American National Standard

for Plastics Machinery –

Injection Blow Molding Machines – Safety Requirements for Manufacture, Care, and Use

ANSI/SPI B151.21-2003

Approved American National Standard

ANSI

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ANSI/SPI B151.21-2003
Revision of
ANSI/SPI B151.21-2000

American National Standard
for Plastics Machinery –

Injection Blow Molding Machines – Safety Requirements for Manufacture, Care, and Use

Sponsor

The Society of the Plastics Industry, Inc.

Approved July 23, 2003

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard ANSI/SPI B151.21-2003.)

This standard is a revision of *American National Standard for Plastics Machinery - Injection Blow Molding Machines - Safety Requirements for the Manufacture, Care, and Use*, ANSI/SPI B151.21-2000. The standard was revised because some paragraphs (5.2.4 and 5.2.5) required modification to conform more closely to changes in technology.

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, clauses 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, 1801 K Street, NW, Suite 600K, Washington, DC 20006-1301.

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

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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, Chairperson
(Uniloy Milacron, Inc./P.M.D.)

Glen Atkinson
(Husky IMS)
Karl Bruning
(Bekum America)
Frank Kennedy
(Davis-Standards)
Tim Koury
(Blue Water Plastics, Inc.)
Robert Monteith
(Milacron, Inc.)
Peter Schmidt
(Krupp Plastics & Rubber Machinery/USA)

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

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

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Explanation of Standard Format

American National Standard ANSI/SPI B151.21-2003 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 and is printed in bold type.

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.

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.

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American National Standard
for Plastics Machinery –

Injection Blow Molding Machines – Safety Requirements for Manufacture, Care, and Use

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

(Not part of American National Standard for Plastics Machinery – Injection Blow Molding Machines – Safety Requirements for Manufacture, Care, and Use, ANSI/SPI B151.21-2003.)

1 Scope, Purpose, and Application

1.1 *Scope*

The requirements of this standard shall apply to all injection blow molding machines (IBMMs) (including Injection Stretch Blow) that process plastic materials and produce and/or deliver a preform that is then blown into the shape of a mold held together by a vertically or horizontally acting clamp(s). Safety requirements for the manufacture of ancillary equipment for IBMMs are not covered by this standard.

1.2 *Purpose*

The purpose of this standard is to minimize hazards to personnel.

1.3 *Application*

Injection Blow Molding Machines shall be referred to as IBMMs throughout 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., 1801 K Street, NW, Suite 600K, Washington, DC 20006-1301.

1.3.1 *New Installations*

The requirements of this standard pertaining to manufacture shall apply to all new or remanufactured IBMMs installed in the United States of America. Date of manufacture of the new or remanufactured machine (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 after the approval date of this standard.

E1.3.1 *New Installations*

IBMMs may be manufactured or remanufactured anywhere in the world.

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1.3.2 ***Former Installations***

Existing IBMMs that do not comply with this standard shall be modified by the employer in accordance with the requirements of clauses 6, 7 and 8 of this standard. The employer shall be responsible for compliance with this standard within three years after the approval date of this standard. The effective date is established by the standards-developing organization and not by the American National Standards Institute.

1.3.3 ***All Installations***

An employer shall not permit an IBMM to be operated unless it is in compliance with this standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI Z535.3-2002, *Criteria for Safety Symbols*

ANSI Z535.4-2002, *Product Safety Signs and Labels*

ANSI Z97.1-1987 (R1994), Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

ANSI/NFPA 79-2002, Electrical Standard for Industrial Machinery

E2 *Bibliography*

ANSI B11 TR1-1993, *Ergonomic Guidelines for the Design, Installation and Use*

ANSI/ASME B20.1-2000, *Safety Standards for Conveyors and Related Equipment*

ANSI/SPI B151.27-1994, *Plastics Machinery – Robots Used with Horizontal Injection Molding Machines – Safety Requirements for the Integration, Care, and Use*

AN-108, *SPI Recommended Guideline for Using Hydraulic Accumulators on Injection Molding Machines*

AN-134, *SPI Recommended Guideline for Technical Manuals Supplied with Plastics Machinery and Related Equipment*

AN-137, *SPI Recommended Guideline for Safety Signs for Plastics Machinery and Related Equipment*

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3 Definitions

3.1 *Alarm*

An indication that a failure or misadjustment of a device has occurred.

