

GGG-G-17C
 June 26, 1987
 SUPERSEDING
 GGG-G-17B
 November 17, 1967

FEDERAL SPECIFICATION

GAGES, GENERAL PURPOSE

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers measuring gages used by machinists, toolmakers, and other craftsmen.

1.1.1 Federal specification coverage. Federal specifications do not include all varieties of the commodity as indicated by the title of the specification or which are commercially available, but are intended to cover only those generally used by the Federal Government.

1.2 Classification.

1.2.1 Types, classes, and styles. The gages covered by this specification shall be of the following types, classes, and styles, as specified (see 6.2):

- Type I. Planer.
- Type II. Depth, steel rule.
 - Class 1. Depth.
 - Class 2. Depth and angle.
- Type III. Internal measuring.
 - Class 1. Small hole.
 - Style A. Range in decimals.
 - Style B. Range in fractions.
 - Class 2. Telescoping.
- Type IV. Surface, universal.
- Type V. Screw pitch.
 - Class 1. 60 degree.
 - Style A. 26 blades (range 2-1/4 to 20 threads per inch).
 - Style B. 29 blades (range 4 to 80 threads per inch).
 - Style C. 30 blades (range 4 to 42 threads per inch).
 - Style G. 51 blades (range 4 to 84 threads per inch).
 - Style H. 26 blades (range 32 to 82 threads per inch).
 - Style I. 27 blades (range 2-1/4 to 28 threads per inch).
 - Class 2. Metric.
 - Style A. 17 blades (range 0.50 to 7.00 mm. thread pitch).
 - Style B. 28 blades (range 0.25 to 2.50 mm. thread pitch).
 - Class 3. Whitworth (55 degree).
 - Style A. 26 blades (range 4 to 60 threads per inch).
- Type VI. Center, 60 degree.
- Type VII. Fillet and radius.
 - Class 1. Hinged blade.
 - Style A. Double radius ends.
 - Style B. Single radius ends.
 - Class 2. Individual blades.
- Type VIII. Thickness (feeler).
 - Class 1. Thickness.
 - Style A. 3 inch.
 - Style B. 6 inch.
 - Style C. 9 inch.
 - Style D. 12 inch.
 - Style E. 2-1/16 inch.
 - Class 2. 45 degree angle tip.
 - Class 3. Combination, thickness, taper and wire.
 - Class 4. Feeler stock.
 - Style A. Individual leaves.
 - Style B. Roll.

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- Class 4. Feeler stock.
 - Style A. Individual leaves.
 - Style B. Roll.
- Type IX. Gap setting.
 - Class 1. Combination.
 - Style A. Leaf and wire.
 - Style B. Long and short leaf.
 - Class 2. Spark plug gap.
 - Style A. Folding, double end.
 - Style B. Circular.
- Type X. Thread tool, 29 degree.
 - Class 1. Acme circular.
 - Class 2. Acme rectangular.
 - Class 3. Worm, circular.

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards. The following specification, of the issues in effect on the date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein:

Federal Specification:

PPP-P-40 - Packaging and Packing of Hand Tools

Federal Standard:

FED-STD-H28 - Screw-Thread Standards for Federal Services

(Activities outside the Federal Government may obtain copies of Federal Specifications, and Standards as outlined under General Information in the Index of Federal Specifications and Standards. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the General Services Administration, Specifications Unit (WFSIS), 7th and D Street SW, Washington, DC 20407.)

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Commercial Item Descriptions and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Standard:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.)

3. REQUIREMENTS

3.1 Illustrations. The illustrations shown herein are descriptive, not restrictive, and are not intended to preclude the purchase of gages which are otherwise in accordance with this specification.

3.2 Materials. The material used in construction of the gages shall be alloy tool steel for all parts subject to wear which will affect the gage accuracy.

3.3 Design. The gages shall be composed essentially of the components or parts specified herein for each type. To facilitate fabrication, it will be permissible to build up parts from separate elements, and in such cases, the various elements composing a part shall be rigidly held together, but in no case shall solder be used as a connecting medium.

3.4 Screw threads. Screw threads shall conform to FED-STD-H28.

3.5 Heat treatment. All parts of the tools shall be heat-treated in accordance with standard commercial practice.

3.6 Type I gage, planer. Planer gages shall consist of a base with level, slide, and extension, as shown in figure 1.

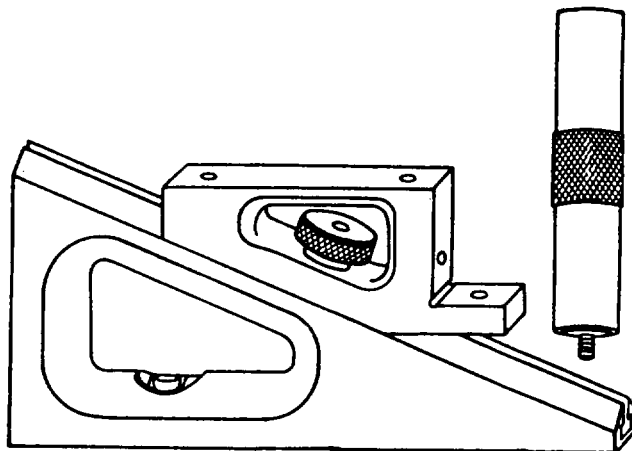


FIGURE 1. Type I gage, planer.

3.6.1 Base. The base shall be steel forging, hardened and ground. Unless otherwise specified (see 6.2), base shall have a level mounted in the bottom plane in such position as to be easily readable. It shall be not less than 5/8 inch wide, and not less than 5 inches in length.

3.6.2 Slide. The slide shall be a steel forging, hardened and ground, and designed in such a manner that it shall be capable of sliding over the entire range of the base without perceptible shake or play. The measuring surfaces of the slide shall be parallel with the contact planes of the base within 0.0005 inch. It shall be capable of being locked in any position on the base by means of a knurled locking screw.

3.6.3 Extensions. Knurled extensions shall be furnished with each gage. They shall be of steel, hardened and ground, and shall screw into the slide in such a manner that the top surface shall be parallel within 0.0005 inch with the measuring contact plane of the base. Sufficient extensions, 1, 1-1/2, 2, 2-1/2, or 3 inches in length, shall be furnished to give the planer gage a minimum range of not less than 1/4 through 8-1/4 inches. When required, additional extensions shall be furnished in the lengths specified (see 6.2).

3.6.4 Case. When specified (see 6.2), the planer gage shall be furnished in a sturdy wooden or vinyl covered steel case with an interior cushion of soft material. The case shall be fitted to hold all parts of the planer gage in such a manner as to preclude damage to any of the parts during ordinary usage and handling.

3.7 Type II gage, depth, steel rule.

3.7.1 Class 1, depth. Steel rule depth gages shall be similar to figure 2 and shall consist of a head, steel rule, and rule clamping device, and unless otherwise specified (see 6.2), shall be furnished with a flat rule. When specified (see 6.2), the round rule or flat and round rule shall be furnished. The gage shall conform to table I.

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TABLE I. Type II gage, depth, steel rule, classes 1 and 2 dimensions.

Head						Flat rule					Round rule		
Width		Height		Thickness		Length	Width		Thickness		Length	Diameter	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.	Min.	Min.	Max.
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
2	3	1	1-3/4	1/8	1/4	6	5/32	7/32	1/32	3/32	6	5/64	11/64

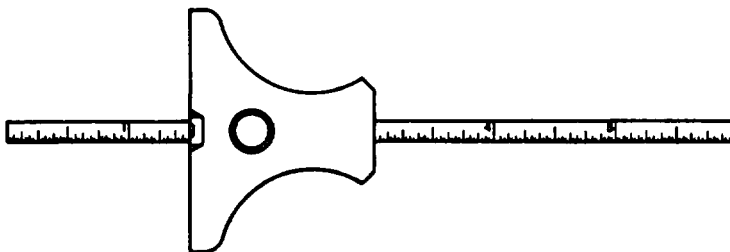


FIGURE 2. Type II gage, depth, steel rule, class 1.

3.7.1.1 Head. The head shall be hardened. It shall be flat, and shall have a ground reference finish not to exceed 32 microinches AA from which measurements may be made. The head of flat-rule gages shall have a slot for holding the rule; the head of round-rule gages shall have either a hole or a groove suitable for guiding the rule. The arrangement of the slot, hole, or groove shall be such that when the rule is clamped at any point along its length, the edges and faces of the flat rule and the surface of the round rule shall form an angle of 90 degrees (plus or minus 15 minutes) with the reference measuring surface of the head.

3.7.1.2 Accuracy of graduations. The scale error of any graduated edge or surface on the gage shall not exceed a tolerance of 0.002 inch between edge and center or between centers.

3.7.1.3 Flat rule. Rules shall be tempered and hardened and shall have parallel edges and parallel faces and shall be ground to a surface roughness not to exceed 32 microinches AA. The full length of the rule shall be graduated on one edge of one face to thirty-seconds of an inch and one edge of the opposite face to sixty-fourths of an inch, with the proper figures indicating each inch from 1 through 5 inches, inclusive. Graduation lines shall be of a uniform and readily distinguishable width, straight, permanent, and free from discontinuities and ragged edges. The maximum variation in width between like types of graduations shall be such that the maximum width shall not exceed the minimum width by more than 35 percent of the minimum width. Graduations shall extend to the reading edge of the rule. The graduation lines shall be sunk below the surface and shall have sharp edges. Graduation lines representing equal fractional segments of any scale, in descending order, shall be of equal height and readily distinguishable by their relative height from graduation lines representing other fractional segments of the same scale. Figures and markings shall be applied in a manner identical with that used to apply the graduation lines. Graduations, figures, and markings shall be clear and permanent. The rule shall be readily removable, reversible, and insertable from either end, and the figures on opposite faces shall be numbered consecutively from the same end of the rule, or from the opposite ends of the rule.

3.7.1.4 Round rule. Round rules shall conform to flat rule requirements as to materials, temper, straightness, and marking. Rules shall be provided with or without subdivided graduations to thirty-seconds of an inch at least 4 inches beginning from one end, with the proper figures indicating each inch from 1 to 4 inches, inclusive. Rules shall be readily removable from the head and shall conform to the accuracy of graduation requirements for flat rules.

3.7.1.5 Rule clamping device. The rule clamping device shall consist of a screw, nut, and either a coiled, steel-wire spring or spring-steel washer so formed and tempered as to give spring action. The arrangement of the members shall be

such that the rule may be securely clamped to the head at any desired length and maintained in a clamped position by friction. The nut shall be either steel or brass with knurled rim or other means for providing a firm grip. The coiled spring, if used, shall be arranged to compress into a recess in the nut. The spring washer, if used, shall rest under the nut.

3.7.2 Class 2, depth and angle. Class 2 steel-rule combination depth and angle gages shall be similar to figure 3 and shall conform to class 1, except for special requirements for head, and turret, as specified herein.

