American National Standard

for Plastics Machinery –

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

ANSI/SPI B151.1-1997

ANSI American National Standards Institute
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New York, New York
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ANSI/SPI B151.1-1997
Revision of
ANSI/SPI B151.1-1990

American National Standard
for Plastics Machinery –

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

Sponsor

The Society of the Plastics Industry, Inc.

Approved July 22, 1997

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard ANSI/SPI B151.1-1997.)

This standard is a revision of *American National Standard for Plastics machinery – Horizontal injection molding machines – Safety requirements for the manufacture, care, and use,* ANSI/SPI B151.1-1990. The standard was revised because:

– the scope needed to be expanded and the title modified;

– some illustrations required modification to conform to the text and some illustrations were deleted to permit design freedom;

– additional definitions were required;

– some paragraphs required modification and some paragraphs were added to conform more closely to change in technology;

– some paragraphs required modification for clarity and intent.

The project on safety requirements for the manufacture, care, and use of horizontal injection molding machines was initiated under the auspices of the Injection Molding Section of the Machinery Division, and the Safety Committee of the Molders 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 horizontal 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:

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

– 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 grace period has been provided to employers for updating machines (see clause 6).

Recognizing the impossibility of immediate updating of design and manufacturing methods, clauses 5 and 8 shall become effective one year after the approval date (July 22, 1997) of this standard.

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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, Washington, DC 20006.

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

The following organizations recognized as having an interest in the standardization of horizontal injection 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.

Aerospace Industries Association
Alliance of American Insurers
American Automobile Manufacturers Association
American Insurance Services Group
American Standards Testing Bureau
ASTM
Factory Mutual Research
Industrial Safety Equipment Association
Masonry and Concrete Saw Manufacturers Institute
National Institute of Standards and Technology
Robotic Industries Association
Rubber Manufacturers
Society of the Plastics Industry, Machinery Manufacturers Division
Society of the Plastics Industry, Molders Division

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

J. Rexford, Chairman
(HPM Corporation)
W. Bishop, Secretariat
(Machinery Division of the
Society of the Plastics Industry)

R. Arnott
(Husky Injection Molding Systems, Ltd.)
T. Betts
(Battenfeld of America, Inc.)
V. Chudoba
(Ube Industries, Inc.)
F. Engers
(Hoffer Plastics Corporation)
D. Hidding
(Dana Molded Products, Inc.)
C. Irick
(EPCO Division, John Brown)
T. Koury
(Blue Water Plastics, Inc.)
L. Mills
(Van Dorn Demag Corporation)
R. Monteith
(Cincinnati Milacron, Inc.)

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Explanation of Standard Format

American National Standard ANSI/SPI B151.1-1997 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. Where supplementary photographs or sketches are required, they are designated as "illustrations."

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 –

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

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

(Not part of *American National Standard for Plastics machinery – Horizontal injection molding machines – Safety requirements for manufacture, care, and use*, ANSI/SPI B151.1-1997)

1 Scope, purpose, and application

1.1 Scope

The requirements of this standard shall apply to all HIMMs that process plastic materials and inject said material into a mold held closed by a horizontally acting clamp.

Safety requirements for the manufacture, care, and use of ancillary equipment for HIMMs are not covered by this standard.

1.2 Purpose

The purpose of this standard is to minimize hazards to personnel working on, or adjacent to, a HIMM.

1.3 Application

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, Washington, DC 20006.

1.3.1 New HIMMs

The requirements in clauses 5 and 8 of this standard shall apply to all new or remanufactured HIMMs, installed in the United States of America, that were manufactured after the compliance date of this standard. The compliance date shall be one year after the approval date (July 22, 1997) of this standard.

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Date of shipment of the new or remanufactured HIMM (month and year) shall be affixed permanently and legibly to the HIMM along with the name of the manufacturer or remanufacturer.

1.3.2 Existing HIMMs

Existing HIMMs 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.

1.3.3 All installations

An employer shall not permit a HIMM to be operated unless it is in compliance with this standard. The use shall be in accordance with clause 7 of 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 Z97.1-1984 (R1994), *Glazing materials used in buildings – Safety performance specifications and methods of test*

ANSI Z535.1-1991, *Safety color code*

ANSI Z535.2-1991, *Environmental and facility safety signs*

ANSI Z535.3-1991, *Criteria for safety symbols*

ANSI Z535.4-1991, *Product safety signs and labels*

ANSI Z535.5-1991, *Accident prevention tags*

ANSI/NFPA 79-1994, *Electrical standard for industrial machinery*

E2 Related references

ANSI/ASME B20.1-1993, *Safety standard 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-105, *SPI recommended guideline for recommended guarding of safety circuits in programmable controllers*[1)]

AN-108, *SPI recommended guideline for using hydraulic accumulators on injection molding machines*[1)]

AN-126, *SPI recommended guideline for safety signs for molding machines*[1)]

1) Available from the Society of the Plastics Industry, Inc. 1801 K Street, NW, Washington, DC 20006.

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3 Definitions

3.1 *alarm:* An indication that a failure or misadjustment of a device has occurred.

3.2 *automatic cycle:* A selectable mode of operation of the HIMM that allows it to perform more than one cycle.