3.2 *Anti-Repeat*

The part of the control system that is designed to limit the machine to one cycle even though the actuation mechanism is held in the "operate" position.

E3.2 *Anti-Repeat*

The primary purpose of anti-repeat is to limit the operation to one cycle when a single cycle is intended.

3.3 *Anti-Tie Down*

Circuitry in a two-hand control system that prevents machine operation if one control is "tied down" in an attempt to allow one-hand operation.

3.4 *Automatic Cycle*

A selectable mode of operation of the control of the IBMM that allows it to perform more than one complete cycle.

3.5 *Barrel*

The cylinder portion of the plasticating unit within which the material is processed.

3.6 *Clamp Unit*

That portion of the IBMM that holds the two halves of the mold and opens and closes the mold.

3.7 *Concurrent*

The actuation of both controls of a two-hand control at the same time without a significant time lag between the initiation of one control and the initiation of the other.

3.8 *Control Circuit*

The means controlling sequential motion/cycling of the IBMM by signaling the device (hydraulic/pneumatic valving, electric servo motors, etc.) to effect IBMM motion.

3.9 *Control Reliability*

A method of ensuring the effective integration of the performance of guards, devices or control systems for safety.

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3.10 *Control Systems*

Sensors, manual input and mode selection elements, interlocking and decision-making circuitry and output elements provided to the IBMM operating devices or mechanisms.

3.11 *Cores/Core Rod*

Stationary and/or movable mold parts that shape the interior of a part.

E3.11 *Cores/Core Rod*

Movable cores are normally moved into position before injection takes place. Movable cores are normally moved out of position to allow ejection of the molded part to occur.

3.12 *Cycle*

A complete movement from the initial start position back to that same start position of the IBMM.

3.13 *Emergency Stop Button*

A red, mushroom-shaped button that, when depressed, will stop all IBMM motion.

E3.13 *Emergency Stop Button*

The word "stop" may be interpreted to include movement to a next position or opening of a clamp or both, if by doing so, danger of injury is reduced.

3.14 *Employer*

Any person who contracts, hires, or is responsible for the personnel associated with IBMM installation, operation, service, troubleshooting, set-up and/or maintenance.

3.15 *Fixed Guard*

A guard requiring the use of tools for removal.

3.16 *Guard*

A physical barrier that prevents access to areas of the IBMM where known hazards exist.

3.17 *Hardwired Electrical Interlock*

An electrical interlock that operates independently of any programmable device(s).

3.18 *Hazardous Movement*

Any movement/motion that can cause injury.

3.19 *Hot Runner Manifold*

The system by which molten plastic is conveyed into the mold cavities.

3.20 *IBMM*

Injection Blow Molding Machine.

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3.21 *Indexing Head (Core Rod Holder)*

The indexing head carries the core rods from station to station.

3.22 *Injection Unit*

The portion of the IBMM that plasticizes and then injects material through a nozzle into a mold.

3.23 *Installer*

The party that is responsible for the placement and preparation for the use of an IBMM.

3.24 *Instructions*

Documentation for the installation, operation, maintenance, setup, trouble shooting and safe use of the IBMM.

3.25 *Interlock*

An arrangement whereby the status of one control or mechanism allows or prevents the operation of another.

3.26 *Maintenance Personnel*

Individuals who are trained and authorized by the employer to provide preventative maintenance and other technical services of a required skill level.

3.27 *Manufacturer*

A person(s) whose business is to manufacture new IBMMs for installation in the United States of America.

3.28 *Mechanical Device*

The intent of this device is to provide a physical obstruction to impending closing motion of the moving platen. The mechanical device may be a ratchet-bar or a friction-type device.

3.29 *Modification*

For the purposes of this standard, any changes to a product that affects personnel safety is considered a modification.

E3.29 *Modification*

Modification is intended to include adding, deleting, converting, or altering the original product. This could affect such areas as control systems (electrical, hydraulic, pneumatic, etc.), IBMM motions, walkways, ladders, enclosures, platforms, guards, etc. Anything that has been added, moved or removed, converted, or altered, which affects the interface between the IBMM and personnel, constitutes modification.

