ASME B5.56M-1994

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# Specification and Performance Standard, Power Shears

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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ASME B5.56M-1994

The American Society of Mechanical Engineers

345 East 47th Street, New York, N.Y. 10017

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this Edition.



This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

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# FOREWORD

(This Foreword is not part of ASME B5.56M-1994.)

Recognizing the need for an industry standard for power shears, the American Society of Mechanical Engineers Committee on Machine Tools and Components (B5) established in February 1990 a technical committee, B5 TC31, to develop the first American standard relating to this equipment. In the latter part of February 1990 an organizational meeting was held to develop this Standard. The make-up of this committee consists of power shears manufacturers, distributors, and users.

The technical committee's objective was to develop a standard to define and describe power shear specification and performance.

To accomplish this objective, the committee approached this task by inviting the North American shear manufacturers and users to submit basic data relative to the subject of this Standard so the committee could study, determine the variations, and obtain a consensus definition for a standard for power shears. This committee has adhered to the ANSI B5.51M-1987 Preferred Metric SI units for Machine Tools in the preparation of this Standard.

Following approval by ASME, the document was submitted to the American National Standards Institute, and was approved as an American National Standard on August 18, 1994.

Suggestions for improvement of this Standard are welcomed. They should be addressed to the Secretary, ASME B5 Committee, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017.

## POWER SHEAR SAFETY REQUIREMENTS

The ASME B5.56M-1994 does not cover safety. Safety requirements for the construction, care, and use of power shears are specified in the latest edition of the American National Standard B11.4.

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# SPECIFICATION AND PERFORMANCE STANDARD, POWER SHEARS

## 1 SCOPE, PURPOSE, AND APPLICATION

### 1.1 Scope

The requirements of this Standard apply to power shears used to cut metal by shearing, utilizing a fixed lower knife(s) and a non-rotary, moving upper knife(s).

This Standard applies to those shears commonly referred to as squaring, guillotine, gap, plate, pivot blade (swing beam), and slitting (non-rotary).

This Standard specifically excludes machines referred to as right angle, alligator, cut to length, crop, slitting (rotary), nibblers, portable hand tools, coil slitters, rotary blade slitters, iron workers, angle, bar, beam, channel, notching, rotary drum, flying, and billet shears.

### 1.2 Purpose

The purpose of this Standard is to define and describe shear size, capacity, and performance.

### 1.3 Application

Any shear referred to as an American National Standard Power Shear shall comply with all the requirements of this Standard.

## 2 DEFINITIONS AND TERMINOLOGY

The glossary provided in Appendix A contains a list of definitions associated with the power shear industry and may or may not be referenced in this Standard (see Fig. 1).

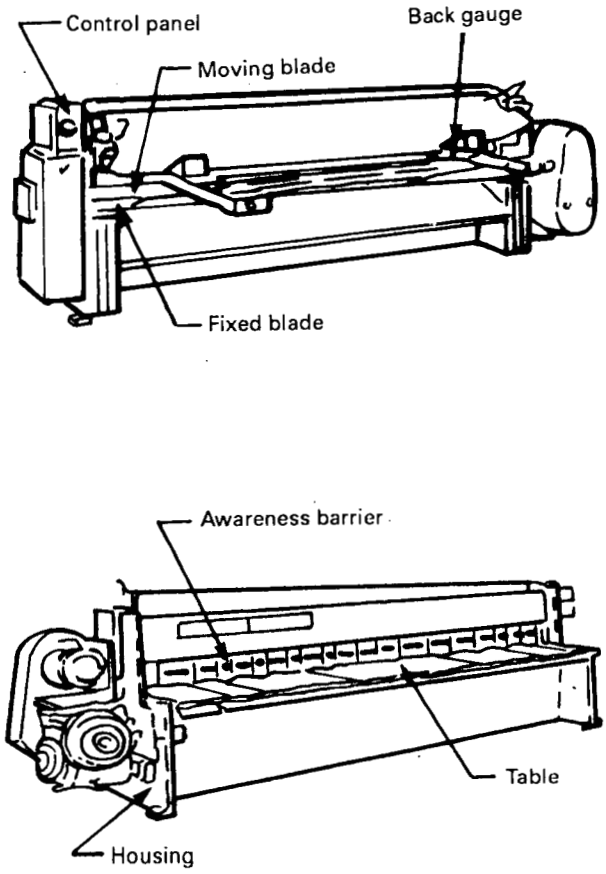



**FIG. 1 SHEAR TERMINOLOGY**

## 3 UNITS OF DIMENSION AND CAPACITY

### 3.1 Metrication

All units of dimension and capacity are per ANSI B5.51M-1979 (R1987), Preferred SI Units for Machine Tools. Equivalent English unit rating is shown in parentheses.

