ASME B107.500-2020

(Revision of ASME B107.500-2010)

Pliers and Shears

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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This Standard will be revised when the Society approves the issuance of a new edition.

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

The American National Standards Committee B107, Socket Wrenches and Drives, under sponsorship of The American Society of Mechanical Engineers (ASME), was reorganized on June 28, 1967 as an ASME Standards Committee, and its title was changed to Hand Tools and Accessories. In 1996, its scope was expanded to include safety considerations.

In 1999, ASME initiated a project to consolidate hand tool standards by category of tool. The initial implementation included distinct standards within a single publication bearing a three-digit number corresponding to the responsible B107 subcommittee. It was intended that subsequent revisions would integrate the component standards resulting in a more traditional document. To maintain continuity within the user community, the former component standard numbers are renamed as categories in the consolidated standard. Types, classes, styles, and designs were retained.

The purposes of this Standard are to define dimensional, performance, and safety requirements specifically applicable to pliers and shears; to specify test methods to evaluate performance relating to the defined requirements; and to indicate limitations of safe use.

To comply with the ASME directive to address Additive Manufacturing processes in B107 standards, a failure mode test has been added.

This Standard may be used as a guide by state authorities or other regulatory bodies in the formulation of laws or regulations. It is also intended for voluntary use by establishments that use or manufacture the tools covered.

This Standard supersedes, replaces, and renders obsolete the following standards:

B107.11 Pliers: Diagonal Cutting and End Cutting
B107.13 Pliers: Long Nose, Long Reach
B107.16 Shears (Metal Cutting, Hand
B107.18 Pliers: Wire Twister
B107.19 Pliers: Retaining Ring
B107.20 Pliers: Lineman's, Iron Worker's, Gas, Glass, Fence, and Battery
B107.22 Electronic Cutters and Pliers
B107.23 Pliers: Multiple Position, Adjustable
B107.24 Pliers: Locking, Clamp, and Tubing Pinch-Off
B107.25 Pliers: Performance Test Methods
B107.27 Pliers: Multiple Position, Electrical Connector
B107.37 Pliers: Wire Cutters/Strippers

Members of the Hand Tools Institute Pliers and Shears Standards Committee, through their knowledge and hard work, have been major contributors to the development of the B107 standards. Their active efforts in the promotion of these standards are acknowledged and appreciated.

ASME B107.500-2020 was approved by the B107 Standards Committee on January 3, 2020, and by the Board on Standards and Testing on January 3, 2020. It was approved as an American National Standard on January 21, 2020. The requirements of this Standard take effect upon its issue date.

ASME B107 COMMITTEE
Hand Tools and Accessories

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B107 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the B107 Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B107 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B107 Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Attending Committee Meetings. The B107 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B107 Standards Committee. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/B107committee.

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PLIERS AND SHEARS

1 SCOPE

This Standard provides performance and safety requirements for pliers suitable for cutting wire; for long-nose, long-reach pliers; for hand shears generally used for cutting sheet metal; for wire-twister pliers, which are used primarily for securing safety wires; for pliers suitable for inserting and removing internal and external retaining rings, including those covered by ASME B18.27; for pliers having gripping surfaces and/or cutting edges; for cutters and pliers less than 6 in. long, equipped with a spring, typically used in the manufacture of electronic equipment; for adjustable joint and slip joint pliers; for locking pliers that are suitable for gripping, clamping, pinching, cutting, and wrenching; for pliers (also known as Cannon Plug Pliers) that are used primarily for connecting or disconnecting threaded lock collars of electrical connectors; and for wire strippers, and the cutting and stripping functions of multipurpose tools, for use on solid and stranded copper wire. The tools covered in this Standard are listed by Category number in Sections 6 through 16.

Inclusion of dimensional data in this Standard does not mean that all products described herein are stock production sizes, nor that all production sizes are listed. Consumers should consult with manufacturers concerning lists of stock production sizes.

This Standard also details the purpose, apparatus, procedures, and performance specifications for the functional testing of pliers and shears. It is intended to be used by manufacturers, purchasers, and other persons involved with evaluating these products. Test procedures described herein are used to evaluate conformance to performance requirements.

This Standard may be used as a guide by state authorities or other regulatory bodies in the formulation of laws or regulations. It is also intended for voluntary use by establishments that manufacture the tools covered.

2 DEFINITIONS

blade pattern: orientation and configuration of the cutting blades.

compound leverage: a system of pivot points that multiply the force applied at the handles and transfer that force to the cutting blades.

convertible: changeable from internal to external setting by disassembly.

copier paper: 20-lb 84-92 GE brightness grain long multipurpose paper or other paper conforming to ASTM D3460.

crusher: parallel flat areas on the inside handle surfaces near the pivot, designed for crushing.

deflection: movement under load.

force: the action of one body on another body that changes, or tends to change, the position or motion of the body acted on.

full length of cut: maximum distance cut in one operation.

initial load: a small force applied to the pliers' handles during the hand load test prior to the major load.

jaw area: the portion of the pliers between the fastener (pivot point) and the cutting or gripping end.

length of cut: the distance cut in one operation.

load: mass or force, depending on use. A load that produces a force due only to gravity may be expressed in mass units. Any other load is expressed in force units.

major load: the force applied to the pliers' handles during the handle load test intended to deflect the handles.

moment: a measure of the tendency of a force to rotate a body upon which it acts about an axis.

permanent set: the difference in distance, measured at a right angle to the centerline, between handles before and after application and removal of the major load (also known as plastic deformation).

room temperature: 60°F to 80°F.

scored surface: serrated or crosshatched surface to enhance gripping ability.

shall, should, and may: mandatory requirements of this Standard are characterized by the word *shall*. If a provision is of an advisory nature, it is indicated by the word *should* or is stated as a recommendation. If a provision is of an optional or alternative nature, it is indicated by the word *may.*

shearing blades: blades that have a single contact point (with each other) that moves from the joint end of the blade to the tip of the blade as handles close.

shroud: device used to limit tip travel on external ring pliers.

universal: changeable from internal to external setting without disassembly.

Additional definitions are shown in ISO 5742.

3 REFERENCES

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest edition shall apply.

ASME B18.27, Tapered and Reduced Cross Section Retaining Rings (Inch Series)
ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay)
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM A240/A240M, Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A313, Standard Specification for Stainless Steel Spring Wire
ASTM A1008/A1008M, Standard Specifications for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM D2240, Standard Test Method for Rubber Property — Durometer Hardness
ASTM D3460, Standard Specification for White Watermarked and Unwatermarked Bond, Mimeo, Spirit Duplicator, Reprographic, and Laser Printer Cut-Sized Office Papers
ASTM E18, Standard Test Methods for Rockwell Hardness of Metallic Materials
ASTM E384, Standard Test Method for Microindentation Hardness of Materials
Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

ISO 5742, Pliers and nippers — Nomenclature
Publisher: International Organization for Standardization (ISO), Central Secretariat, Chemin de Blandonnet 8, Case postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

MIL-W-16878, Wire, Electrical Insulated, High Temperature
Publisher: Department of Defense, Standardization Documents, Order Desk, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094 (www.dsp.dla.mil)

Guide to Hand Tools — Selection, Safety Tips, Proper Use and Care
Publisher: Hand Tools Institute (HTI), 25 North Broadway, Tarrytown, NY 10591 (www.hti.org)

SAE J1703, Motor Vehicle Brake Fluid
Publisher: Society of Automotive Engineers (SAE International), 400 Commonwealth Drive, Warrendale, PA 15096-0001 (www.sae.org)

4 CLASSIFICATION

Categories, Types, Classes, and Styles of tools covered in this Standard are shown within each appropriate Section.

5 GENERAL PERFORMANCE REQUIREMENTS

Requirements in this section apply to all categories. Sections 6 through 16 indicate additional requirements specific to the respective category.

Pliers and shears shall pass applicable tests in Section 17 without cracking, breaking, or requiring repair or readjustment to any components during testing.

Pliers and shears shall be similar to those depicted in the referenced figures and shall be proportioned in all parts to be strong, durable, and easy to operate.

(a) Figures. The illustrations shown herein are descriptive, not restrictive, and are not intended to preclude the manufacture of pliers that are otherwise in accordance with this Standard. All figures are shown without comfort grips.

(b) Dimensions. Table values are in inches unless otherwise specified. Dimensions in tables are without comfort grips. Overall length dimensions shall be determined by measuring the pliers with jaws in the closed (and locked, where applicable) position.

5.1 Materials

The materials used in the manufacture of the pliers and shears shall be such as to produce pliers and shears conforming to this Standard.

5.2 Finish

Metallic surfaces shall have a rust preventive treatment and be free from pits, nodules, burrs, cracks, and other conditions that adversely affect the performance or safety of the pliers. When provided, coatings shall be adherent and free from any condition that interferes with their protective value, safety, and function.

5.3 Marking

Pliers shall be marked in a plain and permanent manner with the manufacturer's name or trademark of such known character that the manufacturer can be readily determined. Marking shall be as permanent as the normal life expectancy of the pliers to which it is applied (provided the marked surface has not been subjected to a fretting or abrading action) and be capable of withstanding the cleaning normally experienced during its intended use.

5.4 Handles

Handles shall be shaped to provide a comfortable grip and shall be free from rough edges and sharp corners. Ends of handles shall not touch when the jaws are in a closed position. Outer hand gripping surfaces shall be smooth, knurled, impressed, or furnished with comfort grips.

5.5 Comfort Grips

When comfort grips are furnished on handles, they shall be made of rubber, plastic, or other suitable material capable of withstanding normal use without deteriorating or rubbing off and shall pass the solvent resistance test specified in para. 17.4. Comfort grips shall remain permanently attached under normal use. Unless specifically designed, labeled, and tested for such use, tools with comfort grips shall not be advertised or marked as having any nonconductive or electrically insulating properties.

5.6 Joint

Pliers' halves shall be joined in a permanent manner using a fastener, rivet, or other suitable device. The joint shall operate without binding in all positions and shall not disengage under load. The joint shall not require adjustment. Joints shall have no excessive looseness, play, or any other indications of side play of the two halves of the pliers when opened or closed that would impair the function of pliers.

5.7 Spring

The spring, when supplied, shall be captive, durable, and capable of returning the handles to an open position.

5.8 Jaws

Jaws shall operate through the required pliers movement without binding and shall be either integral with, or securely affixed to, the handles. There shall be no excessive movement, play, or other indication of looseness of jaws that will affect pliers' function when they are in use.

5.8.1 Jaw Opening. Jaw opening shall be measured at the tips of the jaws. Jaws shall open in a smooth and uniform manner to their respective minimum jaw opening as specified in the applicable tables for the individual types and sizes of pliers. Beyond the minimum opening distance specified, the jaws may open at increased loads until the positive stop of the tool is engaged.

5.8.2 Cushion Grip Throat. The cushion grip throat, when provided, shall grip and retain the cut wire end. It shall be made of rubber, plastic, or other suitable material capable of withstanding normal use without deteriorating or rubbing off and shall pass the solvent resistance test specified in para. 17.4. Cushion grip throat shall remain permanently attached under normal use.

6 CATEGORY 11 DIAGONAL-CUTTING AND END-CUTTING PLIERS

(a) General. Pliers shall be suitable for cutting wire, with cutting edges diagonal to or at right angles to their longitudinal axis.

Cutting edges shall be designed to produce one of the severed wire profiles illustrated in Figure 6-1.

(b) Classification. See Table 6-1.

6.1 Type I, Diagonal Cutting, Regular Nose

One side of the jaws shall be recessed to provide a suitable cutting-edge clearance. Pliers shall be similar to Figure 6.1-1, Figure 6.1-2, Figure 6.1-3, or Figure 6.1-4 and shall conform to dimensions shown in Table 6.1-1 for the size specified. Type I pliers may have stripping notches (a W-shaped notch on the outside of each jaw) and/or a skinning hole (a hole in the cutting edges for stripping insulation from wire) as shown in Figure 6.1-3. Type I pliers may also have a cushion grip throat similar to that shown in Figure 6.1-4.

6.2 Type II, Regular Nose, Compound Action

Pliers shall be of a compound leverage construction with spring-operated, self-opening handles. Pliers shall be similar to Figure 6.2-1 and conform to the dimensions shown in Table 6.1-1 for the size specified.

6.3 Type IV, End Cutting

The cutting edges shall be at right angles to the plane of the handles. Pliers shall be similar to Figure 6.3-1 and shall conform to dimensions shown in Table 6.1-1 for the size specified.

6.4 Handle Hardness

Handles shall have a hardness from 35 HRC to 50 HRC or equivalent.

6.5 Fastener Hardness

The fastener hardness shall be from 25 HRC to 50 HRC except when the fastener receives a case-hardening treatment in addition to the through hardening, in which case a maximum hardness equivalent to 60 HRC shall be permitted.

6.6 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

6.7 Jaw and Cutting-Edge Hardness

Cutting-edge hardness shall be 55 HRC to 65 HRC or equivalent. The balance of the jaw area shall have a minimum hardness of 35 HRC.