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3.30 *Modifier*

Any person who performs a modification to an IBMM.

3.31 *Mold Area*

The zone between the platens.

3.32 *Monitoring Device*

A device used to verify the correct function of another device.

3.33 *Movable Guard*

A guard that may be moved or removed without the use of tools.

3.34 *Operator*

An individual who is trained and authorized by the employer in the use of an IBMM to perform production work.

3.35 *Operator's Gate*

A movable barrier designed to guard the operator from point of operation.

E3.35 *Operator's Gate*

The operator's gate may be opened and closed with each IBMM cycle.

3.36 *Operator's Station*

The specified area from which the operator(s) initiates IBMM controls.

3.37 *Plastic*

Any material processed by the IBMM.

3.38 *Platen*

The stationary or moving member of an IBMM to which the mold is fastened.

3.39 *Point of Operation*

The immediate area in which the plastic article is formed, conveyed and/or trimmed.

3.40 *Power Circuit*

The source of energy providing sequential motion or motion of IBMM.

3.41 *Preform*

The injection molded part that is formed in the first stage of a multi-stage process.

3.42 *Presence-Sensing Device*

A device that is capable of detecting an intrusion into a specified area.

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3.43 *Purging*

The clearing of plasticized material from the injection unit.

3.44 *Rear Guard*

A barrier arranged to guard the rear mold area.

E3.44 *Rear Guard*

This guard is also referred to as an auxiliary guard.

3.45 *Remanufacture*

The restoration of a complete IBMM to conformance with clauses 5 and 8 of this standard.

3.46 *Remanufacturer*

Any person whose business is the redesign and/or reconstruction of the IBMM for installation in the United States of America.

3.47 *Repair*

The restoration of a portion of an IBMM to original function using original design by replacement or reworking of worn or damaged parts.

E3.47 *Repair*

Repair may include such items as replacement or rework of an injection unit, barrel, screw, pump, motor, tie bars, clamp cylinders, valves, seals, gaskets, timers, relays, etc.

3.48 *Robot*

A multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

3.49 *Safety Sign*

A visual alerting device in the form of a 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.

3.50 *Semi-Automatic Cycle (Single Cycle)*

A selectable mode of operation of the IBMM that allows it to perform one complete cycle and then stop.

3.51 *Set-Up Personnel*

Individuals who are trained and authorized by the employer to prepare the IBMM and all ancillary equipment for production.

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3.52 *Shall*

The word “shall” is to be understood as denoting a mandatory requirement.

3.53 *Should*

The word “should” is to be understood as denoting a recommendation.

3.54 *Splatter*

Inadvertent discharge of hot plastic from the injection nozzle.

3.55 *Start-Up/Auxiliary Gate*

The start-up/auxiliary gate may be part of the operator's gate or a separate gate. It is designed to be opened when necessary to manually strip unblown containers from the core rods and to be so interlocked as to prevent operation of the machine when the gate is opened. This gate may be interlocked with two-hand controls.

3.56 *Stripper*

A plate that strips a molded piece from core rods.

3.57 *Synchronous Actuation*

Actuation of each control of a two-hand control system within a time interval of 0.5 seconds or less.

3.58 *Two-Hand Controls*

Two-hand controls, when furnished as a device, shall conform to the following construction requirements:

a) Each hand control shall be arranged by design, so that concurrent and synchronous operation by both hands are required before machine operation occurs.

b) The control system shall be designed to require continuous pressure from both hands while there is hazard at the operator's station.

c) The two-hand controls shall incorporate anti-tie-down circuitry.

E3.58 *Two-Hand Controls*

Push buttons should be so shrouded or located that they cannot reasonably be operated by any other body part and cannot be spanned by any means, such as flat bar held in one railing, or both, and should be so placed about the machine as to prevent the intervention of persons other than the operator.

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3.59 *Vapors*

Gas or steam formed by processing plastic.

3.60 *Vent Cover*

A barrier covering the vent port opening.

3.61 *Vent Port*

An opening provided in the barrel to permit vapors to exit from the plastic material during processing.

4 Instructions - Responsibility for

4.1 *Manufacturer*

It shall be the responsibility of the manufacturer to furnish the instructions with the IBMM.

4.2 *Modifier*

It shall be the responsibility of any modifier to furnish instructions specific to the modification of the IBMM.