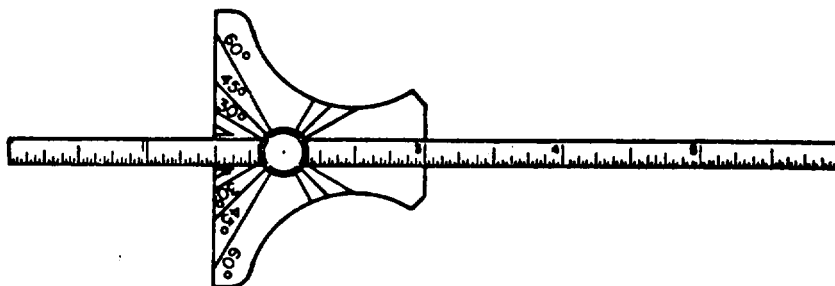


FIGURE 3. Type II gage, depth and angle, steel rule, class 2.

3.7.2.1 Head. The head shall be hardened. It shall be flat and shall have a smooth reference surface ground to a surface roughness not to exceed 32 microinches AA from which measurements may be made. The head shall be designed for mounting a turret. Graduation lines and figures shall be permanently and legibly marked on the face of head or base of turret for providing positions to set the rule at an angle of 30, 45, and 60 degrees or 10, 20, 30, 40, 45, 50, 60, 70, 80, and 90 degrees, as specified (see 6.2). The maximum variation in width of graduations shall be such that the maximum width shall not exceed the minimum width by more than 35 percent of the minimum width. Maximum tolerance of angular graduations shall be plus or minus 30 minutes (maximum 0.002 inch at zero line, that is, vertical setting).

3.7.2.2 Turret. The turret shall consist of a flanged bearing made to fit the head, a screw or nut and spring or spring washer for clamping it in any desired radial position to the head, and a rule clamping device. The details of clamping devices shall conform to the requirements for type II, class 1, clamping devices.

3.8 Type III gage, internal measuring.

3.8.1 Class 1, small hole, styles A and B. Class 1, small hole, internal measuring gages shall be similar to figure 4, and shall consist of a handle, an expandable ball, and an adjusting device.



FIGURE 4. Type III gage, internal measuring, class 1, small hole.

3.8.1.1 Handle. The handle shall be cylindrical in shape, hollow, and knurled on the outer surface. The diameter of the handle and the length, size, and type of knurling shall be in accordance with the manufacturer's practices. On one end of the handle, provision shall be made for the adjusting screw. On the opposite end, provision shall be made for mounting the expandable ball.

3.8.1.2 Expandable ball. The ball shall be round or flattened and shall have a hardness value equivalent to not less than 55 nor more than 65 on the Rockwell C scale. It shall be so designed as to provide sensitivity of contact and adjustment. The radius of the ball or flat measuring face shall be at least 0.010 less than the radius of the smallest hole the gage is designed to enter. The ball shall be attached to the handle in such a manner as to provide for adjustment within the range of the gage as shown in table II for the size specified (see 6.2).

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TABLE II. Type III gage, internal measuring, class 1, small hole ranges.

Size	Range, minimum	
	Style A	Style B
	<u>Inch</u>	<u>Inch</u>
A	0.125 to 0.200	1/8 to 3/16
B	.200 to .300	3/16 to 1/4
C	.300 to .400	1/4 to 3/8
D	.400 to .500	3/8 to 1/2

3.8.1.3 Adjusting device. The adjusting device shall consist of a knurled cap or knob and adjusting rod so designed and fitted to the handle as to provide proper adjustment of the gage.

3.8.1.4 Sets. Small-hole gages shall be supplied in individual sizes or in sets as specified (see 6.2).

3.8.1.5 Cases. Each set shall be furnished in a durable case of vinyl or other flexible material.

3.8.2 Class 2, telescoping. Telescoping internal-measuring gages shall be similar to figure 5 and shall consist of a handle, a telescoping plunger, and locking device:

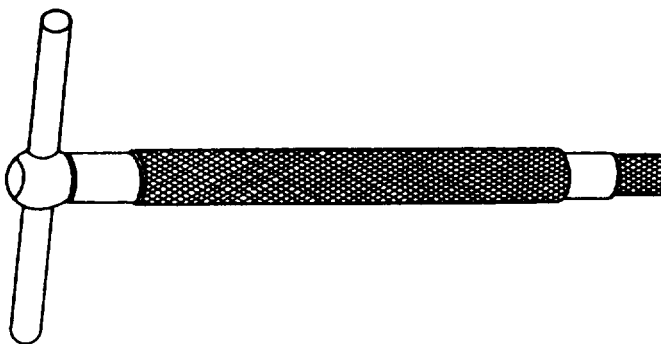


FIGURE 5. Type III gage, internal measuring, class 2, telescoping.

3.8.2.1 Handle. The handle shall be cylindrical in shape, hollow, and knurled on the outer surface. The diameter of the handle and the length, size, and type of knurling shall be in accordance with the manufacturer's practices. On one end of the handle, provision shall be made for the locking screw. On the opposite end, provision shall be made for mounting the telescoping plunger at right angles to the handle.

3.8.2.2 Telescoping plunger. The telescoping plunger shall be spring loaded and shall be designed so as to provide sensitivity of contact and adjustment. The plunger shall be attached to the handle in such a manner as to provide for adjustment within the range of the gage as shown in table III for the size specified (see 6.2). The spring shall not bind nor shall any parts be loose enough to affect the setability of the gage. The force required to compress the gage to the minimum size shall not exceed 24 ounces for sizes AA, A and B, and shall not exceed 3 ounces for sizes C, D, and E. The misalignment between the gaging members in an extended position shall not exceed 5 percent for sizes AA, A, B, and C, and shall not exceed 2-1/2 percent for sizes D and E.

TABLE III. Type III gage, internal measuring, class 2, telescoping ranges.

Size	Range Inches
AA	$5/16$ to $1/2$
A	$1/2$ to $3/4$
B	$3/4$ to $1-1/4$
C	$1-1/4$ to $2-1/8$
D	$2-1/8$ to $3-1/2$
E	$3-1/2$ to 6

3.8.2.3 Sets. Telescoping gages shall be supplied in individual sizes or in sets as specified (see 6.2). Sets shall consist of three or more gages in sizes specified (see 6.2).

3.8.2.4 Locking device. The locking device shall consist of a knurled cap or knob and rod so designed and fitted to the handle as to provide proper locking of the gage setting. Release of the locking screw shall not result in disassembly of the gage except for the locking screw, nor shall the handle become loose in the sphere holding the telescoping plunger.

3.8.2.5 Measuring faces. The measuring faces shall have a hardness value equivalent to not less than 55 nor more than 65 on the Rockwell C scale. They shall have a radius less than the radius of the smallest hole for which the gage is designed to enter.

3.8.2.6. Cases. Each set shall be furnished in a durable case of vinyl or other flexible material.

3.9 Type IV gage, surface, universal. Type IV, universal surface gage shall be similar to figure 6 and shall consist essentially of a base, adjusting and locking devices, gage pins, scriber, and spindle and scriber clamp. Type IV surface gages shall conform to the requirements of table IV for the size specified (see 6.2).

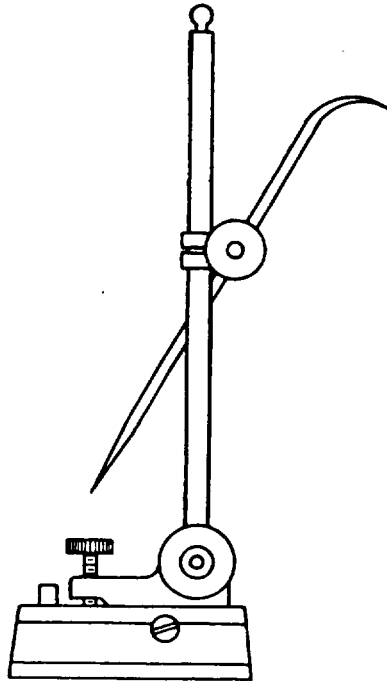


FIGURE 6. Type IV gage, surface, universal.

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TABLE IV. Type IV gage, surface, universal, major dimensions.

Size	Base						Spindle			Scriber		
	Length		Width		Thickness		Dia.	Length		Dia.	Length	
	Min.	Max.	Min.	Max.	Min.	Max.		Min.	Max.		Min.	Min.
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
0	2-1/8	2-1/2	1-3/8	1-3/4	11/16	1-3/8	7/32	4	5	5/64	3	6
1	2-13/16	3-1/2	2-1/4	2-3/4	7/8	1-1/2	5/16	8-3/4	12-1/4	9/64	5	9-1/2
2	3-3/4	4-1/8	3-1/4	3-1/2	1	1-1/2	5/16	12	18-1/4	9/64	5	9-1/2

3.9.1. Base. The base of size 0 surface gages shall be of hardened steel. For sizes 1 and 2, the base shall be of hardened steel or fine grained, seasoned cast iron. The bottom of the base shall be smoothly finished flat and shall be provided with a centrally located longitudinal V-groove. The V-groove shall have an included angle of 90 degrees to 100 degrees and width of from 1/3 to 2/3 of the overall base width and shall be suitable for use of the gage on cylindrical work. The front of the base shall have a notch or groove arranged so that the outer end of the spindle may be depressed below the level of the bottom of the base. The sides of the base shall be provided with grooves arranged to facilitate handling of the gage.

3.9.2. Locking and adjusting devices. The base shall be provided with a head of steel construction having a spindle locking member, and a spindle adjustment member. The spindle locking member shall be arranged to lock the spindle by means of a knurled thumb nut and clamping screw after manual adjustment of the position or angle of the spindle has been made. The arrangement of the hole or holes in the spindle locking member shall be such that either the spindle or the scriber may be used, as required. The spindle adjustment member shall consist of a bracket (lever) snugly fitted to the base and arranged so that the spindle may be readily rotated about the inner end through an angle of at least 10 degrees by means of a knurled solid-head thumbscrew. The spindle adjustment member shall be provided with either a flat or coiled steel spring arranged to prevent any backlash when adjustment with the thumbscrew is made.

3.9.3. Gage pins. The base shall be provided with two or more gage pins arranged so that by pushing them flush with the top of the base they may be made to project at least 1/16 inch below the bottom surface and used for bearing against edges of surface plates or slots in machine heads for linear work. The gage pins shall be not less than 5/32 inch in diameter, and shall have either sleeves or slotted heads arranged to retain the gage pins in position by friction.

3.9.4. Scriber. The scriber shall be made of tool steel, hardened, and shall have tapered sharpened points. One end shall be straight and the opposite end shall have a right-angle bend. The points at the bent end shall be not less than 1/2 inch from the major axis of the scriber. Points shall have hardness value equivalent to Rockwell C hardness of 58 to 63.