Figure 6-1 Typical Profiles of Severed Copper Wire With Corresponding Cutting-Edge Cross Sections

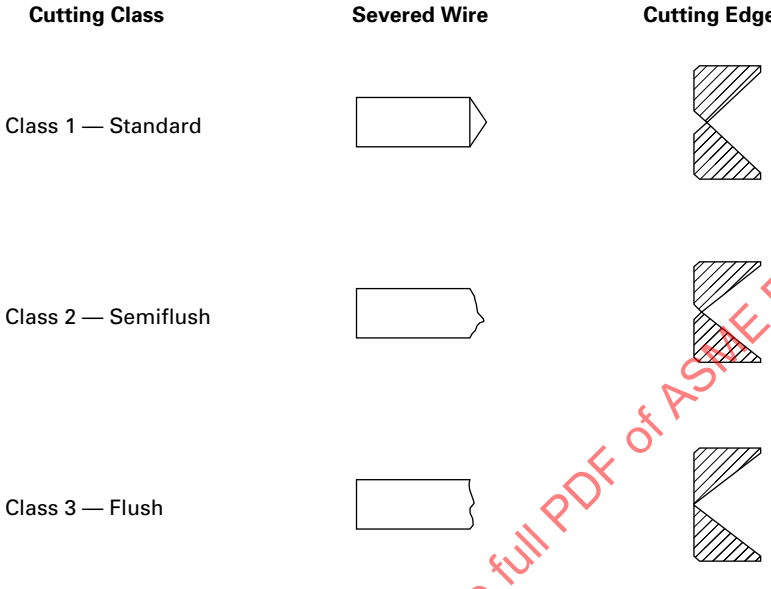


Table 6-1 Classification for Diagonal-Cutting and End-Cutting Pliers — Category 11

Type	Class
I — diagonal cutting, regular nose	1 — standard cutting edges
	2 — semiflush cutting edges
	3 — flush cutting edges
II — regular nose, compound action	1 — standard cutting edges
	2 — semiflush cutting edges
	3 — flush cutting edges
III — discontinued	...
IV — end cutting	1 — standard cutting edges
	2 — semiflush cutting edges
	3 — flush cutting edges

Figure 6.1-1 Category 11 Type I, Diagonal Cutting, Regular Nose, Plain

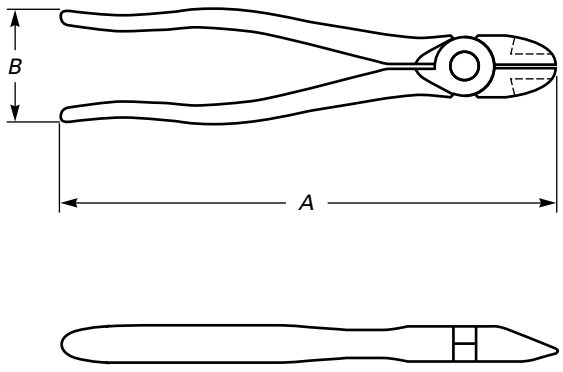


Figure 6.1-2 Category 11 Type I, Alternate Design

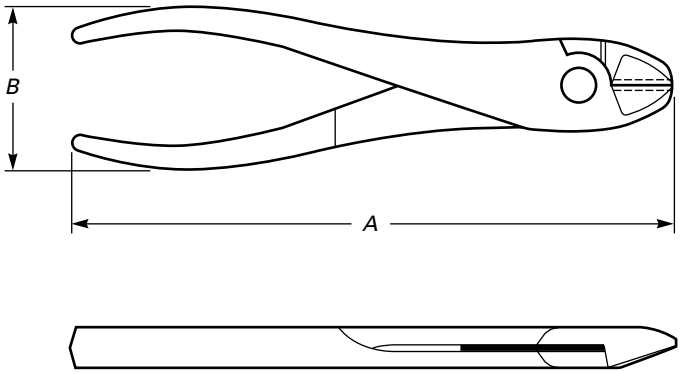


Figure 6.1-3 Category 11 Type I, Alternate Design With Stripping Notches and Skinning Hole

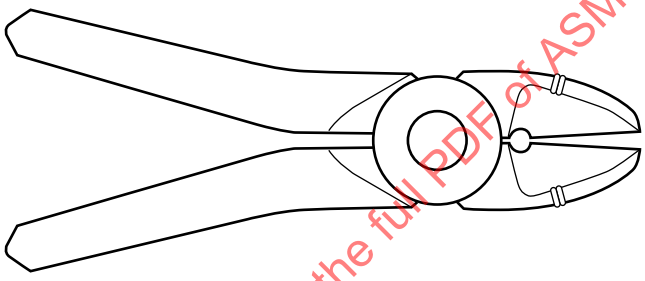


Figure 6.1-4 Category 11 Type I, Alternate Design With Cushion Grip Throat

Table 6.1-1 Category 11 Dimensional Requirements

Type	Nominal Size	Overall Length, *A* [Note (1)]		Handle Span, *B* [Note (1)]		Minimum Jaw Opening
		Min.	Max.	Min.	Max.	
I	4	3.87	4.25	1.65	2.00	0.19
I	4½	4.25	4.69	1.65	2.13	0.25
I	5	4.87	5.25	1.65	2.13	0.31
I	6	5.50	6.50	1.65	2.25	0.44
I	7	6.62	7.81	1.65	2.25	0.50
I	8	7.50	8.50	1.65	2.25	0.50
I	9	8.51	10.00	1.65	2.25	0.50
I	11	10.50	11.50	1.75	2.25	0.50
II	5½	5.25	5.75	1.69	2.25	0.19
IV	4½	3.87	5.00	1.31	1.94	0.12
IV	6	5.75	6.75	1.44	2.06	0.19
IV	7	6.75	7.75	1.56	2.19	0.25
IV	8	7.75	8.75	1.56	2.19	0.25

NOTE: (1) For plain handles without comfort grips.

Figure 6.2-1 Category 11 Type II, Regular Nose, Compound Action

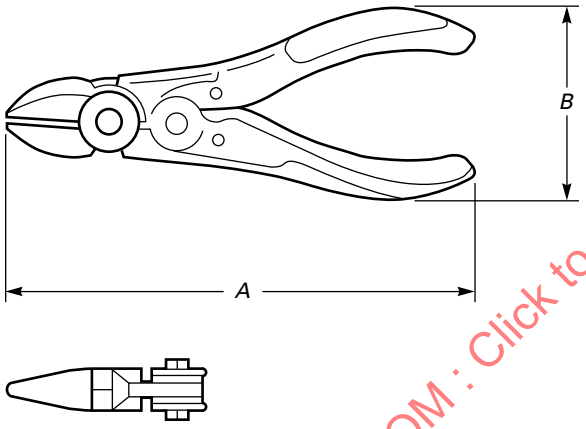
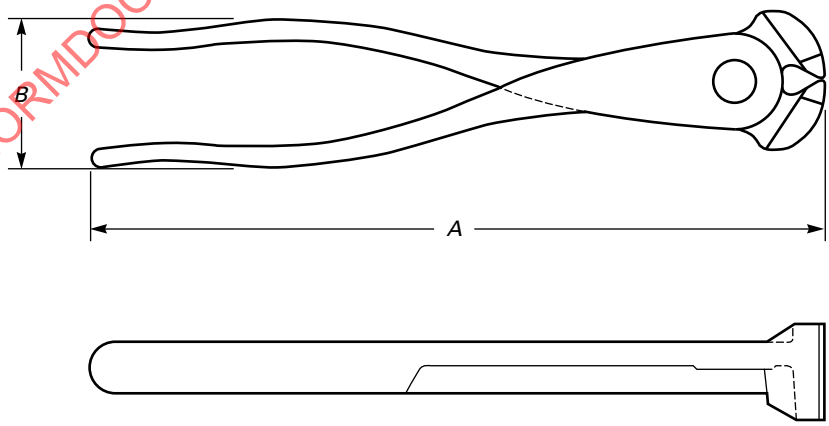


Figure 6.3-1 Category 11 Type IV, End Cutting



7 CATEGORY 13 LONG-NOSE, LONG-REACH PLIERS

See Table 7-1 for classification of long-nose, long-reach pliers.

7.1 Type I, Flat Nose/Duckbill

The jaws of Type I pliers shall taper as specified in the tables. The jaws shall contact each other at the outermost end when the pliers are in a closed position.

7.1.1 Class 1, Narrow Nose. Class 1 pliers shall taper uniformly in thickness and in width from near the joint to the outermost end. Scoring on jaw gripping surfaces shall begin at the jaw tips and extend 25% to 33% of jaw length. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to those shown in Figure 7.1.1-1.

7.1.2 Class 2, Medium Nose. The width of the jaws shall be uniform throughout and shall taper in thickness from near the joint to the outermost end. Scoring on jaw gripping surfaces shall begin at the jaw tips and extend 25% to 33% of jaw length. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.1.2-1.

7.1.3 Class 3, Wide Nose. The gripping jaws shall be of uniform width and shall taper in thickness from near the joint to the outermost end. Scoring on jaw gripping surfaces shall begin at the jaw tips and extend 25% to 33% of jaw length.

(a) Style A. Style A pliers (without cutter) shall conform to the requirements shown in Table 7.1.1-1 and shall be similar to the illustration shown in Figure 7.1.3-1.

(b) Style B. Style B pliers (with cutter) shall conform to the requirements of (a) except that the jaws have cutting edges on one side near the joint end.

7.1.4 Class 4, Long Reach, Flat Nose. The jaws shall taper uniformly in thickness and width from near the joint to the outermost end. The gripping surfaces of the jaws shall be scored. The length of the scoring shall be at least 0.5 in. back from the outermost end. The pliers shall conform to the requirements shown in Table 7.1.1-1 and shall be similar to the illustration shown in Figure 7.1.4-1.

7.2 Type II, Double Round Nose

Pliers shall be suitable for bending and shaping wire. The jaws shall be round in cross section so that the gripping surfaces are circular. The jaws shall taper uniformly from near the joint to the outermost end. With the pliers in a closed position, the jaws shall contact each other only at the outermost end. With the jaws parallel to each other, the distance between jaws shall be not less than 0.03 in. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.2-1.

7.3 Type III, Round Nose

The jaws shall be suitable for forming wire loops, handling small objects, and reaching into small openings. Each jaw shall be of half-round cross section so that the gripping surfaces are planar and straight. The jaws shall taper uniformly from near the joint section to the outermost end. Scoring on jaw gripping surfaces shall begin at the jaw tips and extend 25% to 33% of jaw length. The jaws shall contact each other at the outermost end when the pliers are in the closed position. If the nose design is elliptical, use dimensions *F* and *G*. If the nose design is circular, use dimension *F* only.

7.3.1 Class 1, Long Nose

(a) Style A. Pliers (without cutter) shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.3.1-1.

(b) Style B. The jaws (with cutter) shall be provided with cutting edges on one side adjacent to the joint. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.3.1-2.

7.3.2 Class 2, Bent Nose. The jaws of Class 2 pliers shall be of half-round cross section so that the gripping surfaces are planar. The jaws shall be curved and shall taper from near the joint section or the bend to the outermost end. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.3.2-1.

7.3.3 Class 3, Short Nose. The jaws of Class 3 pliers shall be suitable for forming wire loops, handling small objects, and reaching into small openings. Each jaw shall be of half-round cross section so that the gripping surfaces are planar and straight. The jaws shall taper uniformly from near the joint section to the outermost end.

(a) Style A. Style A pliers (without cutter) shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.3.3-1 or Figure 7.3.3-2.

(b) Style B. The jaws of Style B pliers (with cutter) shall be provided with cutting edges on one side adjacent to the joint. The pliers shall conform to the requirements shown in Table 7.1.1-1 for the size specified and shall be similar to the illustration shown in Figure 7.3.3-3.

7.3.4 Class 4, Needle Nose

(a) Style A. The jaws of Style A pliers (without cutter) shall be straight and shall taper from near the joint section to the outermost end. The pliers shall conform to the

requirements shown in Table 7.1.1-1 and shall be similar to the illustration shown in Figure 7.3.4-1.

(b) Style B. Style B pliers (with cutter) shall conform to the requirements of (a) except that the jaws shall be provided with cutting edges on one side adjacent to the joint.

7.4 Handle Hardness

Handles shall have a hardness from 35 HRC to 50 HRC or equivalent.

7.5 Fastener Hardness

The fastener hardness shall be from 25 HRC to 50 HRC except when the fastener receives a case-hardening treatment in addition to the through hardening, in which case a maximum hardness equivalent to 60 HRC shall be permitted.

7.6 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

7.7 Jaw and Cutting-Edge Hardness

Cutting edges shall have a hardness of 55 HRC to 65 HRC or equivalent. The balance of the jaw area shall have a minimum hardness of 35 HRC.

7.8 Scored Surfaces

Scored surfaces, where specified for gripping jaws, shall have visually sharp projections and be uniform in appearance.

