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American National Standard

for machine tools –

metal powder compacting presses – safety requirements for construction, care, and use

american national standards institute, inc.
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ANSI B11.16-1988

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American National Standard
for Machine Tools –

Metal Powder Compacting Presses – Safety Requirements for Construction, Care, and Use

Secretariat
National Machine Tool Builders' Association

Approved May 10, 1988
American National Standards Institute, Inc

Foreword

(This Foreword is not part of American National Standard B11.16-1988 (MPIF #47).)

Recognizing the need for an ANSI Safety Standard for Metal Powder Compacting Presses, Accredited Standards Committee B11 on Safety Requirements for Machine Tools established Subcommittee B11.16 in 1985 to develop for its approval a draft standard to cover safety requirements for this equipment. The first standard for Metal Powder Compacting Presses was developed and approved by the Metal Powder Industries Federation in 1973 and published in 1974 as MPIF #47. It was subsequently revised in 1977.

The primary objective of this standard is to eliminate injuries to personnel associated with presses used in powder metallurgy (P/M) by establishing safety requirements for the construction, safeguarding, care, and use of P/M presses.

To accomplish this objective the B11.16 subcommittee, with the approval of the B11 Parent Voting Committee, approached the safe operation of P/M presses from four directions:

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

(2) Minimizing by design, procedure, and process the necessity of having the operator place hands, fingers, or other body parts within the point of operation, thus minimizing the operator's exposure to point-of-operation hazards.

(3) Safeguarding the point of operation to protect personnel, should they inadvertently expose themselves to hazards at the point of operation.

(4) Establishing guidelines for general training and specific job-related instruction for eliminating unsafe practices and procedures for all personnel working on P/M presses.

It is recognized that the words "safe" and "safety" are not absolutes. Safety is influenced by many factors, including attitude. This standard is not intended to replace good judgment. Operator skill, training, experience, and job organization are all safety factors that must be considered in proper compliance with written regulations or recommended practice.

In order to achieve the above goals and to assist persons in the implementation of this standard, responsibilities have been assigned to the manufacturer, the reconstructor, the modifier, the employer, the employee, and the owner. To achieve uniform interpretation, it is imperative to read and understand the definitions (Section 4) used in this standard.

Whenever possible, the mandatory requirements of this standard are stated in performance styled language to indicate that an objective must be met without making mandatory the specifications of how it is to be accomplished. These mandatory requirements are listed in the left-hand column. To assist those persons concerned in complying with the mandatory requirements of this standard a two-column format is used wherein all explanatory information or recommendations for specifications have been placed in the right-hand advisory column, adjacent to the mandatory requirements found in the left-hand column.

The grace periods provided in MPIF #47 have expired. Therefore, all metal powder compacting P/M presses and their operation should now be in compliance with this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the National Machine Tool Builders' Association, 7901 Westpark Drive, McLean, VA 22102, Attention: Safety Department, or Metal Powder Industries Federation, 105 College Road East, Princeton, NJ 08540.

Recognizing the importance of distributing and encouraging the use of this standard as important to the proper use of the equipment described, it is recommended that all interested persons and associations make known the availability of this standard and encourage its use.

The standard was written by the B11.16 subcommittee, processed by the National Machine Tool Builders' Association, as Secretariat, and finally, approved by the B11 Parent Voting Committee for submittal to ANSI in accordance with the requirements of the Accredited B11 Operating Procedures. The ANSI B11 process provides for a consensus to be reached by a broad representation of associations, labor, safety organizations, Federal government agencies, and industry. The following, while not necessarily voting on this standard, are members of the B11 Parent Voting Committee:

Aerospace Industries Association of America, Inc
Alliance of American Insurers
American Boiler Manufacturers Association
American Die Casting Institute, Inc
American Institute of Steel Construction
American Insurance Association
American Ladder Institute
American Metal Stamping Association
Can Manufacturing Institute
Computer and Business Equipment Manufacturers Association
Defense Industrial Plant Equipment Center
Electronic Industries Association
Forging Industry Association
Grinding Wheel Institute
Human Factors Society
Industrial Safety Equipment Association
International Association of Machinists & Aerospace Workers District Lodge #142
International Union, United Automobile, Aerospace and Agricultural Implement Workers of America
Machinery Dealers National Association
Manufacturing Jewelers & Silversmiths of America, Inc
Metal Building Manufacturers Association
Metal Powder Industries Federation
Motor Vehicle Manufacturers Association
National Association of Architectural Metal Manufacturers
National Association of Government Labor Officials
National Association of Metal Name Plate Manufacturers, Inc
National Electrical Manufacturers Association
National Fluid Power Association
National Machine Tool Builders' Association
National Safety Council
National Tooling & Machinery Association
Northern Illinois Industrial Association
Rubber Manufacturers Association
Sheet Metal & Air Conditioning Contractors National Association, Inc
Society of Manufacturing Engineers
Steel Plate Fabricators Association
Steel Service Center Institute
Tool & Die Institute
U.S. Bureau of the Navy, Bureau of Ships
Welded Steel Tube Institute

At the time the standard was written, the following companies of powder metal press builders, end-user parts manufacturers, and trade association personnel supported and comprised active membership on the B11.16 Subcommittee:

AC Compacting Presses, Inc
Brockway Pressed Metals, Inc
Burgess-Norton Mfg. Co.
Cincinnati Incorporated
Coors Porcelain Company
Data Instruments, Inc
Federal-Mogul Corporation
Gasbarre Products, Inc
General Motors Corporation
Metal Powder Industries Federation
PTX-Pentronix, Inc
Stokes/Pennwalt Corporation
Supermet Division of Stanadyne, Inc

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Explanation of Standard Format

American National Standard B11.16-1988 (MPIF #47) 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. Where supporting tables, photographs, or sketches are required, they are designated as "tables" or "figures."

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."

All material designated as "tables," "figures," or "illustrations" appears at the end 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.

American National Standard
for Machine Tools –

Metal Powder Compacting Presses – Safety Requirements for Construction, Care, and Use

STANDARD REQUIREMENTS

1. Scope, Purpose, and Application

1.1 Scope

1.1.1 Types of Machines Included. The requirements of this standard apply to those mechanically or hydraulically powered machines that are designed, modified, or converted for the compressing of metallic or nonmetallic powders. These machines are commonly referred to as metal powder presses, powder metal presses, compacting presses, P/M briquetting presses, metal powder sizing presses, or metal powder coining presses. For the purpose of this standard, they shall be referred to as "P/M presses."

1.1.2 Types of Machines Excluded. Excluded from this standard are: metal powder hot forming presses, mechanical and hydraulic power press brakes, mechanical and hydraulic power presses, bulldozers, hot bending and hot metal presses, forging presses, hammers, riveting machines and similar types of fastener applications, isostatic and hydrostatic presses, and high energy rate powered presses.

1.2 Purpose. The purpose of this standard is to establish safety requirements with respect to the construction, safeguarding, care, and use of P/M presses.

1.3 Application. The grace periods provided in Metal Powder Industries Federation Safety Standard, Safety Requirements for the Construction, Safeguarding, Care, and Use of P/M Presses, MPIF #47, 1977, 1.3.1 (New Installations) and 1.3.2 (Former Installations), have expired.

EXPLANATORY INFORMATION

(Not part of American National Standard for Machine Tools – Metal Powder Compacting Presses – Safety Requirements for Construction, Care, and Use, ANSI B11.16-1988 (MPIF #47))

E1.1 Scope

E1.1.1 Types of Machines Included. Typical nonmetallic powders are ceramics, carbides, iron oxide, plastics, food products, chemicals, and pharmaceutical powders.

E1.1.2 Types of Machines Excluded. Typical of those machines excluded are metal stamping presses and sheet and plate working press brakes.

1.3.1 New Installations. The requirements of this standard pertaining to construction, Section 5, shall be the responsibility of the manufacturer, reconstructor, or modifier. New installations are those P/M presses installed subsequent to the approval date of this standard (May 10, 1988).

1.3.2 Existing Installations. The requirements of this standard pertaining to construction, Section 5, as it applies to former installation of P/M presses, shall be the responsibility of the employer. Existing installations are those P/M presses installed prior to the approval date of this standard (May 10, 1988).

1.3.3 All Installations. The requirements of this standard pertaining to safeguarding (Section 6), design, construction, and setting of tool sets (Section 7), feeding and part removal (Section 8), and service and use (Section 9) shall be the responsibility of the employer.

E1.3.1 New Installations. The grace periods provided in MPIF #47, Safety Requirements for the Construction, Safeguarding, Care, and Use of P/M Presses, have expired; therefore, all P/M presses should be in compliance with the construction requirements of this standard.

E1.3.2 Existing Installations. After the approval date of this standard (May 10, 1988), a two (2) year grace period should apply to Section 5.

2. Description

2.1 P/M Press. A P/M press is the machine utilized for compressing metallic or nonmetallic powders. P/M presses are composed of a frame, tooling platens, and upper or lower rams and may utilize any combination of mechanical, hydraulic, or pneumatic power.

E2.1 P/M Press. P/M presses include compacting presses for the initial consolidation of powder into a desired shape, as well as coining and sizing presses for repressing of previously compacted parts.

The unique characteristic that differentiates the P/M press from other presses is the process by which it is utilized to achieve the conversion from metallic and nonmetallic powder to the green part or to size, coin, or densify the previously compacted P/M part.

See Illustrations 1-10.

2.2 Mechanical P/M Presses. Mechanical P/M presses are machines utilizing a frame, platens, upper or lower rams with fixed or moving die platens, utilizing a single motion, multi-motion, or rotary motion. The tooling components are located in, or attached to, the rams and are mechanically driven.

2.3 Hydraulic P/M Presses. Hydraulic P/M presses are machines utilizing a frame, platens, upper or lower rams with fixed or moving die platens, utilizing a single motion, multi-motion, or rotary motion. The tooling components are located in or attached to the rams and are hydraulically driven.

2.4 "Hybrid" P/M Presses. P/M presses may utilize any combination of mechanical, pneumatic, or hydraulic power for driving the rams and have the same basic description as the mechanical P/M presses.

3. Referenced Publications

3.1 American National Standards. This standard shall be used in conjunction with the following American National Standards. When these standards are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply.

ANSI Z35.1-1972, Specifications for Accident Prevention Signs

ANSI Z53.1-1979, Safety Color Code for Marking Physical Hazards

ANSI/ASME B15.1-1984, Safety Standard for Mechanical Power Transmission Apparatus

4. Definitions

4.1 Antirepeat. The part of the control system designed to limit the press to a single stroke if the tripping means is maintained in an operating position. Antirepeat requires release of all tripping mechanisms before another stroke can be initiated. Antirepeat is also called single stroke reset or reset circuit.

E4.1 Antirepeat. There should be no inference that the purpose of antirepeat is to prevent a repeat, since a repeat is the result of a malfunction. The function of antirepeat is to prevent the successive strokes which could occur if the antirepeat control did not exist. Antirepeat is the control equivalent of single stroke mechanism.

4.2 Barrier Gate Device. A mechanism that is designed to allow compacted parts to pass through it from the point of operation but restricts the entry of the operator into the point of operation.

E4.2 Barrier Gate Device. See Illustration 11.

4.3 Brake. The mechanism used on a mechanical P/M press to stop the crankshaft, or hold the crankshaft, or both, either directly or through a gear train, when the clutch is disengaged.

E4.3 Brake. The brake may be a constant drag type (typical on a full-revolution clutch machine) or may be a type disengaged while the clutch is engaged (most typical with part-revolution clutch machines).

4.4 Brake Monitor. A sensor designed, constructed, and arranged to monitor the effectiveness of the P/M press braking system.

4.5 Clutch. An assembly used to connect and disconnect a driving and driven part of a mechanism and, when connected, transmits rotary motion from the driving to the driven member.

4.5.1 Full-Revolution Clutch. A type of clutch that, when tripped, cannot be disengaged until the P/M press has completed a full cycle.

E4.5.1 Full-Revolution Clutch. Positive type clutches are almost always full-revolution types. Usually, a tripping device releases spring pressure to move engaging members which by nature require a full revolution before they can be disengaged, generally by a throwout cam arrangement which is part of the clutch mechanism.

4.5.2 Part-Revolution Clutch. A type of clutch that may be engaged or disengaged during any part of the cycle.

E4.5.2 Part-Revolution Clutch. Part-revolution clutches are usually air engaged and usually are friction-type mechanisms, although some types of positive engagement clutches are capable of being disengaged with-

in the stroke of the ram. Other types of clutches such as eddy current, or hydraulically engaged, are sometimes used for part-revolution operations.

4.6 Coining. The re-pressing of the P/M compact part on the P/M press for the purpose of further densifying the compact part, reestablishing dimensional control, or reshaping the part.

E4.6 Coining. Coining and cold forming may be used interchangeably.

4.7 Cold Forming. See *Coining* (4.6).

4.8 Compaction. The compression or consolidation of metallic or nonmetallic powder into a desired shape.

4.9 Concurrent. Acting in conjunction – used to describe a situation wherein two or more controls exist in an operated condition at the same time.

E4.9 Concurrent. Specifically as applied to the operation of RUN buttons or INCH controls, the use of the word "concurrent" means that the clutch or control valve will be activated after each hand of the operator is holding a control in the operated position.

The use of the word "concurrent" is intended to exclude any inference that a simultaneous moment of actuation must exist between the operations of the individual two-hand controls.

4.10 Continuous. Automatic multiple strokes of the P/M press that can include momentary intervening stops during each stroke.

4.11 Control Valve. The valve that initiates or stops press motion by controlling the fluid power source.

4.12 Conversion. The taking of other than a P/M press and making it into a P/M press. See *Modifier* (4.35).

4.13 Counterbalance. The mechanism that is used to balance or support the weight of the ram and its attachments.

4.14 Cycle. A complete movement of the ram from its present or preset start position and return to that same position.

4.15 Device. A press control or attachment that:

(1) Restrains the operator from reaching into the point of operation; or

(2) Prevents normal press operation if the operator's hands are within the point of operation during the closing portion of the cycle; or

(3) Automatically withdraws the operator's hands, if the operator's hands are within the point of operation as the tools close.

E4.15 Device. In this standard, the use of the word "device" is reserved exclusively for describing mechanisms or controls designed for safeguarding at the point of operation.

Some examples of devices may be:

Pull-backs
Restraints
Presence-sensing devices
Type-A gate
Type-B gate
Movable barrier

4.16 Die Closing. Die closing is that portion of the P/M press cycle from top dead center to where the punch enters the die.

4.17 Die Set. Die set (unitized) means a removable tool-holder assembly held in alignment by guideposts, bushings or ways and including platens for mounting the tool set.

4.18 Direct Drive – with a Brake. The type of driving arrangement wherein no clutch is used; coupling and decoupling of the driving torque is accomplished by energization and de-energization of a motor. The pressing motion of the P/M press is stopped by the application of a brake at the time the motor is de-energized.

For the purposes of this standard, this is considered in the same category as a part-revolution clutch.

4.19 Direct Drive – without a Brake. The type of driving arrangement wherein no clutch is used; coupling and decoupling of the driving torque is accomplished by energization and de-energization of a motor.

4.20 Employer. Any legal entity who is responsible for the personnel associated with P/M press operations.

4.21 Feed Shoe. The container or components for transferring the powder from the supply hopper to the die cavity. It may be used for removing the part from the point of operation.

4.22 Feeding or Removal. The process of placing or removing material within or from the point of operation.

4.22.1 Nonmanual Feeding or Removal. An operation wherein the material or part being processed is placed within or removed from the point of operation by a method or means not requiring action by an operator at the point of operation.

4.22.2 Manual Feeding or Removal. Feeding wherein the material or part being processed is placed into or removed from the point of operation by the operator's hand, with or without a hand tool.

4.23 Foot Control. The foot-operated control mechanism designed to activate a P/M press.

E4.23 Foot Control. This control usually takes the form of a foot-operated electrical switch to operate a solenoid or solenoid-operated valve, or it may take the form of a foot-operated valve.

4.24 Foot Pedal or Treadle. The foot-operated lever designed to operate the mechanical linkage that trips the clutch.

4.25 Gate or Movable-Barrier Device. An attachment arranged to enclose the point of operation before the P/M press stroke can be started.