### 3.2 Conversion

A reference Metric/English Conversion Table is provided in Appendix B of this Standard.

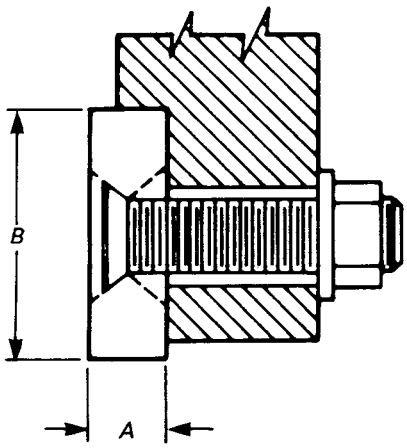



FIG. 2 SHEAR KNIFE CROSS-SECTION

## 4 MACHINE CHARACTERISTICS

### 4.1 Capacity

This Standard defines power shear sizes ranging from 1.5 mm to 25 mm (.06–1.00 in.) shearing capacity. Eleven standard sizes are defined in Table 1. Equipment falling between two standard capacity sizes will be grouped with the lower standard size for designation.

### 4.2 Length

Equipment conforming to this Standard shall have an overall knife length as defined in ANSI B94.53-1984. When specifying equipment, shearing length should be selected from one of the preferred standard lengths shown in Table 2. Equipment falling between two standard capacity sizes will be grouped with the lower standard size for designation.

### 4.3 Bed Height

The distance from the floor to the top of the bed shall be no less than 750 mm (30 in.) and not greater than 1050 mm (42 in.).

### 4.4 Stroke/Cut Rate

Stroke rate and cut rate are not interchangeable.

**4.4.1 Stroke Rate.** Stroke rate is the number of stroke cycles completed in one minute of continuous shear operation at maximum length with the absence of material and the rake angle adjusted to provide rated shear capacity.

**4.4.2 Cut Rate.** Cut rate is the number of cuts completed in one minute of continuous shear operation shearing the maximum length of the rated material with the rake angle adjusted to provide rated shear capacity.

### 4.5 Table Slot Design

When provided to aid in material handling, table slots in the bed top shall be 75 mm (3.0 in.) wide and 12.5 mm (.50 in.) deep.

## 5 TOOLING INTERFACE

Shear knives, per ANSI B94.53, are to be provided with a table and ram interface that will provide secure mounting and seating.

The dimensions listed in this section are preferred/recommended at this time. The intent of this Standard is to make these dimensions mandatory at a later date.

### 5.1 Preferred Knife Dimensions

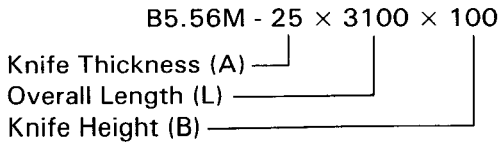
Power shears complying with this Standard will use knives with the cross section shown in Fig. 2 and Table 3.

### 5.2 Preferred Knife Interface

Power shears complying with this Standard should accept solid steel shear knives with cross section, length, hole size, and hole spacing as recommended in ANSI B94.53, shown in Fig. 3 and Table 3.

### 5.3 Knife Coding

Knives provided for shears which comply with this Standard shall be identified as follows:




## 6 ERGONOMICS

### 6.1 Operator Control Locations

Operator controls shall comply with ANSI B11.4.