Table 7-1 Classification for Long-Nose, Long-Reach Pliers — Category 13

Type	Class	Style
I — flat nose/duckbill	1 — narrow nose	...
	2 — medium nose	...
	3 — wide nose	A — without cutter
		B — with cutter
	4 — long reach, flat nose	...
II — double round nose	...	...
III — round nose	1 — long nose	A — without cutter
		B — with cutter
	2 — bent nose	...
	3 — short nose	A — without cutter
		B — with cutter
	4 — needle nose	A — without cutter
		B — with cutter

Table 7.1.1-1 Category 13 Pliers Dimensional Requirements

Type	Class	Nominal Size	Overall Length, *A*		Jaw Length, *B*		Handle Span, *E*		Nose Tip Thickness, *F*		Nose Tip Width, *G*		Bent Nose Length, *H*		Minimum Jaw Opening
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I	1	4½	4.69	4.94	1.06	1.19	1.63	2.13	0.03	0.06	0.13	0.19	...	...	0.63
I	1	5	5.31	5.69	1.63	1.88	1.63	2.13	0.03	0.06	0.09	0.16	...	...	0.63
I	1	7	7.25	7.75	2.25	2.75	1.63	2.13	0.02	0.08	0.13	0.38	...	...	1.00
I	2	4	4.38	4.88	0.75	1.25	1.69	2.19	0.03	0.13	0.06	0.19	...	...	0.38
I	2	5	5.00	5.50	1.13	1.63	1.50	2.00	0.08	0.19	0.28	0.41	...	...	0.50
I	2	6	6.00	6.50	1.25	1.75	1.75	2.25	0.08	0.19	0.28	0.41	...	...	0.63
I	2	7½	7.50	8.00	1.25	1.75	1.63	2.25	0.08	0.19	0.25	0.38	...	...	0.69
I	3	4	3.75	4.75	0.75	1.25	1.63	2.13	0.03	0.09	0.22	0.28	...	...	0.38
I	3	6	6.00	7.00	2.00	2.50	1.63	2.13	0.06	0.13	0.31	0.44	...	...	0.75
I	4	8	7.50	8.50	1.19	1.69	1.63	2.25	0.08	0.17	0.23	0.38	...	...	1.50
II	1	4½	4.25	4.75	0.63	0.88	1.75	2.00	0.09	0.16	0.05	0.08	...	...	0.38
II	1	6	5.75	6.75	1.13	1.63	1.63	2.13	0.13	0.25	0.06	0.13	...	...	0.63
III	1	4½	4.69	4.94	1.06	1.19	1.75	2.00	0.05	0.09	0.04	0.08	...	...	0.75
III	1	5	5.38	5.75	1.44	1.69	1.63	2.13	0.05	0.16	0.04	0.16	...	...	0.75
III	1	6	5.90	6.75	1.67	2.25	1.63	2.32	0.05	0.16	0.04	0.13	...	...	1.00
III	1	7	6.80	8.00	2.19	2.81	1.63	2.53	0.05	0.20	0.05	0.13	...	...	1.13
III	1	8	7.81	8.81	1.90	3.30	1.63	2.53	0.08	0.20	0.08	0.16	...	...	1.13
III	2	4½	4.00	5.00	0.50	1.00	1.75	2.00	0.09	0.16	0.06	0.13	0.38	0.63	0.50
III	2	6	5.50	7.40	1.25	1.90	1.63	2.53	0.08	0.20	0.06	0.13	0.63	2.40	0.50
III	3	4½	4.63	4.88	0.83	1.06	1.63	2.13	0.08	0.11	0.03	0.09	...	...	0.38
III	3	5	4.63	5.44	0.88	1.38	1.63	2.13	0.05	0.13	0.03	0.09	...	...	0.38
III	3	6	6.00	6.75	1.25	1.75	1.63	2.13	0.06	0.13	0.03	0.13	...	...	0.63
III	3	8	7.50	8.00	0.94	1.44	1.63	2.13	0.06	0.13	0.03	0.13	...	...	0.75
III	4	5	5.22	5.59	1.63	1.88	1.50	2.00	0.05	0.08	0.05	0.08	...	...	1.00
III	4	6½	6.00	7.00	1.80	2.69	1.50	2.25	0.04	0.19	0.02	0.14	...	...	1.50

Figure 7.1.1-1 Category 13 Type I, Class 1, Flat Nose/Duckbill, Narrow Nose

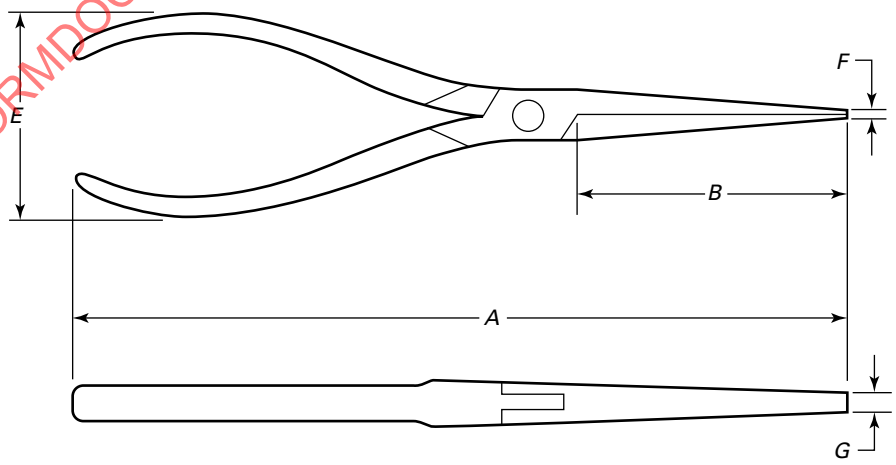


Figure 7.1.2-1 Category 13 Type I, Class 2, Flat Nose/Duckbill, Medium Nose

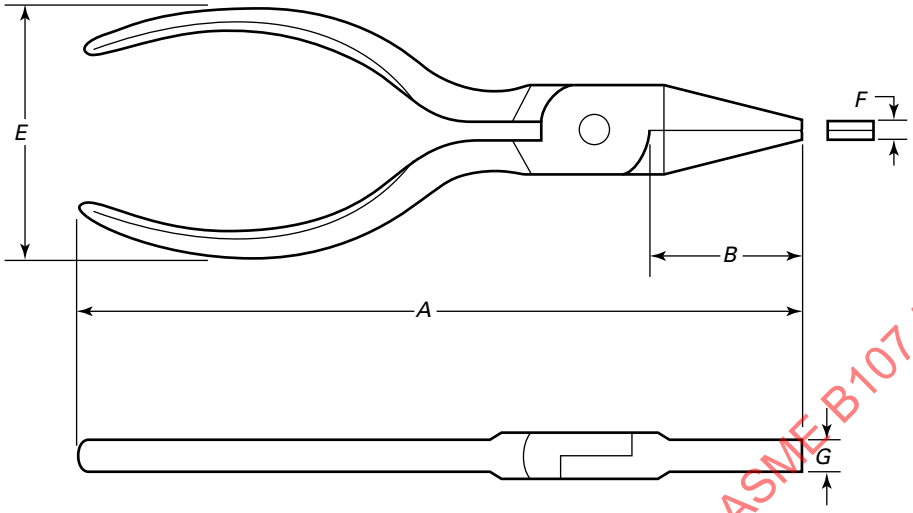


Figure 7.1.3-1 Category 13 Type I, Class 3, Style A, Flat Nose/Duckbill, Wide Nose, Without Cutter

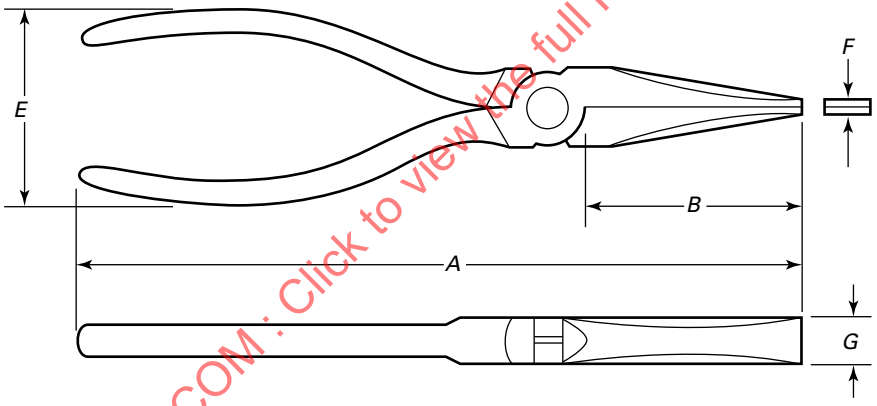


Figure 7.1.4-1 Category 13 Type I, Class 4, Flat Nose/Duckbill, Long Reach, Flat Nose

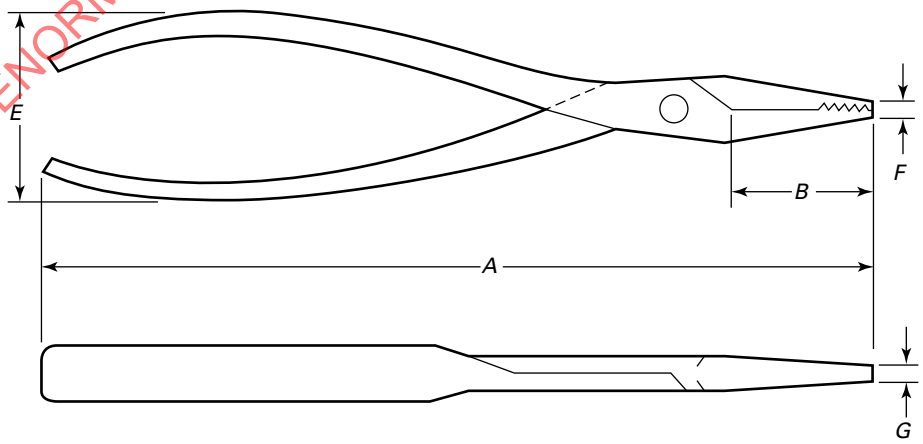


Figure 7.2-1 Category 13 Type II, Double Round Nose

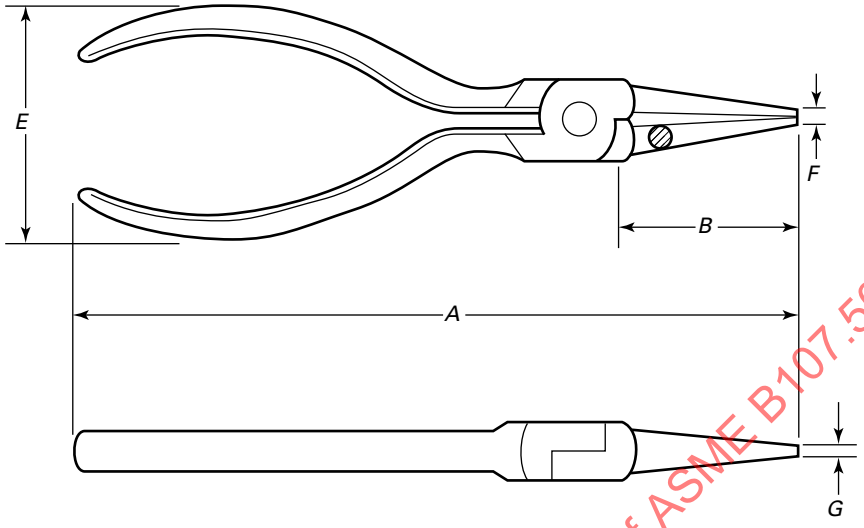


Figure 7.3.1-1 Category 13 Type III, Class 1, Style A, Round Nose, Long Nose, Without Cutter

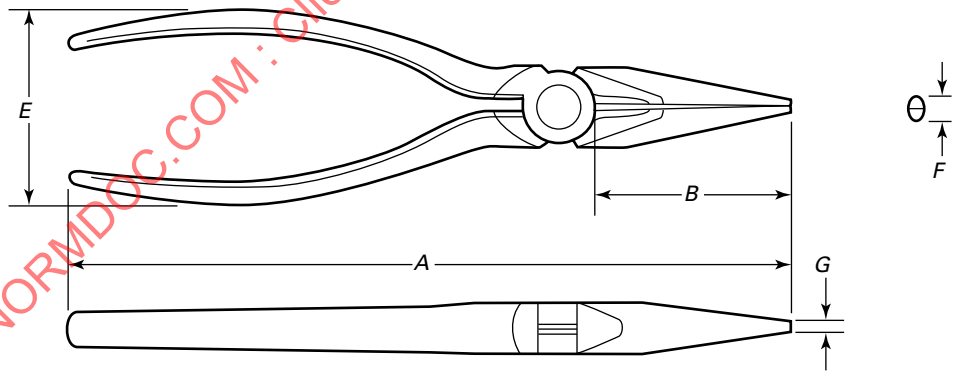


Figure 7.3.1-2 Category 13 Type III, Class 1, Style B, Round Nose, Long Nose, With Cutter