E4.25 Gate or Movable-Barrier Device. See Illustration 12.

4.26 Green Part. A compacted part that retains its shape by mechanical bond of the individual particles as opposed to the metallurgical bond that is typical of cast, wrought, or sintered materials.

Mechanical bonds can be easily broken and can result in a compacted part that is highly fragile and can

require special handling to retain its shape or details of its shape.

4.27 *Guard.* A barrier that prevents entry of any part of the operator's body into the point of operation.

E4.27 Guard. In this standard, the use of the word "guard" is reserved exclusively for referring to barriers designed for safeguarding at the point of operation.

See Illustration 13.

E4.27.1 Die-Enclosure Guard. See *Fixed-Barrier Guard* (E4.27.2).

E4.27.2 Fixed-Barrier Guard. A die space barrier attached in a fixed position to the P/M press frame, die table, or platen.

E4.27.3 Interlocked Press Barrier Guard. A barrier attached to the P/M press frame and interlocked so that the press stroke cannot be started normally unless the guard itself, or its hinged or movable sections, encloses the point of operation.

E4.27.4 Adjustable-Barrier Guard. A barrier requiring adjustment for each job or die setup.

4.28 *Guidepost.* The pin(s) attached to the upper or lower platen operating within a bushing on the opposing platen, used to maintain the alignment of the tooling elements.

4.29 *Hand Tool.* Any hand-held object designed for placing or removing material or parts to be processed within or from the point of operation.

4.30 *Holdout or Restraint Device.* A device, including attachments for operator's hands, that when anchored and adjusted, prevents the operator's hands from entering the point of operation.

E4.30 Holdout or Restraint Device. See Illustration 14.

4.31 *Inch.* An intermittent motion imparted to the ram (on machines using part-revolution clutches) by momentary engagement of the driving clutch.

E4.31 Inch. Operation of the INCH operating means engages the driving clutch so that a small portion of one stroke or indefinite stroking can occur, depending upon the length of time the INCH operating means is held operative. INCH is a function used by the die setter for setup of dies and tooling, but is not intended for use during production operations by the operator.

4.32 *Jog.* An intermittent motion of the ram of the press by momentarily energizing the drive motor, with the flywheel at rest.

4.33 *Maintenance Personnel.* Individuals who service, inspect, and maintain P/M presses.

4.34 *Manufacturer.* Any person or legal entity who manufactures, reconstructs, or modifies P/M presses or presses for P/M use, for installation in the United States.

4.35 *Modifier.* One who converts, changes, or otherwise alters the original design of machines that fall within the scope of this standard.

4.36 Operating Station. The controls used by or available to an operator on a given operation for stroking the P/M press.

4.37 Operator. An individual performing production work on the P/M press.

4.38 P/M Part. A part which is compacted, formed, or compressed into a specific shape starting from metallic or nonmetallic powder.

E4.38 P/M Part. After forming to a specific shape a P/M part in the as-pressed or "green" state goes through a sintering process to metallurgically bond the particles. Subsequent processing steps may be performed, such as sizing, coining, machining, or other secondary operations.

4.39 P/M Press. The machine utilized for compressing metallic or nonmetallic powders. P/M presses are composed of a frame, tooling platens, and upper or lower rams and may utilize any combination of mechanical, hydraulic, or pneumatic power.

E4.39 P/M Press. P/M presses include compacting presses for the initial consolidation of powder into a desired shape, as well as coining and sizing presses for re-pressing of previously compacted parts.

The unique characteristic that differentiates the P/M press from other presses is the process by which it is utilized to achieve the conversion from metallic and and nonmetallic powder to the green part or to size, coin, or densify the previously compacted P/M part.

See Illustrations 1-10.

4.40 Pinch Point. Any point other than the point of operation where it is possible for a part of the body to be caught between the moving parts of a P/M press or auxiliary equipment, or between moving and stationary parts of a P/M press or auxiliary equipment, or between the material and moving part or parts of the P/M press or auxiliary equipment.

E4.40 Pinch Point. The expression "pinch point," as used in this standard, refers only to hazards which may exist as a part of the machine, or its associated parts. The expression is not used to describe hazards caused by the tooling at the point of operation, since these hazards are a different problem and require different treatment.

4.41 Platen. A member of the P/M press or die set used for mounting or attaching the individual tool elements contained in the tool set.

4.42 Point of Operation. The area of the P/M press where compaction, coining, sizing, or cold forming takes place and includes the space between that area and the face of the upper punch.

E4.42 Point of Operation. See Illustration 15.

4.43 Presence-Sensing Device. A device designed, constructed, and arranged to create a sensing field or area and to deactivate the control of the P/M press when any body part is within such field or area.

E4.43 Presence-Sensing Device. Such devices may be electronic and may employ active circuit elements (for example, semiconductor amplifiers) in conjunction with passive circuit elements (for example, transformers, inductors, capacitors, and resistors) and an output element (typically an electromagnetic relay or a static type contact).

See Illustration 16.

4.44 Pull-Back Device. A mechanism attached to the operator's hands and connected to the upper die or ram of the P/M press that is intended, when properly adjusted, to withdraw the operator's hands as the dies close.

E4.44 Pull-Back Device. See Illustration 17.

4.45 Ram. The main reciprocating load-transmitting press member.

E4.45 Ram. A ram may also be called a slide or crosshead.

4.46 Reconstructor. Anyone who is responsible for, and engaged in, restoring or rebuilding a machine to its original condition and capability.

4.47 Repeat. An unintended or unexpected successive stroke of the press resulting from a malfunction.

4.48 Run. SINGLE STROKE or CONTINUOUS stroking of a P/M press.

4.49 Setup. The process of removing or installing work-holding devices, or tooling, safeguarding, and selecting P/M press settings to ensure proper and safe operation.

4.50 Shall. A mandatory requirement.

4.51 Should. As used in this standard it is to be understood as denoting a recommendation. It does not denote a mandatory requirement.

4.52 Single Cycle or Single Stroke. One complete cycle of the P/M press, from the initial (open) position through the closing or work-performing position and a return to the initial position.

4.53 Single Cycle Mechanism. A control arrangement used to limit the P/M press to one complete cycle.

4.54 Sizing. The re-pressing of the compacted part in the P/M press for the purpose of dimensional control.

4.55 Stop Control. An operator control designed to initiate the stopping action of the P/M press.

E4.55 Stop Control. The words "emergency stop" are sometimes used to refer to this control, even though its use is most commonly not on an emergency stop basis. Also, quite commonly, a TOP STOP control is used to stop CONTINUOUS stroking at top of stroke, or at another predetermined point in stroke. A TOP STOP control action is delayed after actuation of the operating means, so as to cause stopping at the proper point in stroke.

4.56 Stroking Selector. The part of the P/M press control that determines the type of stroking when the operating means is actuated.

E4.56 Stroking Selector. This is sometimes referred to as a "cycle selector." The stroking selector generally includes positions for OFF, INCH, SINGLE STROKE, and CONTINUOUS when furnished.

4.57 Tool Set. One or more of the following elements: upper punches, lower punches, dies and core rods, each necessary to form the part.

4.58 Trip or Tripping. Activation of the P/M press control to run the press.

4.59 Turnover Bar. A bar used in tool setting to manually turn the crankshaft of the P/M press.

4.60 Two-Hand Control Device. A two-hand trip that requires concurrent use of both hands of the operator

E4.60 Two-Hand Control Device. See Illustration 18.

during the die closing portion of the stroke of the press and includes an antirepeat feature.

4.61 Two-Hand Trip. An actuating means requiring the concurrent use of both hands of the operator to trip the press.

4.62 Unitized Die Set. See *Die Set* (4.17).

5. Construction, Reconstruction, Modification, and Conversion

5.1 Responsibility

5.1.1 Manufacturer. It shall be the responsibility of the P/M press manufacturer to design and construct P/M presses in accordance with Section 5.

5.1.2 Reconstruction and Modification – P/M Presses. It shall be the responsibility of any manufacturer or employer reconstructing or modifying a P/M press to do so in accordance with Section 5.

5.1.3 Reconstruction, Modification, and Conversion – Any Press. It shall be the responsibility of any manufacturer or employer reconstructing, converting, or modifying any press into a P/M press to do so in accordance with Section 5.

5.2 Inherent Hazards

5.2.1 Hazards to Personnel Associated with Moving Parts (Other than Point of Operation Hazards). The manufacturer shall eliminate the hazard by design, or provide protection against the hazard in accordance with ANSI/ASME B15.1-1985. Where the hazard cannot be eliminated by design or protection, the manufacturer shall warn against the hazard.

5.2.2 Hazards to Personnel Associated with the Point of Operation. See Section 6.

5.2.3 Hazards to Personnel Associated with Broken or Falling Machine Components. Machine components shall be designed, secured, or covered to minimize hazards caused by breakage, or loosening and falling, or release of mechanical or hydraulic energy.

5.2.4 Hazards to Personnel Associated with Machine Maintenance. If necessary, safeguards shall be provided for areas that require frequent maintenance and adjustment.

5.2.5 Provisions for Handling at Installation. Where it is necessary, provisions for handling the P/M press shall be provided.

E5.1.2 Reconstruction and Modification – P/M Presses. Repair and maintenance is not to be construed as reconstruction or modification.

E5.2.1 Hazards to Personnel Associated with Moving Parts (Other than Point of Operation Hazards). Some methods of warning are color coding by the use of contrasting or bright colors or signs. ANSI Z35.1-1972 and ANSI Z53.1-1979 should be referenced.

E5.2.2 Hazards to Personnel Associated with the Point of Operation. Hazards at the point of operation are an entirely different problem than are those hazards which can be considered in construction of the basic machine and its accessory equipment. Thus, hazards at the point of operation should be considered separately.

E5.2.5 Provisions for Handling at Installation. These may be lifting hooks, eye bolts, lifting links, or other means, and must be adequate to handle the anticipated load.

5.2.6 Hazards to Personnel Associated with Machine Installation. Where it is necessary, due to machine design or application, a means shall be provided for properly securing the P/M press in place.

5.3 Mechanical P/M Press

5.3.1 Part-Revolution Clutch

5.3.1.1 Air, Electric, or Hydraulic Activation

5.3.1.1.1 Cycle Start Control. The cycle start control shall be protected and guarded against accidental operation.

E5.3.1.1.1 Cycle Start Control. One method of complying with this section is the use of a recessed or guarded push button to initiate the cycle (cycling) of the P/M press.

5.3.1.1.2 Stop Control. A red STOP control shall be provided with the clutch and brake control system. Momentary operation of the STOP control shall immediately deactivate the clutch and apply the brake. The STOP control shall override any other control, and reactuation of the clutch shall require use of the operating (tripping) means that has been selected.

5.3.1.1.3 Mode Selector. A means for selecting OFF or INCH for setup, and one or more production modes of operation such as, but not limited to SINGLE STROKE and CONTINUOUS shall be supplied within the stroking control system. The arrangement shall be OFF, INCH, SINGLE STROKE (when provided), CONTINUOUS (when provided), OTHER PRODUCTION MODES AS IDENTIFIED (when provided), as the control is turned clockwise. Fixing of the selection shall be by a means capable of being controlled by the employer. Changing of the selection from one mode to another shall not cause ram movement.

E5.3.1.1.3 Mode Selector. The intent of this section is not to require a key-lock selector. It is recognized as a method of meeting the requirements of this section.

Some methods for complying with this section are:

(1) Remote location of selector

(2) Key-lock selector

(3) Removable selector

(1) The OFF mode shall make the press inoperative.

(1) OFF does not mean the motor is stopped.

5.3.1.1.4 Inch. The INCH operating means shall be designed to prevent exposure of the operator within the point of operation by:

(1) Requiring the concurrent use of both hands to actuate the clutch; or

(2) Being a single control protected against accidental actuation and so located that the operator cannot reach into the point of operation while operating the single control.

5.3.1.1.5 Single Stroke Two-Hand Control. Two-hand controls for SINGLE STROKE, when provided, shall conform to the following requirements:

E5.3.1.1.5 Single Stroke Two-Hand Control. Precautions in design or installation should be followed to prevent operation of two buttons by the use of one hand and the elbow of the same arm, or other such attempts to circumvent the two-hand requirement.

(1) Each hand control shall be protected against unintended operation and arranged by design, construction, or separation so that the concurrent use of both hands is required to trip the press.

(1) The use of rings around the palm-operated buttons protects them from unintended operation.

(2) The control system shall be designed to require concurrent use of both hands during the die-closing portion of the stroke.

(2) A control adjustment should be used to establish a point in the die-closing portion of the stroke prior to which ram motion will be halted if either mechanism is released, but after which ram motion will automatically continue if either mechanism is released.

(3) The control system shall incorporate an antirepeat feature.

(4) The control system shall be designed to require release of all operator's hand controls before an interrupted stroke can be resumed.

(5) For limitations in the use of a two-hand tripping control as a safeguard device at the point of operation, see 6.4.8.

(6) For limitations in the use of a two-hand control device as a safeguard at the point of operation, see 6.4.6.

5.3.1.1.6 Continuous. A clutch and brake control system that contains both SINGLE STROKE and CONTINUOUS functions shall be designed so that the completion of the CONTINUOUS circuit shall be capable of being supervised by the employer. The initiation of CONTINUOUS run shall require a prior action or decision by the operator in addition to the selection of CONTINUOUS on the stroking selector, before actuation of the operating means shall result in CONTINUOUS stroking.

5.3.1.1.7 Hand-Foot Selection. If foot control is provided, in addition to a hand control, the selection method between the hand and foot control shall be separate from the stroking selector and shall be designed so that the selection shall be capable of being supervised by the employer.

5.3.1.1 8 Foot Control. Foot-operated controls, if used, shall be protected against unintended operation.

5.3.1.1.9 Clutch and Brake Air-Valve Failure. The control of air clutch machines utilizing safeguarding devices that depend on clutch and brake reliability to protect the operator shall be designed to prevent a significant increase in the normal stopping time due to a failure within the operating valve mechanism, and to prohibit further operation if such failure does occur.

5.3.1.1.10 Pneumatic Controls. Pneumatic controls shall be protected against foreign material and water entering the pneumatic system of the press if this creates a potential safety hazard. A means of air lubrication shall be provided when needed.

5.3.1.1.11 Press Drive Motor Interlock. The clutch and brake control shall incorporate an automatic means to prevent initiation or continued activation of the SINGLE STROKE or CONTINUOUS functions

E5.3.1.1.6 Continuous. The intent of this section is to have the sequence for activating the CONTINUOUS mode different from selecting all other modes. This is in addition to the employer being capable of supervising the selection of CONTINUOUS.

E5.3.1.1.7 Hand-Foot Selection. The intent of this section is not to require a key-lock selector. It is recognized as one method of meeting the requirements of this section.

Some methods for complying with this section are:

(1) Plug-in connection for the operating control

(2) Key-lock selector

E5.3.1.1.8 Foot Control. Some methods for complying with this section are:

(1) Cover over the footswitch

(2) Removable foot pedal

(3) Locking pin in treadle or linkage

(4) Key-lock selector

(5) Plug-in footswitch connection

E5.3.1.1.9 Clutch and Brake Air-Valve Failure. Inspection to determine mechanical condition is difficult, and the results to be obtained from such inspections are not positive. A method for complying with this section is the use of a tandem or dual air valve.

The EXCEPTION in MPIF #47, revised 1977, excluding the application of 4.3.1.1.1.10 to machines manufactured and installed prior to February 15, 1972, has been eliminated. This was done to encourage the updating of P/M presses to this level of control reliability, especially to make this available to setup persons.

E5.3.1.1.11 Press Drive Motor Interlock. A method for complying with this section is a control circuit interlock contact on the drive motor starter (forward direction contactor) to allow RUN function only

unless the press drive motor is energized and in the forward direction.

5.3.1.1.12 Removal of Engaging Force. The clutch shall release and the brake shall be applied when the external clutch-engaging means is removed, deactivated, or de-energized.

5.3.1.1.13 Engaging-Method Failure. The clutch and brake control shall automatically deactivate in the event of failure of the power or pressure supply for the clutch-engaging means. Reactivation of the clutch shall require restoration of normal air supply and use of the operating control(s).