3.9.5. Spindle and scriber clamp. The spindle shall be cylindrical, smoothly polished, and shall not overbalance the base when used in any possible position. The spindle shall be provided with a scriber clamp. The clamp shall include a slotted block which fits the spindle, a head for holding the scriber, and knurled thumb nut. The arrangement of the members shall be such that before the thumb nut is fully tightened, the position of the scriber may be changed by rotation or longitudinal movement and the block adjusted along the spindle with the thumb nut fully tightened, the scriber shall be securely locked on the spindle.

3.9.6. Accuracy of adjustments. There shall be no change or loss of adjustment of the scriber or spindle when the thumb nuts on the scriber clamp or spindle locking member are tightened to lock the adjusted members in position.

3.9.7. Finish. The gage shall have a natural finish except that the base may be blued, mottled, or the sides and top of the base may have a durable coating of enamel or equally suitable coating.

3.10. Type V gage, screw pitch. Type V, screw pitch gages shall consist of a specific number of blades and a metal case into which the blades fold, and shall be similar to f

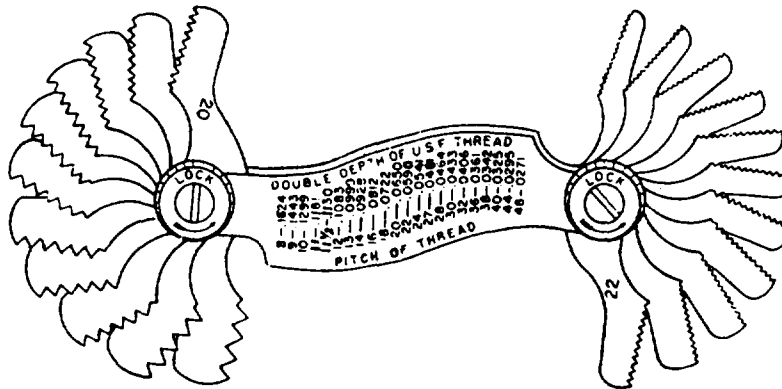


FIGURE 7. Type V gage, screw pitch, classes 1, 2, and 3.

3.10.1 Blades. Blades shall be flat, and of uniform thickness of not less than 0.023 inch and shall be made of stainless steel satin finish or cold rolled steel. The teeth shall be uniformly, cleanly, and accurately formed. The blade surfaces shall be finished to a surface roughness not to exceed 32 microinches AA. Each blade shall be plainly and permanently marked with the respective number of threads per inch. Each blade shall be of narrow width design suitable for checking the threads of nuts, screws, and bolts. The length of engagement of the teeth shall be not less than 1/2 inch. Blades shall have a Rockwell hardness of 91 to 95 on the B scale. The profile of the teeth shall be as follows. The angle of the tooth shall be 60 degrees with the bisector of the angle perpendicular to the toothed edge of the blade.

Blades of class 1 gages shall have a tolerance on the half-angle of the tooth of plus or minus 1 degree for 1/20 pitch and coarser and plus or minus 2 degrees for pitches finer than 1/20 pitch. The tolerance on pitch shall be plus or minus 0.0010 inch between any two successive teeth and plus or minus 0.005 inch in the overall length of the blade. The truncation of the crest of each tooth shall result in a flat having a width equal to not less than 0.20 times the pitch nor more than 0.30 times the pitch of the blade. The roots of the tooth spaces shall be cut to either a sharp V, or be cleaned to a truncation not to exceed 0.033 times the pitch of the thread or 0.002 inch, whichever is greater, depending on the pitch.

Blades of class 2 gages shall have a tolerance on the half-angle of the tooth of plus or minus 1 degree for 1.25 mm pitch and coarser and plus or minus 2 degrees for pitches finer than 1.25 mm pitch. The tolerance on pitch shall be plus or minus 0.0254 mm between any two successive teeth and plus or minus 0.127 mm in the overall length of the blade. The truncation of the crest of each tooth shall result in a flat having a width equal to not less than 0.20 times the pitch nor more than 0.30 times the pitch of the blade. The roots of the tooth spaces shall be cut to either a sharp V, or be cleaned to a truncation not to exceed 0.033 times the pitch of the thread or 0.051 mm, whichever is greater, depending on the pitch.

3.10.1.1 Case. The case shall be made of mild steel, not less than 0.030 inch thick and shall enclose the edges of all blades. Unless otherwise specified (see 6.2), the hinged ends of the case except for class 3 gages shall have metal screws and locknuts for clamping any or all blades in any opened position. Clamping screws shall be removable. The ends of the case shall be fully rounded. Cases shall be notched through both sides of one edge at hinge to facilitate access to the leaves. When specified (see 6.2), double depth of threads shall be clearly and permanently marked on side of case.

3.10.1.2 Locknut. The nut shall be made of steel. The edge of the nut shall be knurled or serrated and shall be designed to be comfortable to the feel and easy to operate. The nut shall be not less than 3/32 inch thick and no smaller in diameter than the full width of the case at the hinge. An arrow indicating locking direction shall be shown on the face of the nut.

3.10.2 Classes and styles, type V gages. Type V gages shall be furnished in the following classes and styles as specified (see 6.2).

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3.10.2.1 Class 1, 60 degree.

3.10.2.1.1 Style A, 26 blades. Class 1, style A gage shall consist of a minimum of 26 blades, one blade for each of the following number of threads per inch: 2-1/4, 2-3/8, 2-1/2, 2-5/8, 2-3/4, 2-7/8, 3, 3-1/4, 3-1/2, 4, 4-1/2, 5, 5-1/2, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, and 20; also a blade to gage grinding of threading tools.

3.10.2.1.2 Style B, 29 blades. Class 1, style B gage shall consist of 29 blades, one blade for each of the following number of threads per inch: 4, 4-1/2, 5, 6, 7, 7-1/2, 8, 9, 10, 11, 11-1/2, 12, 13, 14, 16, 18, 20, 24, 27, 28, 32, 36, 40, 44, 48, 56, 64, 72, and 80.

3.10.2.1.3 Style C, 30 blades. Class 1, style C gage shall consist of 30 blades, one blade for each of the following number of threads per inch: 4, 4-1/2, 5, 5-1/2, 6, 7, 8, 9, 10, 11, 11-1/2, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 27, 28, 30, 32, 34, 36, 38, 40, and 42.

3.10.2.1.4 Style G, 51 blades. Class 1, style G gage shall consist of 51 blades, one blade for each of the following number of threads per inch: 4, 4-1/2, 5, 5-1/2, 6, 7, 8, 9, 10, 11, 11-1/2, 12, 13, 14, 15, 16, 18, 20, 22, 24, 26, 27, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, 82, and 84.

3.10.2.1.5 Style H, 26 blades. Class 1, style H gage shall consist of 26 blades, one blade for each of the following number of threads per inch: 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60, 62, 64, 66, 68, 70, 72, 74, 76, 78, 80, and 82.

3.10.2.1.6 Style I, 27 blades. Class 1, style I gage shall consist of 27 blades having the following number of threads per inch: 2-1/4, 2-3/8, 2-1/2, 2-5/8, 2-3/4, 2-7/8, 3, 3-1/4, 3-1/2, 4, 4-1/2, 5, 5-1/2, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 20, 24, 28, and one center gage with coarse and fine notches.

3.10.2.2 Class 2, metric.

3.10.2.2.1 Style A, 17 blades. Class 2, style A gage shall have 17 blades with the following pitches in metric thread form: 0.50, 0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.50, 3.00, 3.50, 4.00, 4.50, 5.00, 5.50, 6.00, 6.50, and 7.00 mm. A center gage with coarse and fine notches shall be provided, mounted in the case.

3.10.2.2.2 Style B, 28 blades. Class 2, style B gage shall have 28 blades with the following pitches in metric thread form: 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60, 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 1.00, 1.10, 1.20, 1.25, 1.30, 1.40, 1.50, 1.60, 1.70, 1.75, 1.80, 1.90, 2.00, and 2.50 mm.

3.10.2.3 Class 3, Whitworth.

3.10.2.3.1 Blades. Blades shall be in accordance with 3.10.1, except the angle of the tooth shall be 55 degrees with the bisector of the angle perpendicular to the toothed edge of the blade, and the truncation of each tooth shall result in a radius equal to 0.1373 times the pitch.

3.10.2.3.2 Number of blades. Class 3 gage shall consist of 26 blades, one blade for each of the following number of threads per inch: 4, 4-1/2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 18, 19, 20, 22, 24, 25, 26, 28, 30, 32, 40, 48, and 60.

3.10.2.4 Special screw pitch gages. Screw pitch gages with other blade (thread per inch) combinations or blade quantities shall be as specified (see 6.2). These gages shall otherwise conform to the requirements of this specification for screw pitch gages.

3.11 Type VI gage, center, 60 degrees. Type VI, center gages shall be similar to figure 8 with dimensions and hardness as shown in table V. All edges and face shall be ground and smooth, and with a chrome plated dull (non-glare) finish. Opposite longitudinal edges shall be parallel within 0.001 inch. One end shall be pointed and shall have an included angle of 60 degrees extending the full width of the gage; the other end shall have a notch, having an included angle of 60 degrees

with an opening (width) of not less than $19/32$ inch. The gage shall have two side notches, each shall have an included angle of 60 degrees, located one on each longitudinal edge of the gage, or both on the same edge. One side notch shall have an opening (width) of not less than $7/32$ nor more than $1/4$ inch; the other side notch shall have an opening of not less than $3/32$ nor more than $1/8$ inch. Each notch shall be relieved at the vertex as shown in figure 8. The width of the relief shall not exceed 0.028 inch. The sides of the pointed end shall form 150 degree angles with the longitudinal edges of the gage, the sides of the side notches shall form 120 degree angles with the longitudinal edges, and the centerline of the end notch shall be parallel to the longitudinal edges. The included angle between the transverse edges of the gage at the notched end and the longitudinal edges shall be 90 degrees within 0.001 inch measured on the longitudinal edges. All angles shall be held within plus or minus 15 minutes. Faces of gage shall be flat.

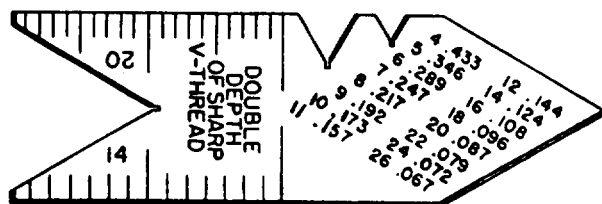


FIGURE 8. Type VI gage, center, 60 degree.

TABLE V. Type VI gage, center, 60 degree.