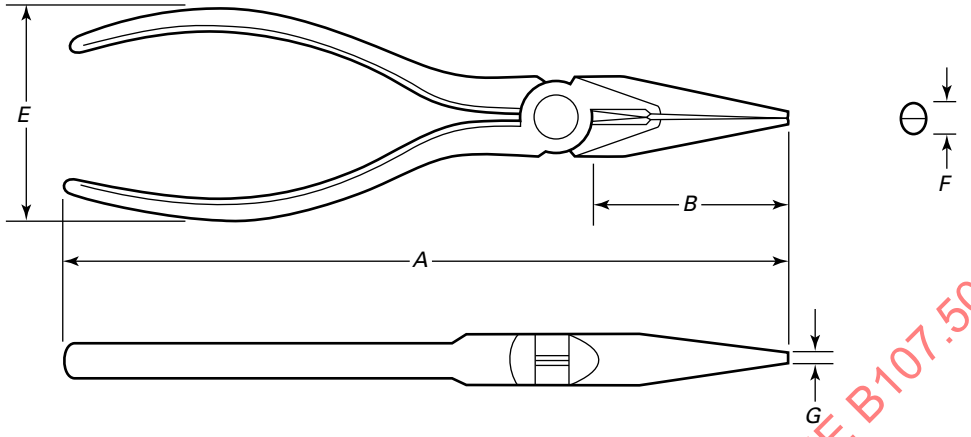


Figure 7.3.2-1 Category 13 Type III, Class 2, Round Nose, Bent Nose

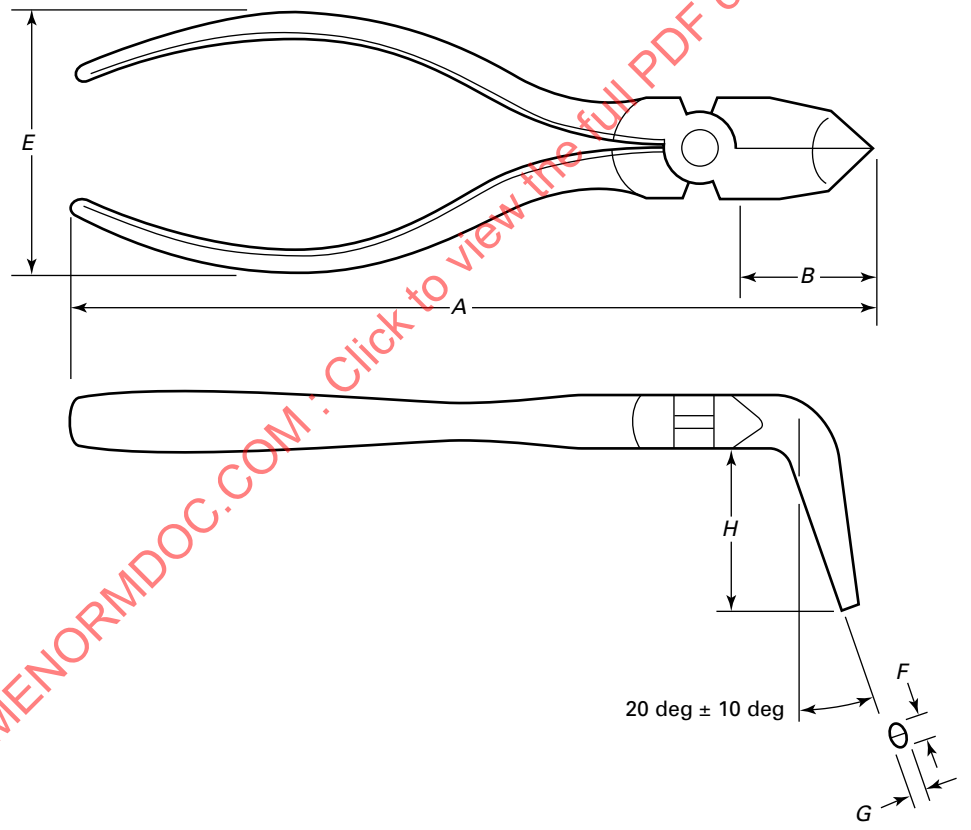


Figure 7.3.3-1 Category 13 Type III, Class 3, Style A, Round Nose, Short Nose, Without Cutter

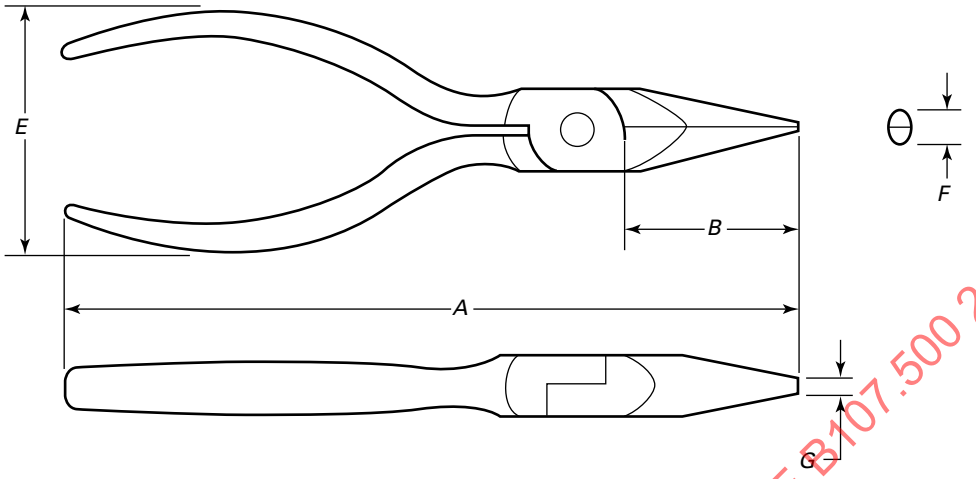


Figure 7.3.3-2 Category 13 Type III, Class 3, Style A, Round Nose, Short Nose, Without Cutter (Optional Design)

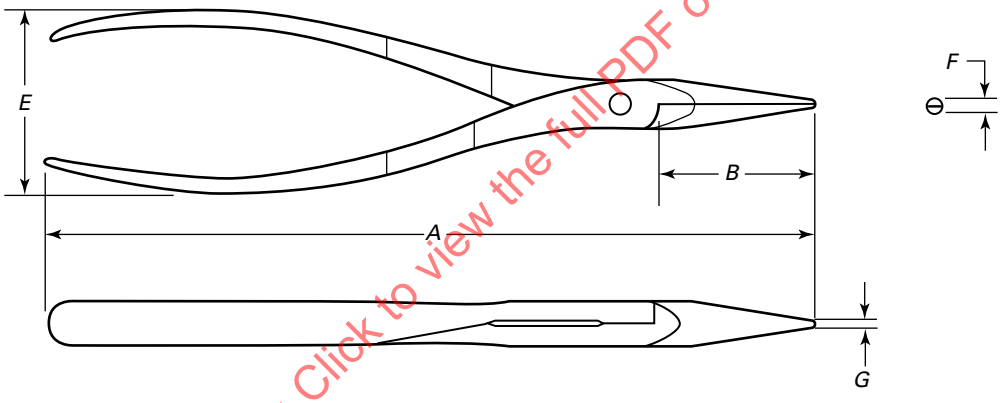


Figure 7.3.3-3 Category 13 Type III, Class 3, Style B, Round Nose, Short Nose, With Cutter

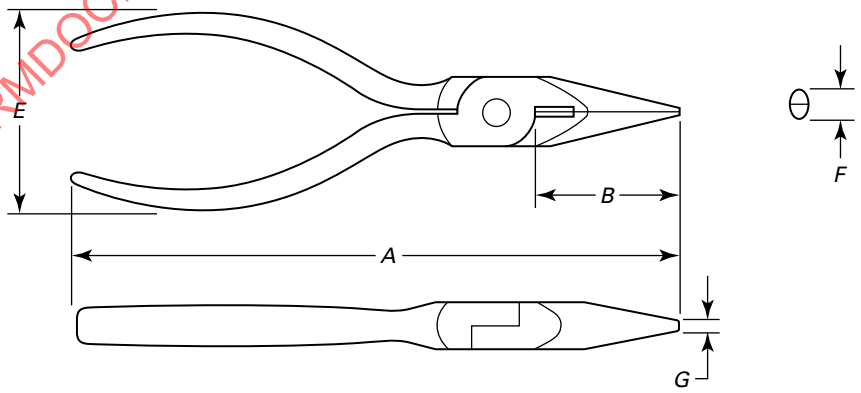
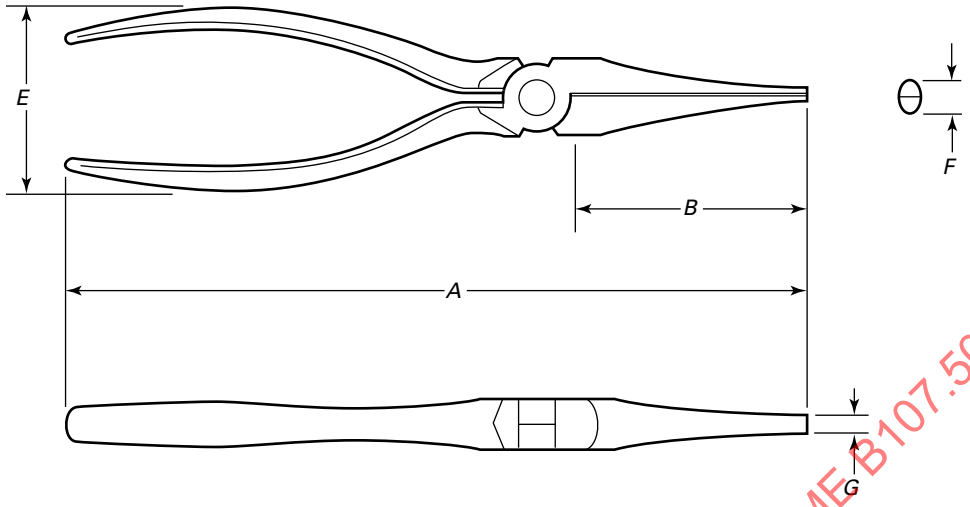


Figure 7.3.4-1 Category 13 Type III, Class 4, Style A, Round Nose, Needle Nose, Without Cutter



8 CATEGORY 16 SHEARS

(a) General. Shears shall be designed for hand operation. The cutting edges shall not need to be opened more than 45 deg (included angle) to obtain the length of cut specified in Table 8-1 in a single cutting operation. The handle area shall be smoothly finished and shaped to afford comfortable hand and finger gripping surfaces. Shears shall operate smoothly, with blade surfaces and pivots working smoothly and easily (without binding) from fully open to a fully closed position.

(b) Classification. See Table 8-2.

8.1 Type I, Tinner Shear

Shears shall consist essentially of two shearing blades, two handles, and a fastener. Clearance shall be provided between handles in a closed position to protect an operator's thumb and fingers.

8.1.1 Class 1, Straight Cut. Shears shall be straight cut blade pattern shears with bow-shaped handles.

(a) Style A, Fixed Blade. Shears shall be of solid construction with integral blades. Style A shears shall be similar to Figure 8.1.1-1 and shall comply with Table 8-1.

(b) Style B, Replaceable Blade. Shears shall be of replaceable blade construction. Style B shears shall be similar to Figure 8.1.1-2 and shall comply with Table 8-1.

(c) Style C, Fixed Blade Bulldog. Shears shall perform short cuts in thick material. Shears shall be similar to Figure 8.1.1-3 and shall comply with Table 8-1.

8.1.2 Class 2, Duckbill. Shears shall be duckbill blade pattern shears made with integral blades and handles and shall be designed for cutting intricate patterns and curves having short radii with a minimum amount of bending of the material being cut. Shears shall have bow-shaped handles, shall be similar to Figure 8.1.2-1, and shall comply with Table 8-1.

8.2 Type II, Compound Leverage

Shears shall have the same components as Type I, plus a mechanism to compound leverage. The cutting edges at the tips of Type II shears shall not overlap more than 0.09 in. when handles are pressed against their positive stops.

8.2.1 Class 1, Straight Cutting. Class 1 shears shall be designed primarily for straight cutting but may be capable of cutting patterns and wide curves. They shall be similar to figures referenced and shall conform to the applicable requirements of Table 8-1.

(a) Style A shears shall have a regular blade pattern and be similar to Figure 8.2.1-1.

(b) Style B shears shall have a bulldog blade pattern and be similar to Figure 8.2.1-2.

(c) Style C shears shall have a long cut blade pattern and be similar to Figure 8.2.1-3.

8.2.2 Class 2, Straight and Circular Cutting to the Right. Class 2 shears shall be designed primarily for making straight and circular cuts to the right, shall be similar to Figure 8.2.2-1, and shall conform to the applicable requirements of Table 8-1.

8.2.3 Class 3, Straight and Circular Cutting to the Left. Class 3 shears shall be designed primarily for making straight and circular cuts to the left, shall be similar to Figure 8.2.3-1, and shall conform to the applicable requirements of Table 8-1.

8.2.4 Class 4, Offset Jaw Straight and Circular Cutting to the Right. Class 4 shears shall be designed primarily for making straight and tight circular cuts to the right while flowing material away from the shearing blades and raising the user's hand above the working

surface. Shears shall be similar to Figure 8.2.4-1 and shall conform to the applicable requirements of Table 8-1.

8.2.5 Class 5, Offset Jaw Straight and Circular Cutting to the Left. Class 5 shears shall be designed primarily for making straight and tight circular cuts to the left while flowing material away from the shearing blades and raising the user's hand above the working surface. Shears shall be similar to Figure 8.2.5-1 and shall conform to the applicable requirements of Table 8-1.

8.3 Finish

Shears may have a painted, lacquered, enameled, plated, black oxide, or natural finish.

8.4 Handle Characteristics

Category 16 handles shall be free from flash and irregular or sharp projections and edges. All shears shall be provided with stops arranged to preclude the possibility of the handles being closed beyond the effective blade cutting point.

