American National Standard

for Plastics Machinery –

Vertical Clamp Injection Molding Machines (VCIMM) – Safety Requirements for Manufacture, Care, and Use

ANSI/SPI B151.29-2002

Approved American National Standard

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for Plastics Machinery –

Vertical Clamp Injection Molding Machines (VCIMM) – Safety Requirements for Manufacture, Care, and Use

Sponsor

The Society of the Plastics Industry, Inc.

Approved April 22, 2002

American National Standards Institute, Inc.

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Foreword (This foreword is not part of American National Standard ANSI/SPI B151.29-2002.)

The project on safety requirements for the manufacture, care, and use of vertical 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 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 vertical 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 immediate updating of design and manufacturing methods, clauses 5 and 7 shall become effective one year after the approval date (April 22, 2002) 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, Washington DC 20006-1301.

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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 Plastics Industry, Inc., which were was responsible for this standard, had the following members:

B. Carteaux, Chairman
(Van Dorn Demag Corp)
W. Bishop, Secretariat
(Machinery Division of the
Society of the Plastics Industry)

J. Adamowicz
(Arburg, Inc.)
G. Atkinson
(Husky Injection Molding Systems, Ltd.)
C. Carls
(Battenfeld of America, Inc.)
J. Ewing
(BOY Machines Inc.)
G. Frohring
(Mini-Jector Machinery Corporation)
S. Glover
(Herzog USA)
R. Hetke
(Engel Canada, Inc.)
D. Hidding
(Dana Molded Products, Inc.)
C. Irick
(EPCO)
T. Koury
(Textron Automotive, Inc.)
L. Mills
(Van Dorn Demag)
R. Monteith
(Milacron, Inc.)
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J. Rexford
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(Autojectors, Inc.)

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American National Standard ANSI/SPI B151.29-2002 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 –

Vertical Clamp Injection Molding Machines (VCIMM) – Safety Requirements for Manufacture, Care, and Use

STANDARD REQUIREMENTS

EXPLANATORY INFORMATION

(Not part of American National Standard for Plastics Machinery – Vertical Clamp Injection Molding Machines (VCIMM) – Safety Requirements for Manufacture, Care, and Use, ANSI/SPI B151.29-2002)

1 Scope, Purpose, and Application

1.1 *Scope*

The requirements of this standard shall apply to all new VCIMMs that process plastic materials and inject said material into a mold held closed by a vertically acting clamp(s).

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

E1.1 *Scope*

Many configurations exist for these VCIMMs. Examples include, but not limited to:

a) Single station, down and/or up, moving clamp (SSVCIMM).

b) Multiple vertical clamp stations rotating about a common axis serving one or multiple *injection units* (MSVCIMM).

c) Shuttle table between clamp and auxiliary station(s) or clamp(s) (MSVCIMM).

d) Rotary table operating within one or more clamp or auxiliary station(s) (MSVCIMM).

1.2 *Purpose*

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

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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 20006-1301

1.3.1 *New VCIMMs*

E1.3.1 *New VCIMMs*

The requirements in clauses 5 and 7 of this standard shall apply to all new or remanufactured VCIMMs, 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 (April 22, 2002) of this standard.

The standard is based on manufacture date, not date of shipment or installation.

1.3.2 *All Installations*

An employer shall not permit a new or remanufactured VCIMM to be operated unless it is in compliance with this standard. The use shall be in accordance with clause 6 of this standard.