4.3 *Remanufacturer*

It shall be the responsibility of any remanufacturer to furnish instructions with the remanufactured IBMM.

E4 *Instructions*

The documentation includes the proper installation, operations, maintenance, service, set-up, troubleshooting and safety of the IBMM.

5 Manufacture, Remanufacture and Modification

5.1 *Responsibility*

5.1.1 *Manufacture*

The manufacture of new IBMMs shall be in accordance with clauses 5 and 8 of this standard.

5.1.2 *Remanufacture*

The remanufacture of a complete IBMM shall be in conformance with clauses 5 and 8 of this standard.

E5.1.2 *Remanufacture*

Remanufacture typically consists of the following:

a) Complete dismantling of the IBMM.

b) Cleaning and carefully inspecting all parts.

c) Reworking worn parts to as-new condition or replacing with new parts.

d) Reconditioning tie bars, ways, linkages, cylinders, barrels, screws…etc. to meet applicable standards and guidelines.

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5.1.3 *Modification*

The modification made to existing IBMMs shall be in accordance with clause 8, and the parts of clause 6 of this standard that apply to the modification. Any modification shall not reduce the level of safety existing on the IBMM at the time of manufacture or remanufacture.

E5.1.3 *Modification*

An example would be a change from an electric drive system to a hydraulic drive system.

5.1.4 *Repair*

Repair shall not reduce the level of safety of the IBMM.

5.2 *Mold Area Guarding*

5.2.1 *Operator's Gate(s)*

Gates shall be provided as a barrier to keep an operator away from hazardous moving parts, the mold and splattering of hot melt while the IBMM is operating. The operator's gate(s) shall be closed before the IBMM can be operated. Interlocks shall be provided in accordance with 5.2.4, 5.2.5, and 5.2.6.

E5.2.1 *Operator's Gate(s)*

The IBMM may have more than one operator's gate.

5.2.2 *Power-Operated Gate*

When a power-operated gate is used, the exposed leading edge(s) shall incorporate a pressure-sensitive switch or equivalent safety device such that when the switch is activated the gate motion stops or reverses.

- **The power assist mechanism shall not lessen the effectiveness of the operator's gate.**
- **The pressure-sensitive switch or equivalent safety device shall be designed into the circuit such that a failure of the switch duplicates actuation of the switch.**
- **Closure of a power-operated gate shall not directly initiate an IBMM cycle.**

Exception: **When a part removal system is used, clamp closure may be initiated by a part removal system.**

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5.2.3 *Start-Up/Auxiliary Gate*

When the start-up/auxiliary gate is opened, clamp close, table rotation and unprotected injection motion shall be inhibited. All other motions shall be allowed in manual mode only and only by the use of two-hand controls or equivalent protection.

Exception: **In automatic cycle when this gate is open, only the stripper shall be allowed to continue its outward motion providing it does not create a hazard to the operator when the gate is opened. Interlocks shall be provided in accordance with 5.2.4, 5.2.5 and 5.2.6.**

5.2.4 *Electrical Interlock*

A hardwired electrical interlock shall be provided that will prevent hazardous clamp and tooling movement when the operator's gate is opened sufficiently to permit access to the mold area. The safety interlock shall be so located as to prevent inadvertent actuation. When an IBMM is powered by sources other than hydraulics or pneumatics, an additional independently controlled electrical safety interlocking system shall be provided. A monitoring device shall be provided to verify the operation of the safety interlock(s). When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

5.2.5 *Hydraulic or Pneumatic Interlock*

When hydraulic or pneumatic power is used to cause motion, then at least one hydraulic or pneumatic safety interlock shall be provided to prevent clamp safety and tooling movement when the operator's gate is opened sufficiently to permit access to the mold area. The safety interlock shall be so located as to prevent inadvertent actuation. A monitoring device shall be provided to verify the operation of the safety interlock(s). When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

5.2.6 *Mechanical Device*

A mechanical device shall be provided on all IBMMs with vertically acting clamps. When a gate is opened sufficiently to permit access to the mold area, the clamp will be physically

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prevented from closing. A monitoring device shall be provided to verify the operation of this safety interlock. When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

5.2.7 *Emergency Stop Button*

At least one emergency stop button shall be provided at the operator station.