5.3.1.1.14 Air Counterbalance Air Supply. The clutch and brake control shall automatically deactivate in the event of failure of the counterbalance(s) air supply. Reactivation of the clutch shall require restoration of normal air supply and use of the operating control(s).

5.3.1.2 Manual Activation

5.3.1.2.1 Foot Pedal or Treadle

(1) *Contact Area.* The pedal shall have a nonslip contact area.

(2) *Return Spring.* The return spring shall be of a compression type, operating on a rod or guided within a hole or tube, and designed to prevent interleaving of spring coils in the event of breakage.

(3) *Unintended Operation.* The pedal mechanism shall be protected against unintended activation of the control.

(4) *Counterweights.* If pedal counterweights are provided, the path of the travel of the counterweights shall be enclosed.

5.3.1.2.2 Hand-Operated Levers. Hand-lever-operated P/M presses shall be protected against premature or accidental tripping.

5.3.1.3 Brakes. Friction brakes provided for stopping or holding the ram movement shall be set with compression springs or positive locking linkage. The return spring shall be of a compression type operating on a rod or guided within a hole or tube and designed to prevent interleaving of spring coils in event of breakage. Brake capacity shall be capable of stopping the motion of the ram and be capable of holding its attachments at any point in its travel.

5.3.1.4 Brake System Monitoring. When required by 6.4.2(2), 6.4.3(3), or 6.4.6(5), the brake monitor shall meet the following requirements:

(1) Be so constructed as to automatically prevent the activation of a successive stroke if the stopping time or braking distance deteriorates to a point where when the contactor is energized.

E5.3.1.1.12 Removal of Engaging Force. Typically, the clutch is released and the brake applied in the event of an air-supply failure with an air-friction clutch.

E5.3.1.1.13 Engaging-Method Failure. A method for complying with this section on air-friction clutch machines is by the use of an air-pressure switch on the incoming air supply.

E5.3.1.1.14 Air Counterbalance Air Supply. A method for complying with this section is an air-pressure switch on the counterbalance air supply, downstream from the pressure regulators.

(3) *Unintended Operation.* Some methods for complying with this section are:

(1) Removable foot pedal

(2) Locking pin in the treadle linkage

E5.3.1.2.2 Hand-Operated Levers. Some methods for complying with this section are:

(1) Spring-loaded hand lever

(2) Latching mechanism in the operating linkage

(3) Locking pin in the operating linkage

the safety distance being utilized does not meet the requirements set forth in 6.3.

(2) Be installed on a P/M press that indicates when the performance of the braking system has deteriorated to the extent described in 5.3.1.4(1).

(3) Be constructed and installed in a manner to monitor the stopping action of the brake system.

5.3.1.5 Counterbalance System

5.3.1.5.1 Spring Counterbalance

(1) *Retaining Broken Parts.* Spring counterbalance systems, when used, shall incorporate means to retain system parts in the event of breakage.

(2) *Capability.* Spring counterbalances, when used shall have the capability to hold the ram and its attachments at midstroke, without brake applied.

5.3.1.5.2 Air (Pneumatic) Counterbalance

(1) *Retaining Broken Parts.* Air counterbalance cylinders, when used, shall incorporate means to retain the piston and rod in the event of breakage or loosening.

(2) *Capability.* Air counterbalance cylinders, when used, shall have capacity to hold the ram and its attachments at any point in the stroke without brake applied.

(3) *Air Supply Failure.* Air counterbalance cylinders, when used, shall incorporate means to prevent failure of capability in the event of air supply failure.

5.3.1.6 Turnover Bar. Selection of bar operation shall be by a means capable of being supervised by the employer. A separate control or interlock shall be used to prevent press power operation while the turnover bar is used. A method shall be provided to ensure removal of the turnover bar prior to operating the P/M press.

E5.3.1.6 Turnover Bar. Some methods of complying with this section are:

(1) Use of a turnover bar with an ejector spring.

(2) Use of an electrically interlocked cover over the location where the turnover bar is positioned for use.

(3) Use of a combination of (1) and (2) above.

5.3.2 Full-Revolution Clutches

5.3.2.1 Single Cycle. Machines using full-revolution clutches shall incorporate a single-cycle mechanism.

5.3.2.2 Air, Electric, or Hydraulic Activation

5.3.2.2.1 Cycle Start Control. The cycle start control shall be protected and guarded against accidental operation.

5.3.2.2.2 Stop Control. A raised red STOP control shall be provided with the clutch and brake control system. The STOP control shall override any other control, and reactuation of the clutch shall require use of the operating (tripping) means that has been selected.

5.3.2.2.3 Mode Selector. A means for selecting OFF and one or more production modes of operation such as, but not limited to SINGLE STROKE and CONTINUOUS shall be supplied within the stroking control system. The arrangement shall be OFF, SINGLE STROKE (when provided), CONTINUOUS (when provided), OTHER PRODUCTION MODES AS IDENTIFIED (when provided), as the control is turned clockwise. Fixing of the selection shall be by a means capable of being controlled by the employer. Changing of the selection from one mode to another shall not cause ram

E5.3.2.2.3 Mode Selector. The intent of this section is not to require a key-lock selector. It is recognized as one method of meeting the requirements of this section. Some methods for complying with this section are:

(1) Remote location of selector

(2) Key-lock selector

(3) Removable selector

movement. A means of selecting JOG shall be supplied within the mode selector or by a separate control

Selection of any of these modes of operation shall be capable of being supervised by the employer.

5.3.2.2.4 Jog. The JOG operating means shall be designed to prevent exposure of the operator within the point of operation by:

(1) Requiring the concurrent use of both hands to actuate the clutch, or

(2) Being a single control protected against accidental actuation and so located that the operator cannot reach into the point of operation while operating the single control.

5.3.2.2.5 Off. The OFF mode shall make the press inoperative.

E5.3.2.2.5 Off. OFF does not mean the motor is stopped.

5.3.2.2.6 Two-Hand Trip, Single Stroke. Two-hand trips for single stroke, when furnished, shall conform to the following requirements:

(1) Each hand trip shall be protected against unintentional operation and arranged by design, construction, or separation so that the concurrent use of both hands is required to trip the press.

(2) The control system shall incorporate an anti-repeat feature.

(3) The control system shall be designed to require release of all operator's hand controls before another stroke can be initiated.

Limitations: For limitations in the use of two-hand tripping control as a safeguard device at the point of operation, see 6.4.8.

5.3.2.2.7 Continuous. A clutch and brake control system that contains both SINGLE STROKE and CONTINUOUS functions shall be designed so that the completion of the CONTINUOUS circuit shall be capable of being supervised by the employer. The initiation of CONTINUOUS run shall require a prior action or decision by the operator in addition to the selection of CONTINUOUS on the mode selector, before actuation of the operating means will result in continuous stroking.

E5.3.2.2.7 Continuous. The intent of this section is to have the sequence for activating the CONTINUOUS mode different from selecting all other modes. This is in addition to the employer being capable of supervising the selection of CONTINUOUS.

5.3.2.2.8 Hand or Foot Selection. If foot control is provided, the selection methods between hand and foot control shall be separate from the stroking selector and shall be designed so that the selection shall be capable of being supervised by the employer.

E5.3.2.2.8 Hand or Foot Selection. Some methods for complying with this section are:

(1) Plug-in connection for the operating control

(2) Key-lock selector

5.3.2.2.9 Foot Control. Foot-operated control, if used, shall be protected against unintended operation of the control.

E5.3.2.2.9 Foot Control. Some methods for complying with this section are:

(1) Cover over the foot control

(2) Removable foot pedal

(3) Locking pin in treadle or linkage

(4) Key-lock selector

(5) Plug-in foot control connection

5.3.2.2.10 Press Drive Motor Interlock. A clutch and brake control shall incorporate an auto-

E5.3.2.2.10 Press Drive Motor Interlock. A method for complying with this section is a control

matic means to prevent initiation or continued activation of the SINGLE STROKE or CONTINUOUS function unless the press drive motor is energized and in the forward direction.

5.3.2.2.11 Engaging-Method Failure. The clutch and brake control shall deactivate automatically, at the completion of a cycle, in the event of failure of the power pressure supply for the clutch-engaging means. Reactivation of the clutch shall require restoration of the power pressure supply and use of the tripping mechanism(s).

5.3.2.2.12 Air Counterbalance Air Supply. The clutch and brake control shall deactivate automatically at the completion of a cycle, in the event of a failure of the counterbalance(s) air supply. Reactivation of the clutch shall require restoration of air supply and use of the tripping mechanism(s).

5.3.2.2.13 Pneumatic Controls. Pneumatic controls shall be protected against foreign material and water entering the pneumatic system of the press if this creates a safety hazard. A means of air lubrication shall be provided when needed.

5.3.2.3 Manual Activation

5.3.2.3.1 Removal of Engaging Force. When the engaging force is removed or released, the clutch shall release and the brake be applied upon completion of the cycle.

5.3.2.3.2 Foot Pedal or Treadle

(1) *Contact Area.* The pedal shall have a nonslip contact area.

(2) *Return Spring.* The return spring shall be of a compression type operating on a rod or guided within a hole or tube and designed to prevent interleaving of spring coils in the event of breakage.

(3) *Unintended Operation.* The pedal mechanism shall be protected to prevent unintended operation.

(4) *Counterweights.* If pedal counterweights are provided, the path of the travel of the counterweights shall be enclosed.

5.3.2.3.3 Hand-Operated Levers. Hand-lever-operated P/M presses shall be designed to prevent premature or accidental tripping.

5.3.2.4 Brakes. Friction brakes provided for stopping or holding the ram movement shall be set with compression springs. The return spring shall be of a compression type operating on a rod or guided within a hole or tube and designed to prevent interleaving of spring coils in the event of breakage. Brake capacity shall be capable of stopping the motion of the ram at the completion of a cycle, and capable of holding the ram and its attachments.

circuit interlock contact on the drive motor starter (forward direction contactor) to allow RUN function only when the contactor is energized.

E5.3.2.2.11 Engaging-Method Failure. A method for complying with this section is by the use of an air-pressure switch on the incoming air supply.

E5.3.2.2.12 Air Counterbalance Air Supply. A method for complying with this section is the use of an air-pressure switch on the counterbalance air supply downstream from pressure regulators.

(3) *Unintended Operation.* Some methods for complying with this section are:

(1) Removable foot pedal

(2) Locking pin

(3) Latching mechanism

E5.3.2.3.3 Hand-Operated Levers. Some methods for complying with this section are:

(1) Removable hand lever

(2) Latching mechanism in the operating linkage

(3) Locking pin in the operating linkage

5.3.2.5 Counterbalance System

5.3.2.5.1 Spring Counterbalance

(1) *Retaining Broken Parts.* Spring counterbalance systems, when used, shall incorporate a means to retain system parts in the event of breakage.

(2) *Capability.* Spring counterbalances, when used, shall have the capability to hold the ram and its attachments without brake applied.

5.3.2.5.2 Air (Pneumatic) Counterbalance

(1) *Retaining Broken Parts.* Air counterbalance cylinders, when used, shall incorporate a means to retain the piston and rod in the event of breakage or loosening.

(2) *Capability.* Air counterbalance cylinders, when used, shall have capacity to hold the ram and its attachments without brake applied.

(3) *Air-Supply Failure.* Air counterbalance cylinders, when used, shall incorporate a means to prevent failure of capability in the event of air-supply failure.

5.3.2.6 Turnover Bar. Selection of bar operation shall be by a means capable of being supervised by the employer. A separate control or interlock shall be used to avoid press power operation while the turnover bar is used. A method shall be provided to ensure removal of the turnover bar prior to operating the press.

5.3.3 Electrical Requirements

5.3.3.1 Disconnect Switch. A manually operated disconnect means shall be provided for each incoming supply circuit. The disconnect means shall be capable of being locked only in the OFF position.

5.3.3.2 Motor Start Button. The motor start button shall be protected against accidental operation.

5.3.3.3 Motor Start. All mechanical P/M press controls shall incorporate a type of drive motor(s) starter that will disconnect the motor(s) from the power source in the event of control voltage or power source failure, and shall require operation of the motor start button to restart the motor when voltage conditions are restored to normal.

5.3.3.4 Voltage. All ac control circuits and solenoid valve coils shall be powered by not more than a nominal 120-volt ac supply obtained from a transformer with an isolated secondary. Higher voltages that may be necessary for operation of the machine or control mechanisms shall be isolated from any control mechanism handled by the operator, but motor starters with integral start-stop buttons may utilize line voltage control. All dc control circuits shall be powered by not more than a nominal 240-volt dc supply isolated from any higher voltages.

5.3.3.5 Grounds. All clutch and brake control electrical circuits shall be protected against the possibility of an accidental ground in the control circuit causing false operation of the press.

E5.3.2.6 Turnover Bar. Some methods of complying with this section are:

(1) Use of a turnover bar with an ejector spring.

(2) Use of an electrically interlocked cover over the location where the turnover bar is positioned for use.

(3) Use of a combination of (1) and (2) above.

E5.3.3.5 Grounds. Some methods for complying with this section are the use of electromagnetic relay circuitry operating at a nominal 120 volts ac. These are:

(1) *Grounded Circuit.* One side of the control transformer secondary is connected to ground, and one side

of all control-operating coils and indicating lights (other than the "ground connected" indicator) are wired directly to the grounded side of the circuit. A "ground connected" indicating light is wired between the ungrounded side of the circuit and a separate ground connection. All pilot contacts are connected in the ungrounded fused side of the circuits, so that a ground fault will blow the fuse and prevent operation.

Exceptions: Contacts of overload relays within the control panel may be connected between operating coils and the grounded line. Contacts of other mechanisms may be connected in the grounded side of the circuit when done for the purpose of increased safety.

See Illustration 19.

(2) *Ungrounded Circuit.* The control transformer secondary winding and both sides of the control circuit are fused and completely insulated from ground. Two "ground detector" lights are connected in series across the load side of the secondary fuses, with the common connection between the lights completely through ground so that a ground fault will be indicated. Contacts of the rotary limit switch, relays, and RUN buttons that normally interrupt clutch and brake air-valve current are duplicated on each side of the circuit. RUN buttons are connected so that each operator has one button on each side of the circuit.

See Illustration 20.

(3) *Ungrounded Circuit with Transformer Center-Tap Grounded.* Each end of the control transformer secondary is ungrounded with a secondary center-tap connected to ground through a protective circuit-interrupting mechanism that will remove power from the control circuit. "Ground detector" lights are wired to indicate a disconnection of the center-tap ground and the presence of a ground fault. The control circuitry should meet the double break requirement in E5.3.3.5(2), since it is possible to operate the press with the center-tap ground disconnected.

See Illustration 21.

E5.3.3.6 Control Component Failure. A method for complying with this section is the interruption of the clutch (and brake, if separate) valve current through (1) the cycle-control rotary limit switch, or (2) series contacts of two or more independent relays or static circuits. Adjustable stopping controls using counters or timers may be used with a suitable limit switch backup.

5.3.3.6 Control Component Failure. **Electrical clutch and brake control circuits shall incorporate features to prevent an unintended stroke in the event of a failure of a control component to function properly, including relays, limit switches, pressure switches, solenoid valves, fluidic controls, and static output circuits.**

When required by 6.4.2(1), 6.4.3(4), or 6.4.6(4), the control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the P/M press when required, but does prevent initiation of a successive stroke until the failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system. This requirement does not apply to those elements of the control system which have no

effect on the protection against point-of operation injuries.

5.4 Hydraulic P/M Press

5.4.1 Controls. The press control shall control all movement of the press ram by signaling the hydraulic valving.

5.4.1.1 Cycle Start Control. The cycle start control shall be protected and guarded against accidental operation.

5.4.1.2 Stop Control. At least one of the following shall be provided as a means of stopping the press ram:

5.4.1.2.1 Stop. A means of stopping the motion of the ram shall be provided. Actuation of the STOP control shall deactivate immediately all press controls. The STOP control shall override any other control. If a STOP button is provided, it shall be red.

