ANSI/SPI B151.21-200_ - Rev 6.0
Revision and Redesignation of
ANSI B151.21-2003

American National Standard for Plastics Machinery

Blow Molding Machines - Safety Requirements for Manufacture, Care, and Use

April 3, 2009

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Foreword

(This Foreword is not part of American National Standard ANSI/SPI B151.21-200_.)

This standard is a revision of American National Standard Safety Requirements for the Manufacture, Care, and Use of Injection Blow Molding Machines, ANSI B 151.21-2003. The standard was revised because:

(1) The scope needed to be expanded and the title modified

(2) Some illustrations required modification to conform to the text and some illustrations were deleted to permit design freedom

(3) Additional definitions were required

(4) Some paragraphs required modification and some paragraphs were added to conform more to conform more closely to change in technology

(5) Some paragraphs required modification for clarity and intent

The project on safety requirements for the manufacture, care, and use of injection blow molding machines was initiated under the auspices of the Injection Blow Molding Section of the Machinery Division, and the Safety Committee of the Molders Management Division, of the Society of the Plastics Industry, Inc (SPI).

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

A standard treating the manufacture, care, and use of injection molding machines 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 from two directions:

(1) Eliminating by design certain recognized hazards and establishing standard approaches to design so that machines available from competitive manufacturers will have similar operational characteristics

(2) Safeguarding the machine to protect personnel from recognized hazards

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 updating equipment and changing operation methods allied with existing machines immediately after approval date of this standard, a 3-year period has been provided to employers for updating machines.

Recognizing the impossibility of immediate updating of design and manufacturing methods, Sections 5 and 8 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, Suite 1000, Washington, DC 20006-1620

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

The following organizations recognized as having an interest in the standardization of injection blow molding machines 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.

Alcona Associates
Association for Manufacturing Technology
Ford Visteon Division
Packaging Machinery Manufacturers Institute
Robotic Industries Association
Society of the Plastics Industry: Machinery Division
Society of the Plastics Industry: Molders Division

The Blow Molding Section, Standards Development Committee of the Machinery Division, The Society of the Plastics Industry, Inc, which was responsible for this standard, had the following members:

Douglas L. Sten (Amcor PET) Chairperson
Steve London (Bekum America)
Frank Kennedy (Davis-Standards)
Ed Chorey (Milacron Inc.)
Chuck Flammer (Kautex)
Steve Rocheleau (Rocheleau Tool & Die)
Jim Pilavdzic (Husky IMS)
Tom Scheck (Eurotherm)

Others who worked with the Blow Molding Section of the Machinery Division on the development of this standard were:

Walt Bishop .The Society of the Plastics Industry, Inc.
Secretariat to the committee.

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Explanation of Standard Format

American National Standard ANSI/SPI B151.BM- 20XX 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.

1 Scope, Purpose, Application and Installation	
1.1 Scope The requirements of this standard shall apply to all Blow Molding Machines (BMMs) that process plastic materials to: • blow a parison • blow a preform (including injection blow, injection stretch blow, and reheat & blow) into the shape of a mold cavity held together by a vertically or horizontally acting clamp(s). Safety requirements for the manufacture of ancillary equipment for Blow Molding Machines are not covered by this standard.	**E1.1 Scope** This includes: • Extrusion Blow Molding Machines • Injection Stretch Blow Molding Machines • Injection Blow Molding Machines • Reheat & Blow Molding Machines
1.2 Purpose The purpose of this standard is to identify and address known hazards to personnel working on, or adjacent to, a Blow Molding Machines.	
1.3 Application Blow Molding Machines shall be referred to as BMMs though out this standard.	**E1.3 Application** 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.
1.3.1 New BMMs The requirements of this standard pertaining to manufacture shall apply to all new BMMs installed in the United States of America, that were manufactured after the compliance date of this standard. Compliance date shall be one year after the approval date of this standard. Date of manufacture for the new BMM (month and year) shall be affixed permanently and legibly to the BMM along with the name of the manufacturer.	**E1.3.1 New BMMs** Date of manufacture is understood to be the date the BMM was complete and available for delivery to the employer.
1.3.2 Remanufactured BMMs The requirements in clauses 6 and 8 of this standard shall apply to all remanufactured BMMs, installed in the United States of America, that were remanufactured after the compliance date of this standard. Compliance date shall be one year after the approval date of this standard.	

Date of remanufacture of the BMM (month and year) shall be affixed permanently and legibly to the BMM along with the name of the remanufacturer.	
1.3.3 Existing BMMs Existing BMMs located in the United States of America prior to the approval date of this standard shall be in accordance with the requirements of clauses 6 and 8 of this standard. Compliance date shall be three years after the approval date of this standard.	
1.3.4 All Installations An employer shall not operate a BMM or permit it to be operated unless it is in compliance with this standard. The use shall be in accordance with clause 7 of this standard and shall be effective on the approval date of this standard.	

2 Referenced American National Standards and Publications This standard is to be used with the following American National Standards. ANSI Z535.3-2006, Criteria for Safety Symbols ANSI Z535.4-2006, Product Safety Signs and Labels ANSI Z535.6-2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials ANSI/NFPA 79 -2007, Electrical Standard for Industrial Machinery ANSI Z97.1-2004, Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test SAE J1273-2002, Recommended Practices for Hydraulic Hose Assemblies ANSI/ASSE Z244.1-2003- Control of Hazardous Energy- Lockout/Tagout and Alternative Methods ANSI/NFPA 70E-2004 Standard for electrical safety in work place	**E2 Related Standards and Publications** ANSI/SPI B151.27-2003 Safety Requirements for the Integration, Care, and Use of Robots with Horizontal Injection Molding Machines ANSI/ASME B20.1- 2003, Safety Standard for Conveyors and Related Equipment. AN-104 - SPI Noise Measurement Guideline AN-108 - SPI Recommended Guideline for Using Hydraulic Accumulators on Injection Molding Machines AN-134 – Recommended Guideline for Technical Manuals Supplied with Plastics Machinery and Related Equipment. AN-137- Recommended Guideline for Safety Signs for Plastic Machinery and Related Equipment AN-150 Arc Flash Hazards
3 Definitions	
3.1 Alarm. An indication that a failure or misadjustment of a device has occurred.	
3.2 Barrel. The cylinder portion of the BMM within which the material is processed.	
3.3 Blow Molding Machine. A machine that processes plastic materials to: • blow a parison • blow a preform (including injection blow, injection stretch blow, and reheat & blow) into the shape of a mold cavity held together by a vertically or horizontally acting clamp(s).	**E3.3 Blow Molding Machine.** This includes: • Extrusion Blow Molding Machines • Injection Stretch Blow Molding Machines • Injection Blow Molding Machines • Reheat & Blow Molding Machines
3.3 Electric Motor Control Unit. Unit to control the movement and standstill of the electric motor, with or without integrated electronic device, e.g. frequency converter, contactor.	
3.4 Emergency Stop Device. A mechanism that, when actuated, stops all machine movement associated with the specific machine.	**E3.4 Emergency Stop Device.** This mechanism may include but is not limited to a trip rod, cord, button, electronic device, etc.
3.5 Employer. Any person who contracts, hires, or is responsible for the personnel associated with the Installation, set-up, operation and maintenance of BMMs.	
3.7 Guard. A physical barrier that prevents access to	