Category 16 Type II handles shall be provided with a mechanism to return the handles to the open position when the handle pressure is released. A handle-locking device shall be provided to keep shears in a closed position and designed so that it will not interfere with the operation of the shears.

8.5 Pivot

The pivot shall serve as a joint holding the blades together and shall provide a means for blade adjustment, other than peening. Pivot assembly components of Type I shears shall be made in accordance with one of the following requirements:

(a) hardened from 30 HRC to 40 HRC

(b) case hardened from 83 HR15N to 90 HR15N with a minimum case depth of 0.007 in.

The center pivot fastener of Type II shears shall be material having a minimum tensile strength of 150,000 psi and hardness of 30 HRC to 40 HRC.

8.6 Blades

Blades shall have hardness from 50 HRC to 61 HRC, and matching locations on the blades of any one pair of shears shall be within 4 HRC. Readings shall be taken within 0.12 in. of the cutting edge.

Type II blades shall be curved in the cutting (shearing) plane. One or both blades shall have serrated cutting edges. The serrations shall be evenly spaced and well defined throughout the effective length of the cutting blade.

Table 8-1 Category 16 Shears

Type	Class	Style	Nominal Size	Minimum Length of Cut	Test Material		Minimum Test Torque Limit, lbf-in. [Note (2)]
					Cold-Rolled Steel Gage [Note (1)]	Stainless Steel Gage [Note (1)]	
I	1	A	7	1.62	24	28	175
I	1	A	8	1.75	24	28	207
I	1	A	10	2.00	22	26	562
I	1	A	12½	2.75	20	22	960
I	1	B	12	2.75	26	28	480
I	1	B	13	2.75	26	28	480
I	1	B	14	2.75	26	28	480
I	1	C	16	2.25	16	18	1,683
I	2	...	7	1.50	26	28	155
I	2	...	10	2.00	24	26	450
I	2	...	12½	2.75	22	24	750
II	1	A	10	1.18	18	22	510
II	1	B	9	0.75	16	18	720
II	1	C	12	3.00	24	28	555
II	2, 3	...	10	1.18	18	22	480
II	4, 5	...	9	1.18	18	22	480

NOTES:

(1) See table below for test material steel gage thicknesses.

NOTES: (Cont'd)

Steel Gage	Thickness
16	0.0635–0.0568
18	0.0508–0.0449
20	0.0388–0.0344
22	0.0313–0.0284
24	0.0254–0.0225
26	0.0194–0.0172
28	0.0156–0.0142

(2) See Methods of Testing Torque Options 1, 2, 3, 4.

Table 8-2 Classification for Shears — Category 16

Type	Class	Style
I — tinner	1 — straight cut	A — fixed blade
		B — replaceable blade
		C — fixed blade bulldog
	2 — duckbill (straight and circular cut)	...
II — compound leverage (aviation)	1 — straight cutting	A — regular
		B — bulldog
		C — long cut
	2 — straight and circular cutting to the right	...
	3 — straight and circular cutting to the left	...
	4 — offset jaw straight and circular cutting to the right	...
	5 — offset jaw straight and circular cutting to the left	...

Figure 8.1.1-1 Category 16 Type I, Class 1, Style A

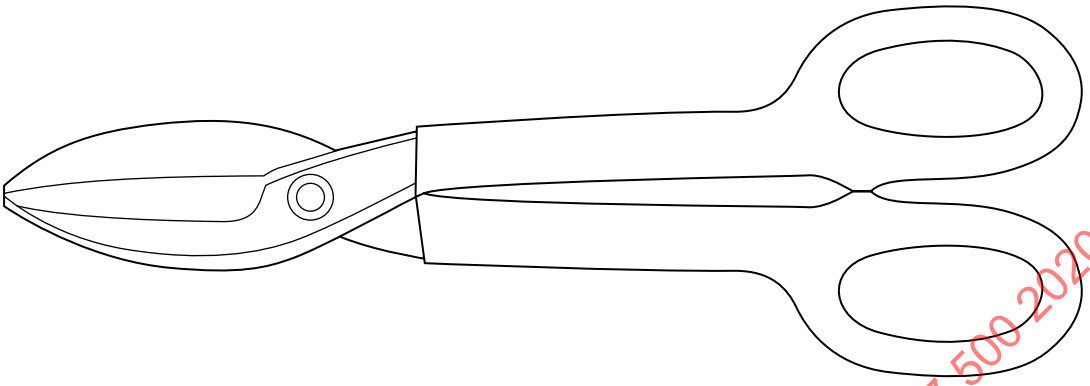


Figure 8.1.1-2 Category 16 Type I, Class 1, Style B

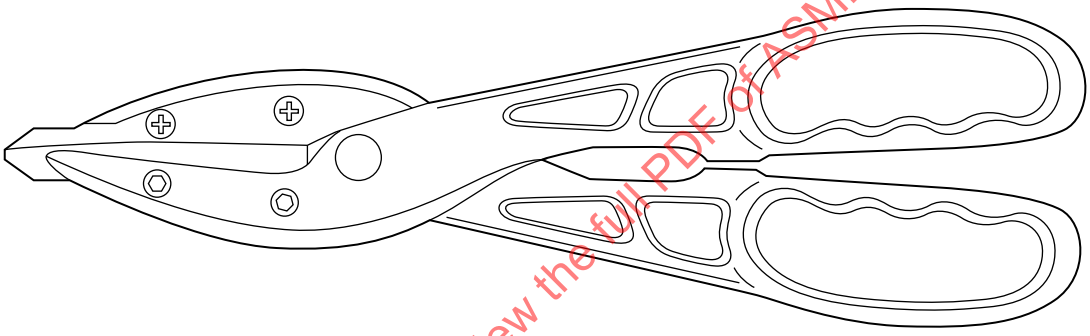


Figure 8.1.1-3 Category 16 Type I, Class 1, Style C

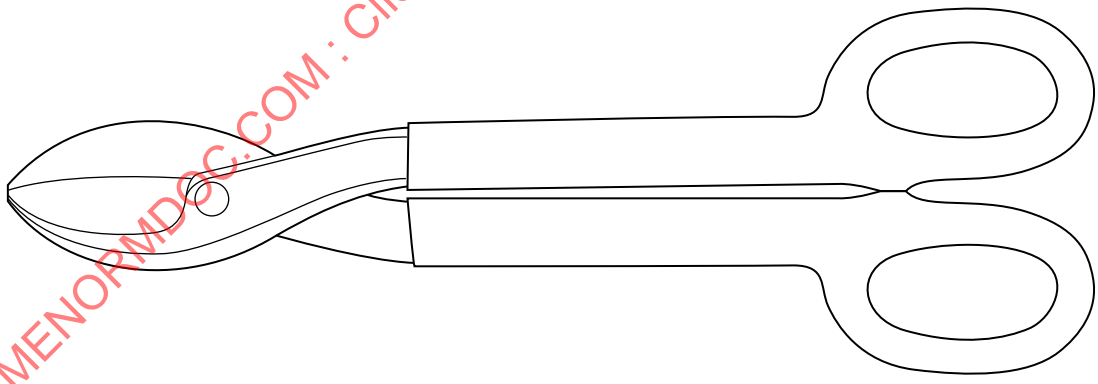


Figure 8.1.2-1 Category 16 Type I, Class 2

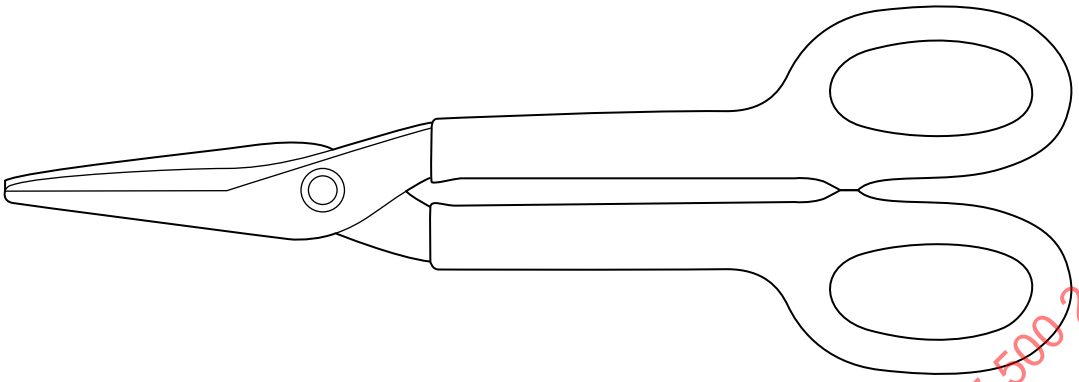


Figure 8.2.1-1 Category 16 Type II, Class 1, Straight Cutting Style A Regular

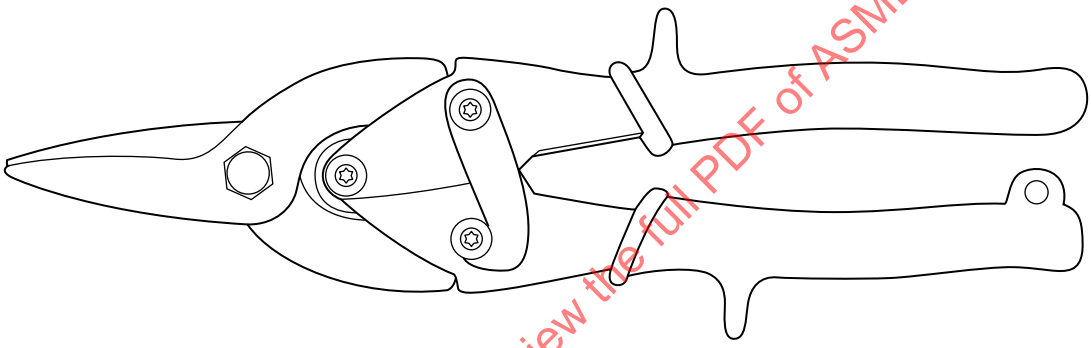


Figure 8.2.1-2 Category 16 Type II, Class 1, Straight Cutting Style B Bulldog

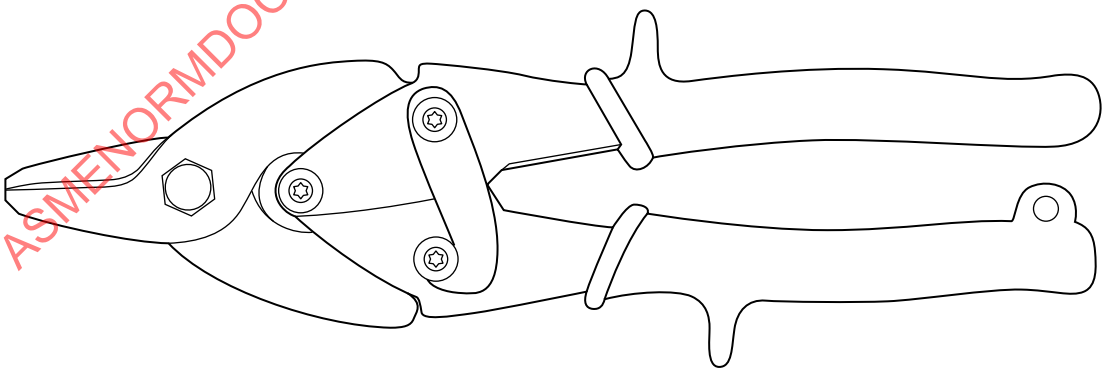


Figure 8.2.1-3 Category 16 Type II, Class 1, Straight Cutting Style C Long Cut

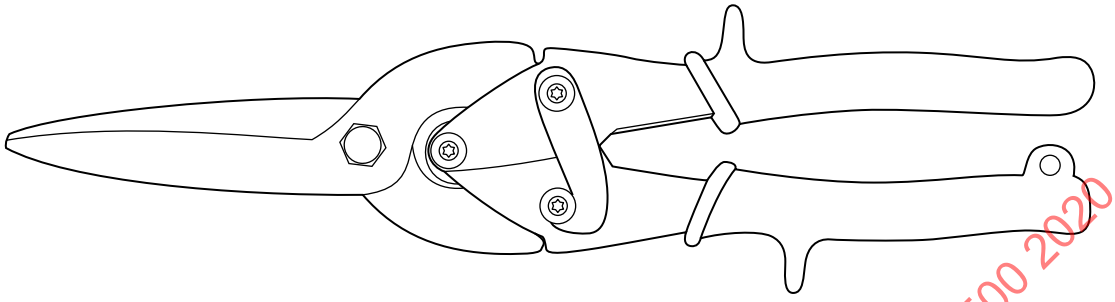


Figure 8.2.2-1 Category 16 Type II, Class 2, Straight and Circular Cutting to the Right