5.4.1.2.2 Stop and Return of Ram. A yellow STOP and auto-return button, when provided, shall stop the press ram and then return the ram to the initial starting position.

5.4.1.3 Mode Selector. When more than one mode is furnished, a means of selecting the different modes, such as OFF, INCH, SINGLE CYCLE, and AUTOMATIC, shall be supplied with the press control. The arrangement shall be OFF, INCH, SINGLE CYCLE (when provided), CONTINUOUS (when provided), or OTHER PRODUCTION MODES AS IDENTIFIED (when provided), as the control is turned clockwise. Selecting the mode shall not in itself create press motion. Selection shall be by means capable of being supervised by the employer.

5.4.1.4 Off. The OFF mode shall make the press inoperative.

5.4.1.5 Inch. The INCH operating means shall be designed to prevent exposure of the operator within the point of operation by:

(1) Requiring the concurrent use of both hands to actuate the control; or

(2) Being a single control protected against accidental actuation and so located that the operator cannot reach into the point of operation while operating the single control.

5.4.1.6 Single Stroke Two-Hand Control. Two-hand controls for SINGLE STROKE, when provided, shall conform to the following requirements:

(1) Each hand control shall be protected against unintended operation and arranged by design, construction, or separation so that the concurrent use of both hands is required to trip the press.

E5.4.1 Controls. The press control may be electrical, fluid logic, or mechanical.

E5.4.1.2.1 Stop. A STOP control should be readily accessible to each operator station. The STOP control should stop all motion, but does not necessarily stop the motor.

E5.4.1.2.2 Stop and Return of Ram. A STOP and auto-return control should be readily accessible to each operator station. The STOP control should stop all motion, but does not necessarily stop the motor.

E5.4.1.3 Mode Selector. The word CONTINUOUS is sometimes used in place of AUTOMATIC. The word SEMIAUTOMATIC is sometimes used in place of SINGLE CYCLE.

E5.4.1.4 Off. OFF does not necessarily mean the motor is stopped.

E5.4.1.6 Single Stroke Two-Hand Control. Precautions in design or installation should be followed to prevent operation of two buttons by the use of one hand and the elbow of the same arm, or other such attempts to circumvent the two-hand requirement.

(1) The use of two rings around the palm-operated buttons protects them from unintentional operation.

(2) The control system shall be designed to require concurrent use of both hands during the die-closing portion of the stroke.

(3) The control system shall incorporate an anti-repeat feature.

(4) The control system shall be designed to require release of all operator's hand controls before an interrupted stroke can be resumed.

(5) For limitations in the use of a two-hand control as a safeguard at the point of operation, see 6.4.6.

5.4.1.7 Continuous. A control system which contains both SINGLE STROKE and CONTINUOUS functions shall be designed so that completion of the CONTINOUS circuit shall be capable of being supervised by the employer. The initiation of CONTINUOUS run shall require a prior action or decision by the operator in addition to the selection of CONTINOUS on the stroking selector, before actuation of the operating means will result in CONTINUOUS stroking.

5.4.1.8 Hand or Foot Selection. If foot control is provided, the selection method between hand and foot control shall be separate from the stroking selector and shall be designed so that the selection shall be capable of being supervised by the employer.

5.4.1.9 Foot Control. Foot-operated controls, if used, shall be protected against unintended operation.

5.4.1.9.1 Return Spring. The pedal return spring(s), when used, shall be of the compression type operating on a rod or guided within a hole or tube and designed to prevent interleaving of spring coils in the event of breakage.

5.4.1.10 Control Component Failure. P/M press control circuits shall incorporate features to prevent an unintended motion of the press ram in the event of the failure of a control component to function properly, including relays, limit switches, pressure switches, valves, fluidic controls, and static output circuits.

When required by 6.4.2(1), 6.4.3(4), or 6.4.6(4), the control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the P/M press when required, but does prevent initiation of a successive stroke until the failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system. This requirement does not apply to those elements of the control system which have no effect on the protection against point-of-operation injuries.

(2) A control adjustment should be used to establish a point in the die-closing portion of the stroke, prior to which ram motion will be halted if either mechanism is released, but after which ram motion will automatically continue if either mechanism is released.

E5.4.1.7 Continuous. The intent of this section is to have the sequence for activating the CONTINUOUS mode different from selecting all other modes. This is in addition to the employer being capable of supervising the selection of CONTINUOUS.

E5.4.1.8 Hand or Foot Selection. Some methods for complying with this section are:

(1) Plug-in connection for the operating control
(2) Key-lock selector

E5.4.1.9 Foot Control. Some methods for complying with this section are:

(1) Cover over the foot switch
(2) Removable foot pedal
(3) Locking pin in treadle or linkage
(4) Key-lock selector
(5) Plug-in foot-switch connection

5.4.1.11 Press Pump Motor(s) Interlock. The press control shall incorporate an automatic means to prevent initiation or continued activation of the controls unless at least one press pump motor is engaged.

5.4.1.12 Pneumatic Controls. Pneumatic controls shall be protected against foreign material and water entering the pneumatic system of the press if this creates a safety hazard. A means of air lubrication shall be provided when needed.

5.4.2 Counterbalance System. Counterbalance systems provided for holding or stopping the ram movement shall have the capacity to stop the motion of the ram and shall be capable of holding the ram and its attachments at any point in travel.

5.4.3 Electrical Requirements

5.4.3.1 Engaging-Method Failure. The P/M press control shall automatically deactivate in the event of failure of the power. Reactivation shall require the use of the operating mechanism(s).

5.4.3.2 Disconnect Switch. A manually operated disconnect means shall be provided for each incoming supply circuit. The disconnecting means shall be mounted within the enclosure or adjacent thereto. The operating means shall be capable of being locked only in the OFF position.

5.4.3.3 Motor(s) Start Button. The motor(s) start button shall be protected against accidental operation.

5.4.3.4 Motor(s) Starter. All hydraulic P/M press controls shall incorporate a type of drive motor(s) starter that will disconnect the motor(s) from the power source in the event of control voltage or power source failure, and require operation of the motor start button to restart the motor when voltage conditions are restored to normal.

5.4.3.5 Voltage. All ac voltage circuits and solenoid valve coils shall be powered by not more than a nominal 120-volt ac supply obtained from a transformer with an isolated secondary. Higher voltages that may be necessary for operation of the machine or control mechanisms shall be isolated from any control mechanism handled by the operator, but motor starters with integral start-stop buttons may utilize line voltage control. All dc control circuits shall be powered by not more than a nominal 240-volt dc supply isolated from any higher voltages.

5.4.3.6 Grounds. All P/M press control electrical circuits shall be protected against the possibility of an accidental ground in the control circuit causing false operation of the press.

E5.4.3.6 Grounds. Some methods of complying with this section are the use of electromagnetic relay circuitry operating at a nominal 120 volts ac. These are:

(1) *Grounded Circuit.* One side of the control transformer secondary is connected to ground, and one side of all control-operating coils and indicating lights (other than the "ground connected" indicator) are wired directly to the grounded side of the circuit. A

"ground connected" indicating light is wired between the ungrounded side of the circuit and a separate ground connection. All pilot contacts are connected in the ungrounded fused side of the circuits so that a ground fault will blow the fuse and prevent operation.

See Illustration 19.

Exception: Contacts of overload relays within the control panel are connected between operating coils and the grounded line. Contacts of other mechanisms may be connected in the grounded side of the circuit when done for the purpose of increased safety.

(2) *Ungrounded Circuit.* The control transformer secondary winding and both sides of the control circuit are fused and completely insulated from ground. Two "ground detector" lights should be connected in series across the load side of the secondary fuses, with the common connection between the lights completed through ground so that a ground fault will be indicated. Contacts of the rotary limit switch, relays, and RUN buttons that normally interrupt valve current are duplicated on each side of the circuit. RUN buttons are connected so that each operator has one button on each side of the circuit.

See Illustration 20.

(3) *Ungrounded Circuit with Transformer Center-Tap Grounded.* Each end of the control transformer secondary is ungrounded, with a secondary center-tap connected to ground through a protective circuit-interrupting mechanism that will remove power from the control circuit. "Ground detector" lights are wired to indicate a disconnection of the center-tap ground and the presence of a ground fault. The control circuitry should meet the double break requirements in E5.4.3.6(2), since it is possible to operate the press with the center-tap ground disconnected.

See Illustration 21.

5.4.4 Hydraulic Equipment

5.4.4.1 General Requirements

5.4.4.1.1 Identification. **The press shall show the maximum tonnage as determined by pressure settings in accordance with press design. Where applicable, counterbalance pressure settings for die weights shall be affixed to the press.**

5.4.4.1.2 Selection and Application of Components. **Hydraulic equipment shall be used within its design capacity.**

5.4.4.1.3 Overpressure Protection. **Overpressure protection shall be consistent with the design rating of the press.**

5.4.4.2 Hydraulic Circuits and Applications

5.4.4.2.1 Decompression. **Where severe shock would result, the hydraulic circuit shall incorporate a**

E5.4.4.1.2 Selection and Application of Components. This equipment may include valves, accumulators, surge tanks, and fluid.

E5.4.4.1.3 Overpressure Protection. Some methods of accomplishing this are:

(1) A preset, locked (sealed) pressure-control valve

(2) A hydraulic fuse

(3) Use of a self-limiting pump or pressure source

means of decompression before reversing the directional control.

5.4.4.2.2 Intensification. Design provisions shall be made to prevent intensification of system pressure, where it would create a hazard.

5.4.4.2.3 Valving. Design and circuit application shall prevent unintended ram closing in case of valve failure.

5.4.4.2.4 Piping. Hydraulic piping, including pipe, tubing, hose, and associated fittings, shall be selected so as to provide adequate service factors, based upon rated operating parameters, to prevent unintended motion in the event of failure.

Hydraulic circuit designs shall incorporate means to minimize hydraulic shock as a factor in piping failure.

Hydraulic piping runs shall be designed and constructed so as to minimize structurally borne or self-generated vibration.

5.4.4.2.5 Accumulators. Accumulator applications shall include the following:

(1) *Shut-Off.* Whenever practical, circuits shall be designed to vent or isolate accumulator fluid pressure when the power is shut off.

(2) *Charge.* Accumulators operating above 200 psi pressure shall be charged with nitrogen unless the fluid media used will not support combustion, in which case air is permissible.

(3) *Safety.* Accumulators shall incorporate means to prevent the gas charge from entering the press hydraulic system.

5.4.4.3 Cylinder(s). A means shall be provided to prevent pistons from causing a hazard by stroking beyond their design limits.

5.4.4.4 Fluid Media Conditioning. Fluid media conditioning is required to minimize hazards due to system malfunctions caused by failure of components such as pumps, valves, and actuators.

5.4.4.4.1 Filtration. A means shall be provided to meet the manufacturer's recommended level of fluid quality.

5.4.4.4.2 Temperature Control. Where necessary, a means shall be provided to maintain the fluid temperature level within the manufacturer's recommended operating limits.

5.4.5 Slide-Lock Mechanism. When provided, the ram-lock shall prevent the ram from closing in an unintended manner. With ram-lock mechanisms designed to hold less than full press tonnage, a means shall be

E5.4.4.2.2 Intensification. This is particularly a problem with accumulator systems and cylinder ratios.

E5.4.4.2.5 Accumulators. An accumulator is a source of stored energy and remains under pressure even when the pump motor is off unless other precautions are taken. Auxiliary equipment that does not present a hazard, such as cushion accumulators, is excluded.

E5.4.4.3 Cylinder(s). One hazard is that a single-acting piston could leave its cylinder if stroked beyond its design limits. Some items that may be used to meet this requirement are:

(1) A cam-operated valve
(2) A full-tonnage positive stop

E5.4.4.4.1 Filtration. Some common means of accomplishing this are:

(1) Pressure or return-line filtration
(2) Recirculating filtration
(3) External conditioning
(4) Micronic air breathers

E5.4.4.4.2 Temperature Control. The intent is that the fluid may have to be heated or cooled to provide full system control.

provided to prevent the forces from exceeding the design capabilities of the ram-lock mechanism.

5.4.6 Safety Blocks. With safety blocks designed to hold less than full tonnage, a means shall be provided to prevent the forces from exceeding the design capabilities of the safety blocks.

6. Safeguarding the Point of Operation

6.1 Responsibility. It shall be the responsibility of the employer to provide and ensure the usage of either a point-of-operation guard or a point-of-operation device(s) on every operation performed on a P/M press.

E6.1 Responsibility. The decision for safeguarding should be made following an assessment of the required tasks and the risk associated with each operation. The potential of shattered tools or other flying objects from the point of operation should be part of this consideration. The method of safeguarding should be based on the assessed risk and consistent with operation requirements. The most effective use of devices may require the use of two or more devices to be used in combination.

See Illustration 22 for assistance in safeguarding selection.

6.2 Point-of-Operation Guards. Every point-of-operation guard shall meet the following design, construction, application, and adjustment requirements:

E6.2 Point-of-Operation Guards

(1) It shall prevent entry of hands or fingers into the point of operation by reaching through, over, under, or around the guard.

(1) Conformance to Illustration 23 is a means of compliance.

(2) It shall, in itself, create no pinch point between the guard and moving machine parts.

(3) It shall utilize fasteners, not readily removable by the operator.

(3) It is recommended that a tool such as a box wrench, open-end wrench, socket or key wrench, or an adjustable wrench be required to remove the fasteners rather than having the guard secured by hooks, magnets, wing nuts, or other methods that do not require the use of a tool such as those listed.

(4) It shall be readily discernible that the guard is in place.

(5) It shall offer maximum visibility of the point of operation consistent with the other requirements.

6.2.1 Fixed-Barrier Guard. A fixed-barrier guard, when used, shall be attached to the frame of the P/M press, die table, or die platen in a fixed position.

6.2.2 Interlocked Press Barrier Guard

6.2.2.1 General. An interlocked P/M press barrier guard, when used, shall be attached to the press frame, die table, or die platen and shall be interlocked with the press controls so that the press cannot be actuated unless the guard itself, or the hinged or movable sections of the guard, is in place.

6.2.2.2 P/M Presses without a Brake. On P/M presses without brakes, all tooling members shall be at rest before the guard can be opened.

E6.2.2.2 P/M Presses without a Brake. Supervision and employer instruction are necessary to ensure that the guard is not removed until the tooling is at rest. See 6.2(3).

6.2.2.3 Full-Revolution Clutch. **On P/M presses with full-revolution clutches, an interlocked-barrier guard shall prevent the operator from reaching the point of operation or other hazardous area before the tooling members come to rest.**

6.2.3 Adjustable-Barrier Guard. **An adjustable-barrier guard, when used, shall be attached to the frame of the P/M press, die table, or die platen in a fixed position.**

6.3 Safety Distance. **The minimum safety distance shall be such that the operator(s) hand(s) cannot reach the point of operation, while the tooling is in motion.**

6.4 Point-of-Operation Devices. **A point-of-operation device shall protect the operator by:**

(1) Preventing or stopping normal stroking of the press, or both, if the operator's hands are in the point of operation during the die-closing portion of cycle, or

(2) Preventing the operator from inadvertently reaching into the point of operation during the die-closing portion of the cycle, or

(3) Requiring application of both of the operator's hands to machine operating controls during the die-closing portion of the cycle, or

(4) Enclosing the point of operation before a P/M press stroke can be initiated and maintaining this closed condition until the motion of the press has ceased, or

(5) Enclosing the point of operation before a P/M press cycle can be initiated and maintaining this closed position during the die-closing portion of the press cycle.

6.4.1 Type-A Gate or Movable-Barrier Device. **The Type-A gate or movable-barrier device, when used, shall enclose the point of operation before a P/M press stroke can be initiated and shall maintain this closed condition until the motion of the press has ceased.**

6.4.2 Type-B Gate or Movable-Barrier Device. **The Type-B gate or movable-barrier device, when used, shall enclose the point of operation before a P/M press stroke can be initiated, so as to prevent an operator from reaching into the point of operation prior to die closure or prior to cessation of the ram motion during the downward stroke.**

(1) Control reliability, in accordance with 5.3.3.6 or 5.4.1.10, is required.

(2) Brake monitor in accordance with 5.3.1.4 is required when the protection of the operator is dependent upon the stopping action of the brake.