areas where known hazards exist.	
3.7.1 Guard, Fixed. A guard that is fixed in place and requires a tool for moving or removal.	
3.7.2 Guard, Movable. A guard which may be moved or removed without the use of tools. A movable guard requires an interlock(s).	
3.8 Hazard. A source of possible injury or damage to health.	
3.9 Instructions. Documentation for the installation, operation, care, maintenance, and safe use of the BMM.	**E3.9 Instructions**. See ANSI Z535.6 – 2006, Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials.
3.10 Interlock. An arrangement whereby the operation of one control or mechanism allows or prevents the operation of another.	
3.11 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.	
3.12 Maintenance Personnel. Individuals who by virtue of their training and skills are qualified to inspect, maintain, and repair BMMs.	
3.13 Manufacturer. Any person whose business is the manufacture of equipment covered in this standard for installation in the United States of America.	
3.14 Modification. For the purpose of this standard, any change to a BMM that affects the safety of personnel is considered a modification.	**E3.14 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 BMM and the personnel constitutes modification.
3.15 Modifier. Any person who performs a modification to a BMM.	
3.16 Normal production. The utilization of the BMMs to perform its intended production function.	
3.17 Operator. An individual who has been trained and authorized by the employer to perform production work on the BMM.	
3.18 Plastic. Any material processed by the BMM.	
3.19 Power Circuit. The source of energy causing motion.	**E3.19** Examples: hydraulic oil flow for hydraulic systems, electrical power for electrical systems.
3.20 Presence Sensing Device. A device which is capable of detecting an intrusion into a specified area.	
3.21 Purging. The clearing of material from the barrel to the atmosphere.	
3.22 Rebuild. Restoring a portion of the BMM to its original purpose, capacity, or function including compliance with Section 7 and 10 of this standard.	**E3.22 Rebuild.** Some change in original design may be required to comply with Section 7 and 10 of this standard.
3.23 Remanufacture. A substantial restoration of the BMM.	**E3.23 Remanufacture.** Remanufacture typically consists of the following: 1.) Complete dismantling of the BMM. 2.) Cleaning and carefully inspecting all parts. 3.) Reworking worn parts to as new condition or replacing with new parts. 4.) Reconditioning barrels, screws, etc., to meet

	applicable standards and guidelines. 5.) Completely reconditioning or replacing power system components to meet applicable standards and guidelines. 6.) Thoroughly inspecting all electrical and control systems and replacing component/systems as required. 7.) Removing modifications which are not in conformance with Sections 7 and 10 of this standard and informing the employer of the removal.
3.24 Remanufacturer. Any person whose business is the redesign and/or remanufacture of BMMs for installation in the United States of America.	
3.25 Repair. The restoration of a portion of the BMMs to original function using original design by replacement or reworking of worn or damaged parts.	**E3.25 Repair**. Repair may include such items as replacement or re-work of the barrel, screw, heater bands, motors, seals,
3.26 Safe Standstill. A state where unexpected movement is prevented by removal of energy supply.	
3.27 Safety Related Input. Input to motor control unit, used to interrupt the energy supply to the drive of the electrically driven axis.	
3.28 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.	**E3.28 Safety Signs**. See AN-137 Safety Signs.
3.29 Servicing and/or maintenance. Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing equipment.	**E3.29 Servicing and/or maintenance**. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.
3.30 Set up. Any work performed to prepare the machine to perform its normal production.	
3.31 Setup Personnel. Individuals who are trained and authorized by the employer to prepare the machine and ancillary equipment for production.	
3.32 Shall. The word "shall" is to be understood as denoting a mandatory requirement.	
3.33 Should. The word "should" is to be understood as denoting a recommendation.	
3.34 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.	
3.35 Vapors. Gas or steam formed by processing plastic.	
3.36 Vent Cover A barrier covering the vent port opening.	
3.37 Vent Port. An opening provided in the barrel to permit vapors to exit from the plastic material during processing.	

4 Care—Responsibility for	

4.1 Instructions	
4.1.1 Manufacturer It shall be the responsibility of the manufacturer to furnish instructions with the BMM.	**E4.1.1 Manufacturer.** See SPI AN-134 Recommended Guideline for Technical Manual Supplied with Plastics Machinery and Related Equipment.
4.1.2 Modifier It shall be the responsibility of any person modifying a BMM to furnish instructions specific to the modification.	**E4.1.2 Modifier** See SPI AN-134 Recommended Guideline for Technical Manual Supplied with Plastics Machinery and Related Equipment.
4.1.3Remanufacturer It shall be the responsibility of any person remanufacturing a BMM to furnish instructions with the remanufactured BMM.	**E4.1.3 Remanufacturer.** See SPI AN-134 Recommended Guideline for Technical Manual Supplied with Plastics Machinery and Related Equipment.
4.2Training 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 BMMs.	
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 BMMs 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	
5.1Responsibility	
5.1.1Manufacture The manufacture of new BMM's shall be in accordance with Sections 7 and 10 of this standard.	
5.1.2 Remanufacture The remanufacture of a BMM shall be in conformance with Sections 8 and 10 of this standard. Remanufacture shall not reduce the level of safety existing on the BMM at the time of manufacture.	
5.1.3 Modification The modification made to existing BMMs shall be in accordance with Section 10 and the parts of Section 8 of this standard that apply to the modification. Any modification shall not reduce the level of safety existing	**E5.1.3 Modification** For the purpose of this standard, bringing a BMM into conformance with the requirements of Section 8 (including the underlined items of clause 8 affected by the modification) is

on the BMM at the time of manufacture or remanufacture.	considered a modification.
5.1.4 Repair Repair shall not reduce the level of safety of the BMM.	**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 an existing BMM shall be in accordance with Section 8 and Section 10 of this standard. Rebuild shall not reduce the level of safety of the BMM.	
5.2Training 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 BMMs.	
5.3Inspection and Maintenance It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of BMMs 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.	