5.2.8 *Reset*

Resetting an interlock shall not directly initiate a cycle.

5.2.9 *Rear Guard*

A fixed or movable guard shall be provided for the mold areas where pinching, shearing, or burn hazards exist. When moveable guards are used, they shall be interlocked. When a fixed guard is used, safety interlocks are not required.

5.2.10 *Top Guard*

A top guard shall be installed when it would be possible for a person standing on the floor or platform to reach over the top of the gate or guard and into a hazardous area. When movable guards are used, they shall be in accordance with 5.2.4, 5.2.5, and 5.2.6 of this standard. When a fixed guard is used, safety interlocks are not required.

5.2.11 *Parts Discharge Opening*

The parts discharge opening shall be guarded to prevent access to hazards through this opening. When conveyors or other parts removal devices require modification of the guards, additional guarding shall be added to prevent access to hazards.

E5.2.9 *Rear Guard*

A rear guard should be so placed on the IBMM as to leave sufficient space between the guard and either the platens or the frame of the IBMM to allow clearance for water lines and other necessary items connected to the molds. The rear guard is designed to be opened and closed during setup and maintenance functions only.

E5.2.11 *Parts Discharge Opening*

The presence of a conveyor or chute may function as a guard (see ANSI/ASME B20.1). When access to the parts discharge area is possible through or around the chute or conveyor, additional guarding (e.g., presence-sensing devices), or interlocked perimeter guarding should be provided.

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5.2.12 *Window*

When a window is used in a gate or guard to provide visibility, the window material shall conform to ANSI Z97.1.

5.2.13 *Nozzle Shutoff Device*

Screw rotation shall be allowed with the gate open only when the nozzle shutoff device is in the closed position.

5.2.14 *Splatter Protection*

A means shall be provided to protect personnel from inadvertent splatter of hot plastic.

5.3 *General Guarding (Other than Point of Operation)*

5.3.1 *Guards*

Guards shall be provided where hazards exist. If a guard is movable, an interlock shall be provided that will stop hazardous motion exposed by moving or removing the guard.

E5.3.1 *Guards*

Guards that require tools to be removed need not be interlocked. For parts discharge area guarding, see 7.3.

5.3.2 *Feed Openings*

All feed openings for plastic materials shall be guarded.

E5.3.2 *Feed Openings*

The feed hopper may function as a guard.

5.3.3 *Vent Cover*

A cover shall be provided over the vent port to protect personnel from hot plastic and/or vapors that may be expelled during production.

5.3.4 *Electrical Systems*

IBMMs shall be in accordance with the requirements of ANSI/NFPA 79.

5.3.5 *Purging Protection*

A guard shall be provided to protect the front, rear, and top of the purging area behind the stationary platen. Where visibility of the purge area is required, a means of viewing that area that will not interfere with the intended protection of the guard shall be provided. The guard shall be interlocked to prevent screw rotation, screw or plunger forward and injection carriage forward motion when the guard is not in position. Purging shall be prevented with the operator's gate open.

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5.3.6 *Extruder Barrel Covers*

A cover or barrier shall be provided to prevent inadvertent contact with high voltage and/or high temperatures when the extruder unit is in the normal operating position.

5.3.7 *Window*

When a window is used in a gate or guard to provide visibility, the window material shall conform to ANSI Z97.1.

5.3.8 *Injection Unit Interlock*

Whenever the injection unit is moved out of normal operating position, screw forward motion shall only be possible in manual mode. Maximum screw forward speed shall be 0.5 in/sec (13 mm/sec).

5.3.9 *Hot Runner Manifold*

A guard shall be provided to prevent accidental contact with the hot runner manifold.

5.4 *Safety Signs*

All new safety signs shall be designed and constructed in accordance with clause 8.

5.5 *Setting Movements*

5.5.1 IBMMs shall be designed to enable setting movements to be undertaken from outside the closed guards.

5.5.2 Where the setting movements for IBMMs can only be undertaken with guards opened, the following shall be met:

5.5.2.1 An operating mode selector shall be provided that can be locked in the setup mode with a removable key. The selector shall be hard wired and monitored to ensure proper operations.