E6.2.2.3 Full-Revolution Clutch. A method for complying with this section is the use of locks or latching controlled by a time delay or machine motion.

E6.3 Safety Distance. The safety distance may be determined by the following:

D_s = 63 inches/second × T_s

where

D_s = minimum safety distance (inches)

T_s = stopping time of the P/M press measured at approximately 90° position of crankshaft rotation (seconds) or at midstroke

63 inches/second = hand speed constant

E6.4 Point-of-Operation Devices. The measure of protection given by a guard may be greater than some devices.

E6.4.1 Type-A Gate or Movable-Barrier Device. See Illustration 12. The hardware configuration appears the same for 6.4.2, however, the contact circuitry will determine if it is a Type-A or a Type-B gate or device.

E6.4.2 Type-B Gate or Movable-Barrier Device. See Illustration 12 and E6.4.1.

(2) Where a brake monitor is not used on mechanical P/M presses, a frequent brake check is suggested.

6.4.3 Presence-Sensing Point-of-Operation Device. A presence-sensing point-of-operation device, when used, shall protect the operator as specified in 6.4(1), and shall be interlocked into the press control circuit to prevent or stop press motion if an operator's hand or other body part is detected in the sensing field of this device.

(1) This device shall not be used on machines using full-revolution clutches or without brakes.

(2) This device shall not be used as a tripping mechanism on mechanical P/M presses. The operator control shall be used to start or restart the mechanical P/M press.

(3) Brake monitor in accordance with 5.3.1.4 is required when the protection of the operator is dependent upon the stopping action of the brake.

(4) Control reliability, in accordance with 5.3.3.6 or 5.4.1.10, is required.

(5) Muting or bypassing of the protective function of this device during the upstroke of the ram is permitted for the purpose of part removal, circuit checking, and feeding, providing there is no exposure from other moving parts of the machine during part removal or feeding.

(6) The safety distance, in accordance with 6.3, shall be maintained.

6.4.4 Pull-Back Device. A pull-back device, when used for hand feeding or hand removal, shall protect the operator as specified in 6.4(2), and shall include attachments for each of the operator's hands. Such attachments shall be connected to and operated only by the P/M press ram or upper die. This device shall pull back his hand(s) during the tool-closing portion of the cycle. A separate pull-back device shall be provided for each operator, if more than one operator is required on a P/M press.

6.4.5 Holdout or Restraint Device. A holdout or restraint device, when used, shall protect the operator as specified in 6.4(2) and shall include attachments for each of the operator's hands. Such attachments shall be anchored and adjusted in such a way that the operator is restrained from reaching into the point of operation. A separate set of restraints shall be provided for each operator, if more than one operator is required on a press.

6.4.6 Two-Hand Control Device. A two-hand control device, when used, shall protect the operator as specified in 6.4(2). In a press operation requiring more than one operator, a separate two hand control shall be provided for each operator. It shall meet the construction requirements of 5.3.1.1.5 or 5.4.1.6.

(1) This device shall be used only on a part-revolution clutch or a hydraulic P/M press capable of being

E6.4.3 Presence-Sensing Point-of-Operation Device. See Illustrations 1 and 16.

(2) The ANSI B11.16 Committee will review this section when technology warrants.

(3) Where a brake monitor is used on mechanical P/M presses, a frequent brake check is suggested.

E6.4.4 Pull-Back Device. This device should be adjusted to allow the operator to remove a part by hand after the part has been pushed (by the feeder shoe or similar method) from the point of operation or to remove the part with the use of a hand tool.

Reminder: On hydraulic P/M presses care should be used to ensure adequate "pull" to the hands because of the variable stroke of the press.

See Illustration 17.

E6.4.5 Holdout or Restraint Device. This device should be adjusted to allow the operator to remove a part by hand after the part has been pushed (by the feeder shoe or similar method) from the point of operation or to remove the part with the use of a hand tool.

Reminder: On hydraulic P/M presses care should be used to ensure adequate "restraint" to the hands because of the variable stroke of the press.

See Illustration 14.

E6.4.6 Two-Hand Control Device. See Illustration 18.

stopped during the closing portion of the stroke.

(2) There shall be concurrent use of both hands of all operators to start the stroke and to continue the tool-closing portion of the stroke when single stroking the press.

(3) The device shall be used only in the SINGLE STROKE or INCH mode when used as a point-of-operation safeguarding device.

(4) Control reliability, in accordance with 5.3.3.6, is required.

(5) Brake monitor in accordance with 5.3.1.4 is required when the protection of the operator is dependent upon the stopping action of the brake.

(6) The safety distance, in accordance with 6.3, is required.

(5) Where a brake monitor is not used on mechanical P/M presses, a frequent brake check is suggested.

6.4.7 Barrier Gate Device. A barrier gate device, when used, shall restrict entry of the operator into the point of operation as specified in 6.4(2) and shall permit ejection of the part through the barrier gate.

E6.4.7 Barrier Gate Device. See Illustration 11.

6.4.8 Two-Hand Trip – Full-Revolution Clutch (Used as a Safeguarding Device). Two-hand trip, when used as a safeguarding device, shall be located so that the operator's hand(s), after tripping the press, cannot reach the point of operation until after the punch enters the die. However, if other hazards remain, the operator shall not be able to reach the point of operation until these hazards no longer exist.

The two-hand trip shall conform to the following requirements:

(1) Each hand trip shall be protected against unintentional operation and arranged by design, construction, or separation so that the concurrent use of both hands is required to trip the press.

(2) The control system shall incorporate an anti-repeat feature.

(3) The control system shall be designed to require release of all operators' hands before another stroke can be initiated.

(4) The device shall be used only in the SINGLE STROKE mode.

(5) Control reliability in accordance with 5.3.3.6 is required.

(6) The safety distance, in accordance with 6.3, is required.

E6.4.8 Two-Hand Trip – Full-Revolution Clutch (Used as a Safeguarding Device). This requirement may be satisfied by the speed of the P/M press, location of the two-hand trip, stroke length, or any combination of these.

6.5 Hand Tools. Hand tools, when used, are intended for placing and removing materials in and from the P/M press. Hand tools are not a point-of-operation guard or protection device and shall not be used in lieu of the guards or devices required in Section 6.

E6.5 Hand Tools. An important use of hand tools is to eliminate the need for the operator to place his hands or fingers within the point of operation. However, these tools do not prevent the operator from inadvertently placing his hands or fingers within the point of operation. Therefore, a guard or device should be used for protection, as specified in Section 6.

See Illustration 24.

7. Design, Construction, and Setting of Tool Sets and Die Sets

7.1 Employer Responsibility. **The employer, where practical, shall design, provide, and use tool sets and die sets that eliminate the need for the operator to place his hands or fingers within the point of operation.**

E7.1 Employer Responsibility. A primary objective of this standard is to eliminate exposure of operator's hands or fingers to the hazard within the point of operation. The intent is to design, construct, or modify tool sets to eliminate the need for "hand pick off." Where this is not practical because of the part configuration, hand pick off is acceptable providing safeguarding specified in 6.3 is provided and used.

7.2 Tool Set Breakage Hazard. **Tool sets shall be constructed to minimize the hazards to employees caused by breakage. Where the probability of the hazard is great, and cannot be minimized by construction or design, appropriate safeguarding shall be used.**

E7.2 Tool Set Breakage Hazard. The probability of exposure to this hazard will vary greatly. When this probability is great, the use of personal protective clothing (face shield, vest plate) or a shield of high-impact-resistant transparent material or a method to sense a potential overload and stop the ram motion are methods for complying with this section.

7.3 Identification – Tool Set and Die Set Members. **To minimize the potential hazard of flying objects from shattered tooling, the members of all tool sets shall be identified and appropriate information made available to facilitate the selection of the proper tools when an employee is assembling a tool set.**

E7.3 Identification – Tool Set and Die Set Members. The members of a tool set may be identified by tagging, labeling, or stamping. The "appropriate" information may consist of:

(1) Compact part number(s)
(2) P/M press settings
(3) Maximum allowable tonnage weight

Another means of complying with this section is the design of the tool set which will prevent a mismatch of tooling assembly.

7.4 Tool Set and Die Set Handling. **Handling equipment attachment points shall be provided on all tool sets requiring mechanical handling.**

7.5 Tool Setting

7.5.1 Tool Setting Procedure. **The employer shall establish a program to assure that the adjustments on the press shall be correct for the tool set and part being compacted to avoid overloading and possible tool breakage.**

7.5.1.1 Protection during and after Tool Setting. **The employer shall require that the individual assigned the responsibility for tool setting shall:**

(1) Follow safe procedures.
(2) Select the safe operating mode for tool setting.
(3) Ensure that appropriate safeguarding is installed.

Note: Safeguarding per Section 6 may be removed during tool setting.

E7.5.1.1 Protection during and after Tool Setting. To facilitate the aligning of the tool by one employee may require the use of a single hand control. It is recommended that the selection of this single hand control be capable of being supervised.

An improperly mounted guard or safety device may instill a false sense of security and create a hazard that the operator may not recognize.

8. Feeding and Part Removal

8.1 Feeding and Part Removal Safeguarding. **When feeding or removing a part, point-of-operation safe-**

guarding as specified in Section 6 is required, except as provided in 7.5.1.1.

8.2 Feeding – P/M Press

8.2.1 Feed Shoe. The feed shoe shall be used unless the nature of the material does not allow for feed shoe feeding.

The motion of the feed shoe shall be synchronized with the motion of the press.

When using a feed shoe in conjunction with a safeguarding device, feed shoe motion shall cease with each cycle interrruption initiated by the safeguarding device.

8.2.2 Hand Feeding. Hand feeding of the powder into the point of operation is permitted on those operations involving prototypes, setup, or when powder slurries or other special mixes are used. Powder hand feeding shall be done using SINGLE STROKE or INCH mode only.

8.3 Green Part Removal – P/M Press. The employer shall conform to the following sequence in determining the method for green part removal:

(1) *Nonmanual Method.* See 8.3.1.

(2) *Manual Method – Hand Tool.* See 8.3.2.

(3) *Manual Method – Hand Removal.* See 8.3.3.

8.3.1 Nonmanual Method. The feed shoe or other nonmanual methods shall be used unless the configuration or the fragile nature of the green part does not allow for nonmanual part removal.

The motion of the part removal mechanism shall be synchronized with the motion of the press.

8.3.2 Manual Method – Hand Tool. Hand tool part removal is permitted when the configuration of the green part or its fragile nature does not allow for nonmanual part removal.

8.3.3 Manual Method – Hand Removal. Hand removal from the point of operation is permitted when the configuration of the green part or its fragile nature does not allow for the use of hand tools or nonmanual part removal.

8.4 Feeding – Coining and Sizing Press

8.4.1 Nonmanual Feeding. An automatic or mechanical feed mechanism shall be used wherever practical. The motion of the feed mechanism shall be synchronized with the motion of the press.

8.4.2 Manual Feeding. Hand feeding of the part into the point of operation is acceptable only when the configuration of the part does not allow for nonmanual feeding.

8.5 Part Removal – Coining and Sizing Press

8.5.1 Nonmanual Part Removal. An automatic or

E8.2 Feeding – P/M Press

E8.2.1 Feed Shoe. The normal function of the feed shoe is to deposit powder into the die cavity and to push the green part out of the point of operation.

E8.3 Green Part Removal – P/M Press

E8.3.1 Nonmanual Method. Some methods for complying with this section are an air blast, vacuum, feed shoe, sweep arm, or part pick off mechanism.

The P/M compacted part in the "green" condition is fragile. However, some of these suggested "nonmanual" methods may be capable of removing the green part without damaging it.

E8.3.2 Manual Method – Hand Tool. Hand tools should be used, when the fragile nature or configuration of the green part does not allow for nonmanual removal, in order to avoid the hand being in the point of operation. In some instances the use of a hand tool will damage the green part.

mechanical mechanism shall be used, wherever practical, to remove the part. The motion of the part removal mechanism, when used, shall be synchronized with the motion of the press.

8.5.2 Manual Part Removal. Hand removal from the point of operation is permitted where the configuration of the part does not allow for nonmanual part removal. The hand tool shall be used when practical.

9. Service and Use

9.1 Responsibility

9.1.1 Instructions

9.1.1.1 Manufacturer. It shall be the responsibility of the manufacturer to provide instructions with each P/M press to establish guidelines for the service and use of the P/M press.

9.1.1.2 Modification and Reconstruction. It shall be the responsibility of anyone modifying or reconstructing a P/M press to provide instructions with the modification to establish new or changed guidelines for the service and use of the P/M press so modified.

9.1.1.3 Employer. It shall be the responsibility of the employer to specify maintenance procedures and maintain the P/M press in a safe operating condition that shall meet the requirements of this standard.

9.1.2 Installation. It shall be the responsibility of anyone installing a P/M press to use procedures that shall meet the requirements of this standard.

9.1.3 Training of Maintenance Personnel. It shall be the responsibility of the employer to ensure the original and continuing competence of personnel servicing, inspecting, and maintaining P/M presses.

9.1.4 Shutdown Procedure for P/M Press Inspection. It shall be the responsibility of the manufacturer to recommend a shutdown procedure and of the employer to establish and follow a shutdown procedure to ensure employee safety.

9.1.5 Startup Procedure. It shall be the responsibility of the manufacturer to recommend a start-up procedure and of the employer to establish and follow a start-up procedure to ensure employee safety.

9.1.6 Hazards at the Point of Operation. The employer shall be responsible for the installation and use of point-of-operation guards or devices to ensure employee safety. See Section 6.

E9.1 Responsibility

E9.1.1 Instructions

E9.1.1.1 Manufacturer. The manufacturer should provide literature of a general nature for guidelines in the care of the P/M press. For a product with unique characteristics, specific material should be provided.

E9.1.1.2 Modification and Reconstruction. Many modifications or rebuilding efforts are so extensive that any original instructions from the original manufacturer are incorrect or meaningless.

E9.1.4 Shutdown Procedure for P/M Press Inspection. For inspections not requiring air or electrical power, the following procedure is suggested:

(1) Turn off drive motor.

(2) Open disconnect switch and lock out or tag out.

(3) Mechanical P/M presses: Allow flywheel to stop completely before attempting any inspection, adjustment, repair, or replacement.

(4) Hydraulic P/M presses: Install the block under the ram where practical.

(5) Turn off air supply and bleed off stored air.

9.1.7 Training. **The employer shall ensure that those employees involved in P/M press setup and operation have training and information to set up and operate a P/M press in accordance with this standard. It is the employer's responsibility to ensure that these instructions are followed.**

9.1.8 Employer Instruction. **The employer shall ensure that all employees associated with P/M presses are instructed so that they can perform the functions for which they are responsible.**

9.1.9 Overloading. **The employer shall operate the P/M press within the capacity ratings.**

9.2 Employee Responsibility. **Each employee shall comply with all safety rules and regulations as outlined by the employer.**

9.2.1 P/M Press Operation. **Each employee shall perform the operation of the P/M press in a safe manner to prevent injury.**

E9.1.7 Training. Some suggested safety guidelines are included in Appendix A.

E9.1.8 Employer Instruction. The guidelines or material in Appendix A, Appendix B, Appendix C, and Appendix D should be helpful in developing an employee instructional program.

E9.2.1 P/M Press Operation. To perform his job in a safe manner the employee should follow the guidelines in Appendix C or other safety guidelines provided by the employer.