Length		Width		Thickness		Hardness value equivalent to Rockwell C number	
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Inches	Inches	Inch	Inch	Inch	Inch		
2-1/8	2-1/2	11/16	13/16	0.035	0.047	45	50

3.11.1 Graduations and markings. Type VI, center gages shall be graduated a distance of 1 inch on each edge of each face beginning at the transverse edge of the notched end. One edge of the face shall be subdivided to fourteenths of an inch, and the outer edge of the same face shall be subdivided to twentieths of an inch; one edge of the opposite face shall be subdivided to twenty-fourths of an inch, and the other edge of the same face shall be subdivided to thirty-seconds of an inch. Accuracy of graduations shall be in accordance with 3.7.1.2. Each graduated edge shall be marked to show the smallest fractional subdivision to which it is graduated. The maximum variation in width between like types of graduations shall be such that the maximum width shall not exceed the minimum width by more than 35 percent of the minimum width. Graduations shall extend to the reading edge of the gage. Unless otherwise specified (see 6.2), the gage may be furnished with or without reference data showing double depth of threads. When double-depth-of-thread data is required to be marked on the gage, the procuring agency shall specify to mark either "Double depth of American National Thread" or "Double depth of sharp V thread" (see 6.2). When the double-depth-of-thread data is specified, it shall show in tabular form on one face, in thousandths of an inch, at least 16 standard pitches of the applicable threads specified. All markings shall be made to contrast with surrounding areas of the gages by chemically etching the markings, or by other similar means so that the markings are distinct and easily readable. Graduations, figures, and markings shall be clear and permanent.

3.11.2 Accuracy of linear scale. The scale error of any graduated edge on the gage shall not exceed 0.002 inch for any graduation.

3.12 Type VII gage, fillet and radius.

3.12.1 Type VII gages shall consist of a specified number of blades and a suitable case into which the blades fold or are inserted.

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3.12.1.1 Single-end blades. One end of each single-end blade shall be suitable for gaging the internal curvature of a single radius and the external curvature of the same radius; the other end shall be hinged to the case by the hinge screw or rivet.

3.12.1.2 Double-end blades. One end of double-end blades shall be suitable for gaging the internal curvature of a single radius and the external curvature of the same radius. The other end shall be similarly constructed, except that it shall be suitable for a different radius. The blade shall have a lengthwise slot arranged to permit extension of the blade or blades.

3.12.1.3 Identification marking. At least one face of each blade shall be clearly and permanently marked near the work edges with the size of the radius in fractional parts of an inch.

3.12.2 Class 1, hinged blade.

3.12.2.1 Style A, double radius ends. Class 1, style A gage shall be similar to figure 9 and shall have either 16 single-end blades or 8 double-end blades.

3.12.2.1.1 Blades. The blades shall be flat, and the edges shall be square with the faces. The blades shall be finished to a surface roughness not to exceed 32 microinches AA r.m.s. The range of the blades shall be for radii from 1/32 to 17/64 inch, inclusive, by sixty-fourths of an inch. The actual radius of any measuring surface of the blade, either external or internal, shall be within 0.002 inch of the nominal radius for that blade. The dimensions and hardness of the blade shall conform to table VI.

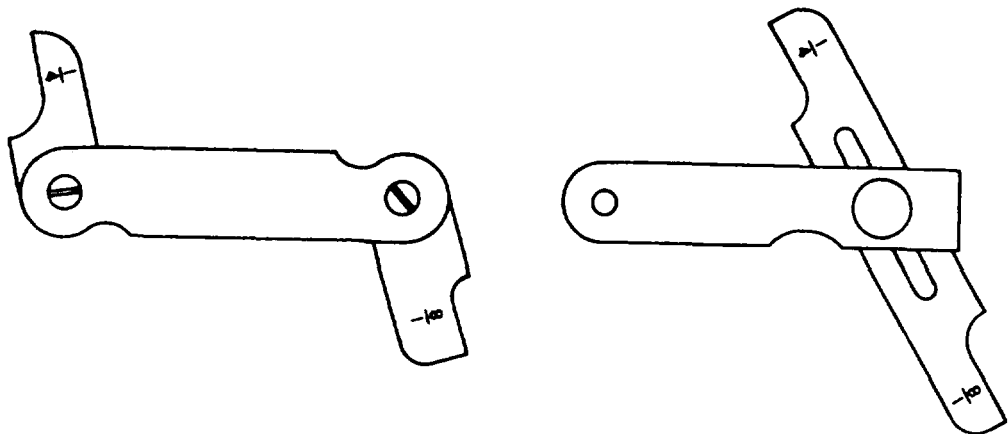


FIGURE 9. Type VII gage, fillet and radius, class 1 hinged blades, style A double radius ends.

TABLE VI. Type VII gage, fillet and radius, class 1 hinged blades, dimensions and hardness.

Length		Width		Thickness	Hardness value equivalent to Rockwell C number	
Min.	Max.	Min.	Max.		Min.	Max.
<u>Inches</u>	<u>Inches</u>	<u>Inch</u>	<u>Inch</u>	<u>Inch</u>		
1-1/8	2-3/16	15/32	1-1/32	0.025	91	95

3.12.2.1.2 Case. The case shall be made of mild steel not less than 0.030 inch thick, and shall be constructed to enclose the edges of all the blades. Each hinge end of the case shall be provided with a metal screw, with American National thread form, suitable for holding any or all blades at the end in any required position around the axis of the screw. Ends of the case for single-end blades shall be fully rounded. Clamping screws shall be removable. Cases for gages having single-end blades shall be notched through both sides of one edge at one end and through both sides of the opposite edge at the other end to facilitate access to the blades. For double-end blades these notches shall be through both sides of one edge at the hinge end only.

3.12.2.2 Style B, single radius ends. Class 1, style B gage shall be similar to figure 10 and shall have 32 single-end blades.

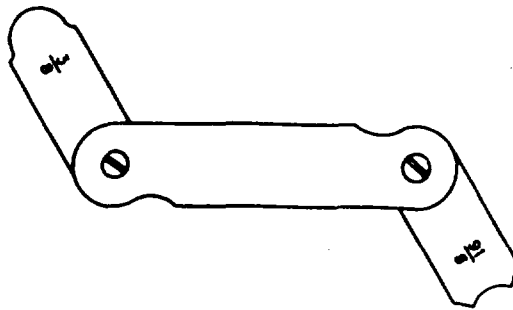


FIGURE 10. Type VII gage, fillet and radius, class 1, hinged blades, style B single radius ends.

3.12.2.2.1 Blades. The blades shall be flat, and the edges shall be square with the faces. The blades shall be finished as specified for class 1, style A. The range of the blades shall be for radii from $17/64$ to $1/2$ inch, inclusive, by sixty-fourths of an inch. The actual radius of any measuring surface of the blade, either external or internal, shall be within 0.002 inch of the nominal radius for that blade. At least one face of each blade shall be marked near the work edges with the size radius, in fractional parts of an inch. The dimensions and hardness of the blades shall conform to table VI. All blades for gaging internal curvatures shall be mounted in one end of the case and all blades for gaging external curvatures shall be mounted in the other end of the case.

3.12.2.2.2 Case. The case for class 1, style B gages shall be as specified for class 1, style A gages.

3.12.3 Class 2, individual blades. The gages shall be similar to figure 11 and shall consist of individual blades having a natural finish, and a suitable case for holding all the blades.

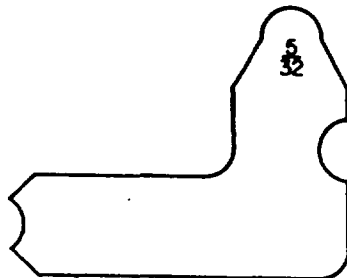


FIGURE 11. Type VII gage, fillet and radius, class 2, individual blades.

3.12.3.1 Blades. The blades shall be corrosion resistant steel, shall be flat, and the edge shall be square with the faces. Each blade shall have five gaging surfaces. Each blade shall have the general outline of a right angle, the two legs of which shall not exceed the following:

Length, inches	Radii, inches
2	Under $9/32$
3	$9/32$ to $1/2$
6	$9/16$ to 1
7	$1-1/16$ to $1-1/2$
9	$1-9/16$ to 2

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The inside edge and the outside edge of each leg shall be parallel. The two legs of each blade shall make a 90 degree angle, plus 4 minutes minus 0 minutes for the inside edges, plus 0 minutes minus 4 minutes for the outside edges. On each blade, the junctures of the inside edges and of the outside edges of the legs shall be in the form of arcs suitable for measuring convex and concave surfaces, respectively. The arcs shall be tangent to their corresponding edges and of radius equal to the gage size of the blade. The end of one leg of each blade shall have a semicircular notch for measuring 180 degrees of convex surface of a radius of the gage size of the blade. Gaging surfaces of each blade shall have the same radius, which shall be the gage size of the blade. The gage size shall be plainly and permanently marked on one face of the blade in fractional parts of an inch. The actual radius of any measuring surface of the blade, either convex or concave, shall be within 0.002 inch of the gage size of the blade. Blades shall have a minimum hardness of Rockwell 65 on the B scale. Blades shall be not less than 0.020 and not more than 0.045 inch in thickness on sizes up to 1/2 inch radius and not less than 0.050 and not more than 0.070 inch in thickness on larger sizes.

3.12.3.2 Sets. Individual blades shall be supplied as specified (see 6.2), in sets in the following radii:

- (a) 1/32 to 17/64 inch, inclusive, by 64th-inch increments - 16 blades.
- (b) 1/32 to 1/2 inch, inclusive, by 32nd-inch increments - 16 blades.
- (c) 9/16 to 1 inch, inclusive, by 1/16th-inch increments - 8 blades.
- (d) 1-1/16 to 2 inches, inclusive, by 1/16th-inch increments - 16 blades.
- (e) 9/32 to 1/2 inch, inclusive, by 1/32nd-inch increments - 8 blades.

3.12.3.3 Radius gage holder. Unless otherwise specified (see 6.2), a holder or handle shall be furnished for each set of gages 1/2 inch radius and smaller. It shall be approximately 4 inches long, knurled, and shall have one end rounded with a slot for holding the blade at either 30 degrees or 40 degrees. The other end shall have a knurled nut for locking the blade into position.

3.12.3.4 Case. Each set of blades shall be furnished in a durable case of vinyl or other flexible material. The case shall have a separate pocket for each blade.

3.13 Type VIII gage, thickness (feeler). Type VIII gages shall consist essentially of the number of leaves herein specified for each class and style and a metal case into which the leaves fold when applicable. Unless otherwise specified (see 6.2), gages shall have the manufacturer's standard finish.

3.13.1 Tolerance in thickness of gage leaves. The actual thickness of all thickness gage leaves shall not vary from the nominal thickness specified by more than that shown in table VII.

TABLE VII. Tolerances in thickness of gage leaves (type VIII gage).