3.3 *barrel:* The cylinder portion of the plasticating unit within which the material is processed.

3.4 *clamp:* That portion of the HIMM that holds the two halves of the mold and opens and closes the mold.

3.5 *control circuit:* The means controlling sequential motion/cycling of the HIMM by signaling the devices (hydraulic/pneumatic valving, electric servo motors, etc.) to effect HIMM motion.

3.6 *core:* Stationary and/or movable mold part that shapes a portion of a molded part.

E3.6 core: 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.

3.7 *ejector:* Any and all provisions built into the HIMM and/or mold for the release of the finished product from the mold.

E3.7 ejector: The ejectors may be actuated by the motion of the HIMM platen or by hydraulic, electric, and/or pneumatic circuitry integral with or independent of, the HIMM circuits.

3.8 *emergency reverse button:* A button that, when depressed, will stop platen closing motion and causes the platen to open at a reduced speed as long as the button is held depressed.

E3.8 emergency reverse button: Platen closing motion ends when the mold halves touch.

3.9 *emergency stop button:* A button that, when depressed, will stop all HIMM motion.

3.10 *employer:* Any person who contracts, hires, or is responsible for the personnel associated with HIMM operation and/or maintenance.

3.11 *fixed guard:* A guard requiring the use of tools for removal from the HIMM.

3.12 *guard:* A physical barrier that prevents access to areas of the HIMM where known hazards exist.

3.13 *hardwired electrical interlock:* An electrical interlock that operates independently of any programmable device(s).

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3.14 *HIMM:* Horizontal Injection Molding Machine

3.15 *injection unit:* That portion of the HIMM that plasticizes and then injects material through a nozzle into a mold.

3.16 *instructions:* Documentation for the installation, operation, care, and safe use of the HIMM.

3.17 *interlock:* An arrangement whereby the status of one control or mechanism, allows or prevents, the operation of another.

3.18 *large HIMM:* A HIMM with a horizontal or vertical distance between tie bars greater than 47 inches (1.2 meters).

E3.18 large HIMM: 47 inches (1.2 meters) is the recognized dimension where whole body access to the mold area may be expected to allow the operator to manually remove the molded part. On machines with 47 inches or less between tie bars, it is expected that the operator will remove the molded part by standing on the normal working surface outside the tie bars.

3.19 *manufacturer:* A person(s) whose business is the manufacture of new HIMMs for installation in the United States of America.

3.20 *modification:* For the purposes of this standard, any addition, deletion, conversion, or alteration to a HIMM that affects personnel safety is considered a modification.

E3.20 modification: A modification could affect such areas as control systems, (electrical, hydraulic, pneumatic, etc.), HIMM motions, walkways, ladders, enclosures, platforms, guards, etc.

3.21 *modifier:* Any person who performs a modification to a HIMM.

3.22 *mold area:* The zone between the platens.

3.23 *monitor device:* A device used to verify the function of another device.

3.24 *movable guard:* A guard that may be moved or removed without the use of tools.

3.25 *operator:* An individual who has been trained and authorized by the employer to perform production work on the HIMM.

3.26 *operator's gate:* A movable barrier arranged to guard the operator side of the mold area.

E3.26 operator's gate: The operator's gate may be opened and closed with each HIMM cycle. See illustration 1.

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3.27 *plastic:* Any material processed by the HIMM.

3.28 *platen:* The stationary or moving member of a HIMM to which the mold is fastened.

3.29 *power circuit:* The source of energy providing sequential motion or motion of the HIMM.

3.30 *presence-sensing device:* A device that is capable of detecting an intrusion into a specified area.

E3.30 presence-sensing device: Examples of presence sensing devices include: safety mat, interlocked platform, photoelectric beam, or other similar devices.

3.31 *purging:* The clearing of material from the injection unit to the atmosphere.

3.32 *rear guard:* A barrier arranged to guard the rear mold area.

E3.32 rear guard: See illustration 2.

3.33 *remanufacture:* The restoration of a complete HIMM to conformance with clauses 5 and 8 of this standard.

E3.33 remanufacture: Remanufacture typically consists of the following:

a) complete dismantling of the HIMM;

b) cleaning and carefully inspecting all parts;

c) reworking worn parts to as-new condition or replacing with new parts;

d) reconditioning slides, tie bars, ways, linkages, cylinders, barrels, screws, etc., to meet applicable standards and guidelines;

e) completely reconditioning or replacing power system components to meet applicable standards and guidelines;

f) thoroughly inspecting all electrical and control systems and replacing components/systems as required;

g) removing modifications that are not in conformance with clauses 5 and 8 of this standard and informing the employer of removal.

3.34 *remanufacturer:* Any person whose business is the redesign and/or remanufacture of HIMMs for installation in the United States of America.

3.35 *repair:* The restoration of a portion of a HIMM to original function using original design by replacement or re-working of worn or damaged parts.

E3.35 repair: Repair may include such items as replacement or re-work of an injection unit, barrel, screw, pump, motor, tie bars, clamp cylinders, valves, seals, gaskets, timers, relays, etc.

