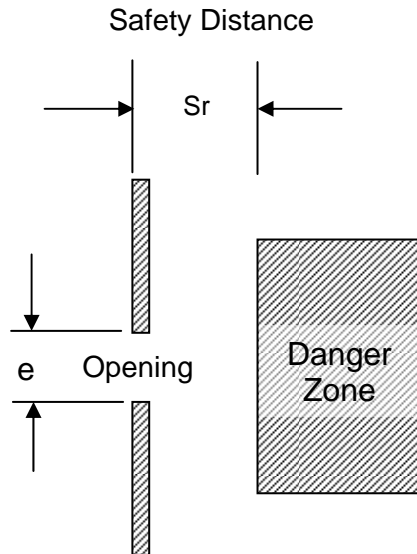


Figure 4- Safety through opening

<p>7.2 General safety requirements</p>	
<p>7.2.1 Window</p> <p>When a window is used in a gate or guard to provide visibility, the window material shall be polycarbonate or tempered glass and meet the requirements of ANSI Z97.1.</p>	
<p>7.2.2 Thermal Hazards</p> <p>A guard shall be provided against hot surfaces above 175°F (80°C).</p> <p>Where guards are not technically or operationally feasible, a safety sign shall be provided.</p>	
<p>7.2.3 Hoses</p> <p>Flexible hoses with pressure higher than 50 bar (725 psi) and their connections shall be designed to prevent unintentional detachment.</p> <p>Hoses and hose assemblies selection and installation shall comply with the specifications in SAE standard SAE J1273.</p>	<p>E7.2.3 Hoses</p> <p>See 9.9.</p>
<p>7.2.4 Electrical Requirements</p> <p>Plastic sheet production machines shall be in accordance with the requirements of ANSI/NFPA 79.</p>	
<p>7.2.4.1 Safety Circuit Performance</p> <p>For Type II interlocks, safety shall be maintained in the case of a single fault. The safety circuit shall be designed, constructed and applied such that any single component failure shall lead to the shutdown of the system in a safe state and prevent the subsequent automatic operation until that component failure has been corrected.</p> <p>Safety circuits shall be hardware or a software/firmware based controller. When safety related software and firmware based controllers are used in place of hardware based components, they shall be listed for such use.</p> <p>In either case the monitoring shall:</p> <ul style="list-style-type: none"> (a) Generate a stop motion signal if a fault is detected. (b) Provide a warning if the hazard remains after cessation of motion. (c) Maintain a safe state until the fault is cleared. (d) Detect the single fault at time of failure. If this is not practical, the failure shall be detected at the next demand upon the safety function, and 	<p>E7.2.4.1 Safety Circuit Performance</p> <p>See 7.3</p> <p>For example, if relays controlled by the position switch(es) are used for the purpose of contact multiplying, monitoring of these relays is necessary.</p>

<p>If a software/firmware controller is not listed for use in safety related control functions, then each position switch shall be connected to its own input module, or if a common input module is used, the inverse signals of both position switches shall be inputted and any fault in the input circuits shall be automatically recognized.</p>	
<p>7.2.4.2 Machine Grounding</p> <p>The machine and all exposed, noncurrent-carrying conductive parts, material, and equipment likely to be energized shall be effectively grounded. Where electrical devices are mounted on metal mounting panels that are located within nonmetallic enclosures, the metal mounting panels shall be effectively grounded.</p> <p>The above items shall be interconnected to the equipment grounding (protective) conductor terminal.</p>	
<p>7.2.4.3 Stop Function</p> <p>Each plastic sheet production machine shall be equipped with a either Category 0 or Category 1 stop. Category 0 and Category 1 stops shall be operational regardless of operating modes. Stop function shall operate by de-energizing that relevant circuit and shall override related start functions.</p> <p>Where required, provisions to connect protective devices and interlocks shall be provided. Where applicable, the stop function shall signal the logic of the control system that such a condition exists. The reset of the stop function shall not initiate any hazardous conditions.</p>	<p>E7.2.4.3 Stop Function</p> <p>Category 0 is an uncontrolled stop by immediately removing power to the machine actuators.</p> <p>Category 1 is a controlled stop with power to the machine actuators available to achieve the stop then remove power when the stop is achieved.</p>
<p>7.2.4.4 Emergency Stop</p> <p>Emergency stop shall be initiated by a single human action.</p> <p>In addition to the requirements for stop functions, emergency stop shall have the following requirements:</p> <p>(1) It shall override all other functions and operations in all modes.</p> <p>(2) Power to the machine actuators, which causes a hazardous condition(s), shall be removed as quickly as possible without creating other hazards (e.g., by the provision of mechanical means of stopping requiring no external power, by reverse current braking for a Category 1 stop).</p> <p>(3) Reset of an emergency stop circuit shall not initiate a restart.</p>	<p>E7.2.4.4 Emergency Stop</p> <p>The palm or mushroom head of the push button device should not be fitted with any kind of protective ring encompassing the head or cover over the head to prevent accidental activation.</p>