## 7 ACCEPTANCE CONDITIONS

### 7.1 General Conditions

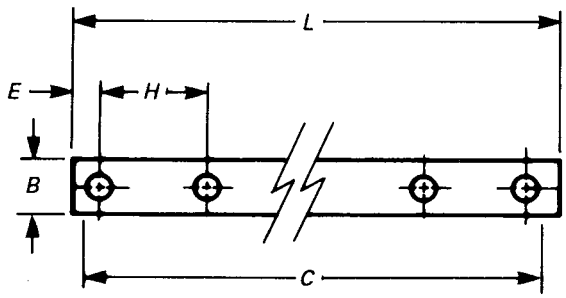
Prior to testing, the power shear shall be installed on a suitable foundation in accordance with the manufac-

**TABLE 1 MACHINE CAPACITY, mm (in.)**

| Standard Size No. | Mild Steel AISI 1018 410 MPa, (60,000 psi) | Structural Steel ASTM A36 550 MPa (80,000 psi) | Stainless Steel 300 Series 690 MPa (100,000 psi) |
|---|---|---|---|
| 1 | 1.5 (.062) | | |
| 2 | 2.5 (.105) | | 2.00 (.075) |
| 3 | 3.5 (.134) | | 3.00 (.119) |
| 4 | | 6.00 (.250) | 5.00 (.187) |
| 5 | | 8.00 (.312) | 6.00 (.250) |
| 6 | | 10.0 (.375) | 8.00 (.312) |
| 7 | | 12.0 (.500) | 10.0 (.375) |
| 8 | | 16.0 (.625) | 12.0 (.500) |
| 9 | | 19.0 (.750) | 16.0 (.625) |
| 10 | | 25.0 (1.00) | 19.0 (.750) |

**TABLE 2 CUT LENGTH, mm (in.)**

| Standard Size No. | Standard Length Letter for Bed and Ram | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | *A* | *B* | *C* | *D* | *E* | *F* | *G* | *H* |
| | 1220 (48) | 1830 (72) | 2440 (96) | 3050 (120) | 3660 (144) | 4270 (168) | 4880 (192) | 6100 (240) |
| 1 | X | X | | | | | | |
| 2 | X | X | X | | | | | |
| 3 | X | X | X | X | | | | |
| 4 | | X | X | X | X | | | |
| 5 | | | | X | X | | | |
| 6 | | | | X | X | | | |
| 7 | | | | X | X | X | X | X |
| 8 | | | | X | X | X | X | X |
| 9 | | | | X | X | X | X | X |
| 10 | | | | | X | X | X | X |
| Minimum Distance Between Side Gauges | 1270 (50) | 1880 (74) | 2490 (98) | 3100 (122) | 3710 (146) | 4320 (170) | 4930 (194) | 6150 (242) |




*B* – Knife height
*E* – End to first hole
*L* – Overall length = *C* + *B*
*H* – Hole spacing
*C* – Cut length

**FIG. 3 SHEAR KNIFE INTERFACE**

turers specifications with all the necessary services connected.

### 7.2 Dimensional Conformance

The tolerances specified shall be absolute values independent of statistical analysis.

**7.2.1 Knife Parallelism.** Set the knife gap in accordance with the manufacturer's specification. Lower the ram until the knife closure point is 150 mm from the side gauge. Shut off power to the machine and, using a feeler gauge, measure the knife gap. Repeat procedure taking measurements every 150 mm. Variations between measurements should not exceed the values shown in Table 4.

**7.2.2 Parallelism of Backgauge to Lower Knife.** Set the backgauge 100 mm from the lower knife. Shut power off to the machine and, using a depth micrometer, measure the distance from the lower knife to the face of the backstop. Repeat procedure taking measurements every 300 mm.

Tolerance:

0.1 mm (.004 in.)

**7.2.3 Part Accuracy.** The following tests are performed, first, by shearing material matching the rated capacity of the machine, and second, shearing material approximately 20% the rated capacity of the machine. The values measured for both materials shall be within the limits specified in Table 5. Trim shearing of the part should be done before the start of any test.

**7.2.3.1 Straightness.** Shear a part of maximum shear length with a width no less than 20 times the thickness of the material or 80 mm, whichever is greater. Place the part on a qualified surface with the part perpendicular to the surface and the concave edge of the part resting on the surface. Using a feeler gauge, measure the gap between the surface and the part edge.

**7.2.3.2 Parallelism.** Shear a part of maximum shear length with a width no less than 20 times the thickness of the material or 80 mm, whichever is greater. Using a micrometer, measure the width of the part at each end and in the center.