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

3.37 ***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.**

3.38 ***semi-automatic cycle (single cycle):*** **A selectable mode of operation of the HIMM that allows it to perform one complete cycle and then stop.**

3.39 ***setup personnel:*** **Individuals who are trained and authorized by the employer to prepare the HIMM and ancillary equipment for production.**

3.40 ***shall:*** **The word "shall" is to be understood as denoting a mandatory requirement.**

3.41 ***should:*** **The word "should" is to be understood as denoting a recommendation.**

3.42 ***vapors:*** **Gas or steam formed by processing plastic.**

3.43 ***vent cover:*** **A barrier covering the vent port opening.**

3.44 ***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 HIMM.

4.1.2 Modifier

It shall be the responsibility of any person modifying a HIMM to furnish instructions specific to the modification.

4.1.3 Remanufacturer

It shall be the responsibility of any person remanufacturing a HIMM to furnish instructions with the remanufactured HIMM.

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4.2 Training of maintenance and/or setup personnel

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

E4.2 Training of maintenance and/or setup personnel

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

4.3 Inspection and maintenance

It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of HIMMs to ensure that safeguards are in safe operating condition and proper adjustment.

5 Manufacture, remanufacture, and modification

5.1 Responsibility

5.1.1 Manufacture

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

5.1.2 Remanufacture

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

5.1.3 Modification

The modification made to existing HIMMs 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 HIMM at the time of manufacture or remanufacture.

E5.1.3 Modification

For purposes of this standard, bringing a HIMM into conformance with the requirements of clause 6 is considered to be a modification.

5.1.4 Repair

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

5.2 Mold area guarding

5.2.1 Operator's gate(s)

An operator's gate shall be provided as a barrier to keep personnel away from moving parts, the mold, and splattering of hot melt while the HIMM is operating. The operator's gate shall be closed before the HIMM

E5.2.1 Operator's gate(s)

The HIMM may have more than one operator's gate. Illustration 1 shows the typical location for the operator's gate. Also see 5.2.5.

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can be operated. Interlocks shall be provided in accordance with 5.2.2, 5.2.3, and 5.2.4 of this standard.

5.2.1.1 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 is activated the gate motion stops or reverses.

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

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

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

Exception: Where a robot is used, HIMM cycle may be initiated by a robot position signal.

5.2.2 Electrical interlock

A hardwired electrical interlock shall be provided that will prevent the following motions when the operator's gate is opened sufficiently to permit access to the mold area:

- **– platen closing;**
- **– core;**
- **– injection forward;**
- **– ejector;**
- **– screw rotation.**

The interlock shall be so located or protected to prevent accidental actuation.

When a HIMM is powered by sources other than hydraulics or pneumatics, an additional independent interlock shall be provided.

5.2.3 Mechanical device

A mechanical device shall be provided such that, when the operator's gate is opened sufficiently to permit access to the mold area, the platen will be physically prevented from closing.

A monitoring device shall be provided to check the operation of the mechanical device. If improper operation is detected, the HIMM cycle shall be inhibited and an alarm shall be activated.

E5.2.2 Electrical interlock

See 5.2.9 for exception regarding screw rotation. See 5.2.5 for Motion/No Motion.

E5.2.3 Mechanical device

The intent of this device is to provide a physical obstruction to impending closing motion of the moving platen.

Some platen closing motion may occur before the mechanical device is fully engaged.

The mechanical device is not intended to resist clamp-up force.

The mechanical device may include a ratchet bar or a friction-type device.

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5.2.4 Hydraulic or pneumatic interlock

If hydraulic or pneumatic power is used to cause platen motion, then a hydraulic or pneumatic interlock shall be provided such that the platen close circuit shall be interrupted unless the operator's gate is closed sufficiently to exclude the operator from hazards.

This hydraulic or pneumatic interlock shall be actuated by mechanical or electrical means that are independent of all other interlocks.

A monitoring device shall be provided to verify the operation of this hydraulic or pneumatic interlock. If improper operation is detected, the HIMM cycle shall be inhibited and an alarm shall be activated.

5.2.5 Motion/no motion option for platen, core, and ejector

The selection between motion and no motion shall be accomplished by the use of a lockable switch and shall only be effective in semi-automatic mode.

When no motion is selected, all platen, core, and ejector motion shall be inhibited with the operator's gate open.

When motion is selected, platen open, ejector forward, and core out motion shall be permitted with the operator's gate open.

No platen, core, or ejector motion shall be permitted in automatic or manual mode with the operator's gate open.

When an opening movement of the movable platen is possible with the operator's gate open, access to shearing and pinching points behind the mold mounting surface of the movable platen shall be prevented.

E5.2.5 Motion/no motion option for platen, core, and ejector

It is recognized that some special molds require that the part be manually lifted from the mold, in single or semi-automatic cycle. See 7.8.

5.2.6 Rear guard

The mold area opposite the operator of the HIMM shall have a rear guard with two interlocks that separately interrupt the control circuit and the power circuit to prevent all HIMM movements if the guard is open or removed.

E5.2.6 Rear guard

A rear guard should be so placed on the HIMM as to leave an opening between the guard and either the platens or the frame of the HIMM to allow clearance for water lines and other necessary items for connecting to the molds. The rear guard is designed to be opened and closed during setup and maintenance functions only. See illustration 2.

The rear guard may be replaced by an additional operator's gate. See 5.2.1.