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2 *Normative References*

The following standards contain provisions which, through references 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 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 Z244.1-1982 (R1993), *Personnel Protection – Lock Out/Tag Out Energy Sources*

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

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

ANSI/NFPA 79-1997, *Electrical Standard for Industrial Machinery*

E2 *Related References*

AN-108, SPI *Recommended Guideline for Using Hydraulic Accumulators on Injection Molding Machines*[1)]

AN-134, SPI *Recommended Guideline for Technical Manuals Supplied with Plastics Machinery and Related Equipment*[1)]

AN-137, SPI *Recommended Guideline for Safety Signs for Plastic Machinery and Related Equipment* [1)]

AN-141, SPI *Recommended Guideline for Wiring and Grounding Machine Controls*[1)]

ANSI/SPI B151.27-1994, *Plastics Machinery – Robots Used with Horizontal Injection Molding Machines – Safety Requirements for the Integration, Care, and Use*[1)]

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 *VCIMM* to one *cycle* even though the actuating mechanism is held in the "operate" position. *Anti-repeat* requires release of actuating controls before another *cycle* can be initiated.

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 single hand or two-hand *control system* that prevents *VCIMM* operation if a control is "tied down".

[1)] Available from The Society of the Plastics Industry, Inc., 1801 K Street, NW, Washington, DC 2006-1301.

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3.4 *Automatic Cycle:* A selectable mode of operation of the *VCIMM* that allows it to perform more than one *cycle* without *operator* intervention.

3.5 *Barrel:* The cylinder portion of the plasticating unit within which the material is processed.

3.6 *Clamp:* That portion of the *VCIMM* that holds the two halves of the mold together during injection of material into the mold.

3.7 *Concurrent:* The actuation of both controls of a *two-hand control* at the same time without regard to the time lag between the initiation of one control and the initiation of the other.

3.8 *Control Circuit:* The means of controlling sequential motion/cycling of the *VCIMM* by signaling the devices (hydraulic/pneumatic valving, electric servo motors, etc.) to effect *VCIMM* motion.

3.9 *Control System:* Sensors, manual input, and mode selection elements, interlocking and decision making circuitry, and output elements provided to the *VCIMM* operating devices or mechanisms.

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

E3.10 *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.

3.11 *Cycle:* A complete movement from the initial start position back to that same start position of the *VCIMM*.

E3.11 *Cycle:* The initial start position for a *VCIMM* is when the *clamp* is open, *injection unit* retracted, screw or plunger at shot size, *ejectors* reset, *cores* pulled, and operator's gate open and *splatter* shield in place.

3.12 *Ejector:* Any and all provisions built into the *VCIMM* and/or mold for the release of the finished product from the mold.

E3.12 *Ejector:* The *ejectors* may be actuated by the motion of the *VCIMM clamp* or by hydraulic, electric and/or pneumatic circuitry integral with, or independent of, the *VCIMM* circuits.

3.13 *Emergency Stop Button:* A button that, when depressed, will stop all *VCIMM* motion.

3.14 *Employer:* Any person who contracts, hires, or is responsible for the personnel associated with *VCIMM* operation, set-up and/or maintenance.

3.15 *Fixed Guard:* A *guard* requiring the use of tools for removal from the *VCIMM*.

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3.16 *Guard:* A physical barrier that prevents access to areas of the *VCIMM* where known hazards exist.

3.17 *Hardwired Electrical Interlock:* An electrical *interlock* that operates independently of any user programmable device(s).

3.18 *Hazardous Motion:* Any motion that can cause injury to personnel.

3.19 *Injection Unit:* That portion of the *VCIMM* that plasticizes and then injects material through a nozzle into a mold.

3.20 *Instructions:* Documentation for the installation, operation, set-up, maintenance, care and safe use of the *VCIMM*.

3.21 *Interlock:* An arrangement whereby the status of one control or mechanism allows or prevents the operation of another.

3.22 *Large VCIMM:* A *VCIMM* with a horizontal or vertical distance between tie bars greater than 47 inches (1200 mm) and a maximum opening between the *platens* is greater than 47 inches (1200 mm).

A *VCIMM* without tie bars where one of the *platen* dimensions is greater than 47 inches (1200 mm) and a maximum opening between the *platens* is greater than 47 inches (1200 mm).

3.23 *Maintenance Personnel:* Individuals who are trained and authorized by the *employer* to provide preventative maintenance and other technical services.