**7.2.3.3 Squareness.** Shear a rectangular part which is no smaller than 300 mm on a side. Place the part on a qualified surface with the part perpendicular to the surface and an inspection quality angle resting against one of the vertical edges of the part. Using a feeler gauge, measure the gap between the inspection angle and the part edge.

## 8 PROVISION FOR INFORMATION AND INSTRUCTION

### 8.1 Information

**8.1.1 Nameplate.** The manufacturer shall provide an identification data plate of durable metal. The data plate is to be permanently attached to the outside of the right hand side frame at a height not to exceed 2000 mm (80 in.) from floor level, as shown in Fig. 4. The data plate shall display all information relative to the equipment, per Fig. 5.

In addition to the data plate, the equipment serial number shall be stamped on the left end of the bed adjacent to side gauge in letters and numerals at least 6 mm (.25 in.) high.

**8.1.2 Machine Designation.** Machines conforming to this Standard will utilize a two character suffix addition to the model designation. The suffix will be comprised of the standard size number from Table 1 and the standard length letter from Table 2.

Example:

Model 1025–4 D
Standard size from Table 1
Standard length from Table 2

**8.1.3 Documentation Package.** The manufacturer shall establish and maintain a file defining the shear configuration at the time of construction. This file shall, at the minimum, include the principal physical features of the machine, description of power and control systems (electrical, electronic, hydraulic, pneumatic), and en-

**TABLE 3 PREFERRED KNIFE DIMENSIONS, mm (in.)**

| Standard Size | *A* | *B* | *H* | *E* |
|---|---|---|---|---|
| 1 | 12 (.50) | 50 (2.00) | 200 (8.00) | 25.0 (1.00) |
| 2 | 20 (.75) | 75 (3.00) | 200 (8.00) | 37.5 (1.50) |
| 3 | 25 (1.00) | 75 (3.00) | 200 (8.00) | 37.5 (1.50) |
| 4, 5, 6 | 25 (1.00) | 100 (4.00) | 200 (8.00) | 50.0 (2.00) |
| 7, 8 | 30 (1.25) | 125 (5.00) | 200 (8.00) | 62.5 (2.50) |
| 9, 10 | 40 (1.50) | 140 (5.50) | 200 (8.00) | 70.0 (2.75) |

**TABLE 4 PARALLELISM TOLERANCE, mm (in.)**

| Material Thickness | Gap tolerance |
|---|---|
| up to 2.5 (0.098) | .025 (.001) |
| 2.5–8.0 (.089–.315) | .05 (.002) |
| over 8.0 (0.315) | .08 (.003) |

**TABLE 5 PART TOLERANCE, mm/300 mm (in./ft)**

| Standard Size | Part Tolerances mm/300 mm (in./ft) | | |
|---|---|---|---|
| | Straightness | Parallelism | Squareness |
| 1–3 | .025 (.001) | .025 (.001) | .025 (.001) |
| 4–5 | .05 (.002) | .05 (.002) | .05 (.002) |
| 6–7 | .05 (.002) | .05 (.002) | .05 (.002) |
| 8 | .1 (.004) | .1 (.004) | .05 (.002) |
| 9 | .2 (.008) | .1 (.004) | .075 (.003) |
| 10 | .25 (.010) | .1 (.004) | .075 (.003) |

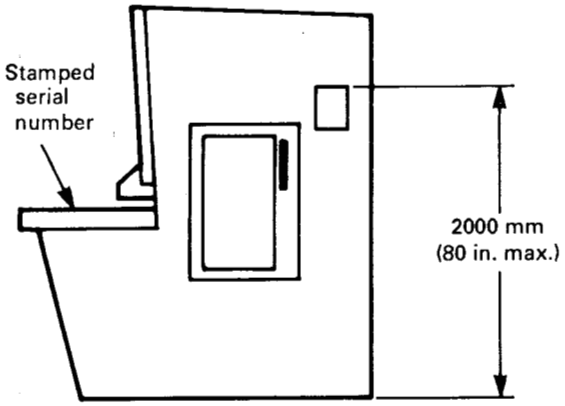



**FIG. 4 IDENTIFICATION DATA LOCATION**

gineering documentation of all related components and systems.