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5.2.7 Top guard

A top guard shall be installed when it would be possible for a person standing on the floor to reach over the top of the operator's gate or guard and into a hazardous area. If the top guard is movable, an interlock shall be provided that will prevent all motion of the HIMM if the top guard is open or removed. If a fixed guard is used, an interlock is not required.

E5.2.7 Top guard

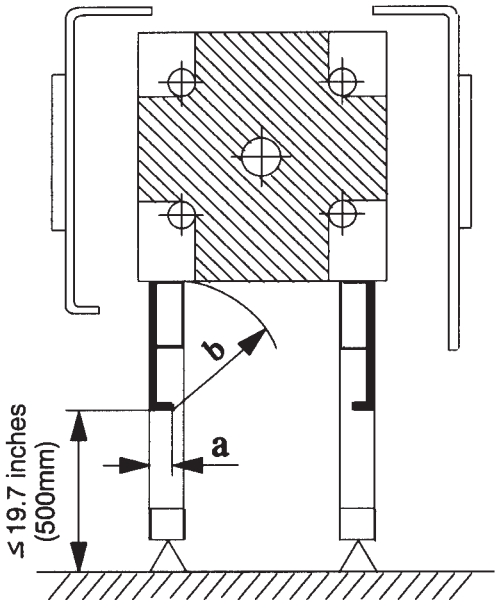
See illustration 1.

5.2.8 Parts discharge opening

The parts discharge opening (front and rear) shall be guarded to prevent access to hazards in the mold area through this opening. The dimensions in figure 1 shall be met with the use of fixed or movable guards, if necessary.

E5.2.8 Parts discharge opening

The presence of a conveyor or chute may function as a guard (see ANSI/ASME B20.1). See 7.3.



if a < 3.9 inches (100 mm),
then b ≥ 21.6 inches (550 mm)

or

if a ≥ 3.9 inches (100 mm),
then b ≥ (21.6 inches (550 mm)-a)

Figure 1 – Parts discharge opening

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5.2.9 Nozzle shutoff device

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

In manual mode, a pneumatically, hydraulically, or electrically actuated nozzle shutoff device shall default to the open position.

E5.2.9 Nozzle shutoff device

The purpose of defaulting to the open position is to help relieve pressure in the barrel.

5.3 General guarding (other than mold area guarding)

5.3.1 Guards

Guards shall be provided where hazards exist. Movable guards shall be interlocked to stop hazardous motion exposed by moving or removing the guard.

Fixed guards need not be interlocked.

E5.3.1 Guards

See illustrations 1 and 2. For parts discharge area guarding, see 7.3.

5.3.2 Feed openings

All feed openings for plastic materials shall be guarded against inadvertent insertion of hands. Safety signs shall be used in this area. See clause 8.

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.

E5.3.3 Vent cover

See 7.5 for vapor hazards and 7.7 for personal protective equipment.

5.3.4 Electrical systems

HIMMs 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.

E5.3.5 Purging protection

See 5.2.9 for screw rotation exception.

See 5.3.7 for screw or plunger forward exception.

5.3.6 Injection barrel covers

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

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5.3.7 Injection unit swivel interlock

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

5.4 Additional safety measures for large HIMMs

5.4.1 Area between operator's gate and the mold area

Where it is possible to stand between the operator's gate and the mold area, an emergency stop or emergency reverse button shall be provided in a location that is readily accessible from this area.

Additionally, where it is possible to stand between the operator's gate and the mold area, one of the following devices shall be provided:

a) *Gate block:* A mechanical device shall be provided that operates with each opening movement of the operator's gate to prevent the unintentional return of the gate to the closed position.

The disengagement of this mechanical device and closure of the operator's gate shall occur only by the direct and continuous action of the operator.

The position from which this device is disengaged and the operator's gate is actuated shall allow a clear view of this area.

A monitoring device shall be provided to check the operation of the mechanical device. If improper operation is detected, the Large HIMM cycle shall be inhibited and an alarm shall be activated.

Exception: Where a floor-entry-mounted robot is used, disengagement of this device and closure of the gate may be initiated by a robot signal.

or

b) *Double acknowledgment system:* A double acknowledgment system shall consist of a push button (#1) located inside of the operator's gate in full view of the mold area and a second push button (#2) located

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outside of the operator's gate and with a clear view of this area, which cannot be actuated from inside the closed operator's gate.

The start of a cycle shall be possible only after the following sequence has been completed within a time interval prescribed by the Large HIMM manufacturer:

1) push button #1;

2) close operator's gate;

3) push button #2 – cycle initiation.

A monitoring circuit shall be provided to check the operation of each push button. If improper operation or sequencing is detected, the Large HIMM cycle shall be inhibited and an alarm shall be activated.

or

c) *Presence-sensing device:* A presence-sensing device that, when activated, will prevent, stop, or reverse the closure of the operator's gate.

5.4.2 Area between the rear guard and the mold area

Where it is possible to stand between the rear guard and the mold area, an emergency stop or emergency reverse button shall be provided in a location that is readily accessible from this area.

E5.4.2 Area between the rear guard and the mold area

Since this area of the machine is protected by two interlocks that stop all machine motion when the rear guard is opened to gain access (see 5.2.6), no additional safety measures are required.