3.24 *Manual Mode:* A selectable mode of operation of the *VCIMM* that allows it to perform one motion with direct and continuous action of control actuators.

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3.25 *Manufacturer:* A person(s) whose business is the manufacture of new *VCIMM*s.

3.26 *Modification:* For the purpose of this standard, any addition, deletion, conversion, or alteration to a *VCIMM* that could affect personnel safety.

E3.26 *Modification:* A *modification* could affect such areas as *control systems*, (electrical, hydraulic, pneumatic, etc.) *VCIMM* motions, walkways, ladders, enclosures, platforms, *guards*, etc.

3.27 *Modifier:* Any person who performs a *modification* to a *VCIMM*.

3.28 *Molding Area:* The zone between the *platens*.

3.29 *Molding Area Gate:* A movable barrier(s) arranged to prevent access to the *molding area*.

E3.29 *Molding Area Gate:* The molding area gate(s) may be opened and closed with each *VCIMM cycle*.

3.30 *Monitor Device:* A device used to verify the function of another device.

3.31 *Movable Guard:* A *guard* which can be moved or removed without the use of tools.

3.32 *Operator:* An individual who has been trained and authorized by the *employer* to perform production work on the *VCIMM*.

3.33 *Operator's Station(s):* An area from which the *operator*(s) initiates *VCIMM* motion.

3.34 *Plastic:* Any material processed by the *VCIMM*.

3.35 *Platen:* The stationary or moving member of a *VCIMM* through which the *clamp* force is applied.

3.36 *Presence-Sensing Device:* A device that is capable of detecting an intrusion into a specified area.

E3.36 *Presence-Sensing Device:* Examples of *presence-sensing devices* include: safey mat, interlocked platform, photoelectric beam, or other similar devices.

3.37 *Purging:* The clearing of material from the *injection unit* to the atmosphere.

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3.38 *Remanufacture:* The restoration of a complete *VCIMM* to conformance with clauses 5 and 7 of this standard.

E3.38 *Remanufacture: Remanufacture* typically consists of the following:

a) complete dismantling of the *VCIMM*;

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 7 of this standard and informing the *employer* of removal.

3.39 *Remanufacturer:* Any person whose business is the redesign and/or *remanufacture* of *VCIMM*s for installation in the United States of America.

3.40 *Repair:* The restoration of a portion of a *VCIMM* to original function using original design by replacement or reworking of worn or damaged parts.

E3.40 *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.

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

3.42 *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.

3.43 *Semi-Automatic Cycle (Single Cycle):* A selectable mode of operation of the *VCIMM* that allows it to perform one complete *cycle* and then stop.

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3.44 *Setup Personnel:* Individuals who are trained and authorized by the *employer* to prepare the *VCIMM* and ancillary equipment for production.

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

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

3.47 *Splatter:* Small spurts of molten *plastic* ejected from the nozzle of the *VCIMM*.

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

3.49 *Two-hand Control:* A control that requires *concurrent* and *synchronous actuation* by both hands to initiate *VCIMM* motion.

3.50 *Vapors:* Gas or steam formed by processing *plastic*.

3.51 *VCIMM:* Vertical clamp injection molding machine.

3.52 *Vent Cover:* A barrier covering the *vent port* opening.

3.53 *Vent Port:* An opening provided in the *barrel* to permit *vapors* to exit from the *plastic* material during processing.

3.54 *Vented Injection Barrel:* The cylinder portion of the plasticating unit within which the material is processed having a *vent port* to allow for the escape of vapor created in the plasticating process.

4 Care - Responsibility for

4.1 *Instructions*

4.1.1 *Manufacturer/Remanufacturer*

It shall be the responsibility of the *manufacturer/remanufacturer* to furnish instructions with the *VCIMM*.

E4.1.1 *Manufacturer/Remanufacturer*

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4.1.2 *Modifier*

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

E4.1.2 *Modifier*

Instructions may include electrical, hydraulic, and pneumatic schematics along with any programmable controller *modifications*, etc.