5.5.2.2 The key for the mode selector shall only be issued to persons trained in setup operations.

5.5.2.3 Hazardous motion required for the setting shall only be possible by means of a hold-to-run control device.

E5.5.2.3 Such movements/motion required for setting might be the movement of:

a) the blow mold and its part

b) the blow pin or blow needle

c) core rods

d) injection molds and its parts

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5.5.2.4 When a hold-to-run control device is fitted on a portable control unit, it shall be capable of being taken into the point of operation. An enabling device and an additional emergency stopping device shall be fitted on such a control unit. The emergency stopping device shall act on all movements associated with setting operations.

5.5.2.5 When a hold-to-run control device is not on a portable unit, it shall be permanently fixed in such a position that the setup person has a clear view of the point of operation.

5.5.2.6 A hold-to-run control device shall only be operable when the mode selector device is in the setting mode.

5.5.2.7 The setting speeds shall be designed not to exceed 1 inch/sec (25 mm/sec).

5.5.2.8 A pneumatic drive for the setting movements shall not be permitted to function in this mode.

5.5.2.9 Valves that could override setup speed restrictions through activation by hand or tool shall be made inaccessible (i.e., guarding).

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6 Former Installations

6.1 *Responsibility*

It is the responsibility of the employer to see that all IBMMs are modified to bring them into conformity with the requirements of clauses 6, 7, and 8, within three years of the approval date of this document. The effective date is established by the standards-developing organization and not by the American National Standards Institute.

6.2 *Mold Area Guarding*

6.2.1 *Operator's Gate(s)*

Gates shall be provided as a barrier to keep an operator away from moving parts, the mold, and splattering of hot melt while the IBMM is operating. The operator's gate(s) shall be closed before the IBMM can be operated. Safety interlocks shall be provided in accordance with 6.2.3, 6.2.4, 6.2.5 and 6.2.6 of this standard.

E6.2.1 *Operator's Gate(s)*

The IBMM may have more than one operator's gate.

6.2.2 *Power-Operated Gate*

When a power-operated gate is used, the exposed leading edge(s) shall incorporate a pressure-sensitive switch or equivalent safety device such that when the switch is activated the gate motion stops or reverses.

- The power assist mechanism shall not lessen the effectiveness of the operator's gate.

- The pressure-sensitive switch shall be designed into the circuit such that a failure of the switch duplicates actuation of the switch.

- Closure of a power-operated gate shall not directly initiate an IBMM cycle.

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Exception: **When a part removal system is used, clamp closure may be initiated by a part removal system.**

6.2.3 *Start-Up/Auxiliary Gate*

When the start-up/auxiliary gate is opened, clamp close, table rotation and unprotected injection motion shall be inhibited. All other motions shall be allowed in manual mode only and only by the use of two-hand controls or equivalent protection.

Exception: **In automatic cycle when the gate is open, only the stripper shall be allowed to continue its outward motion, providing it does not create a hazard to the operator when the gate is opened. Interlocks shall be provided in accordance with 5.2.3, 5.2.4 and 5.2.5 of the standard.**

6.2.4 *Electrical Interlock*

A hardwired electrical interlock shall be provided that will prevent platen, core rod, injection and stripper motion when the operator's gate is opened sufficiently to permit access to the mold area. The safety interlock shall be so located to prevent inadvertent actuation. When an IBMM is powered by sources other than hydraulics or pneumatics, an additional independently controlled electrical interlocking system shall be provided. A monitoring device shall be provided to verify the operation of this safety interlock. When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

6.2.5 *Hydraulic or Pneumatic Interlock*

When hydraulic or pneumatic power is used to cause motion, then at least one hydraulic or pneumatic safety interlock shall be provided to prevent hazardous clamp and tooling movements when the operator's and/or start-up gate is opened sufficiently to prevent access to the mold area. The safety interlock shall be so located as to prevent inadvertent actuation. A monitoring device shall be provided to verify the operation of this safety interlock. When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

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6.2.6 *Mechanical Device*

A mechanical device shall be provided on all IBMMs with vertically acting clamps. When a gate is opened sufficiently to permit access to the mold area, the clamp will be physically prevented from closing. A monitoring device shall be provided to verify the operation of this safety interlock. When improper operation is detected, the cycle shall be inhibited and an alarm shall be activated.