5.4.3 Mold area protection

5.4.3.1 Mold area with working platform

When the Large HIMM is supplied with a working platform in the mold area for the purpose of operator access during normal production, one or more presence-sensing device(s), such as a safety mat, an interlocked platform, a photoelectric beam, or other similar device, shall be provided and positioned such that a person standing on the platform would activate the device(s).

Actuation of the presence-sensing device(s) shall prevent the initiation of platen motion, powered operator's gate closing motion, core and/or ejector motion, and injection motion.

Actuation of the presence-sensing device(s) during platen closing shall stop all motion and require the manual resetting of the Large HIMM before a new cycle may be initiated.

E5.4.3.1 Mold area with working platform

The surfaces of the tie bars are not acceptable standing surfaces and should not be considered a part of the working platform.

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Motion, as provided for in 5.2.5, may be permitted when the presence-sensing device is actuated if this motion does not in itself create a hazard.

5.4.3.2 Mold area without working platform

When the Large HIMM is not supplied with a working platform in the mold for the purpose of operator access during normal production, one of the following devices shall be provided:

a) *Gate block:* A mechanical device as described in 5.4.1(a).

The position from which this device is disengaged and the operator's gate is actuated shall allow a clear view of the mold area.

or

b) *Double Acknowledgment System:* A double acknowledgment system as described in 5.4.1(b).

5.4.4 Cycle initiation

Closure of the operator's gate shall not directly initiate Large HIMM motion.

Closure of the operator's gate shall require direct and continuous action by the operator.

5.5 Emergency stop button

Each operator's control station shall include one emergency stop button.

5.6 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 Existing HIMMs

An existing HIMM is any HIMM that is manufactured prior to the compliance date of this standard.

6.1 Responsibility

The employer shall ensure that all HIMMs are in conformance with clauses 6 and 8 of this standard as required by previous versions of this standard.

Exception: The underlined requirements in this section are new. The employer shall ensure that all HIMMs are brought into conformance with these requirements within three years of the approval date (July 22, 1997) of this standard.

E6.1 Responsibility

See 5.1.3.

6.2 Mold area guarding

6.2.1 Operator's gate(s)

An operator's gate shall be provided as a barrier to keep personnel away from moving parts, the mold, and splattering of hot melt while the HIMM is operating. The operator's gate shall be closed before the HIMM can be operated. Interlocks shall be provided in accordance with 6.2.2, 6.2.3, and 6.2.4 of this standard.

When an opening movement of the movable platen is possible with the operator's gate open, access to pinching and shearing points behind the mold mounting surface of the movable platen shall be prevented.

E6.2.1 Operator's gate(s)

The HIMM may have more than one operator's gate. Illustration 1 shows the typical location for the operator's gate.

6.2.1.1 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 is activated, the gate motion stops or reverses.

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

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

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

Exception: Where a robot is used, HIMM cycle may be initiated by a robot position signal.

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6.2.2 Electrical interlock

A hardwired electrical interlock shall be provided that will prevent the following motions when the operator's gate is opened sufficiently to permit access to the mold area:

a) platen closing;

b) injection forward;

c) screw rotation.

The interlock shall be so located or protected to prevent accidental actuation.

When a HIMM is powered by sources other than hydraulics or pneumatics, an additional independent interlock shall be provided.

Exception: When the mechanical device is a jam bar (which is effective only in the platen-adjusted open position), the electrical interlock shall allow platen open motion to continue to its adjusted open position so that the mechanical device engages.

E6.2.2 Electrical interlock

See 6.2.8 for exception regarding screw rotation.

6.2.3 Mechanical device

A mechanical device shall be provided such that when the operator's gate is opened sufficiently to permit access to the mold area, the platen will be physically prevented from closing when the platen is in its adjusted open position. If the mechanical device is a jam bar, see 6.2.2 for exception.

E6.2.3 Mechanical device

The intent of this device is to provide a physical obstruction to impending closing motion of the moving platen.

Some platen closing motion may occur before the mechanical device is fully engaged.

The mechanical device is not intended to resist clamp-up force.

The mechanical device may include a ratchet bar or a friction-type device.

6.2.4 Hydraulic or pneumatic interlock

If hydraulic or pneumatic power is used to cause platen motion, then a hydraulic or pneumatic interlock shall be provided such that the platen close circuit shall be interrupted unless the operator's gate is closed sufficiently to exclude the operator from hazards.

This hydraulic or pneumatic interlock shall be actuated by mechanical or electrical means that are independent of all other interlocks.

If the hydraulic or pneumatic interlock is actuated by electrical means, a monitoring device shall be provided to verify the opera-

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tion of this hydraulic or pneumatic interlock. If improper operation is detected, the HIMM cycle shall be inhibited and an alarm shall be activated.

6.2.5 Rear guard

The mold area opposite the operator of the HIMM shall have a rear guard with at least one interlock to prevent all machine movement if the guard is open or removed.

E6.2.5 Rear guard

A rear guard should be so placed on the HIMM as to leave an opening between the guard and either the platens or the frame of the HIMM to allow clearance for water lines and other necessary items for connecting to the molds. The rear guard is designed to be opened and closed during setup and maintenance functions only. See illustration 2.