5 Manufacture, Remanufacture, and Modification

5.1 *Responsibility*

5.1.1 *Manufacture*

The manufacture of new *VCIMM*s shall be in accordance with clauses 5 and 7 of this standard.

5.1.2 *Remanufacture*

The *remanufacture* of a *VCIMM* shall be in conformance with clauses 5 and 7 of this standard.

5.1.3 *Modification*

The *modification* made to existing *VCIMM*s shall be in accordance with clause 7, and the parts of clause 5 of this standard that apply to the *modification*. Any *modification* shall not reduce the level of safety existing on the *VCIMM* at the time of manufacture or *remanufacture*.

5.1.4 *Repair*

***Repair* shall not reduce the level of safety of the *VCIMM*.**

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5.2 *Operator(s) Station*

E5.2 *Operator(s) Station.* Refer to 5.3.1 for *Molding Area* Access Protection

5.2.1 *Single Hand Control*

E5.2.1 *Single Hand Control*

On a *VCIMM* using single hand control, either a *presence-sensing device* or a moveable guard shall be incorporated. Activation of the *presence-sensing device* or opening of the interlocked moveable guard shall inhibit *hazardous motion*(s).

Continuous holding is not a requirement of single hand control when a *presence-sensing device* or an interlocking moveable guard is used.

Hazardous *VCIMM* motions may include table shuttle motion, table index motion, *ejector* motion, and *core* motion. Requirements for *molding area* protection are in 5.3.

The single hand *control system* shall incorporate *anti-tie-down*/*anti-repeat* circuitry.

The *control system* shall be designed to require an actuation of the single hand control before a *cycle* can be initiated or an interrupted *cycle* can be re-initiated.

5.2.2 *Two-Hand Controls*

E5.2.2 *Two-Hand Controls*

On a *VCIMM* using *two-hand control*, the control shall be located to remove the *operator* from the *hazardous motion*(s).

Hazardous *VCIMM* motions may include table shuttle motion, table index motion, *ejector* motion, and *core* motion. Requirements for *molding area* protection are in 5.3.

In addition to the above requirements, *two-hand controls*, when used, shall meet the following construction requirements:

5.2.2.1 *Concurrent Application*

E5.2.2.1 *Concurrent Application*

Each *two-hand control* station shall be arranged by design, construction, and/or separation so that *concurrent* and *synchronous actuation* by both hands is required to initiate any motion.

The intent is to preclude an inadvertent actuation or intentional misuse of each independent actuating control.

5.2.2.2 *Holding Requirement*

E5.2.2.2 *Holding Requirement*

The *control system* shall be designed to require continuous action from both hands until *hazardous motions* are no longer present.

Hazardous motions may include, but are not limited to, *clamp*, *ejector* and/or *core* motions which are not protected by physical barriers or *presence-sensing devices*.

5.2.2.3 *Anti-Tie-Down/Anti-Repeat*

The *two-hand control* shall incorporate *anti-repeat*/anti-tie-down control circuitry.

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5.2.3 *Multiple Operator Stations*

Where multiple *operator* stations are provided and *two-hand controls* are used, the *concurrent* and maintained operation of all stations in use shall be required to initiate and maintain *VCIMM* motion until *hazardous motion*(s) is no longer present. *Synchronous actuation* is required only within each *two-hand control* station and is not required between stations.

5.2.4 *Motion/No Motion*

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

No motion position of the key switch shall inhibit *cores* and *ejector* motions when the *operator's station* safety has been interrupted.

Motion position of the key switch allows for movement of *cores* and *ejectors* when the *operator's station* safeties are interrupted.

E5.2.4 *Motion/No Motion*

It is recognized that some molds may require that parts and/or inserts be manually lifted from or placed into the mold in conjunction with either *core* and/or *ejector* motion.
See 6.5.1 for guarding requirements.