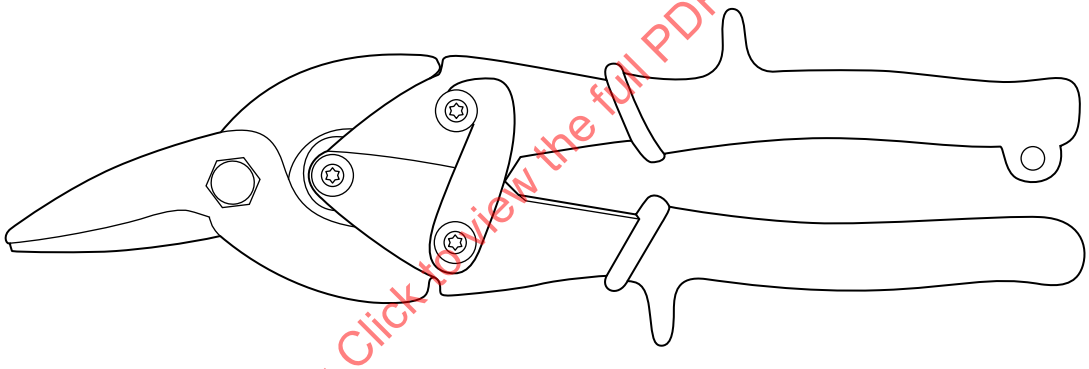


Figure 8.2.3-1 Category 16 Type II, Class 3, Straight and Circular Cutting to the Left

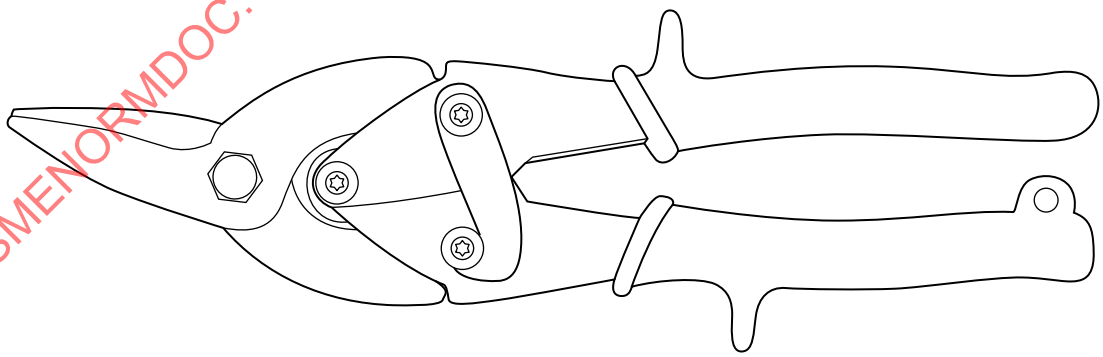


Figure 8.2.4-1 Category 16 Type II, Class 4, Offset Jaw, Straight and Circular Cutting to the Right

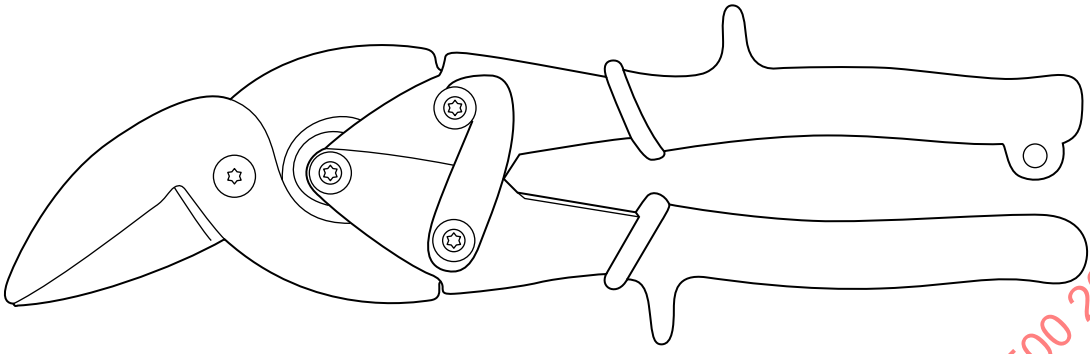
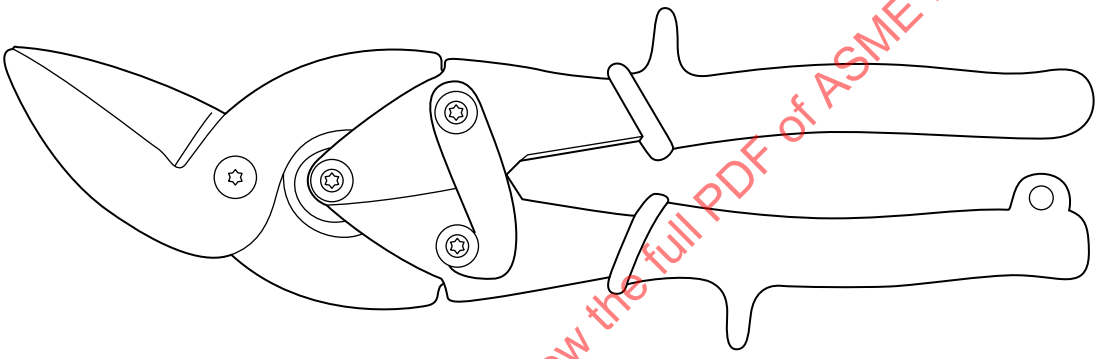


Figure 8.2.5-1 Category 16 Type II, Class 5, Offset Jaw, Straight and Circular Cutting to the Left



9 CATEGORY 18 WIRE-TWISTER PLIERS

See Table 9-1 for classification of wire-twister pliers.

9.1 Design

Wire-twister pliers shall conform to Table 9.1-1 for the size specified, shall be similar to those shown in Figure 9.1-1, and shall meet the dimensional requirements of Figure 9.1-2 or Figure 9.1-3.

Wire-twister pliers shall incorporate a twist rod that, when actuated, will cause the pliers to rotate about its longitudinal axis. The halves of the pliers shall be permanently joined with a through fastener that shall act as the pivot or fulcrum point of the pliers. A locking device, when engaged, shall hold the handles in a closed position in such a manner as to cause the jaws to firmly and securely grip and hold strands of lock wire.

A wire clearance opening shall be provided between the two jaws and located between the gripping and cutting areas of the jaws. This opening shall be of a size and design that will permit the user to deflect double strands of wire out of the sides of the jaws and away from the cutting edges when performing continuous (multiple) lock wiring operations.

The nose design shall be as shown in Figures 9.1-2 and 9.1-3 and blend with the radius of the sides of the pliers in accordance with good commercial practice. The maximum permissible opening at the top of the jaws, when closed, shall be as shown in Figures 9.1-2 and 9.1-3. Jaw surfaces and edges shall not damage the wire being twisted.

9.2 Handle Hardness

Handles shall have a hardness of 36 HRC to 50 HRC.

9.3 Fastener Hardness

The fastener shall have a hardness of 25 HRC to 50 HRC.

9.4 Jaw and Cutting-Edge Hardness

Jaws shall have a hardness of 36 HRC to 50 HRC. The gripping portion of the jaws and wire cutter shall be heat treated to a hardness of 56 HRC to 64 HRC.

9.5 Spiral Mechanism — Category 18

The spiral mechanism shall be capable of producing a close, uniform twist in safety wire without binding of or damage to the mechanism. This mechanism shall be mounted between the handles of the pliers and shall be permanently affixed to one handle in such a position that the longitudinal axis of the mechanism shall correspond to the longitudinal axis of the pliers. The mechanism, when actuated, shall cause pliers to rotate about its longitudinal axis in its intended direction(s). Each full actuation of the mechanism shall cause the pliers to make the following minimum number of complete rotations:

(a) for 6-in. size, 2½ rotations (with automatic return, 2 rotations)

(b) for 9-in. size, 3 rotations (with automatic return, 2½ rotations)

(c) for 12-in. size, 4 rotations (with automatic return, 3½ rotations) (Type III reversible, 3 rotations)

The design of the mechanism shall permit a comfortable, adequate grip by the operator.

9.6 Locking Device — Category 18

A locking device shall be designed so that when the pliers' jaws are closed, the handles must be further compressed to engage the lock. Release of the locking device shall be accomplished automatically when the handles are compressed. The locking device shall not interfere with the user's hands when performing lock wiring operations.

Table 9-1 Classification for Wire-Twister Pliers — Category 18

Type	Class	Style
I — right-hand twist	1 — with automatic (spring-loaded), twist-rod return mechanism	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)
	2 — with hand-push, twist-rod return	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)
II — left-hand twist	1 — with automatic (spring-loaded), twist-rod return mechanism	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)
	2 — with hand-push, twist-rod return	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)
III — reversible	1 — with automatic (spring-loaded), twist-rod return mechanism	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)
	2 — with hand-push, twist-rod return	A — serrated wire-clamping jaw surface
		B — smooth wire-clamping jaw surfaces (no serrations)

Table 9.1-1 Category 18 Dimensions of Pliers, Wire Twister, With Side Cutter

Nominal Size	A	B	C
6	6.75 ± 0.50	1.38 ± 0.25	8.50 ± 0.50
7	7.00 ± 0.50	1.75 ± 0.25	9.37 ± 0.50
9	8.88 ± 0.50	1.50 ± 0.25	10.25 ± 0.25
12	10.18 ± 0.50	1.75 ± 0.25	11.38 ± 0.50

Figure 9.1-1 Category 18 Pliers, Wire Twister, With Side Cutter in Locked Position

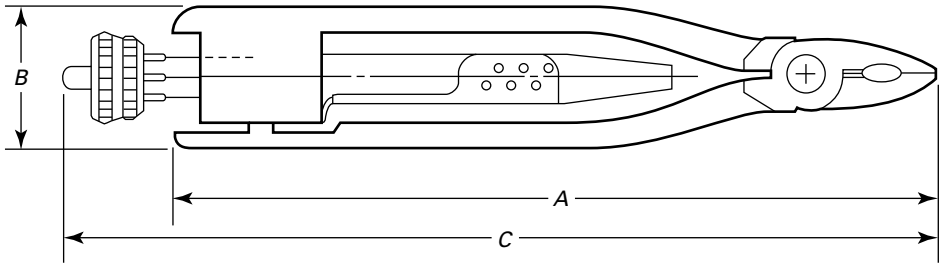


Figure 9.1-2 Category 18 Nose Design, Pliers, Wire Twister, 6 in.

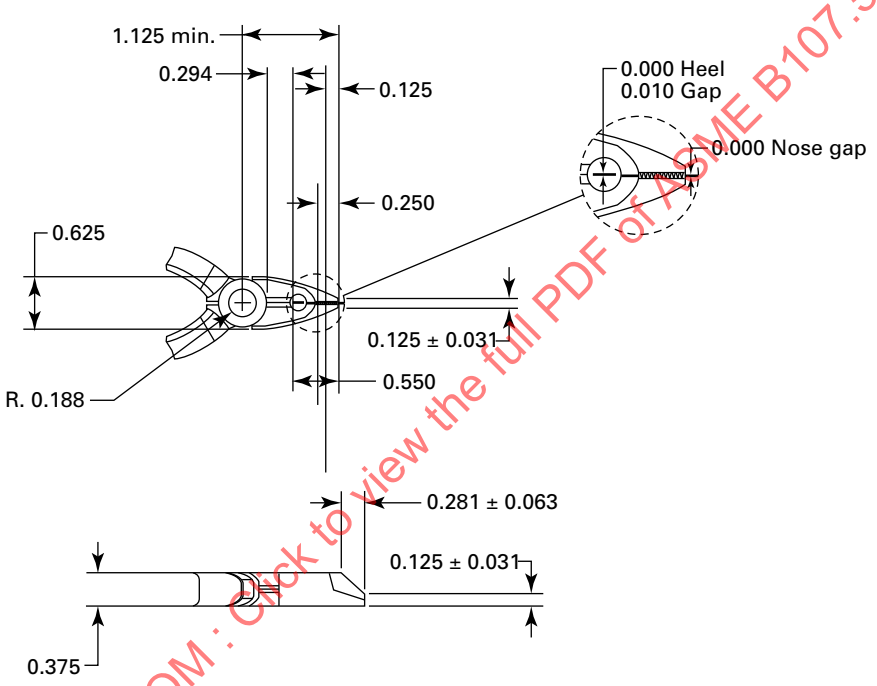
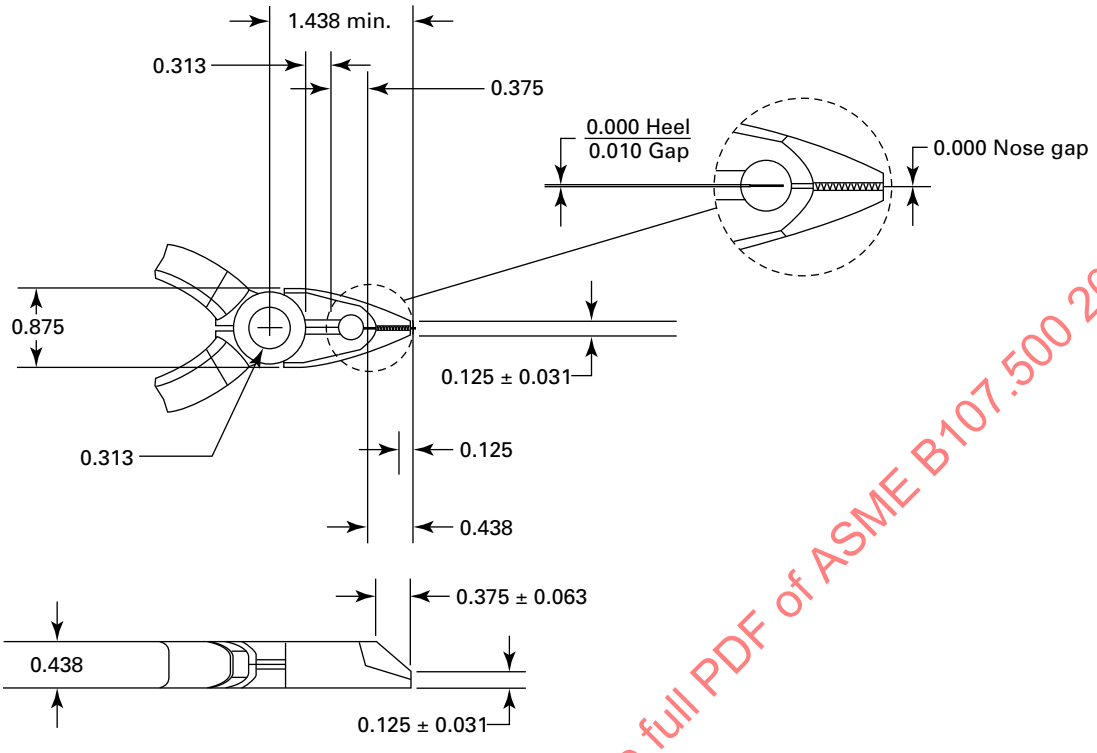


Figure 9.1-3 Category 18 Nose Design, Pliers, Wire Twister, 9 in. and 12 in.