<p>(4) It shall function as either a Category 0 or a Category 1 stop. Where a Category 0 stop is used for the emergency stop function, it shall have only hardwired electromechanical components. Exception: Electronic logic (hardware or software) that meets NFPA 79 requirement can also be used.</p> <p>Where a Category 0 or a Category 1 stop is used for the emergency stop function, final removal of power to the machine actuators shall be ensured and shall be by means of electromechanical components. Where relays are used to accomplish a Category 0 emergency stop function, they shall be nonretentive relays.</p> <p>(5) Emergency stop pushbuttons shall be located at each operator control station or where motion can be initiated and at other locations where emergency stop is required.</p> <p>(6) Pushbutton-type devices for emergency stop shall be of the self-latching type and shall have positive (direct) opening operation.</p> <p>(7) Emergency stop switches shall not be flat switches or graphic representations based on software applications.</p> <p>(8) It shall not be possible to restore an emergency stop circuit until the emergency stop device has been manually reset. Where several emergency stop devices are provided in a circuit, it shall not be possible to restore that circuit until all emergency stop devices that have been operated have been reset.</p> <p>(9) Actuators of emergency stop devices shall be colored RED. The background immediately around pushbuttons and disconnect switch actuators used as emergency stop devices shall be colored YELLOW. The actuator of a pushbutton-operated device shall be of the palm or mushroom-head type. The RED/YELLOW color combination shall be reserved exclusively for emergency stop applications.</p>	
<p>7.2.4.5 Interlock Switches</p> <p>Where doors or guards have interlocked switches used in circuits with safety related functions, the interlocking devices shall have either positive (direct) opening operation, or provide similar reliability and prevent the operation of the equipment when the doors or guards are open (difficult to defeat or bypass). Exception: When two interlock switches are used together in a Type II interlock, one of the switches will not operate in a positive mode.</p>	
<p>7.2.4.6 Continuity of the Grounding Circuit</p>	

One of the following methods shall be used to verify the continuity of the equipment grounding circuit:

(1) Use an impedance measuring device, take into account any impedance in the measuring circuit. The measured impedance shall be 0.1 ohm or less.

(2) Apply a current of at least 10 amperes, 50 Hz or 60 Hz, derived from a Safety Extra Low Voltage (SELV) source. The tests are to be made between the equipment grounding protective earthing (PE) terminal and relevant points that are part of the equipment grounding (protective bonding) circuit; the measured voltage between the equipment grounding protective earthing (PE) terminal and the points of test is not to exceed the values given in Table 5.

Table 5

Minimum Equipment Grounding (Protective Bonding) Conductor Cross-Sectional Area of the Branch Under Test (AWG)	Voltage Drop* (V)
18	3.3
16	2.6
14	1.9
10	1.4
> 8	1.0

*Values are given for a test current of 10 amperes

7.2.4.7 Electrical Disconnects

A lockable supply circuit disconnecting means shall be provided for each incoming supply circuit.

7.2.4.8 Short Circuit / Branch Circuit Protection

Supplementary overcurrent protective devices shall not be used as a substitute for branch-circuit overcurrent protective devices.

7.2.4.9 Arc Flash Hazard

A safety sign shall be provided adjacent to the disconnecting operating handle(s) where the disconnect(s) that is(are) interlocked with the enclosure door does not de-energize all exposed live parts when the disconnect(s) in the open (off) position.

E7.2.4.9 Arc Flash Hazard

See AN-150 for Safety Sign requirements.

7.3 Additional safety requirements and/or methods in specific machine areas

Safety circuit and its monitoring function described below shall comply with clause 7.2.4.1.