6.2.7 *Emergency Stop Button*

At least one emergency stop button shall be provided at the operator station.

6.2.8 *Reset*

Resetting an interlock shall not directly initiate a cycle.

6.2.9 *Rear Guard*

A fixed or movable guard shall be provided for the mold area where pinching, shearing, or burn hazards exist. When moveable guards are used, they shall be interlocked in accordance with 6.2.4, 6.2.5 and 6.2.6 of this standard. When a fixed guard is used, safety interlocks are not required.

E6.2.9 *Rear Guard*

A rear guard should be so placed on the IBMM as to leave sufficient space between the guard and either the platens or the frame of the IBMM to allow clearance for water lines and other necessary items connected to the molds. The rear guard is designed to be opened and closed during setup and maintenance functions only.

6.2.10 *Top Guard*

A top guard shall be installed when it would be possible for a person standing on the floor or platform to reach over the top of the gate or guard and into a hazardous area. When a movable guard is used, the safety interlocking systems shall be provided in accordance with 6.2.4, 6.2.5, and 6.2.6 of this standard. When a fixed guard is used, safety interlocks are not required.

6.2.11 *Parts Discharge Opening*

The parts discharge opening shall be guarded to prevent access to hazards through this opening. When conveyors or other parts removal devices require modification of the guards, additional guarding shall be added to prevent access to hazards.

E6.2.11 *Parts Discharge Opening*

The presence of a conveyor or chute may function as a guard. When access to the parts discharge area is possible through or around the chute or conveyor, additional guarding (e.g., presence-sensing devices), or interlocked perimeter guarding should be provided.

6.2.12 *Window*

When a window is used in a gate or guard to provide visibility, the window material shall conform to ANSI Z97.1.

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6.2.13 *Nozzle Shutoff Device*

Screw rotation shall be allowed with the gate open only when the nozzle shutoff device is in the closed position.

6.2.14 *Splatter Protection*

A means shall be provided to protect personnel from inadvertent splatter of hot plastic.

6.3 *General Guarding (Other than Point of Operation)*

6.3.1 *Guards*

Guards shall be provided where hazards exist. If a guard is movable, a safety interlock shall be provided that will stop hazardous motion when the guard is moved or removed.

6.3.2 *Feed Openings*

All feed openings for plastic materials shall be guarded.

E6.3.2 *Feed Openings*

The feed hopper may function as a guard.

6.3.3 *Vent Cover*

A cover shall be provided over the vent port to protect personnel from hot plastic and/or vapors that may be expelled during production.

6.3.4 *Electrical Systems*

IBMMs shall be in accordance with the requirements of ANSI/NFPA 79.

6.3.5 *Purging Protection*

A guard shall be provided to protect the front, rear, and top of the purging area. Where visibility of the purge area is required, a means of viewing that area shall be provided that shall not interfere with the intended protection of the guard. The guard shall be interlocked and monitored to prevent screw rotation, screw or plunger forward and injection carriage forward motion when the guard is not in position. Purging shall be prevented with the operator's gate open.

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6.3.6 *Extruder Barrel Covers*

A cover or barrier shall be provided to prevent inadvertent contact with high voltage and/or high temperatures when the extruder unit is in the normal operating position.

6.3.7 *Window*

When a window is used in a gate or guard to provide visibility, the window material shall conform to ANSI Z97.1.

6.3.8 *Injection Unit Interlock*

Whenever the injection unit is moved out of normal operating position, screw forward motion shall only be possible in manual mode. Maximum screw forward speed shall be 0.5 in/sec (13 mm/sec).

6.3.9 *Hot Runner Manifold*

A guard shall be provided to prevent accidental contact with the hot runner manifold.

6.4 *Safety Signs*

All new signs and any replacements of old signs shall be designed and constructed in accordance with clause 8 of this standard.

6.5 *Setting Movements*

6.5.1 IBMMs shall be designed to enable setting movements to be undertaken from outside the closed guards.

6.5.2 Where the setting movements for IBMMs can only be undertaken with guards opened, the following shall be met:

6.5.2.1 An operating mode selector shall be provided that can be locked in the set-up mode with a removable key. The selector shall be hard wired and monitored to ensure proper operations.