The rear guard may be replaced by an additional operator's gate. See 6.2.1.

6.2.6 Top guard

A top guard shall be installed when it would be possible for a person standing on the floor to reach over the top of the operator's gate or guard and into a hazardous area. If the top guard is movable, an interlock shall be provided that will prevent all motion of the HIMM if the top guard is open or removed. If a fixed guard is used, an interlock is not required.

E6.2.6 Top guard

See illustration 1.

6.2.7 Parts discharge opening

The parts discharge opening (front and rear) shall be guarded to prevent access to hazards in the mold area through this opening.

E6.2.7 Parts discharge opening

The presence of a conveyor or chute may function as a guard (see ANSI/ASME B20.1). See 7.3.

6.2.8 Nozzle shutoff device

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

In manual mode, a pneumatically, hydraulically, or electrically actuated nozzle shutoff device shall default to the open position.

E6.2.8 Nozzle shutoff device

The purpose of defaulting to the open position is to help relieve pressure in the barrel.

6.3 General guarding (other than mold area guarding)

6.3.1 Guards

Guards shall be provided where hazards exist. Movable guards shall be interlocked to stop hazardous motion exposed by moving or removing the guard.

Fixed guards need not be interlocked.

E6.3.1 Guards

See illustrations 1 and 2. For parts discharge area guarding, see 7.3

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6.3.2 Feed openings

All feed openings for plastic materials shall be guarded against inadvertent insertion of hands. Safety signs shall be used in this area. See clause 8.

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.

E6.3.3 Vent cover

See 7.5 for vapor hazards and 7.7 for personal protective equipment.

6.3.4 Electrical systems

HIMMs shall be in accordance with the requirements of ANSI/NFPA 79 where personnel safety will benefit.

6.3.5 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 shall be provided that will not interfere with the intended protection of the guard. The guard shall be interlocked to prevent screw rotation, screw or plunger forward, and electrically actuated injection carriage forward motion when the guard is not in position. Purging shall be prevented with the operator's gate open.

6.3.6 Injection barrel covers

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

6.4 Additional safety measures for large HIMMs

6.4.1 Area between operator's gate and the mold area

Where it is possible to stand between the operator's gate and the mold area, an emergency stop or emergency reverse button shall be provided in a location that is readily accessible from this area.

Additionally, where it is possible to stand between the operator's gate and the mold area, one of the following devices shall be provided:

a) *Gate block:* A mechanical device shall be provided that operates with each opening movement of the operator's gate to

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prevent the unintentional return of the gate to the closed position.

The disengagement of this mechanical device and closure of the operator's gate shall occur only by the direct and continuous action of the operator.

The position from which this device is disengaged and the operator's gate is actuated shall allow a clear view of this area.

Exception: Where a floor-entry-mounted robot is used, disengagement of this device and closure of the gate may be initiated by a robot signal.

or

b) *Double acknowledgment system:* A double acknowledgement system shall consist of a push button (#1) located inside of the operator's gate in full view of the mold area and a second push button (#2) located outside of the operator's gate and with a clear view of this area, which cannot be actuated from inside the closed operator's gate.

The start of a cycle shall be possible only after the following sequence has been completed within a time interval prescribed by the Large HIMM manufacturer:

1) push button #1;

2) close operator's gate;

3) push button #2 – cycle initiation.

A monitoring circuit shall be provided to check the operation of each push button. If improper operation or sequencing is detected, the Large HIMM cycle shall be inhibited and an alarm shall be activated.

or

c) *Presence-sensing device:* A presence-sensing device that, when activated, will prevent, stop, or reverse the closure of the operator's gate.

6.4.2 Area between the rear guard and the mold area

Where it is possible to stand between the rear guard and the mold area, an emergency stop or emergency reverse button shall be provided in a location that is readily accessible from this area.

E6.4.2 Area between the rear guard and the mold area

Since this area of the machine is protected by an interlock that stops all machine motion when the rear guard is opened to gain access (see 6.2.5), no additional safety measures are required.

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6.4.3 Mold area protection

6.4.3.1 Mold area with working platform

When the Large HIMM is supplied with a working platform in the mold area for the purpose of operator access during normal production, one or more presence-sensing device(s), such as a safety mat, an interlocked platform, a photoelectric beam, or other similar device, shall be provided and positioned such that a person standing on the platform would activate the device(s).

Actuation of the presence-sensing device(s) shall prevent the initiation of platen motion, powered operator's gate closing motion, core and/or ejector motion, and injection motion.

Actuation of the presence-sensing device(s) during platen closing shall stop all motion and require the manual resetting of the large HIMM before a new cycle may be initiated.

Platen open, ejector forward, and core out motion may be permitted when the presence-sensing device is actuated if this motion does not in itself create a hazard.

6.4.3.2 Mold area without working platform

When the Large HIMM is not supplied with a working platform in the mold for the purpose of operator access during normal production, one of the following devices shall be provided:

a) *Gate block:* A mechanical device as described in 6.4.1(a).

The position from which this device is disengaged and the operator's gate is actuated shall allow a clear view of the mold area.

or

b) *Double acknowledgment system:* A double acknowledgment system as described in 6.4.1(b).