10 CATEGORY 19 RETAINING RING PLIERS

(a) General. Pliers shall be designed to install and remove internal and external retaining rings, including those covered by ASME B18.27, through the range of ring sizes specified in the applicable tables.

(b) Classification. See Table 10-1.

10.1 Type I, Pliers, Retaining Ring, Internal

Pliers shall have integral tips for compressing internal retaining rings similar to those shown in Figure 10.1-1. Pliers shall pass the ring contraction test specified in para. 17.14 and the tip load test specified in para. 17.16.1.

10.1.1 Class 1, With Adjustable Jaw Stop and Spring. Pliers shall conform to the requirements of Table 10.1.1-1 and shall be similar to Figure 10.1.1-1.

10.1.2 Class 2, Without Adjustable Jaw Stop and Spring. Pliers shall conform to the requirements of Table 10.1.1-1 and shall be similar to Figure 10.1.2-1.

10.2 Type II, Pliers, Retaining Ring, External

Pliers shall have integral tips for expanding external retaining rings similar to those shown in Figure 10.2-1. Pliers shall pass the ring expansion test specified in para. 17.15 and the tip load test specified in para. 17.16.1.

10.2.1 Class 1, With Fixed Jaw Stop and Spring. Pliers shall have a cover or stop to prevent overexpansion of rings. Pliers sizes shall conform to the requirements of Table 10.2.1-1 and be similar to Figure 10.2.1-1.

10.2.2 Class 2, With Adjustable Jaw Stop and Spring. Pliers shall conform to the requirements of Table 10.2.2-1 and shall be similar to Figure 10.2.2-1.

10.2.3 Class 3, Without Jaw Stop and Spring. Pliers shall conform to the requirements of Table 10.2.2-1 and be similar to Figure 10.2.3-1.

10.2.4 Class 4, Grip Ring Pliers, With Adjustable Jaw Stop and Spring. Pliers shall be suitable for expanding external grip rings and external heavy-duty type rings similar to those shown in Figure 10.2-1. Pliers shall conform to the requirements of Table 10.2.4-1 and be similar to Figure 10.2.4-1.

10.3 Type III, Pliers, Retaining Ring, External (Automotive)

Pliers shall be provided with a spring for holding the jaws in a closed position. Pliers shall pass the test in para. 17.16.2.

10.3.1 Class 1, Straight Jaw. Pliers shall have tapered jaws. The outside of the jaws at the tip end shall be serrated or knurled. Pliers shall conform to the dimensions shown in Figure 10.3.1-1. Jaws shall open a minimum of 1.2 in.

10.3.2 Class 2, Knurled Jaw. Pliers shall be capable of expanding (horseshoe) "C" washers and lock rings, similar to those shown in Figure 10.3.2-1. The tip end of the jaws shall be at right angles to the longitudinal axis of the jaws, and the outside shall be serrated or knurled. Pliers shall conform to the requirements of Table 10.3.2-1 and be similar to Figure 10.3.2-2.

10.4 Type IV, Pliers With Replaceable Tips, Retaining Ring, Internal and External

Pliers shall be of either internal design for compressing rings similar to Figure 10.1-1 or external design for expanding rings similar to Figure 10.2-1. Pliers shall pass the applicable ring contraction test specified in para. 17.14 or the ring expansion test specified in para. 17.15. Pliers shall also pass the tip load test specified in para. 17.16.1 and the replaceable tip pull-off test specified in para. 17.17.

10.4.1 Class 1, With Spring. Pliers shall conform to the dimensions shown in Figure 10.4.1-1. Replaceable tips shall conform to the requirements of Table 10.4.1-1 and be similar to Figure 10.4.1-2.

10.4.2 Class 2, With Ratchet or With Ratchet and Spring. The ratchet shall be designed in such a manner that the jaw may be locked and released in any position within the capacity of the pliers. The locking arrangement of the ratchet shall be capable of being released with the hand maintaining a grip on the handle. The pliers shall conform to the dimensions in Figure 10.4.2-1. Replaceable tips shall conform to the dimensions in Table 10.4.2-1 and be similar to Figure 10.4.1-2.

10.4.3 Class 3, With Double Ratchet. The ratchet shall be designed in such a manner that the jaw may be locked and released in any position within the collapsing or expanding capacity of the pliers. The locking arrangement of the ratchet shall be spring-loaded and capable of being released with the hand maintaining a grip on the handle. The pliers shall conform to the requirements of Table 10.4.3-1 and be similar to Figure 10.4.3-1. Replaceable tips shall conform to the requirements of Table 10.4.2-1 and be similar to Figure 10.4.1-2.

10.5 Type V, Pliers, Retaining Ring, Internal and External (Convertible)

Pliers shall have integral tips for compressing internal retaining rings similar to those shown in Figure 10.1-1, and expanding external rings similar to those shown in Figure 10.2-1, except for grip style and heavy-duty rings. Pliers shall pass tests specified in paras. 17.14, 17.15, and 17.16.1. Pliers shall conform to the requirements of Table 10.5-1 and be similar to Figure 10.5-1. Pliers shall have all parts captive with either of the two jaw-handle sections so that it is not necessary to detach any parts from either of the jaw-handle sections to change the pliers' setting.

10.6 Type VI, Pliers, Retaining Ring, Replaceable Tips, Internal and External (Universal)

Pliers shall be suitable for compressing internal retaining rings similar to Figure 10.1-1, and for expanding basic-type and inverted-type rings similar to Figure 10.2-1. The pliers shall pass tests in paras. 17.14, 17.15, 17.16.1, and 17.17. Replaceable tips shall conform to the dimensions in Tables 10.4.1-1 and 10.4.2-1 and Figure 10.4.1-2. Pliers shall conform to the requirements of Table 10.6-1 and be similar to Figure 10.6-1.

10.7 Marking

Types I, II, and V pliers shall be marked with the pliers' tip size.

10.8 Fastener Hardness

The fastener hardness shall be from 25 HRC to 50 HRC except that when the fastener receives a case-hardening treatment, a maximum hardness equivalent to 60 HRC shall be permitted.

10.9 Tips

Tips shall have a hardness of 45 HRC to 55 HRC. The tips shall be properly formed to provide for gripping and securely holding the retaining rings. Replaceable tips shall be interchangeable for use with both internal and external pliers and shall be held by a screw or similar means to ensure retention. Tips shall be within 5 deg of style description.

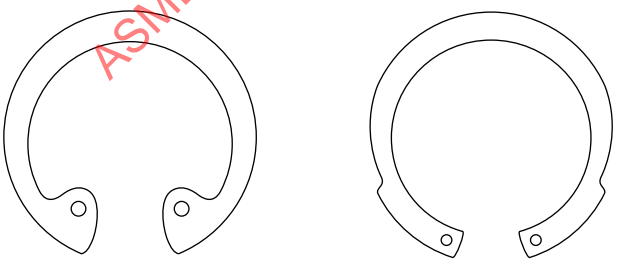
10.10 Jaw Stops

The adjustable jaw stop, when supplied, shall limit jaw travel such that the tip-to-tip distance may be set and changed by the user. The fixed jaw stop (also referred to as a shroud), when supplied, shall limit the jaw travel to a specific tip-to-tip distance.

Table 10-1 Classification for Retaining Ring Pliers — Category 19

Type	Class	Style
I — retaining ring, internal	1 — with adjustable jaw stop and spring	A — straight tip
		B — 90 deg tip
		C — 45 deg tip
	2 — without adjustable jaw stop and spring	A — straight tip
		B — 90 deg tip
		C — 45 deg tip
II — retaining ring, external	1 — with fixed jaw stop and spring	A — straight tip
		B — 90 deg tip
		C — 45 deg tip
	2 — with adjustable jaw stop and spring	A — straight tip
		B — 90 deg tip
		C — 45 deg tip
	3 — without jaw stop and spring	A — straight tip
		B — 90 deg tip
		C — 45 deg tip
	4 — grip ring pliers, with adjustable jaw stop and spring	B — 90 deg tip
		C — 45 deg tip
		E — 20 deg tip
III — retaining ring, external (automotive)	1 — straight jaw	...
	2 — knurled jaw	...
IV — pliers with replaceable tips	1 — with spring	...
	2 — with ratchet or with ratchet and spring	...
	3 — with double ratchet	...
V — retaining ring, internal and external (convertible)	...	A — straight tip
	...	B — 90 deg tip
	...	C — 45 deg tip
VI — retaining ring, replaceable tips, internal and external (universal)	1 — with spring	...
	2 — with spring and adjustable jaw stop	...

Figure 10.1-1 Category 19 Internal Retaining Rings



Basic Type

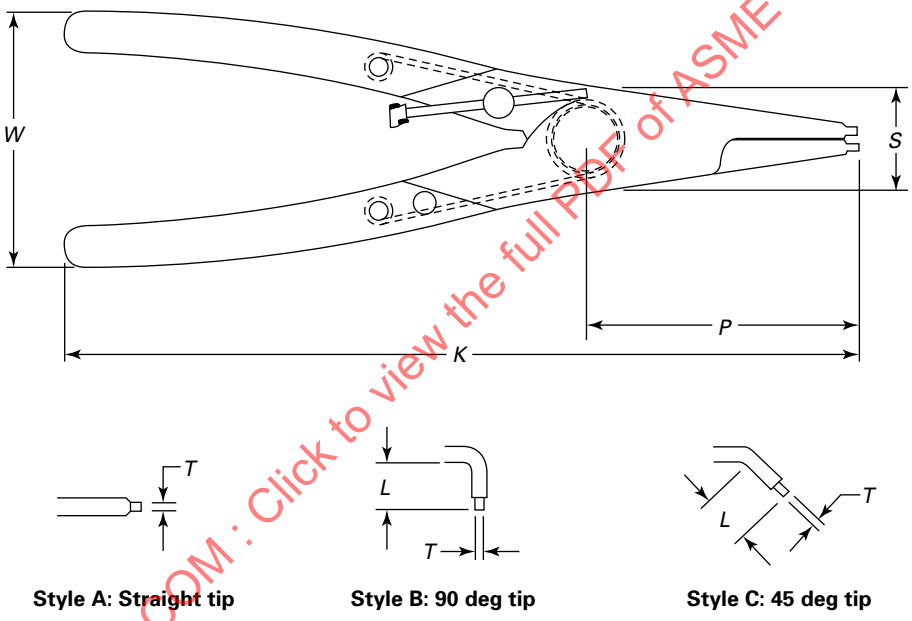
Inverted Type

Table 10.1.1-1 Category 19 Type I

Nominal Size	Tip Diameter, *T*		Overall Length, *K*, ±0.5 [Note (1)]	Jaw Length, *P*, ±0.25 [Note (1)]	Joint Width, *S*, ±0.188	Handle Span, *W*, ±0.5	Tip Offset Length, *L*, Styles B and C	Rings [Note (2)]	
	Min.	Max.						Basic, Bowed, or Beveled Type	Inverted Type
0.025	0.019	0.026	5.5	1.88	0.75	1.8	0.31 ± 0.06	0.250*–0.312*	N/A
0.037	0.031	0.038	5.5	1.88	0.75	1.8	0.31 ± 0.06	0.375*–0.562	0.750–1.000*
0.047	0.039	0.046	5.5	1.88	0.75	1.8	0.31 ± 0.06	0.625*–1.023	1.062–1.375*
0.070	0.065	0.072	6.4	2.13	0.875	2.0	0.38 ± 0.06	1.062*–1.750	1.438–2.000*
0.090	0.082	0.089	8.8	2.50	1.125	2.6	0.50 ± 0.13	1.812*–3.000	2.062–3.000*