A) Type I Interlock (Figure 5)

An interlock consisting of one position sensor that is positively actuated when the guard opens and positively interrupts the energy supply to the device producing the hazardous motion.

The single fault safety requirement stated in clause 7.2.4.1 does not apply to the position switch or the main shutoff device

B) Type II Interlock (Figure 6)

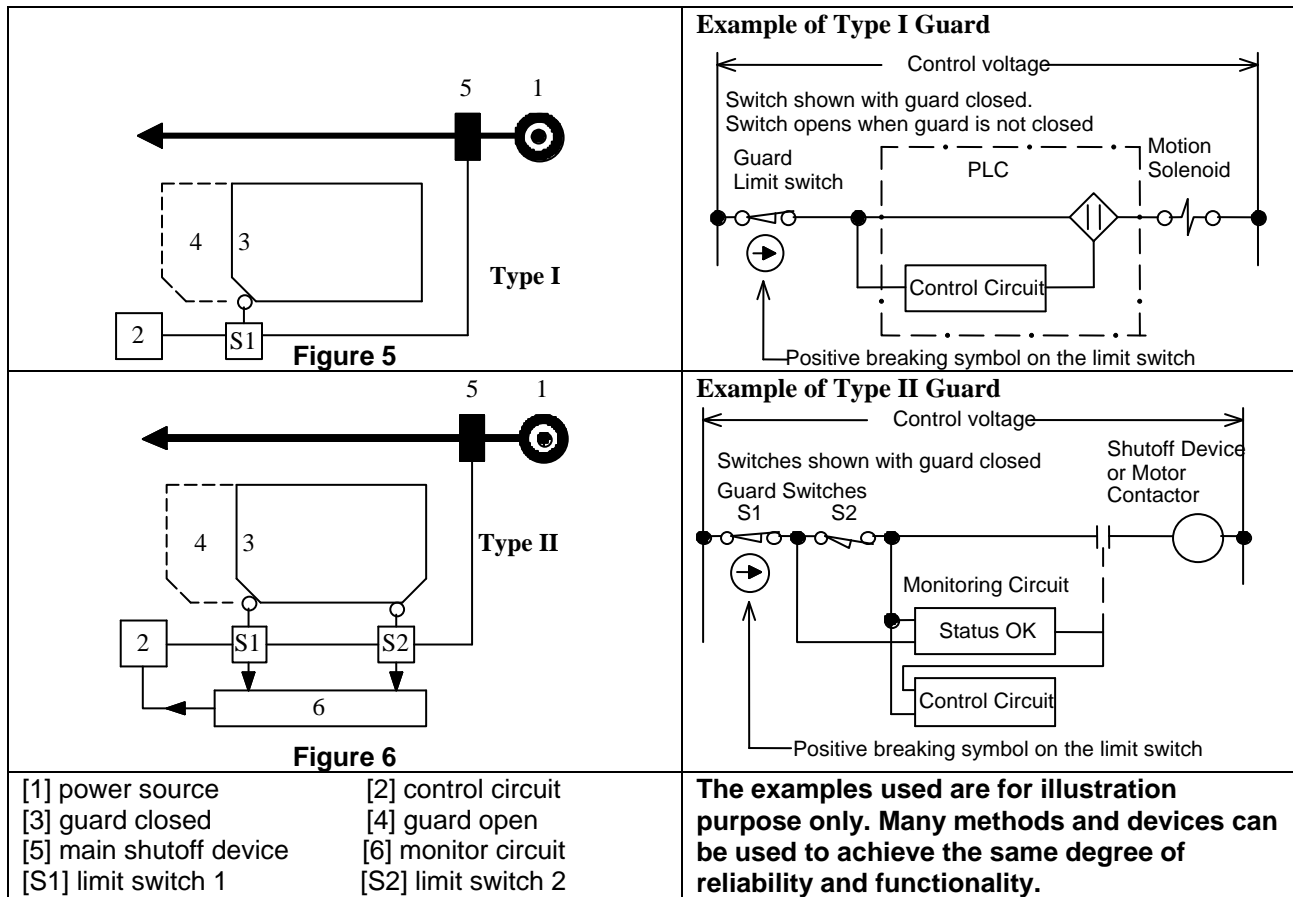
An interlock consisting of two position sensors that interrupt the energy supply to the device producing the hazardous motion when the guard opens.