6.4.4 Cycle initiation

Closure of the operator's gate shall not directly initiate Large HIMM motion.

Closure of the operator's gate shall require direct and continuous action by the operator.

6.5 Emergency stop button

Each operator's control station shall include one emergency stop button.

E6.4.3.1 Mold area with working platform

The surfaces of the tie bars are not acceptable standing surfaces and should not be considered a part of the working platform.

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6.6 Window

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

6.7 Safety signs

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

7 Use

7.1 Training of operators, and setup and supervisory personnel

The employer shall train and instruct personnel in the safe method of operation of the safety devices and procedures as described in clauses 5–8, before starting work on any operation covered in this standard. The employer shall ensure by adequate supervision that correct operating procedures are being followed.

E7. 1 Training of operators, and setup and supervisory personnel

The employer should consider setting up a checklist to ensure that operators are kept aware of procedures to follow in operating the HIMM safely. This checklist should be kept in the instruction manual of the HIMM, and periodically (such as every 6 months), the employer should have operators check off this list.

7.2 Work area

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

E7.2 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 HIMMs and HIMM operators.

7.3 Parts discharge area

When conveyors or other parts removal devices require modification of parts discharge opening guarding, additional guarding, presence-sensing devices, or interlocked perimeter guarding shall be provided by the employer to prevent access to hazards in the mold area and/or stop HIMM motion. Whenever such guarding would render the conveyor or chute unusable, prominent warning means shall be provided by the employer in lieu of such guarding.

E7.3 Parts discharge area

Because of the wide variety of ancillary equipment such as conveyors, chutes, robots, and the like, it is impossible for the HIMM manufacturer to effectively guard the parts discharge area.

See 6.2.7.

7.4 Vent port

Some vented injection barrels are designed only to operate with the 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

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and follow the vented barrel manufacturer's instructions.

7.5 Ventilation

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

7.6 Ancillary equipment

It shall be the responsibility of the employer to ensure that the use of ancillary equipment for handling or access at HIMMs, for example, conveyors, lifts, take-off devices, robots, and the like, shall not reduce the level of safety embodied in this standard.

E7.6 Ancillary equipment

See E7.3.

7.7 Personal protective equipment

Personnel shall wear personal protective equipment for protection against setup and maintenance hazards associated with a HIMM.

Operators may require production-specific personal protective equipment.

7.8 Mold guarding

On HIMMs fitted with a lockable switch as defined in 5.2.5, it shall be the responsibility of the employer to authorize the selectable position of this lockable switch, only after the employer has assured that pinching and shearing points created by these movements are guarded.

Accessible shearing and pinching points within the mold shall be guarded by the employer.

7.9 Interrupted cycle

If, for any reason, the cycle on the HIMM 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.

E7.9 Interrupted cycle

Proper shut-down procedures are dependent upon the type of material being processed. Refer to the Material Safety Data Sheet from the material supplier or to the material supplier's recommendations.

7.10 Automated mold change

When clamp motion is required during automated mold changing, interlocked guarding that does not reduce the level of safety shall be used.

8 Safety signs

All new signs shall conform to the color, format, size, and content requirements of the ANSI Z535 series, where feasible.

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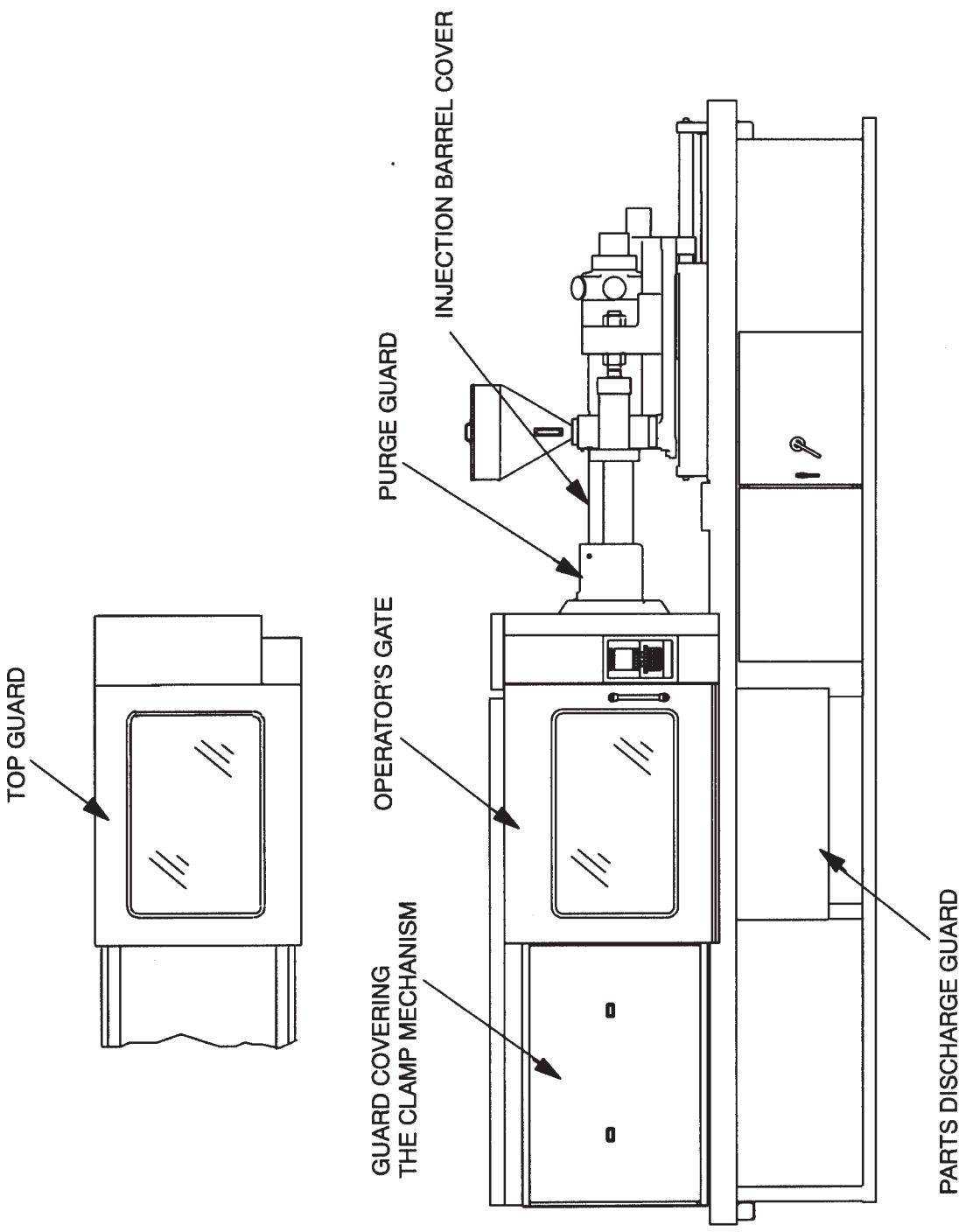