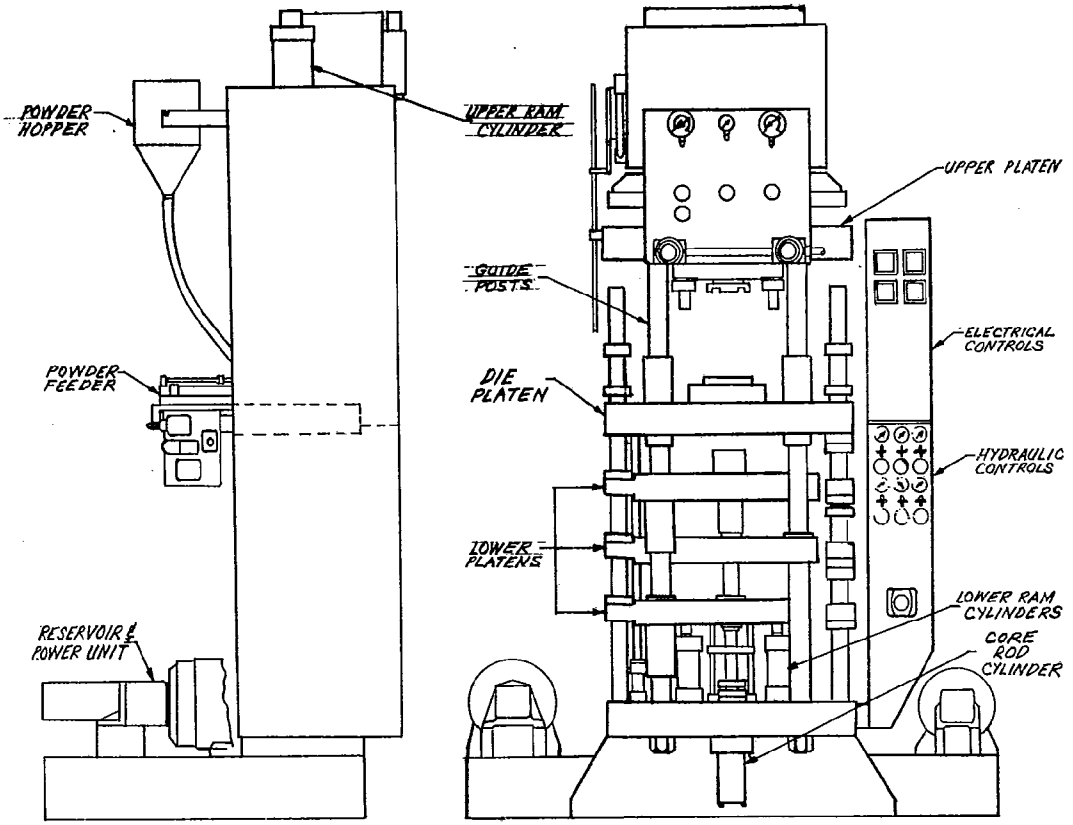

Illustration 1
A Typical P/M Press

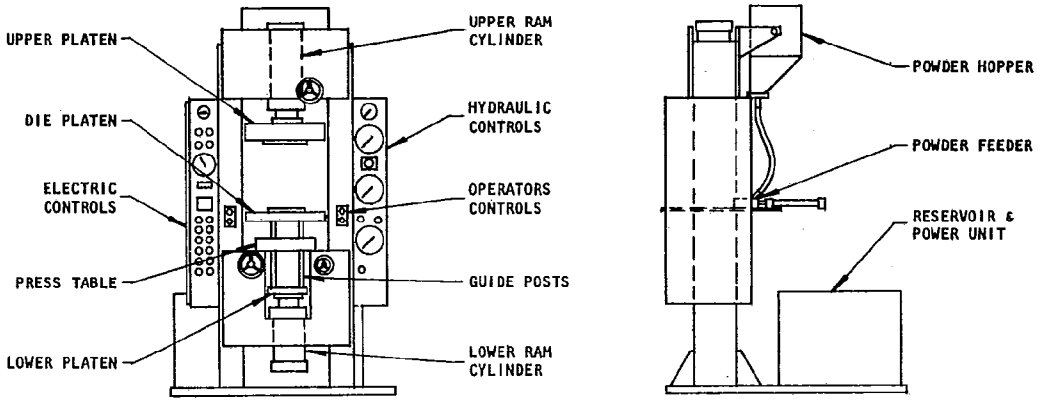

Illustration 2
A Typical P/M Press

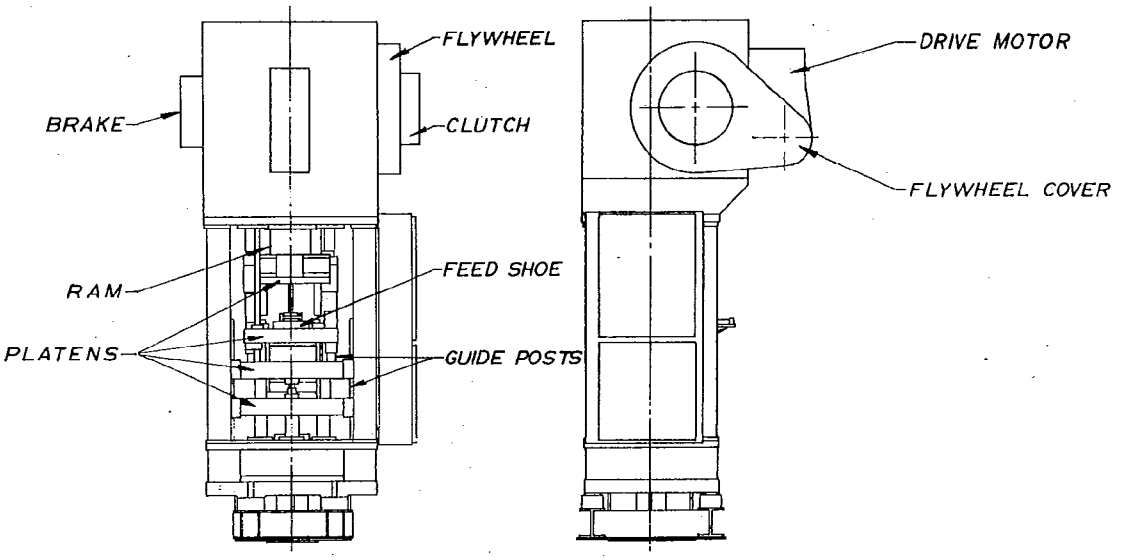

Illustration 3
Typical Top-Drive Mechanical Compacting Press

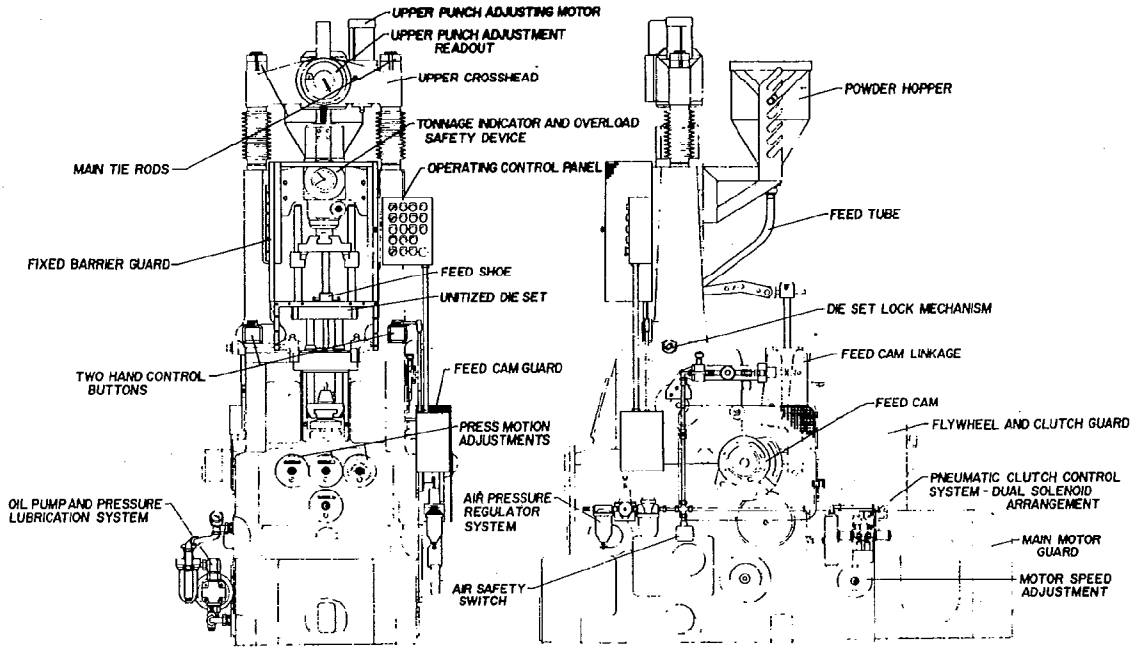

Illustration 4
A Typical P/M Press

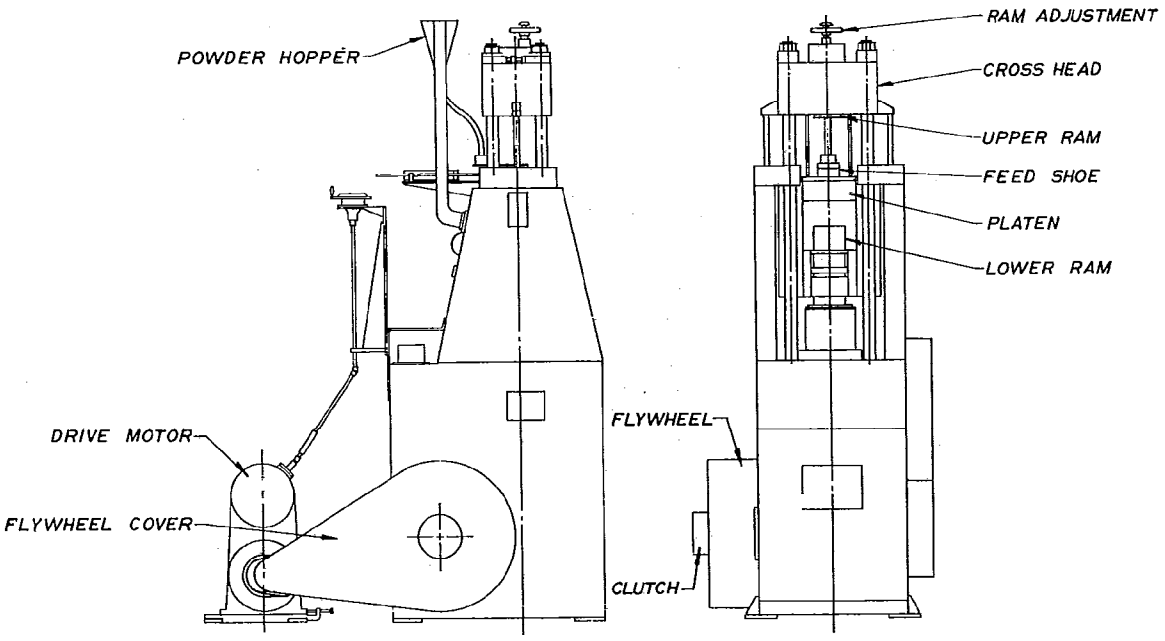

Illustration 5
Typical Bottom-Drive Mechanical Compacting Press

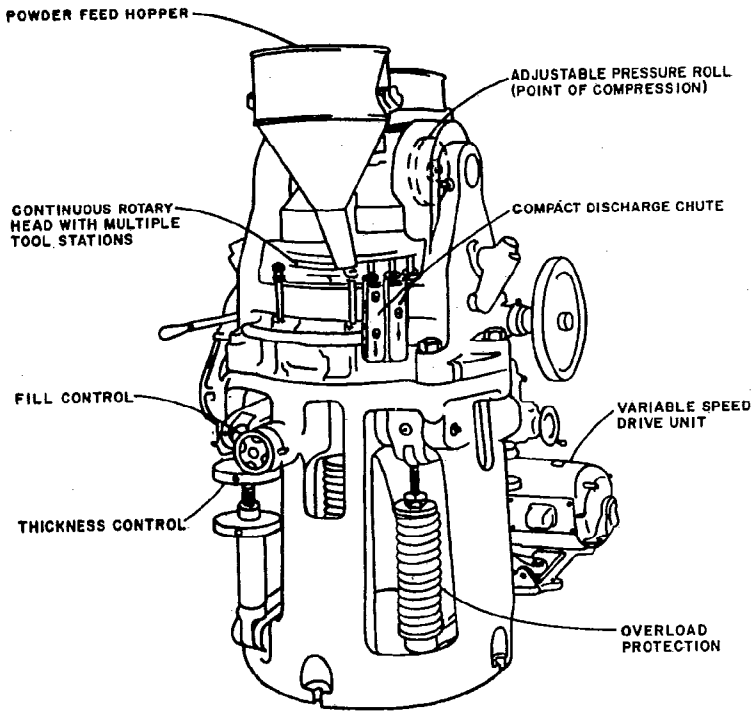

Illustration 6
Typical Rotary Compacting Press

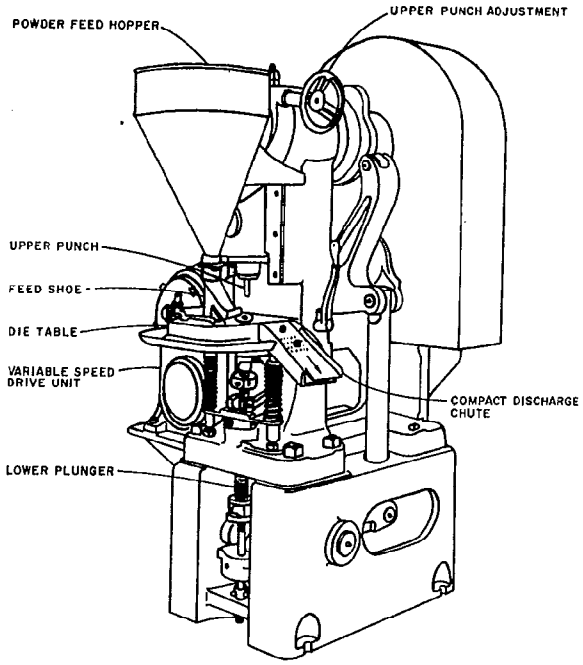

Illustration 7
Typical Mechanical Compacting Press
(Cam and Eccentric Actuation)

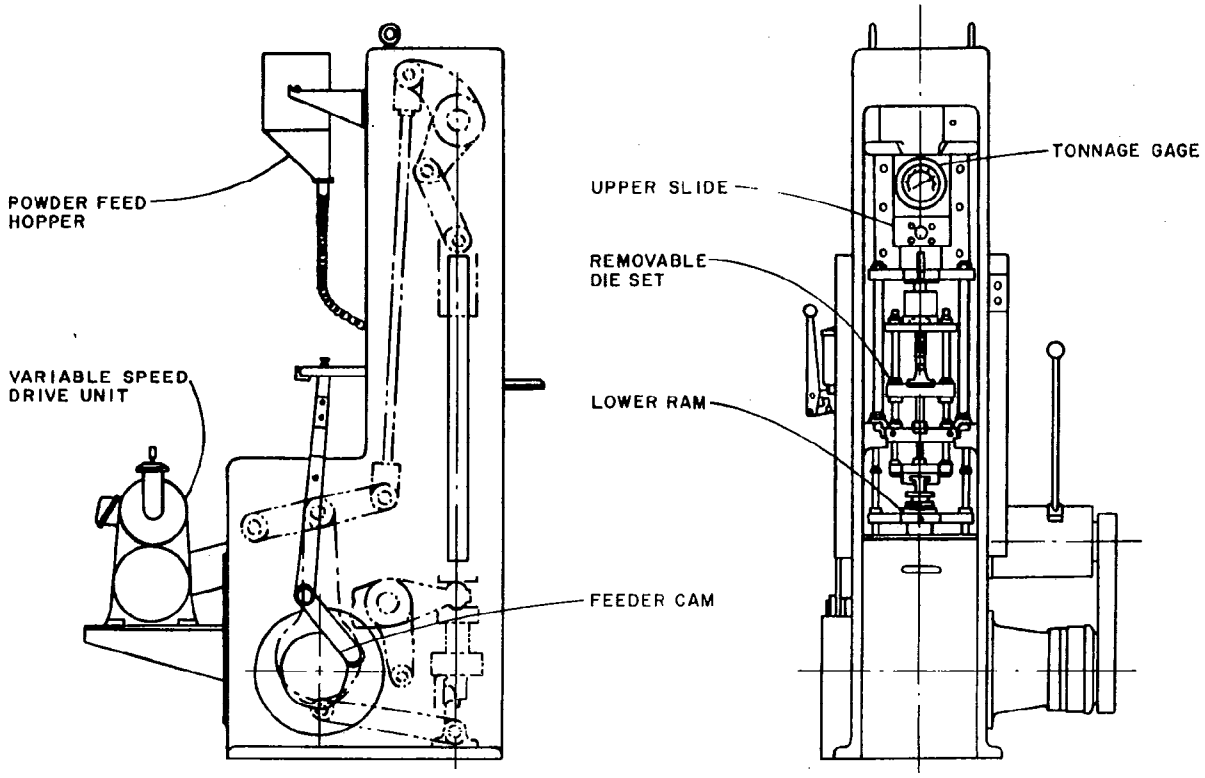

Illustration 8
Typical Mechanical Compacting Press
(Withdrawal Type with Cam and Toggle Actuation)