One position sensor shall be positively actuated and positively interrupt the energy supply to the device producing the hazardous motion when the guard opens. The second position sensor shall be released when the guard opens interrupting the energy supply to the device producing the hazardous motion.

The guard position sensors are monitored to ensure that:

- Each guard position sensor changes state each time the guard is opened or closed.
- The state of each position sensor changes in predetermined sequence with respect of opening and closing the guard.
- Each guard position sensor must be in predetermined state to permit the hazardous motion.

Monitoring of the device shall be per clause 7.2.4.1



<p>7.3.1 Polishing Roll Stand Safety signs, color-coded roll ends, and a readily accessible Emergency Stop Device shall be provided on all inrunning nips.</p>	
<p>7.3.1.1 Primary Nip Guarding</p> <p>The inrunning primary nip shall be guarded across the entire roll width to prevent a person from being caught in the nips.</p> <p>Process considerations require access to the primary nip area. Therefore, a flat die and/or its extensions are used to block access to the nip and provide the guarding function. When blocking access to the nip, the flat die may create a wedging nip that is not technically or operationally feasible to guard.</p> <p>Where a die narrower than the nip rolls fails to guard the outside face of the nip, die extensions, deckles or other safeguards shall be provided to achieve the same guarding function.</p> <p>In view of the large number of dies and operating conditions which may be used on a given line, it shall be the sole responsibility of the employer to safeguard the primary nip.</p> <p>The die shall be interlocked to the polishing roll stand and shall conform to a Type I Interlock. or The die does not need to be interlocked.</p>	<p>E7.3.1.1 Primary Nip Guarding</p> <p>Process considerations include but are not limited to access to the die/roll adjustment, visual inspection, etc.</p>
<p>7.3.1.2 Rotating Shaft Extensions</p> <p>Rotating shaft extensions shall be smooth and shall not project more than one-half of the diameter of the shaft unless guarded. Smooth roll journals fitted with rotary joints and piping and presenting no significant hazards are exempt from these requirements.</p>	
<p>7.3.1.3 Drive and Power Transmission Guarding</p> <p>Guards shall be provided over the drive mechanism. Guards shall meet the requirements of 7.1.</p>	<p>E7.3.1.3 Drive and Power Transmission Guarding</p> <p>Examples of hazardous areas may include but are not limited to moving or rotating motor driven parts such as gears, sheaves, belts, chains shafts, drive couplings, and pinch points.</p>
<p>7.3.1.4 Motor Shaft and Coupling</p> <p>The motor shaft and coupling shall be guarded against insertion of hands and/or clothing. See Table 4 of Figure 4 for reach through opening and safety distance.</p>	
<p>7.3.1.6 Secondary Nip(s) Guarding</p>	<p>E7.3.1.6 Secondary Nip(s) Guarding</p>

<p>The inrunning side of secondary nip(s) shall be guarded across the entire roll width to prevent a person from being caught in the nips. The guard shall not form a wedging nip.</p>	<p>Examples of acceptable safeguarding devices include but are not limited to:</p> <ul style="list-style-type: none"> •Fixed or moveable guard. •Presence sensing device.
<p>7.3.1.7 Roll Arms/Cylinders</p> <p>Guards shall be provided over the roll arms. Where guards are not technically and/or operationally feasible, a safety sign shall be provided. Guards shall meet the requirements of 7.1.</p>	
<p>7.3.1.8 Nip Roll Opening</p> <p>There shall be a minimum of 4 inches (4") between roll surfaces in the open position.</p>	
<p>7.3.1.9 Nip Roll Closing</p> <p>Where possible, nip rolls shall be closed by local control. An audible alarm of at least 2 seconds shall occur after the "CLOSE" button is actuated.</p> <p>Where local control is not possible, the nip rolls shall close after a 3-second delay when the "CLOSE" button is actuated. The "CLOSE" button must be maintained for at least 5 seconds (3 seconds through the pre-close delay and 2 seconds through the actual closing function). If the "CLOSE" button is released during the 3-second alarm delay, the rolls will not close. If the "CLOSE" button is released during the first 2 seconds of closing, the rolls will reopen. After the initial nip roll closing, the rolls may be opened and reclosed without any delay if the "CLOSE" button is activated within 12 seconds of opening.</p>	<p>E7.3.1.9 Nip Roll Closing</p> <p>Local control may not be possible as a result of machine size or design.</p>
<p>7.3.1.10 Emergency Conditions</p> <p>Activation of the Emergency Stop device shall initiate stopping and opening of the driven rolls provided that this does not create additional hazards.</p>	<p>Electrical concerns? Add clause for power failure</p>
<p>7.3.1.11 Opening Time</p> <p>Minimum roll opening under emergency conditions shall be achieved within three (3) seconds from the time the command is given.</p>	<p>European standard?</p>
<p>7.3.1.12 Maximum Stopping Distance</p> <p>The rolls shall stop under emergency conditions in a distance of less than 1.75% of the maximum line speed as measured on the surface of the roll.</p>	<p>E7.3.1.12 Maximum Stopping Distance</p> <p>For example, at 100 fpm, the rolls must stop within 1.75 feet (or 21") of surface travel.</p>