6 List of Hazards	**E6 List of Hazards** A specific design could introduce hazards not covered by this standard.
6.1 Specific machine areas where hazards exist 1 Plasticizing and/or injection unit area(s) 2 Molding area 3 Part takeout/finishing area(s) 4 Power sources	
6.1.1 Plasticizing and/or Injection Unit area(s)	**E6.1.1 Plasticizing and/or Injection Unit area(s)** See Figures 1 and 2 area 1 This area includes: •Feed Opening •Drive and motor •Barrel/screw •Heater/cooling system •Screen changer •Nozzle(s) •Plastic accumulator •Die Head
6.1.1.1 Feed Opening	
6.1.1.1.1 Mechanical Hazards Crushing, shearing, impact and/or entanglement hazards caused by: • Motion between screw(s) and barrel. • Motion between screws. • Movement of material shut-off device. • Expulsion of material.	
6.1.1.1.2 Thermal Hazards Burns due to operating temperature of: • Plastics. • Feed opening area.	
6.1.1.2 Drive and Motor	
6.1.1.2.1 Mechanical hazards Crushing, shearing, and/or entanglement hazards caused by movement of: • Motor shaft(s). • Couplings. • Belts and sheaves. • Gears. • Reducer shaft(s).	
6.1.1.2.2 Thermal Hazards	

Burns due to operating temperature of: • Motor. • Reducer.	
6.1.1.2.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.3 Barrel	
6.1.1.3.1 Mechanical Hazards Impact hazard due to barrel overpressurization. Crushing hazards caused by movement of barrel.	
6.1.1.3.2 Thermal Hazards Burns due to contact with the barrel.	
6.1.1.3.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.3.4 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.1.4 Heating/Cooling System	
6.1.1.4.1 Mechanical Hazards Shearing, impact, and/or entanglement hazards due to movement of: • Fan blades. • Motor shafts. • Failed hose(s) and/or hose coupling.	
6.1.1.4.2 Thermal Hazards Burn hazard due to contact with: • Heating systems. • Overheated coolant. • Motor. • System components.	
6.1.1.4.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.4.4 Chemical hazards Chemical burns, absorption, ingestion, and/or fire hazards due to contact with system fluid(s).	
6.1.1.5 Screen Changers	
6.1.1.5.1 Mechanical Hazards Crushing, shearing, and/or impact hazards due to movement.	
6.1.1.5.2 Thermal Hazards Burn hazard due to contact.	
6.1.1.5.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.5.4 Chemical hazards Certain processing conditions and/or plastics can	

cause hazardous fumes or vapors.	
6.1.1.6 Nozzle(s)	
6.1.1.6.1 Mechanical hazards Crushing, shearing and/or impact hazards caused by: • Forward movement of the plasticizing and/or injection unit including nozzle. • Movements of parts of the power operated nozzle shutoff and their drives. • Over pressurization in the nozzle. • Material expelled from the nozzle.	Need guard clause reference
6.1.1.6.2 Thermal hazards Burns due to operating temperature of: • The nozzle assembly • Plasticized material discharging from the nozzle.	**E6.1.4.2 Thermal Hazards** See 7.2.3 and 10.8
6.1.1.6.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.6.4 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.1.7 Plastic accumulator	
6.1.1.7.1 Mechanical hazards Crushing, shearing, and/or impact hazards caused by movement of the: • Plastic accumulator. • Plasticizing unit components. • Over pressurization.	Need guard clause reference
6.1.1.7.2 Thermal hazards Burns due to operating temperature of: • Plastic accumulator.	**E6.1.4.2 Thermal Hazards** See 7.2.3 and 10.8
6.1.1.7.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.1.8 Die Head	
6.1.1.8.1 Mechanical hazards Crushing, shearing, and/or impact hazards caused by movement of the: • Die head. • Tooling. • Expulsion of material.	Need guard clause reference
6.1.1.8.2 Thermal hazards Burns due to operating temperature of: • Die head. • Material.	**E6.1.4.2 Thermal Hazards** See 7.2.3 and 10.8
6.1.1.8.3 Electrical Hazards Shock and/or burns due to contact with live conductive	

parts.	
6.1.1.8.4 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.2 Molding Area	**E6.1.2 Molding Area** See Figures 1 and 2 area 2 This area includes: •Mold area •Clamping mechanism •Reheat Station •Parison Separation •Parison Manipulation •Blow pins •Clamp transport •Stripper plate
6.1.2.1 Mold Area	**E.6.2.1 Mold Area** The mold area is the area between the platens.
6.1.2.1.1 Mechanical hazards Crushing, shearing, and/or impact hazards caused by movement of: • The platen(s) (including effects of gravity) • The cores and core rods and their drive mechanisms • The tie bar(s) • Objects/blow air expelled from the mold • Power operated gate	
6.1.2.1.2 Thermal Hazards Burns due to operating temperature of: • Heating and cooling systems. • Plasticized material.	**E6.1.1.2 Thermal Hazards** See 7.2.3,10.1and 10.8. For the thermal hazards associated with the mold see SPI guideline AN-148. See 7.3.1.1 See 7.3.4.2
6.1.2.1.3 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.2.2 Clamping Mechanism	
6.1.2.2.1 Mechanical Hazards Crushing, shearing and/or impact hazards caused by movement of: • The platen(s) (including effects of gravity). • The drive mechanism of the platen(s). • The core and ejector drive mechanism. • The mechanical device(s).	See 7.3.1.4 for the description of the mechanical device(s)
6.1.2.3 Reheat Station	
6.1.2.3.1 Mechanical hazards Crushing, shearing, and/or entanglement hazards caused by movement of conveying system.	
6.1.2.3.2 Thermal Hazards Burns due to operating temperature of:	**E6.1.1.2 Thermal Hazards** See 7.2.3,10.1and 10.8.

• Heating elements. • Preforms.	For the thermal hazards associated with the mold see SPI guideline AN-148. See 7.3.1.1 See 7.3.4.2
6.1.2.3.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.2.3.4 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.2.4 Parison Separation and Manipulation	
6.1.2.4.1 Mechanical hazards Crushing, shearing, and/or puncture hazards caused by movement of: • Stripper plate. • Cutting elements. • Spreader Bars • Parison transfer device • Blow pins • Blow pin station • Clamp assembly(ies)	
6.1.2.4.2 Thermal Hazards Burns due to operating temperature of: • Stripper plate. • Cutting elements. • Material. • Spreader bars. • Parison transfer device. • Blow pins.	**E6.1.1.2 Thermal Hazards** See 7.2.3,10.1, and 10.8. For the thermal hazards associated with the mold see SPI guideline AN-148. See 7.3.1.1 See 7.3.4.2
6.1.2.4.3 Electrical Hazards Shock and/or burns due to contact with live conductive parts.	
6.1.2.4.4 Chemical hazards Certain processing conditions and/or plastics can cause hazardous fumes or vapors.	
6.1.3 Part Takeout and Finishing area(s)	**E6.1.3 Part Takeout and Finishing area(s)** See Figures 1 and 2 area 3. This area includes: •Part Takeout •Post-mold cooling area •Deflash area
6.1.3.1. Mechanical hazards Crushing, shearing, entanglement, and/or impact caused by the movements of: • Gripper. • Part transporter. • Pins/tubes. • Transfer next. • Punch • Cutting elements.	