6.5.2.2 The key for the mode selector shall be issued only to persons trained in setup operations.

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6.5.2.3 Hazardous motion required for the setting shall only be possible by means of a hold-to-run control device.

E6.5.2.3 Such movements/motion required for setting might be the movement of:

a) the blow mold and its part

b) the blow pin or blow needle

c) core rods

d) injection molds and its parts

6.5.2.4 When a hold-to-run control device is fitted on a portable control unit, it shall be capable of being taken into the point of operation. An enabling device and an additional emergency stopping device shall be fitted on such a control unit. The emergency stopping device shall act on all movements associated with setting operations.

6.5.2.5 When a hold-to-run control device is not on a portable unit, it shall be permanently fixed in such a position that the set-up person has a clear view of the point of operation.

6.5.2.6 A hold-to-run control device shall only be operable when the mode selector device is in the setting mode.

6.5.2.7 The setting speeds shall be designed not to exceed 1 inch/sec (25 mm/sec).

6.5.2.8. A pneumatic drive for the setting movements shall not be permitted to function in this mode.

6.5.2.9 Valves that could override set-up speed restrictions through activation by hand or tool shall be made inaccessible (i.e., guarding).

7 Care and Use - Responsibility for

7.1 *Training of Maintenance Personnel*

It shall be the responsibility of the employer to ensure the original and continuing competence of personnel caring for, inspecting, and maintaining IBMMs.

E7.1 *Training of Maintenance Personnel*

While much general literature exists to provide a good foundation for training of maintenance personnel, it should be noted that these IBMMs have features not necessarily identical to those of other machinery.

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7.2 *Training of Operators, Set-Up and Supervisory Personnel*

It shall be the responsibility of the of the employer to train and instruct personnel in the safe method of operation of the safety devices and procedures as described in clauses 5, 6, 7, and 8, before starting work on any operation covered in this standard. The employer shall ensure by trained supervision that proper operating and set-up procedures are being followed.

E7.2 *Training of Operators, Set-Up Supervisory Personnel*

The employer should consider setting up a checklist to ensure that operators are kept aware of procedures to follow in operating the IBMM safely. This checklist should be kept in the instruction manual of the IBMM, and periodically (e.g., per shift) the employer should have operators perform a check off from this list.

7.3 *Inspection and Maintenance*

It shall be the responsibility of the employer to perform periodic (e.g., per shift) inspections of IBMM to ensure that the safeguards are maintained in the proper safe operating condition.

E7.3 *Inspection and Maintenance*

The employer should follow instructions provided by the manufacturer, modifier and the remanufacturer.

7.4 *Work Area*

The employer shall provide clearance between IBMMs so that the movement of one operator will not interfere with the work of another. Ample room for cleaning of IBMMs and handling of material, work pieces, and scrap shall also be provided. All surrounding floors shall be maintained in a good, clean and dry condition.

E7.4 *Work Area*

The handling of raw materials, parts in process, finished parts, scrap, and waste is a part of every plastics plant operation. Proper materials handling is important for the safety and performance of IBMMs and IBMM operators.

7.5 *Parts Discharge Area*

When exposure to a hazard is created by the addition of a parts discharge area, the employer shall provide the proper safeguards.

E7.5 *Parts Discharge Area*

The wide variety of ancillary equipment (e.g., conveyors, chutes, robots) that may be added to existing IBMMs in operation is determined by the employer.

7.6 *Vent Port*

Some vented injection 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. Always consult and follow the vented barrel manufacturer's instructions.

7.7 *Ventilation*

A means shall be provided by the employer to vent the vapors away from the work area.

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7.8 *Ancillary Equipment*

It shall be the responsibility of the employer to ensure that the use of ancillary equipment for handling or access at IBMMs (e.g., conveyors, lifts, take-out devices, robots) shall not reduce the level of safety embodied in this standard.

7.9 *Personal Protective Equipment*

Personnel shall wear a face shield, protective gloves, protective clothing and/or any other personal protective equipment for protection against hazards associated with a IBMM.

8 Safety Signs

All new signs shall conform to ANSI Z535.3 and Z535.4 in color, format, size and content where feasible.

E7.8 *Ancillary Equipment*

The wide variety of ancillary equipment (e.g., conveyors, chutes, and robots) that may be added to existing IBMMs in operation is determined by the employer.

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