<p>7.3.1.13 Independently Moveable Nip Guards</p> <p>Where guard motion is independent of roll movement, the guard shall be interlocked to prevent closing of the rolls when the guard is not in place and shall open the nip if the guard is withdrawn from its effective position. Closing of the guard shall not of itself cause the rolls to close. Rotation of the rolls is permitted with the nip open independent of guarding.</p>	
<p>7.3.1.14 Nip Powered Moveable Guards</p> <p>Guards that move open and closed with rolls, and are within the operator's reach point shall meet the requirements of nip roll closing given in 7.3.1.10.</p>	
<p>7.3.1.15 Nip, Fixed Member</p> <p>Where a nip exists within the operator's reach point that can cause physical injury, a guard shall be provided. The guard shall come within ¼ inch of the moving surface at most and not create a hazard.</p>	<p>(Bent guarding table?)</p>
<p>7.3.1.16 Nip, Web Generated</p> <p>Where a web-generated hazard exists within the operator's reach point, the hazards shall be guarded. Where it is not technically or operationally feasible to guard this nip, an Emergency Stop Device readily accessible to that person from any point across the full width of the nip shall be provided.</p> <p>In areas where operator access is required for start-up purposes, guarding or an Emergency Stop Device is not required. See Annex A-2.</p>	<p>E7.3.1.16 Nip, Web Generated</p> <p>A web-generated hazard will be determined largely by the pressure between the web and idler roll. The hazard is not considered to exist if the stationary web can be lifted off the idler using one hand.</p> <p>An example of a case where a web-generated hazard typically does not exist is the conveying section of a sheet line.</p>
<p>7.3.1.17 Start up/Thread up</p> <p>If movement of the roll is necessary during start-up/thread-up, rotation and closing of the nip shall be permitted with the guard out of position, provided that a local hold-to-maintain-close control and low speeds are used.</p>	<p>E7.3.1.17 Start up/Thread up</p> <p>See Annex A-2.</p>
<p>7.3.1.18 Loss of Power</p> <p>Loss of power initiates an Emergency Stop condition.</p>	<p>E7.3.1.18 Loss of Power</p> <p>See 7.3.1.10.</p>
<p>7.3.2 Pull Roll Stand</p> <p>Safety signs and a readily accessible Emergency Stop Device shall be provided on all inrunning nips.</p>	<p>E7.3.2 Pull Roll Stand</p>
<p>7.3.2.1 Inrunning Nip Guarding</p> <p>The inrunning nip shall be guarded across the entire roll width to prevent a person from being caught in the nips and shall have an Emergency Stop Device readily accessible to that person. The guard shall not</p>	

form a wedging nip.	
7.3.2.2 Rotating Shaft Extensions See 7.3.1.2.	
7.3.2.3 Drive and Power Transmission Guarding Guards shall be provided over the drive mechanism. Guards shall meet the requirements of 7.1.	E7.3.2.3 Drive and Power Transmission Guarding Examples of hazardous areas may include but are not limited to moving or rotating motor driven parts such as gears, sheaves, belts, chains shafts, drive couplings, and pinch points.
7.3.2.4 Motor Shaft and Coupling See 7.3.1.4.	
7.3.2.6 Nip Roll Opening See 7.3.1.8.	
7.3.2.7 Nip Roll Closing See 7.3.1.9.	
7.3.2.8 Emergency Conditions See 7.3.1.10.	
7.3.2.9 Opening Time See 7.3.1.11.	
7.3.2.10 Maximum Stopping Distance See 7.3.1.12.	
7.3.2.11 Independently Moveable Nip Guards See 7.3.1.13.	
7.3.2.12 Nip Powered Movable Guards See 7.3.1.14.	
7.3.2.13 Nip, Fixed Member See 7.3.1.15.	
7.3.2.14 Loss of Power See 7.3.1.18.	
7.3.3 Heat Transfer System	7.3.3 Heat Transfer System
7.3.3.1 Fan Blades All cooling fan openings shall be guarded against insertion of hands and/or clothing. See Table 4 of Figure 4 for reach through opening and safety distance.	
7.3.3.2 Motor Shaft and Coupling	