### 8.2 Instruction Manual

The manufacturer shall provide a minimum of two copies of the instruction manual containing information relevant to proper installation, operator and supervisor training, safety, and maintenance of the equipment. The manuals shall be printed in English and bound as a permanent reference document for the equipment.

## 9 MANUFACTURER DECLARATION OF COMPLIANCE

### 9.1 Certificate of Compliance.

Upon request, the machine manufacturer shall provide a certificate of compliance with this Standard. The certificate is to include the following information:

Title: B5.56M Compliance

Manufacturer -

Machine Model -

Machine Serial No. -

Date -

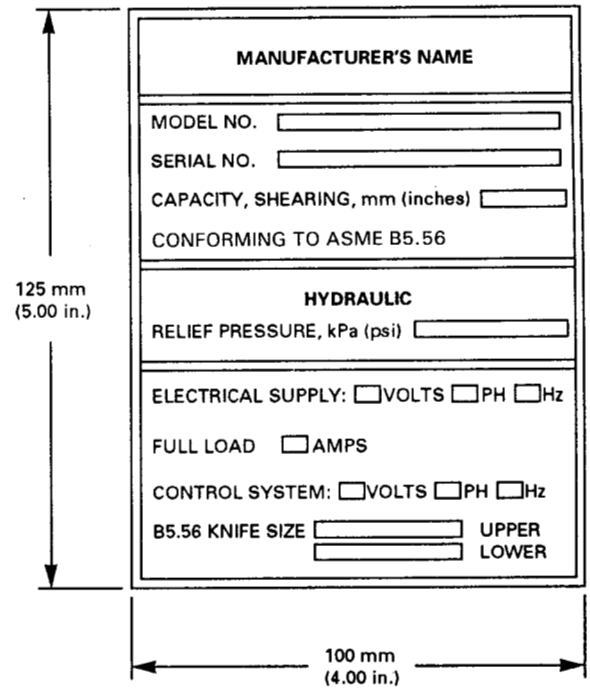



**FIG. 5 SAMPLE IDENTIFICATION DATA PLATE**

## 10 REFERENCE STANDARDS

### 10.1 Safety and Health

ANSI B11.4, Safety Requirements for the Construction, Care, and Use of Shears

ANSI B11.19, Performance Criteria for the Design, Construction, Care, and Operation of Safeguarding When Referenced by the Other B11 Standards

ANSI B15.1, Safety Standard for Mechanical Power Transmission Apparatus

ANSI Z44.1, Lockout Tagout

NFPA 79, Electrical Standard for Industrial Machinery

OSHA 1910.95, Occupational Noise Exposure

OSHA 1910.211, Machinery and Machine Guarding, Definitions

OSHA 1910.212, Machinery and Machine Guarding, General Requirements for All Machines

OSHA 1910.219, Machinery and Machine Guarding, Mechanical Power Transmission Apparatus

### 10.2 Other References

ANSI B5.51M-1987, Preferred SI Units for Machine Tools

ANSI B94.53-1984, Solid Steel Rectangular Metal Cutting Squaring Shear Knives Dimensional Tolerances

# APPENDIX A
# GLOSSARY OF TERMS

(This Appendix is an integral part of ASME B5.55M-1994 and is placed after the main text for convenience.)

Terms relevant to this Standard and its application are as follows:

*actuating means (controls)* — see *control, hand; control, foot or PSD; control, pedal (treadle); two hand trip*

*anti-repeat* — that function of the control system designed to limit the shear to a single cycle (stroke) if the tripping or actuating means is held operated

*automatic (full)* — see *continuous*

*awareness barrier* — an attachment that by physical contact warns personnel of an approaching or present hazard

*awareness device* — a signal or device that, by means of audible sound or visual light, warns of a present or approaching hazard

*barrier* — a physical boundary to a hazard

*bed* — the stationary member of the (shear) that supports the (fixed blade) and other associated equipment

*blade (knife)* — a tool having a cutting edge(s) used in the manufacture of production parts

*bow* — a curvature of the face of the workpiece which prevents it from laying flat on the shear table

*brake* — a mechanism for stopping, slowing, or preventing motion

*camber* — a curvature of the edge of the workpiece which prevents continuous contact to a gauge stop