5.2.5 *Robot Operation*

Where a *robot* is used, *VCIMM cycle* may be initiated by a signal from the *robot,* providing that perimeter guarding is in place.

E5.2.5 *Robot Operation*

See ANSI/SPI B151.27 for *robot*/IMM guarding.

5.3 *Molding Area Protection*

5.3.1 *Molding Area Protection*

***Molding area* protection shall be provided that will protect personnel from mechanical hazards associated with *clamp* opening and closing and hot plastics or inserts that may be expelled from the mold area when the mold is closed.**

***Molding area* protection shall consist of one or more of the following:**

1) *molding area gate*
2) *movable guard*(s)

E5.3.1 *Molding Area Protection*

Molding area protection refers to the area of the machine where the mold is opened and closed. This area is not to be confused with the *operator* station(s) where the *operator* initiates the machine *cycle*, although in some design configurations they may be the same area.

An example of protection against hot plastic would be the case where an insert is missing in the mold and hot *plastic* is expelled through the open area normally occupied by the insert.

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5.3.2 *Molding Area Electrical Interlock*

A *hardwired electrical interlock* shall be provided for a *molding area gate* or moveable guard that will prevent injection forward, injection carriage forward motion, and screw rotation and cause the *clamp* motion to stop and/or open when the *molding area gate* or *movable guard* is opened sufficiently to permit access to the *molding area*. The *interlock* shall be so located or protected to prevent inadvertent actuation.

On *VCIMM*s powered by sources other than hydraulics or pneumatics, an additional independent *hardwired electrical interlock* shall also be provided.

5.3.3 *Molding Area Mechanical Device*

A mechanical device shall be provided as a physical obstruction to impending closing motion or free fall of the *clamp* when the *molding area gate* or *guard* is opened sufficiently to allow access to the mold area.

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

E5.3.3 *Molding Area Mechanical Device*

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

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

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

5.3.4 *Molding Area Hydraulic or Pneumatic Interlock*

When hydraulic or pneumatic power is used to cause *clamp* motion, then at least one hydraulic or pneumatic *interlock* shall be provided such that when the *molding area gate* or *guard* permits access to the *molding area*, the *clamp* will be prevented from closing. The 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 *VCIMM cycle* shall be inhibited and an *alarm* shall be activated.

5.3.5 *Gravity Effect*

When gravity acting upon a gate or *guard* can cause a hazardous movement, a method of preventing such hazardous movement shall be provided.

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5.3.6 *Power-Operated Gate or Guard*

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

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

Where whole body access within the gate is possible on a *large VCIMM*, closure of the power-operated *operator*'s gate shall require direct and continuous action by the *operator* until the gate is closed.

5.4 *Additional Safety Measures for Large VCIMMs*

5.4.1 *Area between Molding Area Gate and 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 VCIMM cycle* shall be inhibited and an *alarm* shall be activated.

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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 outside of the *operator*'s gate 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 VCIMM 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 VCIMM 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 *Molding Area Protection*

When the *large VCIMM* allows for *operator* access to the *molding area* 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

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b) *Double Acknowledgment System:*

A double acknowledgment system as described in 5.4.1(b).

5.5 *General Guarding* (*other than molding area guarding*)

5.5.1 Guards

***Guards* or *presence-sensing devices* 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.**

5.5.2 *Gravity Effect*

When gravity acting upon a gate or *guard* can cause a hazardous movement, a method of preventing such hazardous movement shall be provided.

5.5.3 *Feed Openings*

All feed openings for *plastic* materials shall be protected against inadvertent insertion of hands.

E5.5.3 *Feed Openings*

A material hopper can meet this requirement.

5.5.4 *Purging and Splatter Protection*

Guarding shall be provided to shield personnel from material being purged. The *VCIMM* structure and closed mold may act in whole or in part as this guarding. If guarding is movable, and is not in the closed position, it shall be interlocked to prevent screw rotation, screw or plunger forward, and injection carriage forward motion.