<p>The motor shaft and coupling shall be guarded against insertion of hands and/or clothing. See Table 4 of Figure 4 for reach through opening and safety distance.</p>	
<p>7.3.4 Slitter</p> <p>All web-cutting devices within the reach point during normal production operation shall be guarded to the extent technically and operationally feasible. A guard and/or other safeguarding method shall be provided to prevent unintentional movement during thread-up, blade change, or other adjustment. Blade guard and/or holders shall be color coded and a safety sign shall be provided.</p>	<p>E7.3.4</p>
<p>7.3.5 Die</p> <p>Hazards associated with the die are not covered in this standard.</p>	<p>E7.3.5</p>
<p>7.3.6 Wheels and Machine Movement</p> <p>A plastic sheet production machine equipped for powered locomotion shall be provided with (an) automatically operated audible alarm device(s) to warn prior to and during movement of the machine. There shall be a 3 second minimum delay during which an audible alarm is activated to warn the operator and others when the plastic sheet production machine is about to move. An audible alarm shall be activated during movement. After the 3 second delay, intermittent motion of the machine can continue without repeating the delay requirement. After stopping, motion of machine may be resumed within 12 seconds without the 3 second delay.</p> <p>Either a hold to run control device shall be provided if it is located where there is a clear view of the path of the machine motion; or a protective trip device shall be provided to stop machine motion if a person is detected in the path of the machine motion.</p> <p>Exposed crush points between the wheel and any contact surface shall be guarded.</p>	
<p>7.4 Other Hazards</p>	
<p>7.4.1 Electrical Hazards</p> <p>See 7.2.4 for Electrical Safety Requirements.</p>	
<p>7.4.2 Vapors or Gases</p> <p>A warning sign shall be provided in areas with possible exposure to vapors or gases.</p>	<p>E7.4.2 Vapors or Gases</p> <p>See 9.7 for ventilation</p>
<p>7.4.3 Platforms</p>	

<p>8 Existing Plastic Sheet Production Machinery</p> <p>An existing plastic sheet production machine is any plastic sheet production machine that is manufactured prior to the compliance date of this standard. Compliance date is one year after the publication date of this standard.</p>	
<p>8.1 Employer Responsibility</p> <p>The employer shall ensure that all plastic sheet production machines are in conformance with Sections 7 and 10 of this standard.</p>	
<p>9 Use</p>	
<p>9.1 Instruction</p> <p>The employer shall train and instruct operators and maintenance personnel in the safe methods of work, as well as provide instruction on the safety devices provided, before they start work on any plastic sheet production machine covered by this standard. The employer shall ensure that correct work procedures are being followed. The employer shall make all instructions available to the operator and maintenance personnel.</p>	<p>E9.1 Instruction</p> <p>The employer should consider setting up a checklist to ensure operators and maintenance personnel are kept aware of procedures to follow in operating the machine safely. This checklist should be kept in the machine instruction manual and periodically (such as every 6 months), the employer should have operators and maintenance personnel check off the list.</p>
<p>9.2 Work Area</p> <p>Adequate lighting and clearance shall be provided around the machinery and equipment covered by this standard. Space for operation, maintenance, cleaning machines, handling material stock, and screw removal shall be provided.</p>	
<p>9.3 Ancillary Equipment</p> <p>It shall be the responsibility of the employer to ensure that use of ancillary equipment does not reduce the level of safety embodied in this standard.</p>	
<p>9.4 Personal Protective Equipment</p> <p>It shall be the responsibility of the employer to ensure that all personnel shall wear appropriate personal protective equipment for protection in areas where hazards exist.</p>	
<p>9.5 Temperature Set Point</p> <p>Users shall consult the material manufacturer for the material being processed and set the maximum temperature accordingly to prevent hazardous conditions.</p>	
<p>9.6 Ventilation</p> <p>A means shall be provided by the employer to vent hazardous vapors away from the work area.</p>	