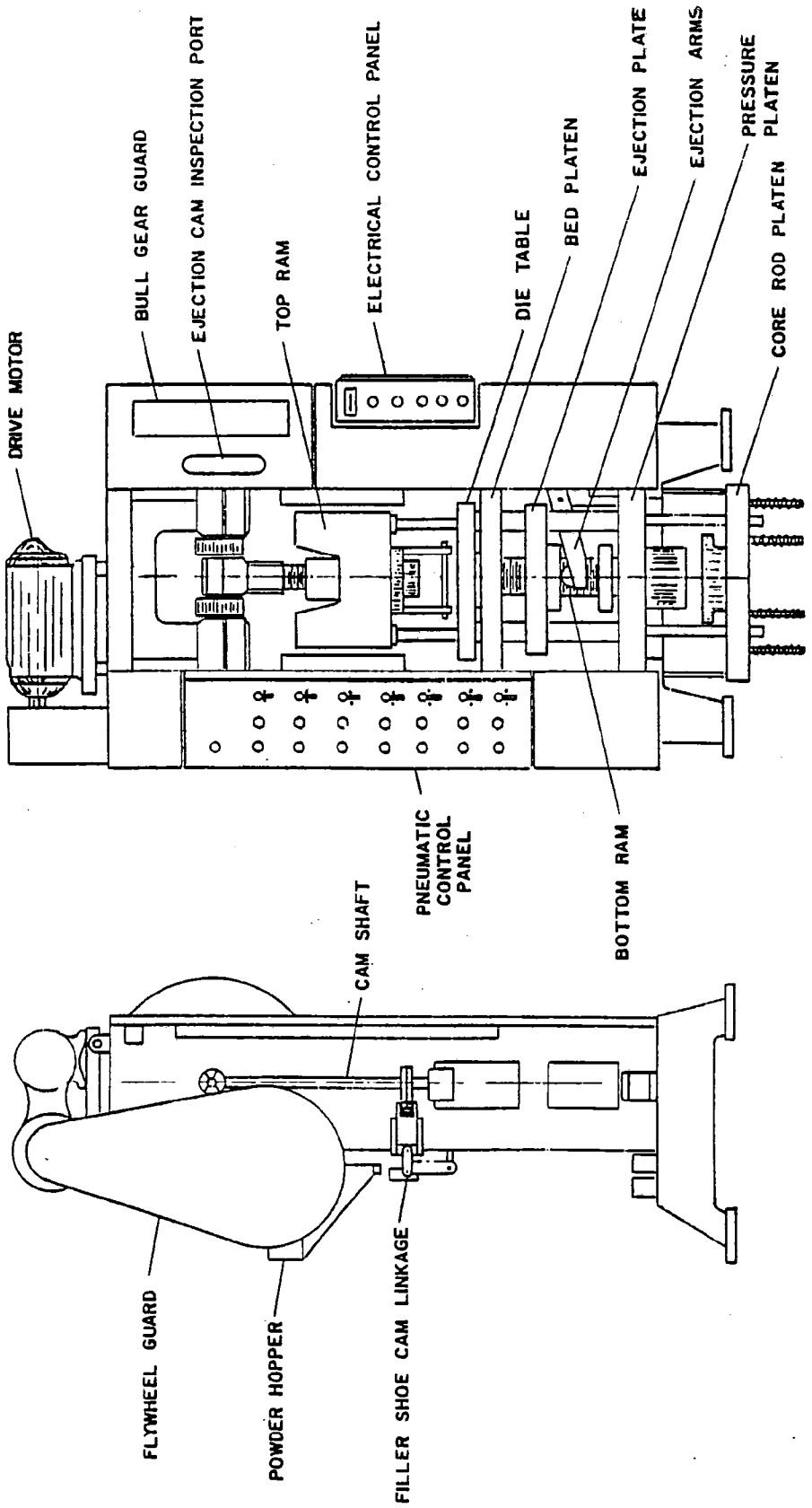

Illustration 9
Typical Mechanical Compacting Press

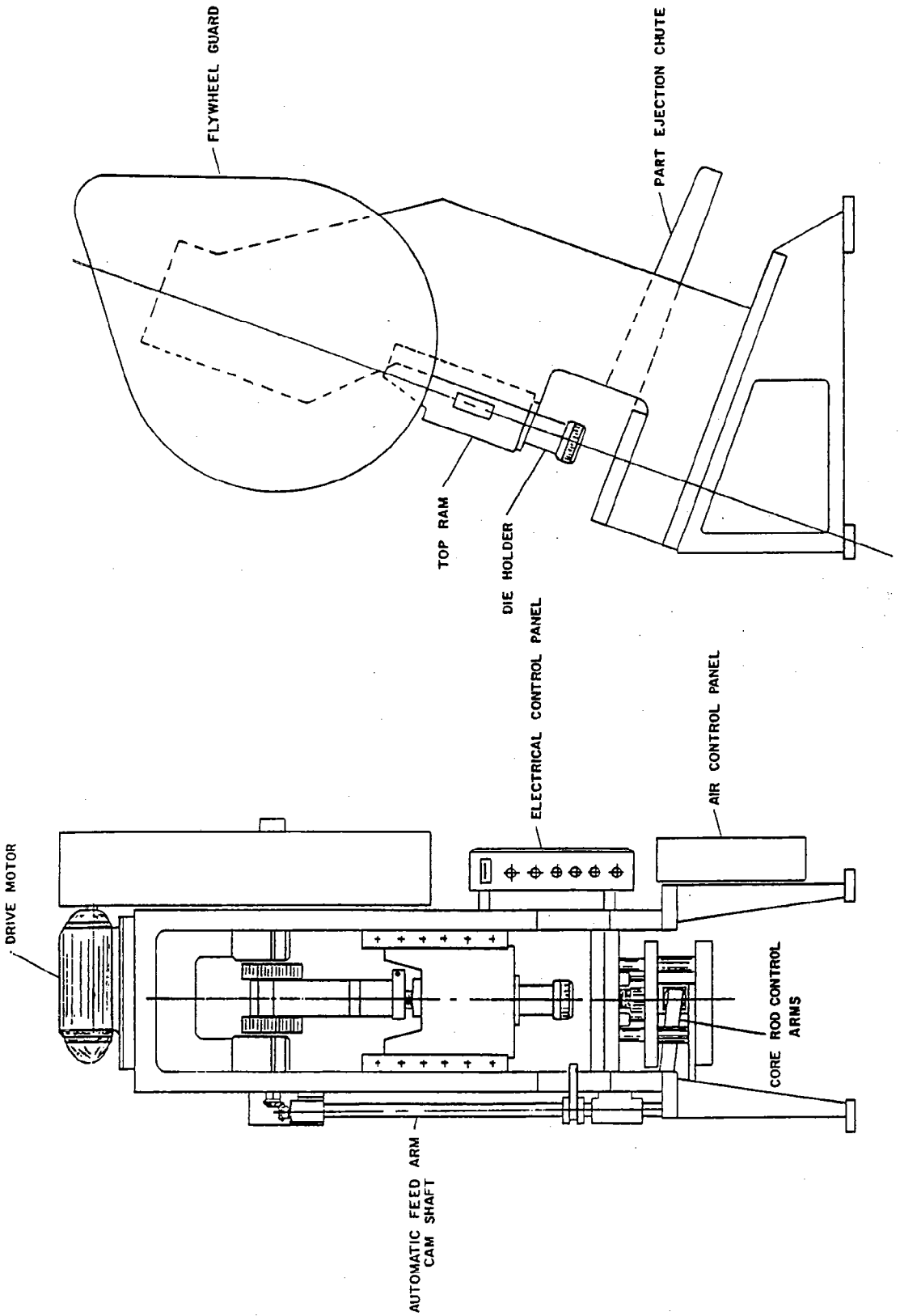

Illustration 10
Typical Automatic Sizing Press

Illustration 11
A Typical Barrier Gate Device

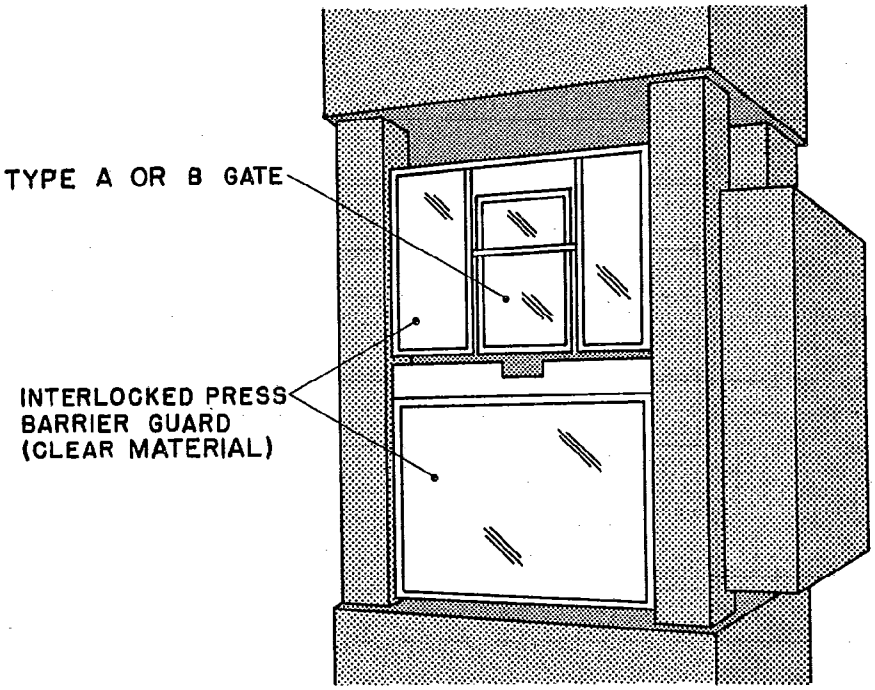

Illustration 12
Gate or Movable-Barrier Device

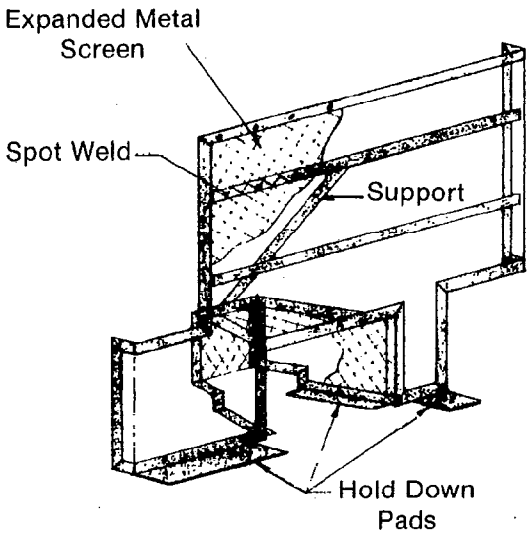

Illustration 13
A Typical Guard

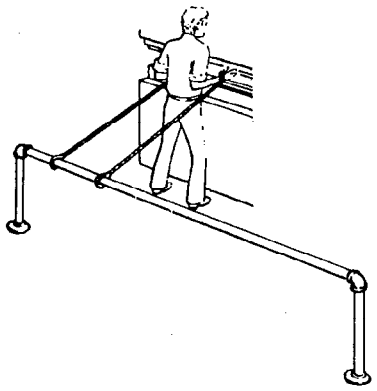

Illustration 14
Holdout or Restraint Device

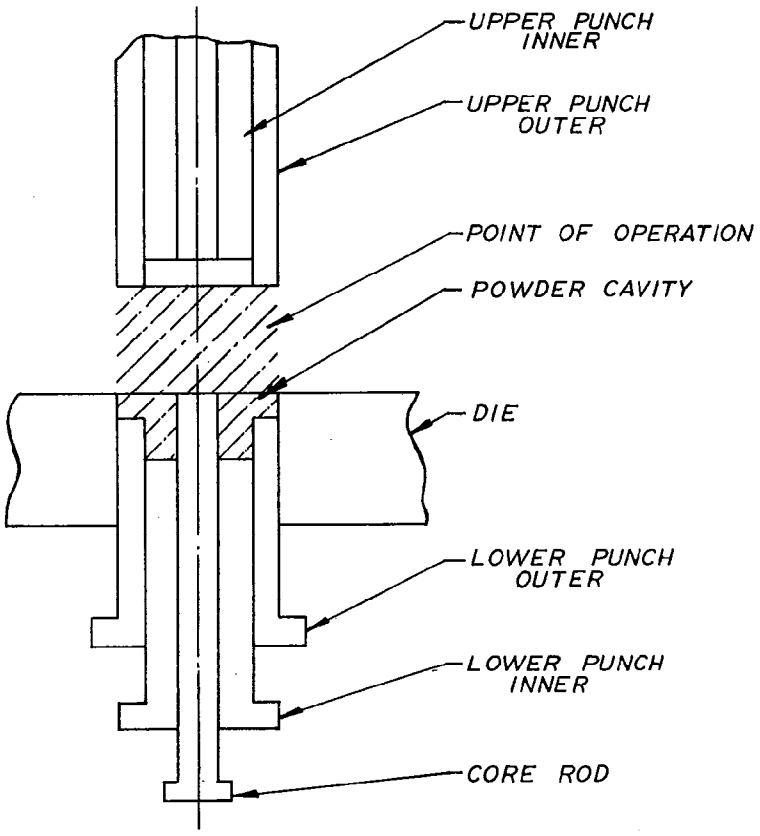

Illustration 15
Point of Operation

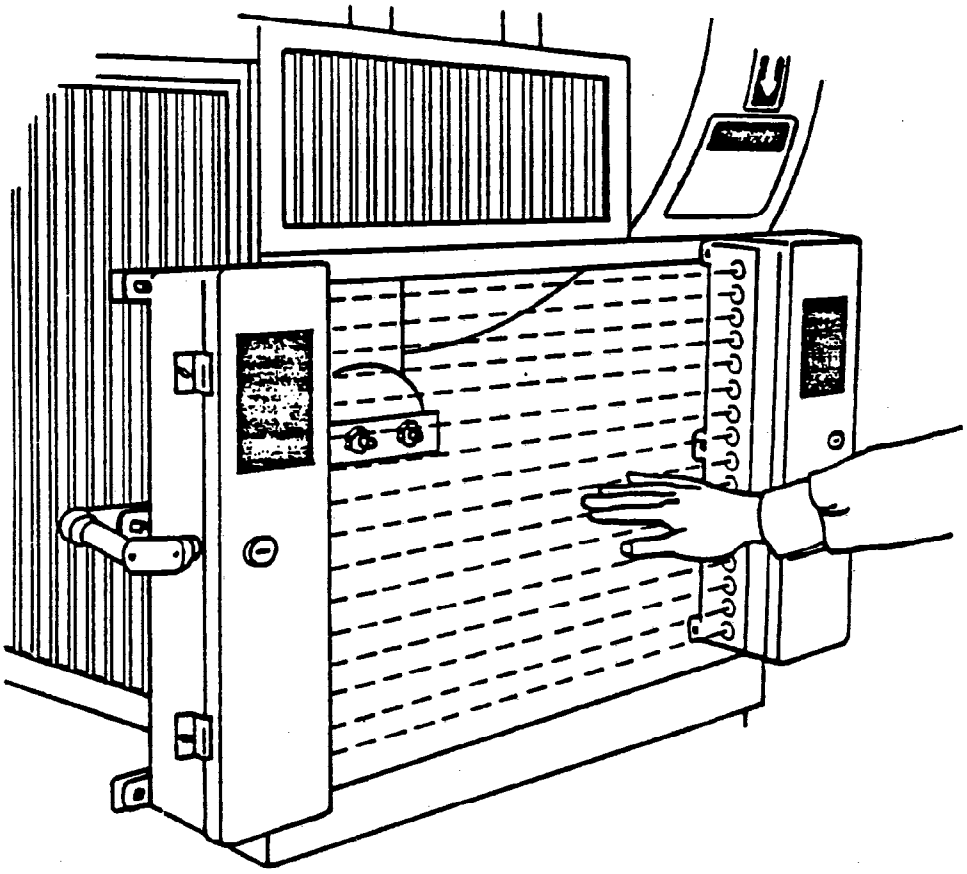

Illustration 16
Presence-Sensing Device

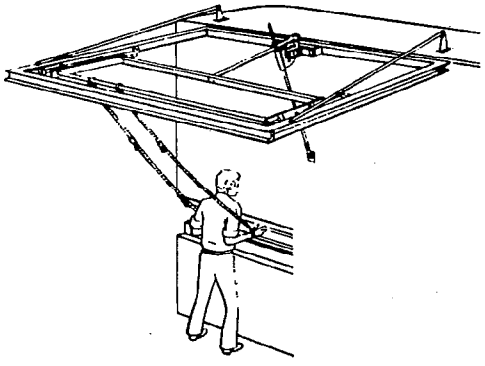

Illustration 17
Pull-Back Device

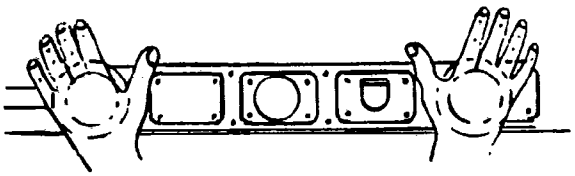

Illustration 18
Two-Hand Control Device

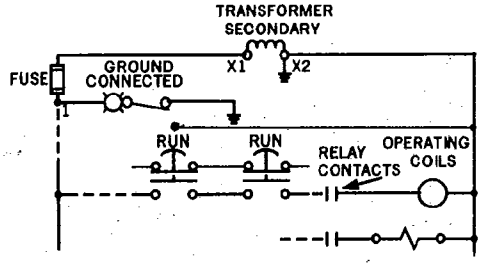

Illustration 19
Grounded Circuit

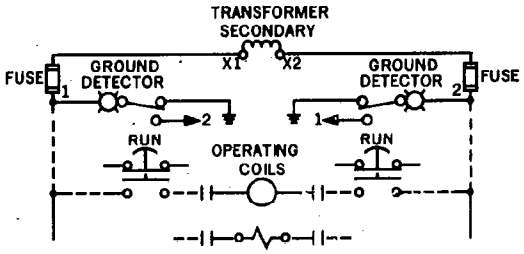

Illustration 20
Ungrounded Circuit

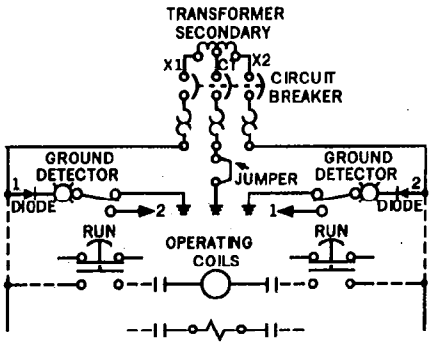

Illustration 21
Ungrounded Circuit with
Transformer Center-Tap Grounded

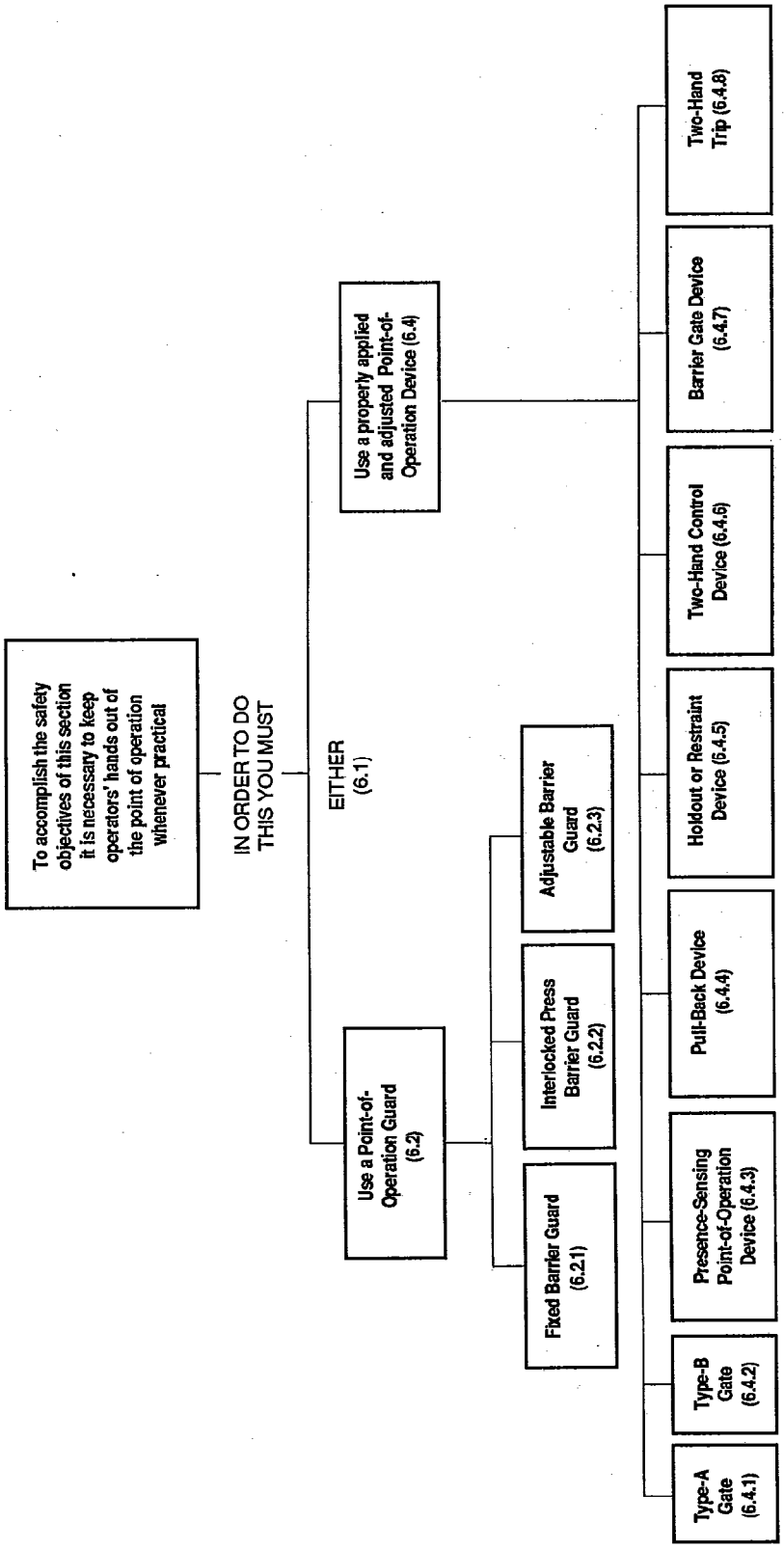

Illustration 22
P/M Press Safety Standards – Safeguarding the Point of Operation

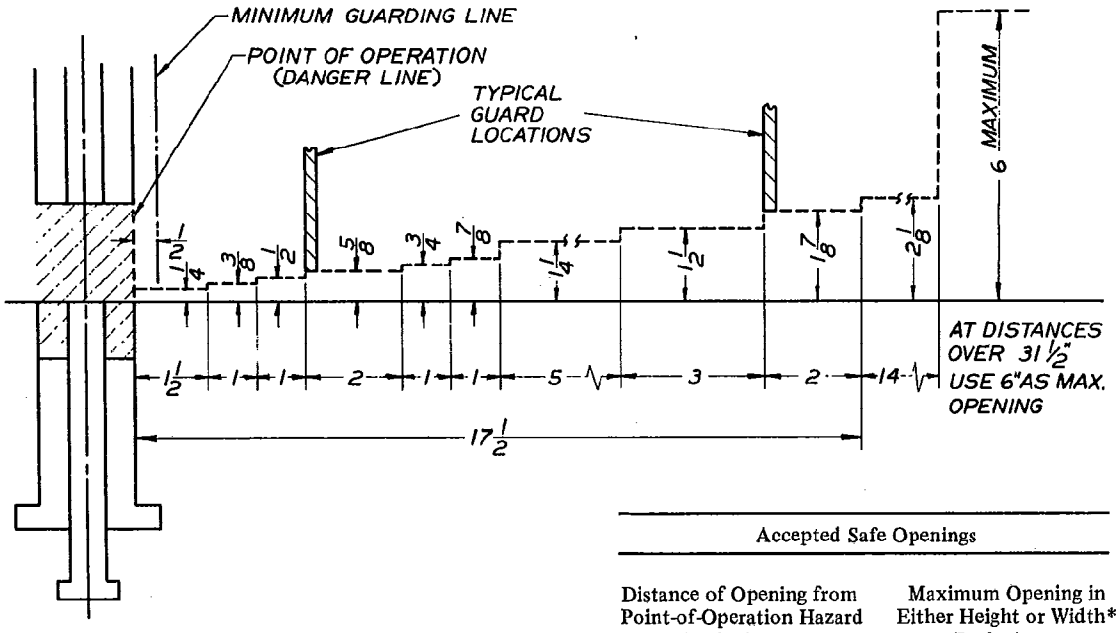

Illustration 23 shows the accepted safe openings at various distances from the danger line (point of operation).

The minimum guarding line is the distance between the infeed side of the guard and the danger line which is ½ inch from the danger line.

The various openings are such that for average size hands, an operator's fingers will not reach the point of operation.

After installation of point-of-operation guards and before a job is released for operation, a check should be made to verify that the guard will prevent the operator's hands from reaching the point of operation.

Accepted Safe Openings

Distance of Opening from Point-of-Operation Hazard (Inches)	Maximum Opening in Either Height or Width* (Inches)
½	¼
½ to 2½	⅜
2½ to 3½	½
3½ to 5½	
½ to 1½	¼
1½ to 2½	⅜
2½ to 3½	½
3½ to 5½	⅝
5½ to 6½	¾
6½ to 7½	⅞
7½ to 12½	1¼
12½ to 15½	1½
15½ to 17½	1⅞
17½ to 31½	2⅛

*Note that only one direction is restricted.

Illustration 23
Positioning of Guards

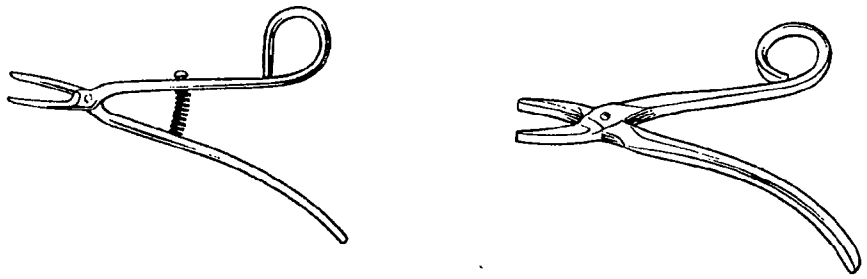

Illustration 24
Some Typical Hand Tools

Appendixes

(These Appendixes are not part of American National Standard B11.16-1988 (MPIF #47), but are included for information only.)

Appendix A

Suggested Guidelines for an Operator Training Program

To assist the users of P/M presses in developing an operator training program, the following guidelines are recommended.

(1) "Tell the Operator" – Provide for adequate opportunity to instruct through verbal or written instructions.

(2) "Show the Operator" – Let the new operator observe another operator running the P/M press using the verbal and written instructions.

(3) "Let the Operator Do It" – After steps 1 and 2 have been satisfactorily completed, let the new operator run the P/M press under close supervision.

(4) "Correct the Operator, If Necessary" – Having observed the operator running the P/M press, make recommendations and corrections, if necessary.

(5) "Follow-up on Instructions" – After steps 1 through 4 have been satisfactorily completed, assign to the operator the responsibility of running a P/M press. Review the instructions with the operator.

(6) "Follow-through to Ensure Compliance with Instructions" – At specified intervals observe the operator and review his performance with him to ensure compliance with the instructions, operating procedures, and guidelines.

(7) "Revise, Update, Retrain" – Keep your instructions current. Make changes when necessary. Review instructions periodically to ensure that they are current. When the instructions have been revised, instruct the operator using the revised instructions and guidelines.

The employer should prepare a training program based on his specific requirements.

Appendix B

Suggested Safety Guidelines for Setup