Specified nominal thickness (inch)	Permissible tolerance (inch) (plus or minus)
0.0015 to 0.007	0.00020
.008 to .009	.00025
.010 to 0.012	.00035
.013 to .015	.00043
.016 to .019	.00047
.020 to .024	.00055
.025 to .031	.00067
.032 to .035	.00075

3.13.2 Special leaf combinations and lengths. Leaf-thickness combinations or leaf lengths and widths other than those listed herein shall be as specified (see 6.2).

3.13.3 Leaves. Leaves shall be made of stainless steel satin finish or electric furnace cold-rolled steel, hardened in accordance with 3.13.4 and tempered. They shall be $1/2 + 1/16$ inch in width. Leaves shall have a smooth flat finish on both faces, free from burrs and surface roughness the entire length. The edges shall be finished smooth. Both ends shall be finished smooth in a true radius. The leaves of class 1 gages shall be tapered the full length or partially parallel and partially tapered. When specified (see 6.2), straight leaves shall be furnished.

3.13.4 Hardness. Leaves shall have a hardness value equivalent to not less than 45 nor more than 55 on the Rockwell C scale.

3.13.5 Identification marking. One face of each leaf shall be permanently and legibly marked with the nominal thickness in decimals of an inch.

3.13.6 Case. The case shall be made of mild steel, not less than 0.030 inch thick and shall be designed to enclose the edges of all leaves. Both ends of the case shall be formed to a radius, except when specified (see 6.2), the case shall be of one piece U-shaped construction with only the leaf-pivoting end formed to a radius. When leaves are assembled in the case they shall be uniform and smooth and conform approximately to the radius of both sides of the case. One end of the fastener or fastener and sleeve shall have a locknut suitable for clamping the leaves in any position around its axis. The other end of the fastener or fastener and sleeve shall be arranged to prevent it from turning when locknut is operated. The fastener shall be staked to prevent accidental removal of the locknut from the case. The fastener or fastener and sleeve shall be designed to prevent damage to the hole in the leaf when locknut is tightened. When threads are provided for in the fastener or fastener and sleeve or locknut, they shall conform with the American National or Unified Thread in accordance with FED-STD-H28. Both sides of the case shall be notched on one edge near hinge to facilitate access to the leaves. Gages, with or without cases, containing leaves under 0.010 inch in thickness shall have the two thickest leaves assembled on the outside of the thinner leaves for protection.

3.13.7 Locknut. The nut shall be made of mild steel. The edge of the nut shall be knurled or serrated and shall be designed to be comfortable to the feel and ease of operation. The nut shall be not less than $3/32$ inch thick and no smaller in diameter than the full width of the case at the hinge. An arrow indicating locking direction shall be shown on the face of the nut.

3.13.8 Class 1, thickness.

3.13.8.1 Style A, 3 inch. Class 1, style A gage shall be similar to figure 12, and shall be supplied in leaf-thickness combinations in accordance with table VIII.

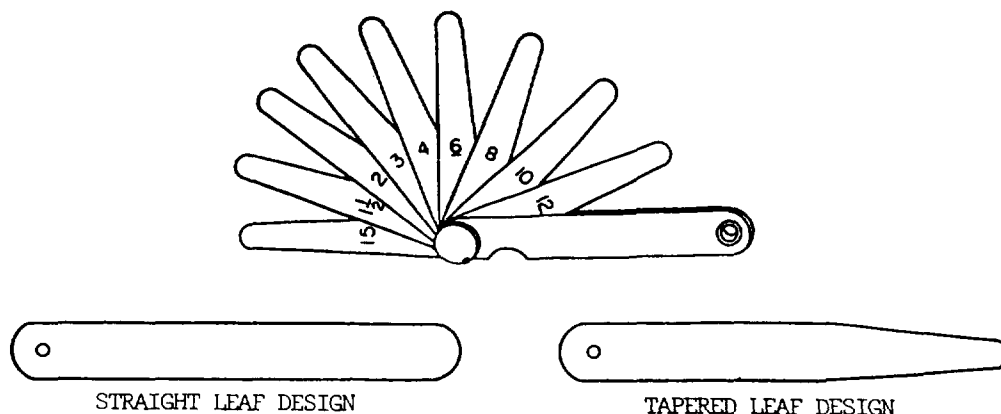


FIGURE 12. Type VIII gage, thickness (feeler), class 1, styles A, B, C, D, and E.

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TABLE VIII, Type VIII gage, thickness (feeler), class 1, styles A, B, C, D, and E.

Length of leaves Inches	Number of leaves	Leaf thickness combinations
9	8	0.002, 0.003, 0.004, 0.005, 0.006, .008, .010, .015
6	8	0.002, .003, .004, .006, .008, .010, .012, .015
2-1/16	9	0.010, .012, .015, .018, .020, .022, .025, .030, .035
3, 6, 9, 12	9	0.0015, .002, .003, .004, .006, .008, .010, .012, .015
3	10	0.001, .002, .003, .005, .010, .020, .030, .040, .050, .060
3	10	0.012, .013, .014, .018, .020, .022, .025, .028, .032, .035
3, 12	14	0.0015, .002, .003, .004, .006, .008, .010, .025, .025, .025
3	15	0.0015, .002, .003, .004, .006, .008, .010, .012, .015, .020, .030, .040, .075, .100, .200
3	26	0.0015, .002, .0025, .003 to .025 by thousandths

3.13.8.2 Style B, 6 inch. Class 1, style B gage shall be similar to figure 12, except the leaf length shall be $6 \pm 1/16$ inch.

3.13.8.3 Style C, 9 inch. Class 1, style C gage shall be similar to figure 12, except the leaf length shall be $9 \pm 1/16$ inch.

3.13.8.4 Style D, 12 inch. Class 1, style D gage shall be similar to figure 12, except the leaf length shall be $12 \pm 1/16$ inch.

3.13.8.5 Style E, 2-1/16 inch. Class 1, style E gage shall be similar to figure 12, except the leaves shall be approximately $2-1/16 \pm 1/16$ inch in length, $3/8$ inch wide at the hinged end and fully tapered to $3/16$ inch width at the small end. The hinged assembly shall be furnished without a case. The hinged end shall have a metal screw stud and nut having threads in accordance with FED-STD-H28. The leaves shall be replaceable by removing the screw stud from the end.

3.13.9. Class 2, 45 degree angle tip. Class 2 gage shall be similar to figure 13 and shall have tapered leaves with a 45 degree angle tip. They shall be so designed that leaves fold together without interference. They shall be held in any position to one another by means of a locking device. In assemblies having less than 0.010 inch thickness, the two thickest leaves shall be placed on the outside to protect the thin leaves from damages and eliminate the necessity of a case. Gages shall be supplied in leaf thicknesses in accordance with table IX, as specified (see 6.2). Gages shall be so designed that leaves will not become disassembled from the locking device under normal working conditions.

3.13.9.1 Leaves. Leaves shall conform to the requirements of table IX for size. The hinged end shall be fully rounded. The leaf shall taper toward the other end, which shall be slightly rounded and bent at a 45 degree angle to the face. Leaves shall conform to the requirements specified herein.

3.13.9.2 Locking device. The locking device shall be similar to the enlarged view shown on figure 13.

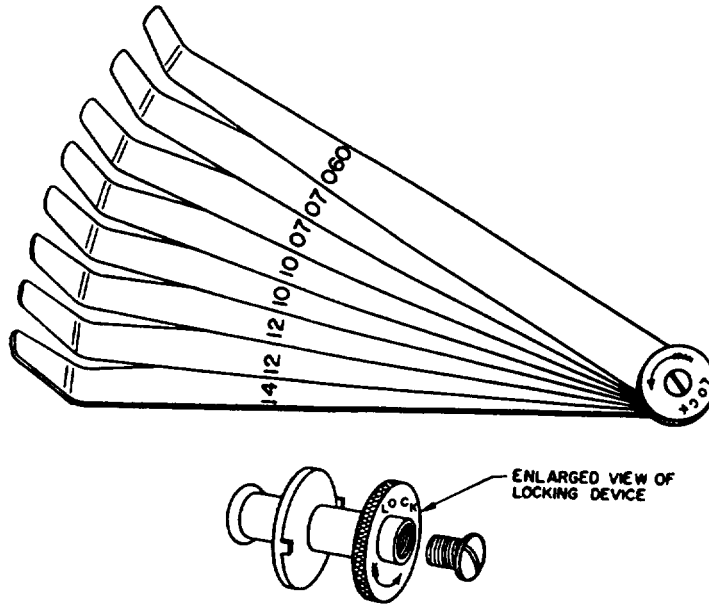


FIGURE 13. Type VIII gage, thickness (feeler), class 2, 45 degree angle tip.

TABLE IX. Type VIII gage, thickness (feeler), class 2, 45 degree angle tip.

Number of leaves							Leaf dimensions							
							Length		Length 45 deg. tip		Length taper sides		Width taper sides	
1	2	2	2	8	8	8	Min. In.	Max. In.	Min. In.	Max. In.	Min. In.	Max. In.	Min. In.	Max. In.
0.015	0.038 .080	0.030 .080	0.040 .110	0.060 .005 .010 .012 .017 .020 .030 .040	0.060 .070 .075 .100 .102 .125 .127 .143	0.080 .002 .005 .010 .020 .025 .040 .060	6	6-1/8	1/2	5/8	3	3-1/4	1/4	1/2

3.13.10 Class 3, combination, thickness, taper and wire. Gage shall be similar to figure 14 and shall have 9 thickness leaves, a taper-thickness leaf, and a wire-gage leaf. The gage shall conform to the dimensions shown in table X.

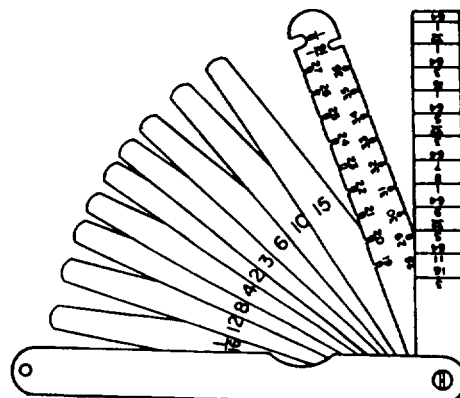


FIGURE 14. Type VIII gage, class 3, combination, thickness, taper, and wire.

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TABLE X. Type VIII gage, class 3, combination, thickness, taper and wire, major dimensions.

Length		Width						Hardness Rockwell superficial 15-N scale	
		Wire and taper gages		Thickness gage					
				At tip		At hinge			
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
In.	In.	In.	In.	In.	In.	In.	In.		
4-15/32	4-17/32	15/32	17/32	15/64	17/64	15/32	17/32	1/82	1/87

1/ Except taper leaf, which shall be 85 to 93 on the Rockwell B scale. In addition to the material specified in paragraph 3.13.3, the taper-thickness gage leaf may be made from alloy tool steel with a hardness of 33 to 45 on the Rockwell C scale.