Illustration 1 – Front and top view of a horizontal injection molding machine (showing typical guarding)

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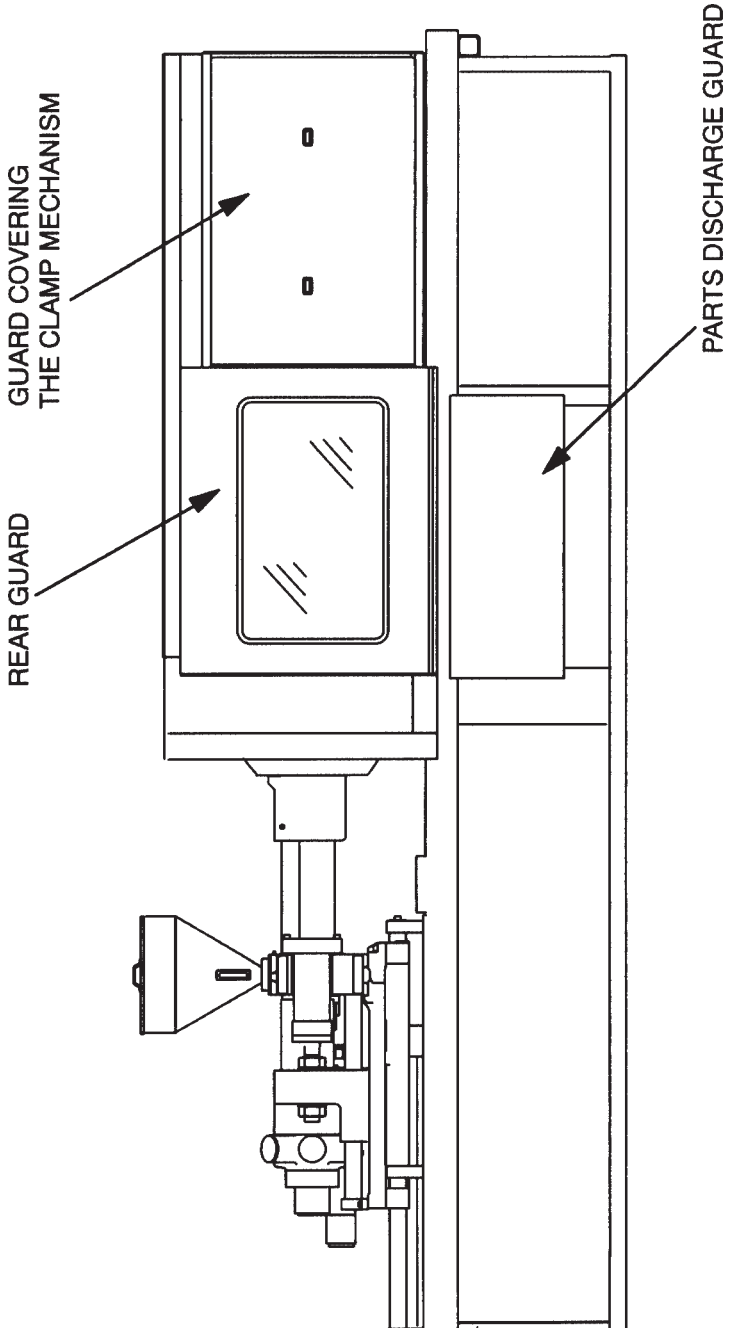


Illustration 2 – Rear view of a horizontal injection molding machine (showing typical guarding)

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