<p>9.7 Interrupted Operation</p> <p>If for any reason, the operation is interrupted for an extended period of time, it shall be the responsibility of the employer to assure that proper shut down and start up procedures are followed.</p>	<p>E9.7 Interrupted Operation</p> <p>Proper shut down procedures are dependent upon the type of material being processed. Refer to the Material Safety Data Sheet from the material supplier or to the material supplier's recommendations.</p>
<p>9.8 Hose Inspection</p> <p>The employer shall evaluate factors such as the nature and severity of the application, past history and manufacturers information to establish the frequency of visual inspections and functional tests. Inspect all hoses for:</p> <ul style="list-style-type: none"> • Leaks at hose fitting or in hose • Damaged, cut or abraded cover • Exposed reinforcement • Kinked, crushed, flattened or twisted hose • Hard, stiff heat cracked or charred hose • Blistered, soft, degraded or loose cover • Cracked, damaged or badly corroded fitting • Fitting slippage on hose • Other signs of significant deterioration <p>If any of the above conditions exist, the hose assembly shall be replaced with a new assembly of equivalent quality and characteristics.</p>	<p>E9.8 Hose Inspection</p> <p>All hoses should be inspected monthly.</p>
<p>10 Safety Signs</p> <p>All signs shall conform to ANSI Z535.3-2006 and ANSI Z535.4-2006 in color, format, size, and content.</p>	<p>E10 Safety Signs</p> <p>Existing signs need not be replaced unless they are unreadable.</p> <p>See SPI AN-137 Recommended Guideline for Safety Signs for Plastic Machinery and Related Equipment.</p>

A1- LOCKOUT/TAGOUT PROCEDURE

1. Read and understand this entire procedure before beginning.



WARNING: Failure to perform the Lockout/Tagout procedure before commencing with maintenance activities can lead to serious injury or death.

A “positive, lockable” means to remove all energy sources prior to maintenance must be provided. For each machine, it is the employer’s responsibility to provide a lockout/tagout procedure and training that is in compliance with all applicable national and local requirements. The following procedure is a general guide:

2. Turn off all motors.
3. Turn off and lock the electrical disconnect switch(s) and all other energy sources. Place a tag on the switch to indicate that work is being performed on the machine.
4. Verify that all auxiliary equipment with separate power sources has been turned off. Lock and tag each disconnect switch in the OFF position.
5. Verify that all electrical power has been disconnected from the machine and from any auxiliary equipment. If the machine or any piece of equipment is energized, locate the electrical circuit(s) supplying the power. Disconnect all power sources and lock and tag these power sources in the OFF position.
6. Verify that no sources of residual energy (accumulators, capacitors, suspended machine components, etc.) are present on any equipment. If necessary, manually discharge hydraulic, pneumatic, or steam pressure and capacitor voltage from charged components. Also, block all suspended or spring-loaded machine parts to prevent movement.
7. Perform required maintenance
8. When work is completed on the machine, visually inspect that all safety devices are in place.
9. Notify other affected employees that the locks and tags are being removed, and verify that all tools and personnel are clear of the machine.
10. When the machine is ready to resume operation, each individual shall remove their own lock(s) and tag(s).

If a personal lock or tag is left on an isolation point after all work has been completed, every attempt must be made by the supervisor responsible to contact the person or persons whose name appears on the tag.

- a. Contact the individual who performed the lockout/tagout instructions. Ask this individual to remove the lock and/or tag. If the person cannot return to the site they may give verbal permission to remove the lock or tag along with any specific instructions that may be required to return the machine to a safe operating condition.
- b. Verify the danger zone is clear of all personnel before attempting to remove the lock or tag.
- c. If the person or persons cannot be contacted to remove the lock or tag, conduct a joint investigation involving the supervisor responsible for the area (or machine) and a competent technician who has a thorough understanding of the process and the machine:

- i. Check all isolation points to make sure lines, wires, and/or systems are set to a safe position or condition.
- ii. Verify the danger zone around the machine is clear of personnel.
- iii. When both the supervisor and the technician agree that all systems are in order and there is no potential for injury, remove the lock and/or tag.