6.1.3.2 Thermal hazards Burns due to operating temperature of cutting elements.	
6.1.4 Power Sources	**E6.1.4 Power Sources** See Figures 1 and 2 area 4. This includes: •Hydraulic Power System •Electrical Systems •Pneumatic Devices
6.1.4.1 Hydraulic Power System	
6.1.4.1.1 Mechanical Hazards Impact or laceration caused by hoses due to: • Whipping action due to hose assembly failure • Possible release of fluid under pressure Hazardous motion caused by the release of stored energy.	**E6.1.9.1 Mechanical Hazards** See ISO 4413 Hydraulic Accumulators
6.1.4.1.2 Thermal Hazards • Burns due to hot surfaces or hot fluid release.	
6.1.4.2 Electrical Systems	
6.1.4.2.1 Electrical Hazards Shock and/or burns due to contact with live conductive parts and/or arc flash.	
6.1.4.3 Pneumatic Systems	
6.1.4.3.1 Mechanical Hazards Impact or laceration caused by hoses due to: • Whipping action due to hose assembly failure • Possible release of air under pressure Hazardous motion caused by the release of stored energy.	**E6.1.9.1 Mechanical Hazards** See ISO 4413 Hydraulic Accumulators

7 Safety Requirements and/or methods	
7.1 General Guarding Reach over safety distances shall be in accordance with table 3 of Figure 3 unless otherwise specified. Reach through opening shall be in accordance with table 4 of Figure 4. Safety measure(s) shall be provided where hazards exist. Fixed guards shall require fasteners to attach guard in place and tools to install or to remove the fasteners. Slot head fasteners shall not be used for attaching the fixed guards. Movable guards shall be interlocked to stop hazardous motion. Moveable guards shall be	**E7.1 General Guarding**

prevented from opening until hazardous motion has ceased, or shall be located so that an individual cannot reach the hazard before cessation of the hazardous motion when the moveable guard is open. When light curtains are used they shall comply with ANSI B11.19 When gravity acting upon a gate or guard can cause a hazardous movement, a method of preventing such hazardous movement shall be provided.	

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	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)																	
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.

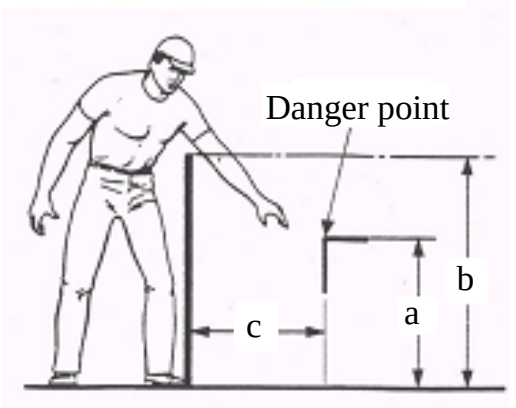


Figure 3 – Reach over protective structure

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 ≤ 4	e ≤ 0.157	≥ 2	≥ 0.079	≥ 2	≥ .079	≥ 2	≥ .079
4 < e ≤ 6	0.157 < e ≤ 0.236	≥ 10	≥ 0.394	≥ 5	≥ .197	≥ 5	≥ .197
6 < e ≤ 8	0.236 < e ≤ 0.315	≥ 20	≥ 0.787	≥ 15	≥ .591	≥ 5	≥ .197
8 < e ≤ 10	0.315 < e ≤ 0.394	≥ 80	≥ 3.150	≥ 25	≥ .984	≥ 20	≥ .787
10 < e ≤ 12	0.394 < e ≤ 0.472	≥ 100	≥ 3.937	≥ 80	≥ 3.150	≥ 80	≥ 3.150
12 < e ≤ 20	0.472 < e ≤ 0.787	≥ 120	≥ 4.724	≥ 120	≥ 4.724	≥ 120	≥ 4.724
20 < e ≤ 30	0.787 < e ≤ 1.181	≥ 850 (1)	≥ 33.465 (1)	≥ 120	≥ 4.724	≥ 120	≥ 4.724
30 < e ≤ 40	1.181 < e ≤ 1.575	≥ 850	≥ 33.465	≥ 200	≥ 7.874	≥ 120	≥ 4.724
40 < e ≤ 120	1.575 < e ≤ 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).

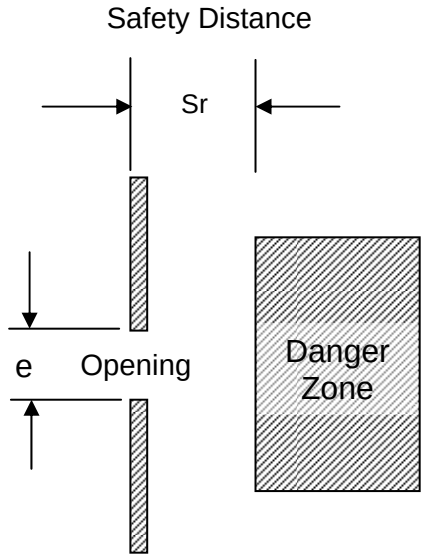


Figure 4- Safety through opening

7.2 General safety requirements	
7.2.1 Window When a solid window material is used in a gate or guard to provide visibility, the window material meet the requirements of ANSI Z97.1.	
7.2.2 Thermal Hazards A guard and/or warning tag shall be provided to prevent inadvertent exposure to hot surfaces above 175°F (80°C).	**E7.2.2 Thermal Hazards** See clause 7.3.3.1 for barrel cover requirements.
7.2.3 Electrical Requirements BMMs shall be in accordance with the requirements of ANSI/NFPA 79 and ANSI/NFPA 70E.	
7.2.3.1 Safety Circuit Performance For Type II or Type III 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. 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. In either case the monitoring shall: (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 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.	**E7.2.3.1 Safety Circuit Performance** See 7.3 For example, if relays controlled by the position switch(es) are used for the purpose of contact multiplying, monitoring of these relays is necessary.
7.2.3.2 Machine Grounding 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. The above items shall be interconnected to the equipment grounding (protective) conductor terminal.	
7.2.3.3 Stop Function Each BMM 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. 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.	**E7.2.3.3 Stop Function** Category 0 is an uncontrolled stop by immediately removing power to the machine actuators. 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. Add to definitions?
7.2.3.4 Emergency Stop Emergency stop shall be initiated by a single human action. In addition to the requirements for stop functions, emergency stop shall have the following requirements: (1) It shall override all other functions and operations in all modes. (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). (3) Reset of an emergency stop circuit shall not initiate a restart. (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. 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	**E7.2.3.4 Emergency Stop** Should all power be cut-off back to the main disconnect? Control system? Heaters?