3.13.10.1 Thickness-gage leaves. The thickness-gage leaves shall be of the following nominal thicknesses: 0.002, 0.003, 0.004, 0.006, 0.008, 0.010, 0.012, 0.015, and 1/16 inch. One face of each leaf shall be permanently and legibly marked with the digit or digits corresponding to the nominal thickness in thousandths of an inch, or with the full decimal fraction, except that the 1/16 inch leaf shall be marked with the full fraction. Each leaf shall be tapered in width and the free end shall be slightly rounded.

3.13.10.2 Taper-thickness-gage leaf. The taper-thickness-gage leaf shall have parallel edges and shall taper uniformly in thickness from hinge to free end. One face shall have permanent and clearly legible reference lines having a minimum depth of 0.0015 inch extending across the face at the following thicknesses: 1/64, 1/32, 3/64, 1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 11/64, and 3/16 inch. The error in thickness at any reference line shall not exceed plus or minus 0.001 inch. Each reference line shall be marked with the corresponding fraction of an inch. The spacing between reference lines shall be uniform and shall be not less than 7/32 nor more than 9/32 inch. The opposite face of the leaf shall be graduated as a rule, with one edge subdivided to eighths of an inch and the other edge to sixteenths of an inch, over a length of 3 inches. The scale error of any graduated edge of the rule shall not exceed + 0.002 inch. Each inch graduation shall be marked with the proper figure and one corner of each edge shall be marked to show the smallest subdivision to which the edge is graduated. The maximum variation in width between like types of the rule graduations shall be such that the maximum width shall not exceed the minimum width by more than 35 percent of the minimum width. Graduations shall extend to the reading edge of the rule. Graduations, figures, and markings shall be clear and permanent.

3.13.10.3 Wire-gage leaf. The leaf shall have 18 gaging sections (slots) for the Birmingham (formerly known as "Stubbs") iron wire gage in consecutive sizes from No. 19 to No. 36, inclusive, and one 1/16-inch slot and one 1/8-inch slot. The gaging sections (slots on one face) shall be marked with the corresponding gage numbers and the fractions for the two fractional inch slots. The gaging sections on the opposite face shall be marked with the corresponding equivalent decimal fractions, in thousandths of an inch, of the gage numbers and the fractional inch slots. The leaf shall have parallel sides and the free end shall be fully rounded. Figures shall be clearly and permanently marked.

3.13.11 Class 4, feeler stock.

3.13.11.1 Style A, individual leaves. Individual leaves of feeler stock shall be similar to figure 15, and shall be furnished in 1/2 inch width. The 12-inch length shall be furnished in the following thicknesses as specified (see 6.2): 0.0015, 0.002, 0.0025, and 0.003 through 0.025 inch by 0.001 inch increments. The 18 inch length shall be furnished in the following thicknesses as specified (see 6.2): 0.005, 0.006, 0.008, 0.010, 0.012, 0.015, 0.025, 0.040, 0.050, and 0.060 inch. Each leaf shall be clearly and permanently marked with the thickness of the leaf. Unless otherwise specified, both ends shall be rounded. Each length shall be furnished in an individual envelope with the correct thickness marked on it.

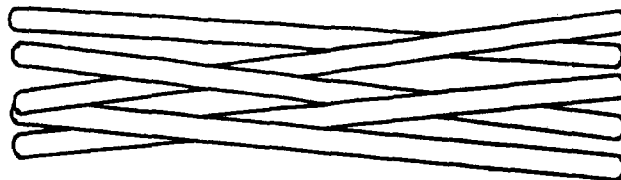


FIGURE 15. Type VIII gage, thickness, class 4, feeler stock, style A, individual leaves.

3.13.11.2 Style B, roll. Feeler stock shall be similar to figure 16 and shall be furnished in rolls of approximately 25 feet. It shall be $1/2 + 1/16$ inch wide and marked at 6 inch intervals with a line, and the thickness marked in decimals of an inch. It shall be supplied in thicknesses of 0.001, 0.0015, 0.002, 0.0025, 0.003, to 0.025 inch by 0.001 inch steps, as specified (see 6.2).

3.13.11.2.1 Case. The case shall be of metal or plastic, approximately $3/4$ inch thick and not less than 3- $1/2$ inches in diameter.

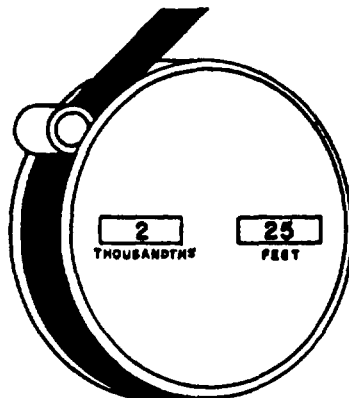


FIGURE 16. Type VIII gage, thickness, class 4, feeler stock, style B, rolls.

3.14 Type IX gage, gap setting. Gap setting gages shall consist of a specific number of leaves or wires, or a combination of both, enclosed in a metal case or attached to a metal frame.

3.14.1 Tolerances in thickness of gage leaves and wire diameter tolerance. Tolerances of gage leaves shall be in accordance with table VII and wire diameter tolerance shall be $+ 0.0005$ inch.

3.14.2 Class 1, combination.

3.14.2.1 Style A, leaf and wire. Class 1, style A gage shall be similar to figure 17 except that the number and size of leaves and wires shall be combinations a and b.

A case shall be provided into which the leaves and the carbon file shall fold. An electrode bender shall also be provided. Unless otherwise specified (see 6.2), leaf combination a or b shall be as follows:

Combination a.

Feeler leaves: 0.012, 0.013, 0.014, 0.018, 0.020, 0.022, 0.025, 0.028, 0.032, and 0.035.

Spark plug wires: 0.022, 0.025, 0.027, 0.028, 0.030, 0.032, 0.035, and 0.040

Combination b.

Feeler leaves: 0.002, 0.003, 0.004, 0.006, 0.008, 0.012, 0.013, 0.020, and 0.025.

Spark plug wires: 0.025, 0.028, 0.030, 0.032, 0.035, and 0.040.

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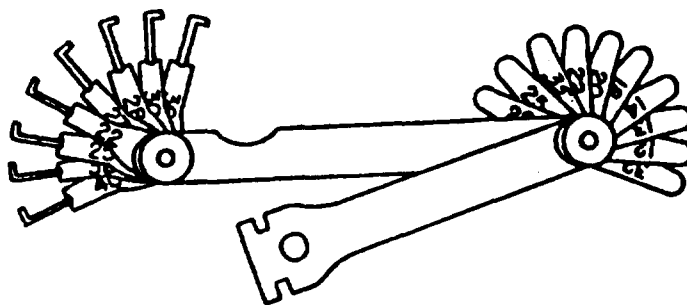


FIGURE 17. Type IX gage, gap setting, class 1, combination, style A, leaf and wire.

3.14.2.1.1 Leaves. Leaves shall be grouped in one end of the case and conform to the requirements of 3.13.3 and 3.13.4 except they shall be $1/4 \pm 1/16$ inch in width on the free end and $1-3/4 \pm 1/16$ inch in length.

3.14.2.1.2 Wires. The wires shall be grouped in the end of the case opposite the leaves and shall conform to the requirements for type IX, class 2, style A wires as to design and hardness.

3.14.2.1.3 Identification marking. Leaves shall be clearly and permanently marked with the thickness. The nominal size of each wire shall be clearly and permanently marked on its metal housing. Marking shall be located approximately as shown on figure 17.

3.14.2.1.4 Electrode bender. The electrode bender shall be of solid construction and designed to efficiently adjust the spark plug electrode wires without damage to the plug. The bender may be assembled on the inside or outside of the case at the option of the manufacturer. The bender may have either a single or double working head with gaps to accommodate all standard commercial electrode sizes.

3.14.2.1.5 Cases. The case shall conform to the requirements for type VIII gage cases except that both ends shall have a screw assembly with locknut.

3.14.2.2 Style B, long and short leaf. Class 1, style B gages shall meet the requirements of style A, except they shall have leaves at both ends. One end shall have 10 leaves approximately 3 inches long, $1/2$ inch wide, one each of the following thicknesses: 0.002, 0.003, 0.004, 0.005, 0.006, 0.007, 0.008, 0.010, 0.013, and 0.015 inch. The other end shall have 10 leaves approximately $1-5/8$ inches long, $1/4$ inch wide, one each of the following thicknesses: 0.012, 0.013, 0.014, 0.018, 0.020, 0.024, 0.025, 0.028, and 0.032 inch. Gages shall also contain a point file approximately 3 inches long.

3.14.3 Class 2, spark plug gap (wire).

3.14.3.1 Style A, folding. Class 2, style A gage shall be similar to figure 18 and shall consist essentially of 8 wires, electrode bender, and locking device. It shall be so fabricated that the wires may be folded together in both ends of the case without interference.

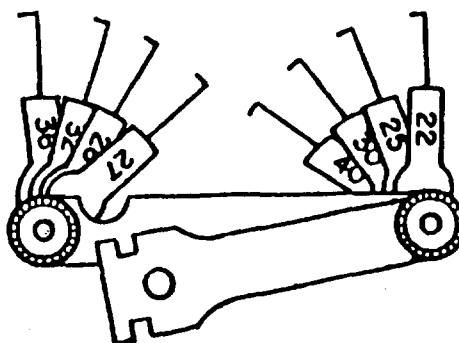


FIGURE 18. Type IX gage, gap setting, class 2, spark plug gap (wire), style A,

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3.14.3.1.1 Wires. Each wire shall be extended from a metal housing 3/8 inch minimum and each end shall be bent at right angles to 3/16 inch minimum. There shall be a wire for not less than each of the following sizes: 0.022, 0.025, 0.027, 0.028, 0.030, 0.032, 0.035, and 0.040 inch.

3.14.3.1.2 Identification marking. The nominal size of the wire shall be permanently and legibly marked on the metal housing of each wire. Markings shall be located approximately as shown on figure 18.

3.14.3.1.3 Electrode bender. The electrode bender shall conform to the requirements for type IX, class 1 gages.

3.14.3.1.4 Case. The case shall conform to type VIII gage cases, except that both ends shall have a screw assembly and locknut.

3.14.3.2 Style B, circular. Class 2, style B gage shall be similar to figure 19 and shall consist essentially of a cylindrical piece of metal approximately 1-3/4 inches in diameter, having the thickness wires and electrode bender attached to the outer periphery of the gage.