A *guard* shall be provided at the front of the nozzle area to shield personnel from inadvertent *splatter* of hot *plastic* when the mold and *molding area gate*s are open. The *VCIMM* structure, mold or other machine *guards* may act in whole or in part as this *guard*(s). This *guard*, if moveable, shall be interlocked to prevent *clamp* opening until the *guard* is in place.

E5.5.4 *Purging and Splatter Protection*

Consideration should be given to providing means for easy purge material removal.

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5.5.5 *Injection Barrel Covers*

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

5.5.6 *Vent Cover*

On machines with vented *barrels*, a cover shall be provided over the *vent port* to protect personnel from hot *plastic* and/or *vapors* that may be expelled.

E5.5.6 *Vent Cover*

See clause 6 for personal protective equipment, *vent port* requirements and vapor hazards.

5.6 *Window*

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

5.7 *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).

5.8 *Emergency Stop Button*

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

5.9 *Electrical Systems*

***VCIMM*s shall be designed in accordance with the electrical requirements of ANSI/NFPA 79.**

6 Use

6.1 *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 *VCIMM*s.

The *employer* shall supply reasonable guarding for the mold *ejector* box and *core* slide action if a hazard exists.

E6.1 *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 *VCIMM*s have features not necessarily identical to those of other machinery.

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6.2 *Inspection and Maintenance*

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

6.3 *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 through 7, before starting work on any operation covered in this standard. The *employer* shall ensure by adequate supervision that correct operating and setup procedures are being followed.

E6.3 *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 *VCIMM* safely. This checklist should be kept in the instruction manual of the *VCIMM*, and periodically (such as every 6 months), the *employer* should have *operators* check off this list.

6.4 **Work Area**

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

E6.4 *Work Area*

The handling or 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 *VCIMM*s and *VCIMM operators*.

6.5 *Operator and Mold Guarding Area*

6.5.1 *Load/Unload and Core/Ejector Area Guarding*

It shall be the responsibility of the *employer* to provide and ensure the usage of any additional guarding for this area of the *VCIMM* consistent with the mold and tooling being used, or other features unique to the operation, so as to provide protection for the *operator* or other personnel in the immediate proximity.

On *VCIMM*s fitted with a lockable switch as defined in 5.2.4, 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.

6.5.1 *Load/Unload and Core/Ejector Area Guarding*

On single-station *VCIMM*, the mold area is the load/unload and *core*/eject area and requires the same degree of guarding when fitted with a lockable switch as defined in 5.2.4. The pinching and shearing points that must be guarded by the *employer* before authorizing the selectable position of this lockable switch includes any that may exist in the mold cavity itself.

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6.5.2 *Extended Mold Protection*

If the mold or inserts extends beyond the mold mounting surface(s), the *employer* shall be responsible for providing adequate protection.

6.6 *Ancillary Equipment*

It shall be the responsibility of the *employer* to ensure that the installation and use of ancillary equipment does not reduce the level of safety embodied in this standard.

E6.6 *Ancillary Equipment*

For example: conveyors, lifts, take-off devices, *robots*, and the like.

6.7 *Personal Protective Equipment*

Personnel shall wear personal protective equipment for protection against hazards associated with a *VCIMM*.

6.8 *Automatic Cycle*

When a *VCIMM* is used in *automatic cycle*, it shall be the responsibility of the employer to assure that hazards created by other movements are guarded.

E6.8 *Automatic Cycle*

Other movements may include *robots*, conveyors, or other handling equipment. Perimeter guarding may be required.

See ANSI B151.27.

6.9 *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 and follow the vented *barrel* manufacturer's instructions.

6.10 *Ventilation*

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

E6.10 *Ventilation*

Refer to applicable standards and regulations to determine hazardous vapor levels.

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7 Safety Signs and Nameplates

7.1 *General*

All plates or signs shall conform to ANSI Z535 in color, format, size, and content where feasible.

7.2 *Identification*

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

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