relays. (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. (6) Pushbutton-type devices for emergency stop shall be of the self-latching type and shall have positive (direct) opening operation. (7) Emergency stop switches shall not be flat switches or graphic representations based on software applications. (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. (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.	
7.2.3.5 Interlock Switches 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 or Type III interlock, one of the switches will not operate in a positive mode.	
7.2.3.6 Continuity of the Grounding Circuit 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

7.2.3.7 Electrical Disconnects

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

7.2.3.8 Short Circuit / Branch Circuit Protection

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

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. All components shall be approved for use in safety circuits. **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. **C) Type III Interlock with hydraulic/pneumatic second shutoff device (Figure 7 and 8)** An interlock consisting of Type II interlock as described above and a hydraulic (or pneumatic) second shutoff device that prevents the platen from closing when the operator gate is not closed. The second shutoff device shall interrupt the flow of hydraulic fluid (or pneumatic) to the clamp closing cylinder(s). The shutoff device shall be an additional valve or a pilot stage of the main shutoff device which is one of the following: • Positively and directly actuated by the operator's gate when the gate is opened. • Controlled by an independent hardwired limit switch which is positively and directly actuated by the operator gate when the gate is opened. • Controlled by a pilot valve that is directly	

actuated by the operator's gate when the gate is opened. • Controlled by a pilot valve, which is controlled by an independent hardwired limit switch which is positively and directly actuated by the operator's gate when the gate is opened. • Mounted directly on the cylinder or as close as possible to the cylinder using flanged (flared or welded) pipe (wording from EN 201) When the additional valve is controlled by hardwired limit switch, the limit switch shall have positive opening contacts and the connection between the hardwired limit switch and the additional valve shall be via a hardwired circuit (possibly a relay) and shall be independent of the programmable controller. The shutoff device shall be provided with an electrical device for monitoring its operation. The following shall be automatically monitored during each cycle of movable guard: • The switching of the position switches of the guard acting on the control circuit. • The switching of the position of the main valve.	Only monitoring a pilot valve that shuts off the main valve is not acceptable.
D) Alternate Type II & III Interlock – Category 4 Presence Sensing Devices Should presence sensing devices be used as the primary method of guarding the molding area, the following conditions shall be met: • Splatter protection • ~~Flash protection~~ • Safety distances	Define Categories
E) Alternate Type I Interlock – Category 2 Presence Sensing Devices If used for table protection only, a Category 2 light curtain shall be sufficient. Monitoring of the device shall be per clause 7.2.4.1.	

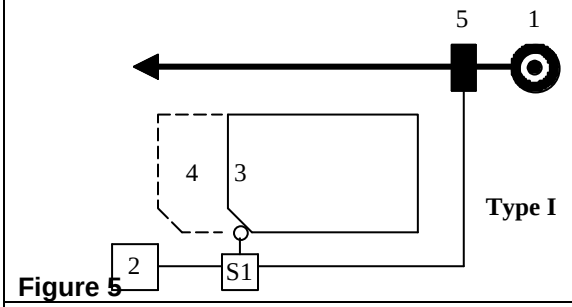
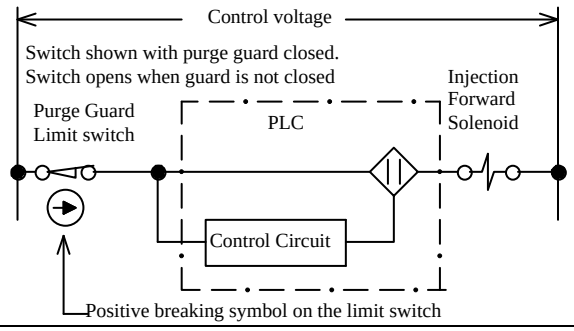


Figure 5

Example of Type I – Purge Guard



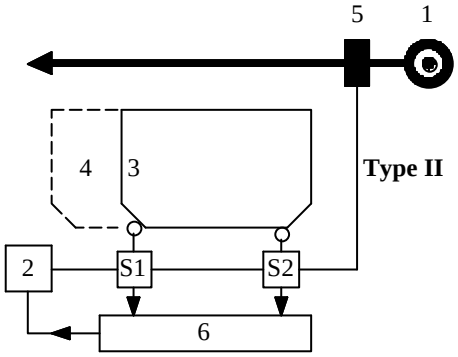
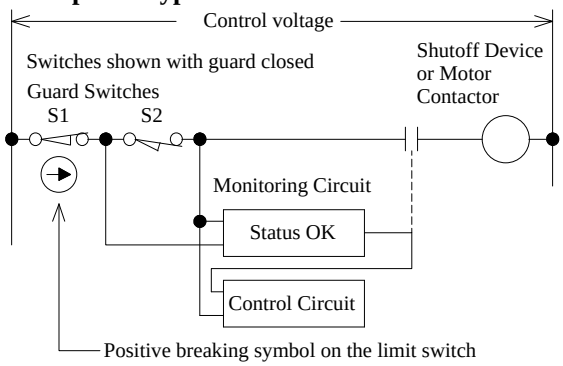


Figure 6

Example of Type II-Other Guard



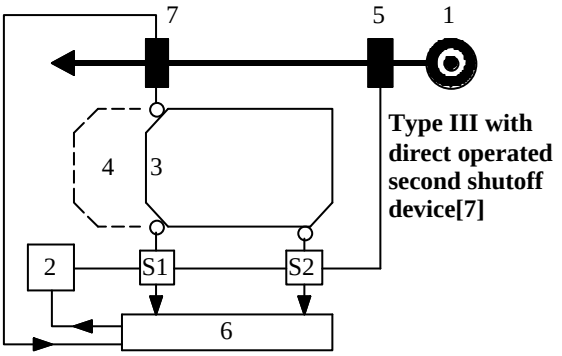
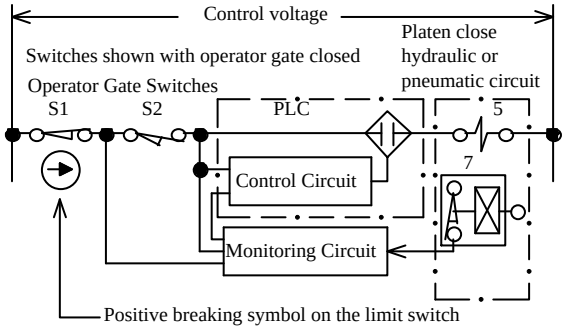