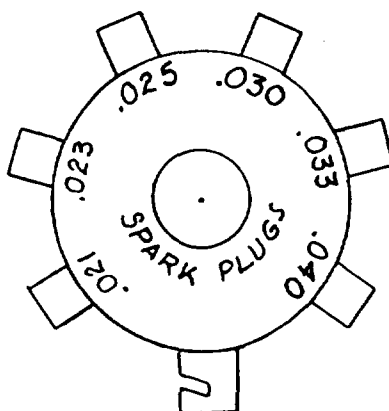


FIGURE 19. Type IX gage, gap setting, class 2, spark plug gap (wire), style B, circular.

3.14.3.2.1 Wires. Each wire shall extend from the gage approximately 3/8 to 1/2 inch and shall be in the form of square loops attached at each end. There shall be a wire for each of the following sizes: 0.025, 0.028, 0.030, 0.032, 0.035, and 0.040 inch.

3.14.3.2.2 Electrode benders. The electrode benders shall conform to the electrode bender requirements for type IX, class 1 gages, and shall accommodate all commercial electrode sizes.

3.14.3.3 Hardness. Wire hardness for both style A and style B gages shall be equivalent to not less than 47 on the Rockwell C scale or the equivalent tensile strength.

3.15 Type X gage, thread tool, 29 degree. Type X gages shall consist of a correct standard to which thread tools may be ground for cutting threads of a uniform angle, and shall be finished in accordance with the manufacturer's practices. Gages shall be accurate to within 15 minutes of included angle except the side notches on class 2 gages shall have an accuracy of 1 degree. The inclination of 14-1/2 degrees to the bottom of the notch and 29 degree included angle shall be accurate within 15 minutes and the error in the angle of the pointed end, end notches, side notches, and the respective angles formed by their sides with the longitudinal edges of the gage shall not exceed 15 minutes. Each gage shall be plainly and permanently marked so to identify it as a 29 degree (Acme) screw-thread tool gage, and each notch with its respective pitch number.

3.15.1 Class 1, Acme circular. Class 1 gage shall be similar to figure 20 and shall be approximately 2-1/4 inches in diameter, hardened and ground, with or without a hole in the center, and shall include tool sizes for cutting the following Acme threads: 1, 1-1/3, 2, 3, 4, 5, 6, 7, 8, 9, and 10. A tool-setting gage shall be furnished for setting Acme threading tools.

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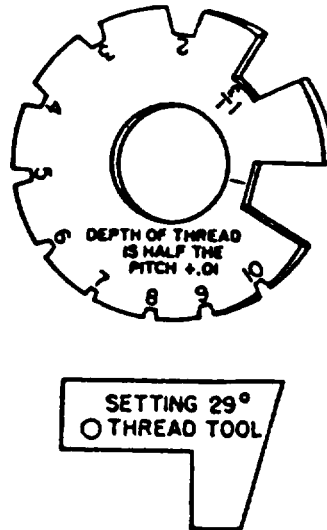


FIGURE 20. Type X gage, thread tool, 29 degrees, class 1, Acme circular.

3.15.2 Class 2, Acme rectangular. Class 2 gage shall be similar to figure 21 and shall be approximately 3-3/8 inches in length, and 1-5/8 inches in width, one end having a 29 degree included angle for checking the included angle of ground threading tools and the other end having a tool setting edge. It shall include tool sizes for cutting the following threads: 1, 1-1/3, 1-1/2, 1-3/4, 2, 2-1/2, 3, 4, 5, 6, 7, 8, 9, and 10.

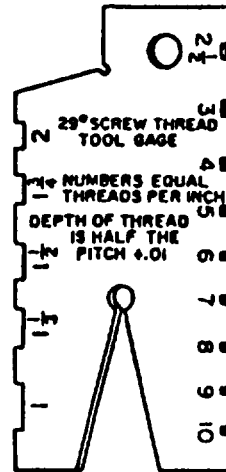


FIGURE 21. Type X gage, thread tool, 29 degrees, class 2, Acme rectangular.

3.15.3 Class 3, worm, circular. Class 3 gage shall conform to the requirements listed for type X gages as related to notch form, and shall be similar to figure 21, except it shall have the following number of thread sizes: 2, 2-1/2, 3, 3-1/2, 4, 4-1/2, 5, 6, 8, and 10. A tool-setting gage shall be furnished with each thread-tool gage for setting 29 degree worm thread tools.

3.16 Special features. When gages with accuracy limits, scale graduations, or other features differing from those required by this specification are specified in the contract or order (see 6.2), the gages shall conform to this specification insofar as applicable.

3.17 Finish. All finished exterior surfaces of gages shall be such that surface roughness does not exceed 63 microinches AA. Unless otherwise specified herein, all gaging surfaces shall have a surface roughness not to exceed 16 microinches AA.

3.18 Manufacturer's identification. Each gage shall be marked in a permanent and legible manner with the manufacturer's name or with a trademark of such known character that the manufacturer may be readily determined, and the country of origin.

3.19 Workmanship. The gages shall be free from rust, fins, burrs, external sharp edges not required to be so, and any other defects which may affect their serviceability, durability, or appearance.

3.20 Marking. Type II, V, VI, VII, VIII, IX, and X gage markings, graduations and figures shall appear in a distinctive manner so as to be readily legible.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Sampling for quality conformance inspection.

4.2.1 Sampling. Sampling procedures shall be in accordance with MIL-STD-105, and shall be at level III for examination and level S-4 for testing.

4.2.2 Quality conformance inspection. Quality conformance inspection shall be performed on each sample gage selected in accordance with 4.2.1. Quality conformance inspection shall consist of the following:

- (a) Examination (4.3).
- (b) Tests (4.4).
- (c) Inspection and preparation for delivery (4.5).

4.3 Examination. Each of the sample gages selected in accordance with 4.2.1 shall be examined to determine conformance with this specification. Individual blades of types V, VII (class 1), VIII, and IX sample gages shall be selected and examined in accordance with table XII to determine conformance with this specification. Classification of defects shall be in accordance with table XI. The acceptable quality level shall be 2.5 percent defective for major defects and 4.0 percent defective for minor defects.

TABLE XI. Classification of defects.

Categories	Defects
<u>Critical</u>	None defined.
<u>Major</u>	
101	Type, class, style, and size not as specified (types I through X).
102	Size of gage not as specified; size of gage in set (if applicable) not as specified (type III, only).
103	Not as specified (type VIII only).
104	Materials defective or not as specified; evidence of cracks, rust, nonmetallic inclusions, injurious porosity, excess segregations, soft spots, hard spots, or other injurious defects.
105	Slide defective, not capable of sliding over the entire range of the base, or slide cannot be securely locked in any position; evidence of sticking, binding, shake, or play when slide is moved throughout its entire range of adjustment (type I only).
106	Extension(s) missing, defective, or not the required length; threads stripped, cracked, crossed, or drunken (not concentric) (type I only).
107	Slide not provided with the required threaded holes for mounting the extension (type I only).

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Categories	Defects
108	Level (if applicable) missing, defective or not secure; level glass cracked, cloudy, or not scribed for centering the bubble (type I only).
109	Measuring contact surfaces not finished as required evidence of fins, burrs, pits, nodules (types I and III only).
110	Range of measurement not as required (type I only).
111	Flat rule (if applicable) bent, warped, or crimped; round rule (if applicable) bent or out of round (type II only).
112	Graduations and numbers (rule and head) missing, illegible, not permanent, or bent or not as specified; graduation lines not uniform or evidence discontinuities, different fractional aliquots not readily distinguishable by their relative height (types II, VI, and VIII, class 3 only).
113	Head not flat or reference surface not smoothly ground (type II only).
114	Rule clamping device fails to clamp the rule in any position of depth or spring not prevented from being dislodged when nut is loosened (type II only).
115	Turret defective, fails to allow the required radial movement, or rule cannot be clamped in any radial position (type II, class 2 only).
116	Rule not readily removable, reversible (if applicable), and insertable from either end (type II only).
117	Thickness of flat rule (if applicable) not within the specified maximum and minimum values (type I only).
118	Diameter of round rule (if applicable) not within the specified maximum and minimum values (type II only).
119	Length of rule less than the specified minimum (type II only).
120	Thickness of head not within the specified maximum and minimum values (type II only).
121	Evidence of sticking, binding, or excessive looseness when rule is rotated (type II, class 2 only) or moved in the clamping device (type II only).
122	Adjusting device defective; threads stripped, torn, cracked, crossed, or not perfect full threads; evidence of sticking, binding, looseness, or excessive backlash when ball is adjusted through its full measuring range (type III, class 1 only).
123	Radius of measuring faces exceeds the maximum allowable (type III only).
124	Telescoping plunger not spring loaded; evidence of sticking, binding, or excessive looseness; locking device fails to clamp the plunger at any position of adjustment (type III, class 2 only).
125	Locking device threads stripped, torn, cracked, crossed, or not perfect full threads (type III, class 2 only).
126	Maximum setting of gage less than specified maximum (type III only).
127	Minimum setting of gage exceeds the specified minimum (type III only).
128	Bottom of base not smoothly finished, V-groove not centrally located, angle of V-groove not as required, or width of V-groove opening less than required (type IV only).
129	Spindle bent, not smoothly finished or less than the required diameter (type IV only).

Categories	Defects
130	Head defective, fails to lock the spindle at any position (angle), adjustment bracket not snugly fitted to the base, amount of angular adjustment less than required, not provided with a means to prevent backlash, or spindle (outer end) cannot be depressed below the level of the bottom of the base (type IV only).
131	Gage pins missing, not aligned, amount of projection below bottom surface of base is less than required, diameter of pins less than required, or not provided with a means to retain the pins in position (type IV only).
132	Scriber defective, points not sharp, length of bent point less than required, or diameter of scriber less than required (type IV only).
133	Scriber clamp fails to lock the scriber at any position on the spindle, or clamp fails to allow for rotation and longitudinal movement of the scriber (type IV only).
134	Evidence of change in position (or adjustment) of the scriber or spindle when the thumb nut is tightened on the scriber clamp or spindle locking member (type IV only).
135	Length of spindle or scriber not within the specified maximum and minimum values (type IV only).
136	Blades bent, crimped, or not flat (types V and VII only).
137	Thickness of any blades less than the specified minimum (type V only).
138	Teeth not uniform, not cleanly formed, evidence of fins or burrs, or blades not of the narrow width design (type V only).
139	Engagement length of teeth less than required (type V only).
140	Case bent, not rigidly constructed, does not enclose the wires and edges of the leaves, not provided with locknuts, clamping screws not removable, or case not notched as required (type V and VIII, classes 1 and 3, type IX, classes 1 and 2, style A only).
141	Each blade not permanently and legibly marked with the number of threads per inch (type V only).
142	Number of blades or thread sizes (number of threads per inch) or range, or size increments not as specified (types V and VII only).
143	Edges not smoothly ground; evidence of fins, burrs, tool marks, nicks or rough edges (type VI only).
144	Width of notches not as specified (type VI only).
145	Opposite longitudinal edges not parallel or included angle between longitudinal and transverse edges not as specified (type VI only).
146	Thickness of gage not within the specified maximum and minimum values (type VI only).
147	Edges not square (with faces) or not smoothly finished; evidence of fins, burrs, tool marks, nicks, or rough edges (type VII only).
148	Case bent, not rigidly constructed, or not notched as required (type VII, class 1 only).
149	Double-end blades (if applicable) not provided with a lengthwise slot to permit extension of the blades (type VII, class 1 only).
150	Not provided with five gaging surfaces of the same size on each blade (type VII, class 2 only).
151	Inside edge and outside edge of each leg not parallel (type VII, class 2 only).