*caution* — see *warning*

*clutch* — an assembly, that when engaged, transmits torque to impart motion from a driving member to a driven member

*clutch, part revolution* — a type of clutch that may be engaged or disengaged during the shear cycle (stroke)

*clutch, full revolution* — a type of clutch that, when engaged, cannot be disengaged until the shear has completed a full cycle (stroke)

*connection (connecting rod) (pitman)* — the part of the shear that transmits motion and force from the revolving crank or eccentric to the ram

*continuous (automatic) (full automatic)* — uninterrupted, multiple cycles (strokes) without intervening stops at the end of an individual cycle (stroke)

*control, foot* — a foot operated mechanism (other than a mechanical pedal) for use with the shear control system

*control, foot pedal, (mechanical)* — a foot operated lever designed to actuate and engage the clutch and disengage the brake to cause ram motion

*control, hand* — a hand operated mechanism for use with shear control system

*control, numerical* — a shear controller or control system that is capable of logic and information processing without manual intervention

*control, operator* — a pushbutton, switch, lever, handwheel, or other device activated by the operator which initiates, cycles, controls, or stops motion of the shear

*control, presence sensing device (PSD)* — a presence sensing device (PSD) is used as an actuating means

*control, emergency (master) stop* — a control that, when actuated, initiates immediate or controlled stopping action of the hazardous motion of the shear

*control, stop or return* — a control that, when actuated, initiates immediate or controlled stopping action of the hazardous motion and causes the slide(s) (ram) to return to its initial open position

*control, two hand* — a control arrangement that requires the concurrent use of both of the operators hands to initiate or continue the shear cycle (stroke)

*counterbalance (system)* — means provided to balance the reciprocating weight of the ram, drive members, and slide (ram) attachments

*cycle (work, machine or single cycle; single stroke)* — a complete movement from the initial start position back to the same start position of the ram shear which may include loading and unloading

*device, barrier gate (safety)* — a mechanism that is designed to allow compacted parts to pass through it to the point of operation but restricts the entry of the operator to the point of operation

*device, hold out (restraint) (safety)* — a device including attachments for the operators hands and wrists that prevents the operator from reaching the pont of operation

*device, presence sensing (safety)* — a device designed, constructed, and arranged to create a sensing field, area, or plane that will detect the presence of the operators or others hand or other body part and send a signal to the shear control system

*device, safeguarding (safety)* — a means that detects or prevents inadvertent access to a hazard

*drive (mechanical)* — the source of mechanical energy for shear motion

*drive, direct* — the type of driving arrangement which does not use a clutch

*eccentric* — the offset portion of the main shaft or main gear that governs the distance that the ram travels

*ejector* — a mechanism for removing a workpiece or material from the point of operation

*ergonomics* — the study of the worker/machine interface for the purpose of adapting the workplace, machine, and job to fit the worker

*feeding* — the process of loading or removing material or workpieces into or from the shear

*frame* — the basic and primary structure of the shear

*gauge, material position* — a stop against which the material or workpiece is placed to locate it within the point of operation

*gap* — see *throat*

*gauge, back* — a stop against which the workpiece edge, furthest from the operator, is placed to determine part size

*gauge, front* — a stop against which the workpiece edge, closest to the operator, is placed to determine part size

*gauge, side* — a stop against which the workpiece edge, located to either the left or right of the operator, is placed

*gibs* — the machine members used for guiding the ram (slide)

*guard* — a barrier which prevents entry into the point of operation or other hazard area (zone)

*guard, fixed barrier* — a guard affixed to the frame, bolster, or other surface in such a manner so as to enclose all or part of the point of operation or other hazard area (zone)

*guard, holddown* — a guard which prevents entry to the pinch point hazard caused by the hold down(s)

*guard, perimeter* — a physical barrier located at the perimeter or segment of the shear (or within the system or cell)

*handling slot* — a recess below the table surface that aids in the handling or positioning of the material or workpieces

*holddown* — a mechanism that restrains movement of the workpiece during the shearing action

*housing* — see the side *frame*

*inch* — to impart momentary motion to the shear by manual means

*jog* — see *inch*

*knife* — see *blade*

*manual (operation)* — the operation of the shear requires the operator initiate and maintain the motion of the machine during the cycle (stroke) or a portion of the cycle (stroke) by use of the actuating means