Figure 7

Example of Type III- Operator Gate- Direct operated second shutoff device [7]



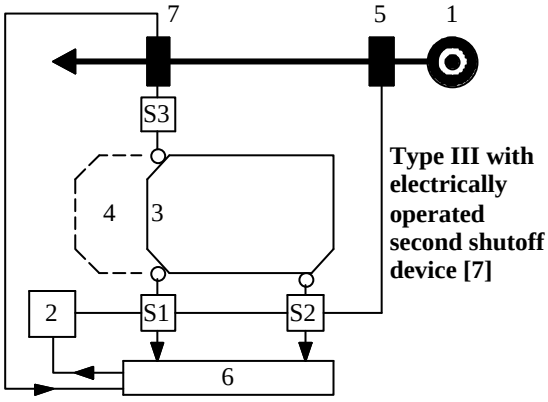
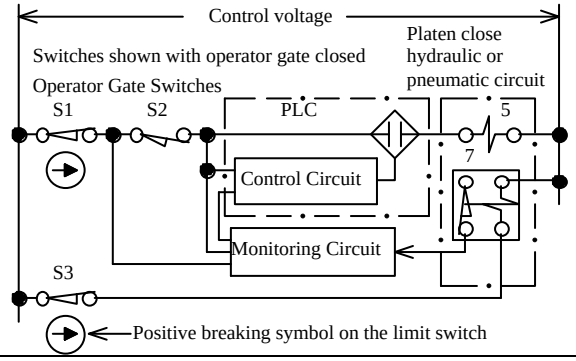


Figure 8

Example of Type III- Operator Gate- Electrically operated second shutoff device [7]



[1] power source	[2] control circuit
[3] guard closed	[4] guard open
[5] main shutoff device	[6] monitor circuit
[7] second shutoff device	[S1] limit switch 1
[S2] limit switch 2	[S3] limit switch 3

The examples used are for illustration purpose only. Many methods and devices can be used to achieve the same degree of reliability and functionality.

7.3.1 Plasticizing and/or Injection Unit Area	
7.3.1.1 Feed Openings All feed openings for plastic materials shall be guarded against insertion of hands and/or clothing. See Table 4 of Figure 4 for reach through opening and safety distance. Safety signs shall be used in this area.	**E7.3.1.1 Feed Openings** A fixed hopper can serve as a fixed guard for the feed throat opening to prevent insertion of hands. See Annex A3 for clearing blocked feed throat.
7.3.1.2 Drive and Motor Guards shall be provided over the drive and motor areas. If these guards are moveable they shall be interlocked. The interlocks shall disconnect all power to the BMM. Guards shall meet the requirements of Section 7.1.	**7.3.1.2 Drive and Motor**
7.3.1.3 Barrel	
7.3.1.3.1 Temperature of barrel The temperature of the barrel shall be automatically monitored to ensure that the maximum permissible barrel temperature is not exceeded. The barrel manufacturer shall declare the maximum permissible temperature of the barrel. The energy supply to all barrel heating elements shall be automatically interrupted: • If the monitored barrel temperature exceeds the maximum permissible barrel temperature or • In case of a detected fault in the temperature control of one or more zones that, if ignored, could result in the maximum permissible barrel temperature being exceeded	**E7.3.8.1 Temperature of barrel** Reference section 9.8 for interrupted cycle. Faults may be detected by controller diagnostics or other monitoring elements. The intent of this standard is not to require redundant temperature controls and/or sensors. The machine should control and automatically monitor the temperature of the barrel. The maximum and/or minimum and/or deviation process set points should be alarmed. See 9.5 for set point.
7.3.1.3.2 Barrel over pressurization protection To prevent the over pressurization of the barrel, the BMM shall be provided with a pressure-relieving device or pressure-limiting device.	(Should it be material specific?)
7.3.1.3.3 Barrel Covers A cover or barrier shall be provided to prevent inadvertent contact with high temperatures when the barrel(s) is(are) in normal operating position. If the cover or the barrier surface temperature is above 175° F (80° C), safety signs shall be provided on or adjacent to barrel covers.	**E7.3.3.1 Barrel Covers** Insulating blankets may serve as the cover or barrier to prevent inadvertent contact with high temperature.

7.3.3.2 Electrical Connections to Heated Areas Electrical connections to heated areas shall be covered with a fixed nonconductive guard or a grounded metal barrier to prevent contact with live terminals.	
7.3.1,4 Heating/Cooling System	
7.3.1.4.1 Fan Blades All heating/cooling system 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. Safety signs shall be used in this area.	
7.3.1.4..2 Hoses The manufacturer shall instruct the employer in proper, regular hose inspection procedures.	**E7.3.4.2 Hoses** See section 9.9.
7.3.1.4.3 Motor Shaft and Coupling 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. Safety signs shall be used in this area.	
7.3.1.4.4 Heating/Cooling System Components A cover or barrier shall be provided to prevent inadvertent contact with high temperatures. If component surface temperature is above 175° F (80° C), safety signs shall be provided on or adjacent to components.	(Discuss difference with Barrel Cover clause)
7.3.1.5 Screen Changers Screen changers shall be in compliance with ANSI/SPI B151.XXXX	
7.3.1.6 Injection Nozzle(s)	(Review further with Injection members)
7.3..1.6.1 Purge Guard A solid (not perforated) guard shall be provided to enclose the front, rear, and top of the purging area on the injection side of the mold. The BMM structure and closed mold may act in whole or in part as a guard. If using a moveable guard an Interlock using Type I described in Figure 5 shall be provided. Purging shall be prevented with the mold area protection open or interrupted. When the guard is not in position it shall prevent: • Screw rotation • Screw or plunger forward motion • Injection carriage forward motion In case of dangerous coasting, where access time t is	**E7.3.4.1 Purge Guard** Fixed and movable guards that enclose all sides of the injection unit and the top of the nozzle area may be considered purging protection.