11. If no other locks or tags remain on the machine, restart the machine using the startup procedures.

12. Before operating the machine, perform a full safety check. Personnel can be seriously injured if the machine is operated with non-functioning safety devices.

LOCKOUT/TAGOUT SERVICE PROVISION

Some service operations must be performed with the power on. The temporary removal of locks or tags from the machine is permitted **ONLY** under special testing or positioning conditions: for example, when power is needed to test or troubleshoot the machine, equipment, or components. Conduct machine startup and operation in accordance with the sequence of steps listed below:

1. Clear the machine or equipment of tools and materials.
2. Clear all employees from the machine or equipment area.
3. Remove only the lockout or tagout devices necessary to operate the machine or equipment for testing.
4. Power up the machine or equipment only as necessary to perform the operation or to proceed with testing or positioning.
5. After completing the procedure, de-energize all systems, isolate the machine or equipment from the energy source, and reapply the lockout or tagout devices removed in step 3.

A2- SHEETLINE START-UP PROCEDURE (VERTICAL ROLL STAND)



WARNING: Wear PPE. Do not reach between the roll stands.

1. The die needs to be purged prior to stringing the line to remove any entrapped air and degraded polymer. After purging, turn the extruder off and clean the die lip with a brass tool. Do not stand in front of the die during this process. The plastic when first exiting the die will push any entrapped air forward which may cause it to expell rapidly out of the die.
2. A piece of clean plastic sheet or other non-abrasive leader material is strung through the primary and secondary nips of the polishing roll stand and pull roll stand. The use of clean plastic sheet or other non-abrasive material is important so as not to damage the roll surface.
3. The polishing roll stand is moved into operating position.
4. The extruder(s) are turned on to slowly start the flow of plastic onto the leader material.
5. Once the plastic has extruded and adhered to the leader material the polishing and pull rolls are turned on to a slow rotation. The pull rolls are closed to pull the leader material downstream.
6. Once the large bank of plastic created by the purging onto the leader material passes through the primary nip it can be closed. Closing of the primary nip prior to the passing of the start up purging can damage the polishing rolls.
7. Once the large bank of plastic created by the purging onto the leader material passes through the secondary nips they can be closed. Closing of the secondary nips prior to the passing of the start-up purging can damage the polishing rolls.
8. Once the large bank of plastic has reached the pull rolls they will need to be opened to allow it to pass through. The leader material will be required to be pulled through the pull roll stand when the rolls are open so that the extrusion process can continue. Once the large bank of plastic has passed, the pull rolls need to be closed.
9. The leader material is then cut from the newly extruded sheet.
10. The newly extruded sheet is fed to one of several devices: inline thermo-former, shear and conveyer, winder, etc.

A3- POLISH ROLL CLEANING PROCEDURE



WARNING: Wear PPE. Do not reach between the roll stands.

1. The cleaning of the polishing roll requires the operator to work between the die and the polishing roll stand. Be sure to follow all extruder lock-out/tag-out procedures to insure the extruder(s) do not come into operation during the cleaning of the rolls.
2. If the machine was recently in use, make sure the rolls have cooled before beginning the cleaning procedure. If it is necessary to clean the rolls while hot (>80°C) appropriate PPE is required.
3. The operator should familiarize themselves with all safety devices on the polishing roll stand prior to cleaning the rolls. Be sure not have any loose clothing or other items hanging which maybe become entangled with any part of the polishing roll stand.
4. To properly clean a polishing roll the flowing materials are suggested:
5. Clean all-cotton cloth.
6. Low abrasive cleaning material, such as Bon Ami or alcohol. It is important not to use a cleaning compound which contains silica. The silica will scratch the roll face. Consult roll manufacturer's recommendation for the proper cleaning materials.
7. The polishing roll stand is moved away from the die to its maximum distance which will allow the operator to work safely between it and the sheet die.
8. Open the rolls fully. The rolls will remain open for the entire procedure.
9. Begin slowly rotating the rolls.
10. The cleaning compound is applied to the clean cloth per the compound manufacturer's directions.
11. The operator then wipes the cleaning cloth across the roll face with appropriate amount of pressure to clean the roll. Several passes may be required to clean the roll to the desired level. The rotational speed of the rolls may need to be adjusted to optimize the cleaning process.
12. To remove the cleaning compound from the roll face, use a clean cloth to wipe it clean.