*mode* — the state or condition of the control system which allows specific operations of the shear

*operator* — an individual who performs production work and who controls the shear

*pedal (treadle), foot* — a foot actuated lever designed to operate the mechanical linkage

*plate* — flat material having dimensions of over 5 mm (7 gauge) thickness and 228 mm (9 in.) or more in width

*point of entry* — the opening(s) of a shear through which the material or a workpiece is placed (inserted) for processing

*point of operation* — the location in the shear where the material or workpiece is positioned and work is performed

*probe* — a device that indicates the presence of material or workpiece by pressure, contact, electronic or electro-optical means

*programmable logic control (PLC)* — an electronic system which performs logical, decision making, or arithmetic functions by executing instructions in a specific manner. A PLC usually includes input and output elements (ports) and is usually reprogrammable.

*rake* — the inclination of one blade with respect to the other in the shearing plane, commonly expressed in degrees

*ram* — the linear moving machine member

*run* — single or continuous cycling (stroking) of a shear

*safeguarding* — methods for protection of personnel from hazards using guards, safety devices, or safe work procedures

*safeguarding, safe distance* — a method of workpiece positioning and operator location that eliminates the need for the operator to be in or near the hazardous area during the hazardous portion of the shear cycle (stroke)

*scrap* — fragments of stock removed in the manufacturing; process waste or discarded material

*selector, mode (stroking) (operating mode)* — one or more means used to establish the shear operating sequence

*setup* — the process of adjusting the shear and the installation and adjustment of work holding devices or tooling and appropriate safeguarding to ensure proper and safe operation of the shear

*sheet* — flat material having dimensions less than or equal to 5 mm (7 gauge) thickness and 228 mm (9 in.) or more in width

*single stroke (cycle) capability* — a mechanism or control arrangement used to automatically initiate stopping action of the shear (slide) (ram) at the completion of the cycle (stroke)

*speed, cut rate* — the number of ram cycles completed in one minute while shearing a specified material of a given length

*speed, ram* — the number of ram cycles completed in one minute without shearing material

*squaring, arm* — a stop against which the workpiece edge, located to either the left or right of the operator, is placed to establish a right angle between the edge and the lower blade

*station, work* — the area on the machine where shearing is performed

*stop control, emergency* — see *control, (emergency) (master) stop*

*stop, top (cycle) (stroke)* — an operator control used to stop continuous cycling (stroking) at the end of the cycle (stroke) or at another predetermined point

*support arm* — an extension mounted to the shear table to increase the area available for support of the workpiece

*support, ball* — a workpiece support which rolls against the bottom of the workpiece to improve handling and reduce marring

*table* — that part of the shear on which material or workpieces are positioned

*throat (gap)* — an opening or recess in the frame (housing) to permit the positioning of material or workpieces

*treadle bar (foot)* — the operating bar that extends the full length of the shear and to which a foot pedal (treadle) may be attached

*trip (tripping)* — the momentary actuation of the shear control or mechanism to initiate the shear cycle (stroke)

*twist* — a helical curvature of the workpiece

*two hand trip* — an actuating means that requires concurrent use of both hands of the operator to trip the shear

# APPENDIX B
# METRIC/ENGLISH CONVERSION TABLES

(This Appendix is an integral part of ASME B5.56M-1994 and is placed after the main text for convenience.)

(See Table on following page.)

## Length

### Inches to Millimeters

| Inches | mm |
|---|---|
| 0.001 | 0.0254 |
| 0.005 | 0.1270 |
| 0.010 | 0.2540 |
| 0.015 | 0.3810 |
| 0.020 | 0.5080 |
| 0.030 | 0.7620 |
| 0.040 | 1.0160 |
| 0.050 | 1.2700 |
| 0.060 | 1.5230 |
| 0.070 | 1.7780 |
| 0.080 | 2.0320 |
| 0.090 | 2.2860 |
| 0.100 | 2.5400 |
| 0.125 | 3.1800 |
| 0.250 | 6.3500 |
| 0.500 | 12.7000 |
| 0.750 | 19.0500 |
| 1.000 | 25.4000 |
| 2.000 | 50.8000 |
| 3.000 | 76.2000 |
| 4.000 | 101.6000 |
| 5.000 | 127.0000 |
| 6.000 | 152.4000 |
| 7.000 | 177.8000 |
| 8.000 | 203.2000 |
| 9.000 | 228.6000 |
| 10.000 | 254.0000 |
| 20.000 | 508.0000 |
| 30.000 | 762.0000 |
| 40.000 | 1016.0000 |
| 50.000 | 1270.0000 |
| 100.000 | 2540.0000 |