less than T (overall stopping time) as defined in 7.2.4.1, the guard for the nozzle area shall be an interlocking guard with guard locking device. The nozzle tip shall be within the purge guard when purging is possible. This requirement does not apply when the injection carriage is swiveled out of its normal operating position. Purging through an open mold shall not be permitted.	
7.3.1.6.2 Splatter Guard A guard using Type I interlock shall be provided at the front of the nozzle area to shield personnel from inadvertent splatter of hot plastic when the mold and mold area protection is open or interrupted. This guard shall be interlocked to prevent clamp opening until the guard is in place. A nozzle shutoff valve shall not be used as a splatter guard.	**E7.3.4.2 Splatter Guard** The BMM structure, mold or other machine guards may act in whole or in part as this guard(s). (need further explanation)
7.3.1.6.3 Machine Movement An interlocked, physical guard shall be provided to protect against machine movement.	
7.3.1.7 Plastic Accumulator Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the plastic accumulator during normal operating conditions.	**E7.3.1.7 Plastic Accumulator**
7.3.1.8 Die Head Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the die head during normal operating conditions.	
7.3.2 Molding Area	
7.3.2.1 Mold Area	
7.3.2.1 Mold Area Protection Mold area protection shall be provided that will protect personnel from mechanical hazards associated with clamp opening and closing and hot plastics that may be expelled from the mold area when the mold is closed. Molding area protection shall consist of one or more of the following: 1) Moveable gate 2) Moveable guard(s) 3) Category 4 presence sensing device	**E7.3.2.1 Mold Area Protection** Mold area protection refers to the area of the machine where the mold is opened and closed. This area is not to be confused with the operator station(s) where the operator initiates the machine cycle, although in some design configurations they may be the same area.

7.3.2.1.1 Moveable Gate – Single Station When in the closed position the moveable gate shall prevent access to the mold area. Reaching around, under, or through the moveable gate while standing on the working surface shall be prevented by the use of guards as described in 7.1. The moveable gate shall be interlocked to prevent hazardous motion using Type III interlocks and a mechanical device described in clause 7.3.1.4.	**E7.3.2.1.1 Moveable Gate – Single Station**
7.3.2.2 Hydraulic or Pneumatic Shutoff Device When using a moveable gate, see 7.3(C) for a hydraulic or pneumatic shutoff device. When using a presence sensing device, see 7.3(D).???	
7.3.2.3 Electrical Interlock The electrical interlock portion described in 7.3(C), 7.3(D) and 7.3(F) shall interrupt and/or prevent: • Clamp closing • Clamp opening • Screw rotation • Forward movement of the screw or plunger • Forward movement of the injection carriage • Ejector and core motion. In case of coasting i.e. access time t less than T (overall stopping time), the guards outside the mold area shall be interlocking guards with guard locking device. In case of interlocking guards without guard locking outside the mold area, the access time shall be calculated as in 8.2.1. The guard for the mold area shall remain locked until the cores and ejectors movement stops.	**E7.3.2.3 Electrical Interlock** See 7.3.1.8 for motion/no motion exception. See 7.3.4 for shutoff nozzle exception. See 7.3 (F)
7.3.2.5 Power Operated Gate If a power-operated gate is used, the exposed leading edge(s) shall incorporate a pressure-sensitive switch or equivalent device such that if the switch or device is activated the gate motion stops or reverses. The pressure-sensitive device shall be designed into the circuit such that a failure of the device duplicates actuation of the switch. Closure of a power-operated gate shall require direct and continuous actuation by the operator and shall not	**E7.3.2.5 Power Operated Gate** The standard promotes a two event approach to the initiation of the BMM cycle; 1. closure of the power-operated gate 2. cycle initiation (can be the reactuation of the close button or a second button).

directly initiate a BMM cycle. The position of the manual controls for the power operated gate shall provide a clear view of the mold area.	
7.3.2.6 Guard, sides of the machine where a cycle cannot be initiated An interlocking guard with two position switches as shown in Type II and described in Figure 6 shall be used at the sides where a cycle cannot be initiated. Opening the guard shall: • Stop all motions • Shut off the energy source for all motions. When the guard is returned to its closed position manual resetting of the controls shall be necessary at the side of the machine where a cycle can be initiated. Alternatively, the guard may be replaced by additional mold area protection with interlocks. (See 7.3.1.1 through 7.3.1.4) If the guard is mechanically connected to the front mold area protection such that the guard cannot be opened without opening the front mold area protection, then the front interlocks provide protection for the side(s) of the mold area.	**E7.3.2.6 Guard, sides of the machine where a cycle cannot be initiated**
7.3.2.7 Top Guard A top guard shall be installed when it would be possible for a person standing on the floor or working platform to reach over the top of the mold area protection or guard into the mold area. See Table 3. If the top guard is movable, an interlocking guard with two position switches as shown in Type II and described in Figure 6 shall be used. Opening the guard shall: • stop all motion • shutoff the energy source for all motions When guard is returned to its closed position manual resetting of the controls shall be necessary at the side of the machine where a cycle can be initiated. If the top guard is mechanically connected to the front mold area protection such that the top guard can not be opened without opening the front mold area protection, then the front interlocks shall provide protection for the ~~rear~~ side(s) of the mold area.	
7.3.2.8 Motion/no motion Option for Core and Ejector	**E7.3.2.8 Motion/No Motion Option for Core and Ejector**

When the motion/no motion option is provided the following requirements shall apply: 1. The selection between motion mode and no motion mode shall be accomplished by the use of a lockable switch. The key is removable only in the “no motion” position. 2. Changing the machine mode of operation or pump shutdown shall require re-initiation of motion operation mode. 3. Safety signs shall be used to warn of the motion that occurs when motion is selected. 4. When “no motion” mode is selected the BMM shall meet the requirement of clause 7.3.1.3. 5. When “motion” mode is selected: A. The “motion” mode shall be effective only in the semi-automatic mode of operation.. B. Ejector forward and core out (pull) motion are allowed with the mold area protection open or interrupted. C. Access to shearing and pinching points associated with ejector and core motion shall be prevented.	It is recognized that some special molds require that the part and/or inserts be manually lifted from the mold in conjunction with either core and/or ejector motion. The intent of the lockable switch is to require the employer to implement the requirements of 10.9. (Review for applicability to Blow Molding) C: See section 10.9 for guarding requirement.
7.3.2.9 Safe standstill when mold area guard is open – prevention of unexpected startup The safe standstill when mold area guard is open shall be achieved by interrupting the energy supply to the movement of the platen by two channels. The interruption of both channels shall be independent from the programmable controller. The following shall be used: Contactors in the power supply to the electrical motor or the motor control unit; and/or Safety related input(s) to motor control unit. Safety circuit shall comply with clause 7.2.4.1	**E7.3.2.9 Safe standstill when mold area guard is open – prevention of unexpected startup** See annex C1 for the explanation of standstill and safe standstill. See annex C4 for examples in Figures 12 or Figure 13 or Figure 14.
7.3.2.10 Clamping Mechanism Area This area shall be guarded by either: • A fixed guard or • Movable interlocking guard with two position switches as shown in Type II and described in Figure 6. Opening the movable guard shall interrupt the cycle and, stop all motion in the clamp mechanism area. If the guard is movable and it is possible to stand between the guard and the clamp mechanism, an emergency stop button shall be provided inside the guarded area. Use the dimension in Figure 10 for the clamp mechanism area. Where access to the platen and its drive mechanism	**E7.3.2.10 Clamping Mechanism Area** See Annex C4 for examples in Figures XXXX