(1) Use proper tools and equipment.

(2) Be aware of and follow your established setup procedures.

(3) Have a working knowledge of the modes of operation and operator controls.

(4) Be sure the P/M press is in the proper mode of operation for setup.

(5) Turn off drive motor or operator control when press motion is not required.

(6) Do not bypass safety provisions or circuits provided.

(7) Inspect tools for cracks or chips before installing.

(8) Use guarding when appropriate during setup.

(9) Check tool alignment, stack-up and press settings before cycling the press.

(10) Make certain all final press adjustments are locked.

(11) Remove all parts and tools from the P/M press before turning it over to the operator.

(12) Install or turn on all necessary safeguarding.

(13) Make certain the auxiliary equipment is coordinated with the cycle of the P/M press.

(14) Document the setup.

(15) Report abnormal operating conditions to your supervisor before turning the P/M press over to production.

(16) If setup is not complete before a change of personnel, inform your replacement of any unusual conditions and status of the setup.

(17) Demonstrate the operation to the operator.

The employer should prepare guidelines and a checklist based on his specific requirements.

Appendix C

Suggested Safety Guidelines for Operation

(1) Have a working knowledge of the operator instructions.

(2) Review and understand the P/M press controls, operating modes, shutdown procedures. and safeguards.

(3) Understand the details of each job; for example – mode of operation, part removal method, selector switch settings, tooling, and auxiliary equipment.

(4) Before cycling the press make sure all employees are clear of the equipment.

(5) Use hand tools, when provided, for part feeding or removal.

(6) Check safeguards, auxiliary equipment, and selected operating controls for proper operation before proceeding.

(7) When nonmanual or manual hand-tool part removal or feeding is used, do not place your hands in the point of operation.

(8) Do not use rags or wear loose fitting clothes or jewelry when operating the P/M press.

(9) Do not operate the P/M press when under the influence of drugs or alcohol.

(10) Keep the die area and platen free of unnecessary material and tools.

(11) Turn off the operator control(s) when leaving the press unattended.

(12) After returning to operate the press, check the press settings before cycling.

The employer should prepare guidelines and a checklist based on his specific requirements.

Appendix D

Suggested Safety Guidelines for Supervisor

(1) Familiarize yourself and have working knowledge of requirements in this standard.

(2) Ensure proper training of all personnel associated with P/M presses. Update employees when any changes in procedure or equipment are made.

(3) Maintain accurate records of inspections and maintenance of the P/M presses.

(4) Ensure that all required guards or devices are used and functioning properly when employees are operating a P/M press.

(5) Determine means of feeding and part removal and ensure that they are followed.

(6) Never allow employees to operate a P/M press if they are under the influence of alcohol or drugs.

(7) Never allow employees to bypass any safety provision.

The employer should prepare guidelines for the supervisor based on his specific requirements.

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ANSI B11.1-1988	Mechanical Power Presses
ANSI B11.2-1982	Hydraulic Power Presses
ANSI B11.3-1982	Power Press Brakes
ANSI B11.4-1983	Shears
ANSI B11.5-1988	Iron Workers
ANSI B11.6-1984	Lathes
ANSI B11.7-1985	Cold Headers and Cold Formers
ANSI B11.7a-1987	(Supplement to ANSI B11.7-1985)
ANSI B11.8-1983	Drilling, Milling, and Boring Machines
ANSI B11.9-1975	Grinding Machines
ANSI B11.10-1983	Metal Sawing Machines
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ANSI B11.16-1988	Metal Powder Compacting Presses
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November 1988