### Millimeters to Inches

| mm | Inches |
|---|---|
| 0.1 | 0.0039 |
| 0.5 | 0.0197 |
| 1.0 | 0.0394 |
| 1.5 | 0.0591 |
| 2.0 | 0.0787 |
| 2.5 | 0.0984 |
| 3.0 | 0.1181 |
| 3.5 | 0.1378 |
| 4.0 | 0.1575 |
| 4.5 | 0.1770 |
| 5.0 | 0.1970 |
| 6.0 | 0.2360 |
| 7.0 | 0.2760 |
| 8.0 | 0.3150 |
| 9.0 | 0.3540 |
| 10.0 | 0.3940 |
| 11.0 | 0.4330 |
| 12.0 | 0.4720 |
| 13.0 | 0.5120 |
| 14.0 | 0.5510 |
| 15.0 | 0.5910 |
| 16.0 | 0.6300 |
| 17.0 | 0.6690 |
| 18.0 | 0.7090 |
| 19.0 | 0.7480 |
| 20.0 | 0.7870 |
| 25.0 | 0.9840 |
| 50.0 | 1.9690 |
| 75.0 | 2.9530 |
| 100.0 | 3.9370 |
| 500.0 | 19.6850 |
| 1000.0 | 39.3700 |

## Force

### Tons to Kilonewtons

| Tons | kN |
|---|---|
| 1.0 | 8.9 |
| 5.0 | 44.5 |
| 10.0 | 89.0 |
| 20.0 | 178.0 |
| 30.0 | 267.0 |
| 40.0 | 365.0 |
| 50.0 | 445.0 |
| 100.0 | 890.0 |
| 500.0 | 4450.0 |
| 1000.0 | 8900.0 |

### Kilonewtons to Tons

| kN | Tons |
|---|---|
| 1.0 | 0.1124 |
| 5.0 | 0.5620 |
| 10.0 | 1.1240 |
| 25.0 | 2.8100 |
| 50.0 | 5.6200 |
| 100.0 | 11.2400 |
| 250.0 | 28.1000 |
| 500.0 | 56.2000 |
| 1000.0 | 112.4000 |
| 2500.0 | 280.9000 |

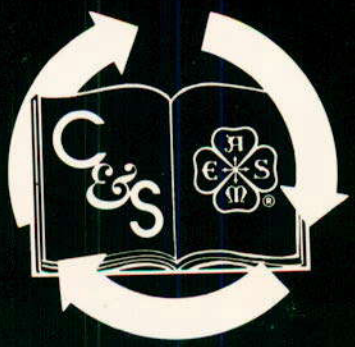
## Pressure

### Pounds/Sq. Inch to Kilopascal

| psi | kPa |
|---|---|
| 1.0 | 6.90 |
| 5.0 | 34.48 |
| 10.0 | 68.95 |
| 20.0 | 137.90 |
| 30.0 | 206.85 |
| 40.0 | 275.80 |
| 50.0 | 344.80 |
| 100.0 | 689.50 |
| 250.0 | 1723.80 |
| 500.0 | 3447.50 |
| 1000.0 | 6895.00 |
| 2000.0 | 13790.00 |

### Kilopascal to Pounds/Sq. Inch

| kPa | psi |
|---|---|
| 1.0 | 0.145 |
| 5.0 | 0.730 |
| 10.0 | 1.450 |
| 25.0 | 3.630 |
| 50.0 | 7.250 |
| 100.0 | 14.500 |
| 250.0 | 36.260 |
| 500.0 | 72.520 |
| 1000.0 | 145.000 |
| 2000.0 | 290.100 |
| 5000.0 | 725.200 |
| 10000.0 | 1450.300 |



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