is prevented by movable guards (see 7.3.1.6, 7.3.1.7 and 7.3.2) these guards shall be interlocked. In case of hazardous coasting, i.e. access time t is less than T (overall stopping time) as defined in 7.2.4.11, the guard for these areas shall be an interlocking guard with guard locking device.	
7.3.2.11 Reheat Station (Hold for IBMM members)	
7.3.2.12 Parison Separation and Manipulation Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the parison separation and manipulation during normal operating conditions. Safety signs shall be provided to warn personnel of hazards associated with parison separation and manipulation when clamp mechanism area guarding is open.	**E7.3.2.12 Parison Separation and Manipulation** The clamping mechanism area guarding may in part or whole act as the parison separation and manipulation guarding.
7.3.3 Part Take-Out and Finishing Area(s) Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the part take-out and finishing areas during normal operating conditions. Safety signs shall be provided to warn personnel of hazards associated with part take-out and finishing area(s) when guarding is open.	
7.3.4 Power Sources	
7.3.4.1 Hydraulic Power System Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the hydraulic power system during normal operating conditions. If component surface temperature is above 175° F (80° C), safety signs shall be provided on or adjacent to components.	
7.3.4.1.2 Hoses Flexible hoses with pressure higher than 725 psi (50 bar) and their connections shall be designed to protect against hazards caused by unintentional detachment. Hoses and hose assemblies selection and installation	

shall comply with the specifications in SAE standard SAE J1273.	
7.3.4.1.3 Stored and Residual Energy Hazard(s) A means for safe dissipation or restraint of the stored or residual energy shall be provided. When machinery run-down or coasting is determined to be a hazard, guarding shall be installed that protects against the hazard or prevents access until the motion has ceased. Warnings shall be posted on the machine to indicate the presence of an accumulator, the fact of its containing potentially dangerous pressure, and the need to refer to detailed instructions in the Operator/Maintenance instructions for the servicing and use of the accumulator.	**E7.3.4.1.3 Stored and Residual Energy Hazard(s)** See AN-108 for Hydraulic Accumulators.
7.3.4.2 Electrical Systems See 7.2.3 for Electrical Safety Requirements.	(Possible deletion as it is repetitive).
7.3.4.2.1 Exposure to live parts A safety sign shall be provided warning of arc flash hazards. The sign shall be placed adjacent to the disconnect operating handle where there is anticipated exposure to live parts when the disconnect in the open (off) position. A safety sign shall be provided adjacent to the disconnecting operating handle(s).	**E7.3.4.2.1 Arc Flash Hazard** See AN-150 for Safety Sign requirements. See NFPA70E for Arc Flash Analysis. There may be more than one disconnect operating handle. Examples:
7.3.4.3 Pneumatic Power System Guarding shall be provided to protect personnel from inadvertent contact with hazards associated with the pneumatic power system during normal operating conditions.	
7.3.4.3.2 Hoses Hoses and hose assemblies selection and installation shall comply with the specifications in SAE standard SAE J1273. If the failure of a flexible hose assembly constitutes a whiplash hazard, it shall be restrained or guarded. If the failure of a flexible hose assembly constitutes a high-pressure air ejection hazard, it shall be guarded.	Flexible hose assemblies shall not be constructed from hoses which have been previously used as part of a hose assembly. Flexible host assemblies shall fulfill all performance requirements specified in the appropriate standard(s).

7.3.4.3.3 Stored and Residual Energy Hazard(s) A means for safe dissipation or restraint of the stored or residual energy shall be provided. When machinery run-down or coasting is determined to be a hazard, guarding shall be installed that protects against the hazard or prevents access until the motion has ceased. Warnings shall be posted on the machine to indicate the presence of a pressure vessel, the fact of its containing potentially dangerous pressure, and the need to refer to detailed instructions in the Operator/Maintenance instructions for the servicing and use of the pressure vessel.	**E7.3.4.3 Stored and Residual Energy Hazard(s)** See ISO 4413 and 4414. Hydraulic systems, Pneumatic systems .
7.3.4.3.4 Blow Air Exhuast BMMs machines shall be designed and constructed so that risks resulting from the emission of airborne noise are reduced as far as operationally feasible.	
7.3.4.3.5 Noise?	
8 Existing BMMs Compliance date is one year after the publication date of this standard.	
8.1 Employer Responsibility The employer shall ensure that all BMMs are in conformance with Sections 7 and 10 of this standard.	
9 Use	
9.1 Instruction 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 BMM 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.	**E9.1 Instruction** 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.
9.2 Work Area 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.	

9.3 Ancillary Equipment 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.	**E9.3 Ancillary Equipment** The user should contact the BMM manufacturer before adding ancillary equipment to the machine.
9.4 Personnel Protective Equipment It shall be the responsibility of the employer to ensure that personnel shall wear appropriate personal protective equipment for protection in areas where hazards exist.	
9.5 Temperature Set Point Users shall consult the material manufacturer for the material being processed and set the maximum temperature accordingly to prevent hazardous conditions.	
9.6 Vented Barrels When using BMM equipped with a vented barrel the user shall consult and follow the vented barrel manufacturer's instructions.	**E9.6 Vented Barrels** Some vented barrels are designed only to operate with vent port open. Others may be designed to operate either in the open vent port mode or with a mechanical plug in the vent port.
9.7 Ventilation A means shall be provided by the employer to safely vent hazardous vapors.	
9.8 Interrupted Operation 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 procedures are followed.	**E9.8 Interrupted Operation** Proper shut down procedures are dependent upon the type of material being processed. Refer to the material supplier or manufacturer for recommendations.
9.9 Lock-Out/Tag-Out The employer shall develop and implement a formal lock-out/tag-out procedure in accordance with ANSI/ASSE Z244.1-2003.	
10 Safety Signs All new and replacement signs shall conform to ANSI Z535.3-2006 and ANSI Z535.4-2006 in color, format, size, and content.	**E10 Safety Signs** Existing signs need not be replaced unless they are unreadable. See SPI AN-137 Recommended Guideline for Safety Signs for Plastic Machinery and Related Equipment.

ANNEX A (informative) - SPI RECOMMENDED PROCEDURES