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Categories	Defects
152	Gage holder (or handle) defective or fails to lock the blade in the required angular position (type VII, class 2 only).
153	Thickness of blades not within the specified tolerance (type VII only).
154	Leaves (or stock) warped, bent, crimped, or cupped (types VIII and IX, class 1 only).
155	Leaves (or stock) not smoothly finished; evidence of nicks, fins, burrs, or tool marks (type VIII only).
156	Leaves fail to fold together (without interference), locking device defective or not as required (type VIII, class 2 only).
157	Wire gage leaf does not provide the specified number and sizes of wire gaging slots or slots not marked; gaging slots not smoothly finished; evidence of fins or burrs (type VIII, class 3 only).
158	Taper-thickness lead does not provide the specified thickness range and increments or spacing between reference lines not within the specified maximum and minimum values; marking (thickness) missing, illegible, or incorrect (type VIII, class 3 only).
159	Case bent or defective (type VIII, class 4, style B only), or leaves (type VIII only).
160	Thickest leaves (on gages having leaves less than 0.010 inch thick) not placed on the outside (type VIII, class 2 only).
161	Wires crimped, broken, or not securely attached (type IX only).
162	Electrode bender missing, defective, or not of solid construction (type IX only).
163	Thickness marking missing, illegible, incorrect, or not permanent (types VIII and IX only).
164	Amount that wires extend from housing (or holder) is less than the required minimum (type IX only).
165	Slots not smoothly ground; evidence of fins, burrs, tool marks, nicks, or rough edges (type X only).
166	Tool setting gage missing, edges not smoothly ground; evidence of fins, burrs, nicks, or tool marks (type X only).
167	Gage(s) bent, crimped, or warped (type X only).
168	Number and sizes of thread notches not as specified; thread size marking missing, illegible, incorrect, or not permanent (type X only).
169	Not provided with a notch (for checking included angle) and tool setting edge (type X, class 2 only).
<u>Minor</u>	
201	Marking, manufacturer's name, trademark, or country of origin missing, illegible, incorrect, or not permanent (types I, through IV, type VI, and types VIII through X).
202	Length or width of base not within the specified minimum values (type I only).
203	Length or width of gage not within the specified maximum and minimum values (types IV and VI, and type VII, class 1 only).
204	Locking screw or extension not knurled (type I only).
205	Diameter of extension not as required (type I only).
206	Case (if applicable), defective, not securely made, or case fails to accommodate all the parts of the gage so as to preclude damage during handling (type I only).
207	Width of head not within the specified maximum and minimum values (type II only).

Categories	Defects
208	Height of head not within the specified maximum and minimum values (type II only).
209	Width of flat rule (if applicable) not within the specified maximum and minimum values (type II only).
210	Gage not smoothly finished; evidence of fins, burrs, or rough surfaces (type II and V only).
211	Clamping nut not knurled (type II only).
212	Handle and adjusting (or locking) device knob not knurled (type III only).
213	Case (if applicable) defective, not flexible, or fails to accommodate all the gages in the set (type III only).
214	Thickness of base not within the specified maximum and minimum values (type IV only).
215	Sides of base not grooved (to facilitate handling) (type IV only).
216	End of case not fully rounded (type V only).
217	Thickness of case material less than required (types V and VII, class 1 only).
218	Ends of case (single and blades only) not fully rounded (type VII only).
219	Length of either leg of blade exceeds the specified maximum (type VII, class 2 only).
220	Length of holder not as required (type VII, class 2 only).
221	Case defective, not flexible, or does not provide a pocket for each blade (type VII, class 2 only).
222	Gage size marking, manufacturer's name or trademark missing, illegible, incorrect, or not permanent (type VII only).
223	Length or width of leaves (of stock, if applicable), not within the specified tolerance (type VIII and type IX, class 1 only).
224	Ends of leaves or case (if applicable), not fully rounded (type VIII, except class 4, style B and type IX, except class 2, style B, only).
225	Diameter or length and width of gage not as required (type X only).

4.4 Tests. Each of the sample gages selected in accordance with 4.2.1 and each blade selected in accordance with table XII shall be tested to determine conformance with this specification. Tests shall consist of 4.4.1 through 4.4.9 as applicable. The acceptable quality level shall be 2.5 percent defective.

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TABLE XII. Sampling of individual blades and wires for testing.

Type	Class	Number of blades and wires per sample gage	Number of blades and wires to be inspected from each sample gage 1/	Test reference
V		30 to 35	4	4.4.1, 4.4.5
		25 to 30	4	
		20 to 25	3	
		15 to 20	3	
		10 to 15	2	
VII	1	15 to 20	3	4.4.1, 4.4.8
		10 to 15	2	
		5 to 10	2	
VIII	1, 2, 3	30 to 35	4	4.4.1, 4.4.9
		25 to 30	4	
		20 to 25	3	
		15 to 20	3	
		10 to 15	2	
IX		20 to 25	3	4.4.1, 4.4.9
		15 to 20	3	
		10 to 15	2	
		5 to 10	2	

1/ The blades and wires shall be selected in such a manner as to insure testing of each blade and wire size.

4.4.1 Blade and wire hardness. Each sample gage and each individual blade selected shall be subjected to a hardness test to determine conformance with this specification. If any sample fails to meet this test, then the sample gage containing the nonconforming blade shall be rejected. A letter from the manufacturer may be furnished to certify that the wires meet the tensile strength requirement of 3.14.3.3.

4.4.2 Surface roughness. Surface roughness shall be determined at representative spots by commercially recognized instruments for surface roughness measurement.

4.4.3 Planeness. Planeness shall be checked with an optical flat where the surface finish so permits, or by means of a precision indicator and precision reference surface.

4.4.4 Angular trueness of reference surfaces. Angular trueness of reference surfaces shall be checked by means of a precision square and feeler gage, precision and angle blocks, precision dividing head, autocollimator, or method of equivalent accuracy.

4.4.5 Threads. Each sample blade for type V selected shall be tested for pitch and thread form by use of plug gages of known accuracy, projection comparator, or other suitable means to determine conformance with the requirements specified herein.

4.4.6 Graduations. Graduations shall be checked for straightness of edges, width, spacing, parallelism, and perpendicularity to edge of graduated surface by means of a toolmaker's microscope or a method of comparable accuracy. Depth of graduations shall be checked by measuring the height of the ridges formed in a wax impression or by a method of comparable accuracy.

4.4.7 Edge straightness. Edge straightness shall be tested with straightedges of known accuracy, with a precision indicator and reference surfaces such as a precision surface plate, with an autocollimator or method of comparable accuracy.

4.4.8 Profiles. Each sample gage selected and each individual blade selected shall be tested for profile by means of precision templates, projection comparator,

or other means of comparable accuracy to determine conformance with the requirements specified herein, as applicable. If any of the individual blades fails to meet this test, then the sample gage containing the nonconforming blade shall be rejected.

4.4.9 Thickness. Each type VIII and IX sample gage selected and each individual blade and wire selected shall be tested by a bench micrometer, or other means of comparable accuracy to determine conformance with the requirements specified herein.

4.5 Inspection of preparation for delivery. An inspection shall be made to determine that the preservation, packaging, packing, and marking requirements comply with section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking shall be in accordance with PPP-P-40.

6. NOTES

6.1 Intended use.

Type I gages, planer, are for use as a standard in setting the cutting tools on planers and shapers.

Type II gages, depth, steel rule, are for use in determining the depths of holes, slots, and grooves.

Type III gages, internal measuring, are intended for use in transferring hole diameters and slot widths to micrometer calipers for direct readings.

Type IV gages, surface, universal, are intended for use in scribing lines in the layout of work.

Type V gages, screw pitch, are for use in measuring the pitch of screw-threads.

Type VI gages, center, 60 degree, are intended for use in measuring and setting 60 degree threading tools.

Type VII gages, fillet and radius, are for use in visual determination of accuracy of radii and fillets.

Type VIII gages, thickness (feeler), are for use in checking narrow slots and clearance between fitted parts.

Type IX gages, gap setting, are for use in setting gaps such as spark plug and relay gaps.

Type X gages, thread tool, 29 degree, are for use in measuring the thread form of and setting 29 degree threading tools.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Type, class, and style of gage required (see 1.2).
- (c) Size required (see tables I through X, 3.8.1.2, 3.9, and 3.13.2).
- (d) Type I, if level in base is not required (see 3.6.1).
- (e) Type I, whether extra extensions are required (see 3.6.3).
- (f) Type I, whether case is required (see 3.6.4)
- (g) Type II, whether round rule or round and flat rules are required (see 3.7.1).
- (h) Type II, class 2, angle and number of graduation lines required (see 3.7.2.1).
- (i) Type III, whether individual gages or sets required; if sets, items comprising same (see 3.8.1.4 and 3.8.2.3).
- (j) Type V, Whether double depth of thread to be shown on side of case and whether blade locking device is not needed (see 3.10.1.1)
- (k) Type V, screw-pitch gage with thread per inch combinations other than listed required (see 3.10.2.4).
- (l) Type VI, if double depth of thread data is required (see 3.11.1), specify either of the following:
 - "Double depth of American National Thread data is required to be marked on gage."
 - "Double depth of sharp V-thread is required to be marked on gage."

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- (m) Composition of sets required (see 3.13.2).
- (n) Type VII, when radius gage holder is not required (see 3.12.3.3).
- (o) Type VIII, thickness blade combination or length other than listed required (see 3.13.2).
- (p) Type VIII, when straight leaves are to be furnished (see 3.13.3).
- (q) When a one-piece case is acceptable for type VIII, class 1, thickness gages (see 3.13.6).
- (r) Type VIII, leaf thickness required (see 3.13.9, 3.13.11.1, and 3.13.11.2).
- (s) Type VIII, class 4, length of individual leaves required (see 3.13.11.1).
- (t) Type VIII, finish required, if other than specified (see 3.13).
- (u) Specify when gage features other than those specified herein are required (see 3.16).
- (v) Type IX, leaf combinations if other than specified (see 3.14.2.1).

MILITARY INTERESTS:

PREPARING ACTIVITY:

Custodian:

GSA/FSS

Air Force - 99

Review Activity:

Air Force - 84