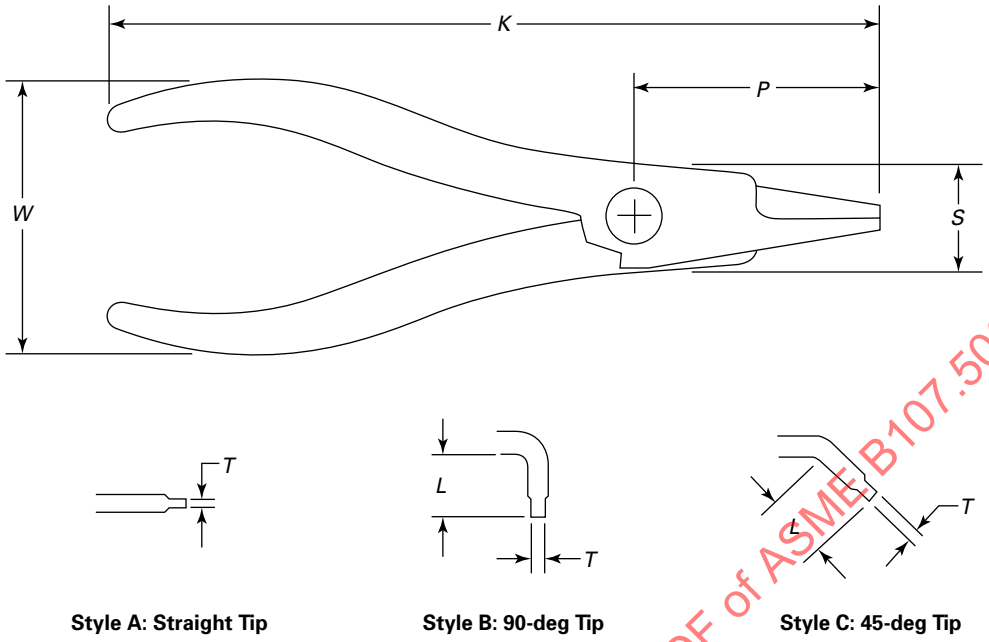
NOTES:
(1) The *K* and *P* dimensions shown are for Style A (straight tip) configuration.
(2) The asterisk (*) indicates test ring sizes.

Figure 10.1.1-1 Category 19 Type I, Class 1



Style A: Straight tip | Style B: 90 deg tip | Style C: 45 deg tip

Figure 10.1.2-1 Category 19 Type I, Class 2



Style A: Straight Tip | Style B: 90-deg Tip | Style C: 45-deg Tip

Figure 10.2-1 Category 19 External Retaining Rings

Basic Type | Inverted Type | External Grip Ring | External Heavy Duty-Type Ring

Table 10.2.1-1 Category 19 Type II, Class 1

Nominal Tip Size	Tip Diameter Min.	Tip Diameter Max.	Overall Length, *K*, ±0.13	Shroud Width, *S*, ±0.06	Handle Span, *W*, ±0.13	Shroud Stop Opening, *J* [Note (1)]	Bend Length, *L*, Styles B and C, ±0.06	Nominal Shaft Diameter for External Rings, Basic Type or Bowed Type [Note (2)]
0.023	0.015	0.02	5.31	0.5	1.63	0.115 ± 0.005	0.22	0.125*
0.023	0.015	0.02	5.31	0.5	1.63	0.143 ± 0.003	0.22	0.156*
0.023	0.014	0.02	5.31	0.5	1.63	0.184 ± 0.004	0.22	0.188*–0.236*

NOTES:
(1) The *J* dimension applies to Style A only.
(2) The asterisk (*) indicates test ring size.

Figure 10.2.1-1 Category 19 Type II, Class 1

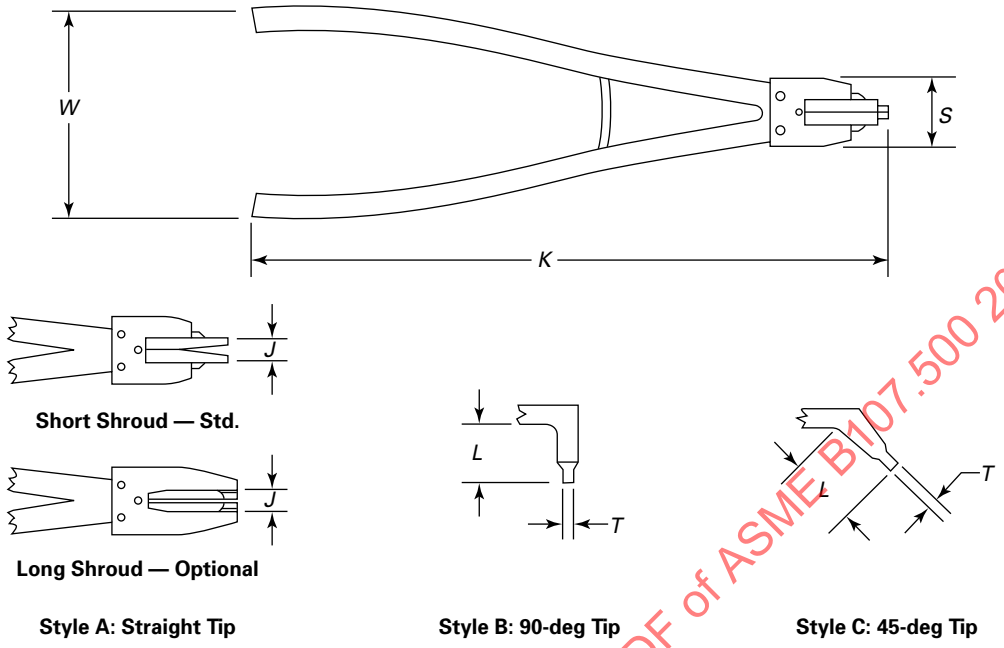


Table 10.2.2-1 Category 19 Type II, Classes 2 and 3

Nominal Tip Size	Tip Diameter, *T*		Overall Length, *K*, ±0.5 [Note (1)]	Jaw Length, *P*, ±0.38 [Note (1)]	Jaw Width, *S*, ±0.31	Handle Span, *W*, ±0.5	Bend Length, *L*, Styles B and C	Nominal Shaft Diameter for External Rings		Test Ring Sizes	
	Min.	Max.						Basic, Bowed, or Beveled Type	Inverted Type	Basic, Bowed, or Beveled Type	Inverted Type
0.037	0.030	0.037	6.0	2.00	0.88	2.5	0.31 ± 0.06	0.250–0.672	0.500–0.781	0.250	0.781
0.047	0.039	0.046	6.0	2.00	0.88	2.5	0.31 ± 0.06	0.688–0.875	0.812–1.000	0.688	1.000
0.070	0.067	0.074	6.6	2.38	1.00	2.8	0.41 ± 0.06	0.938–1.438	1.062–2.000	0.938	2.000
0.115	0.109	0.116	9.0	3.06	1.13	4.0	0.56 ± 0.13	1.500–3.500	2.125–3.156	1.500	3.156

NOTE: (1) The *K* and *P* dimensions are for Style A (straight tip) configuration.

Figure 10.2.2-1 Category 19 Type II, Class 2

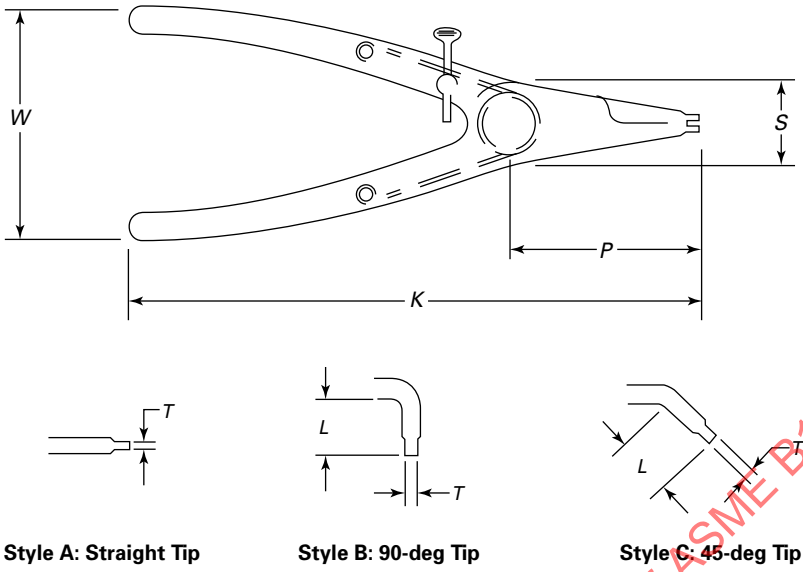


Figure 10.2.3-1 Category 19 Type II, Class 3

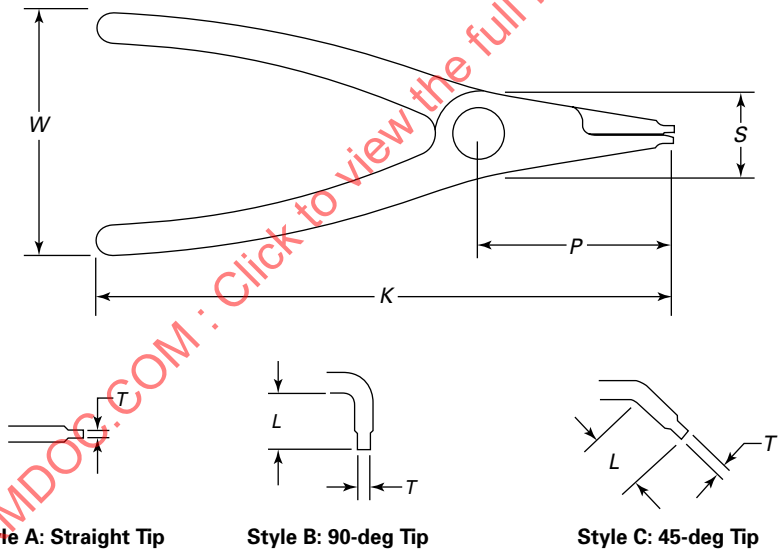
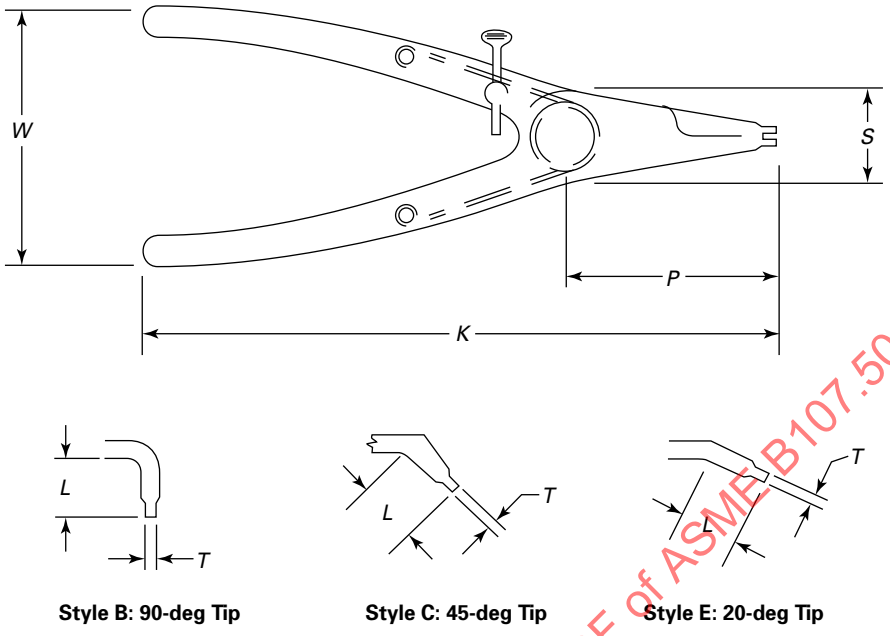


Table 10.2.4-1 Category 19 Type II, Class 4

Nominal Tip Size	Tip Diameter, *T*		Overall Length, *K*, ±0.5 [Note (1)]	Jaw Length, *P*, ±0.25, [Note (1)]	Jaw Width, *S*, ±0.19	Handle Span, *W*, ±0.5	Bend Length, *L*, Styles B and C	Nominal Shaft Diameter for External Rings		Test Ring Sizes	
	Min.	Max.						Grip Type	Heavy Type	Grip Type	Heavy Type
0.034	0.021	0.028	5.0	1.06	0.88	2.88	0.31 ± 0.06	0.094	N/A	0.094	N/A
0.040	0.031	0.038	5.0	1.06	0.88	2.88	0.31 ± 0.06	0.125 – 0.156	0.394 – 0.473	0.125	0.473
0.047	0.038	0.045	5.0	1.06	0.88	2.88	0.31 ± 0.06	0.187 – 0.250	0.500 – 0.669	0.187	0.669
0.070	0.067	0.074	8.8	1.63	0.88	3.88	0.38 ± 0.13	0.313 – 0.750	0.750 – 0.984	0.313	0.984

NOTE: (1) *K* and *P* dimensions are for Style A (20-deg tip) configuration.

Figure 10.2.4-1 Category 19 Type II, Class 4



Style B: 90-deg Tip **Style C: 45-deg Tip** **Style E: 20-deg Tip**

Figure 10.3.1-1 Category 19 Type III, Class 1

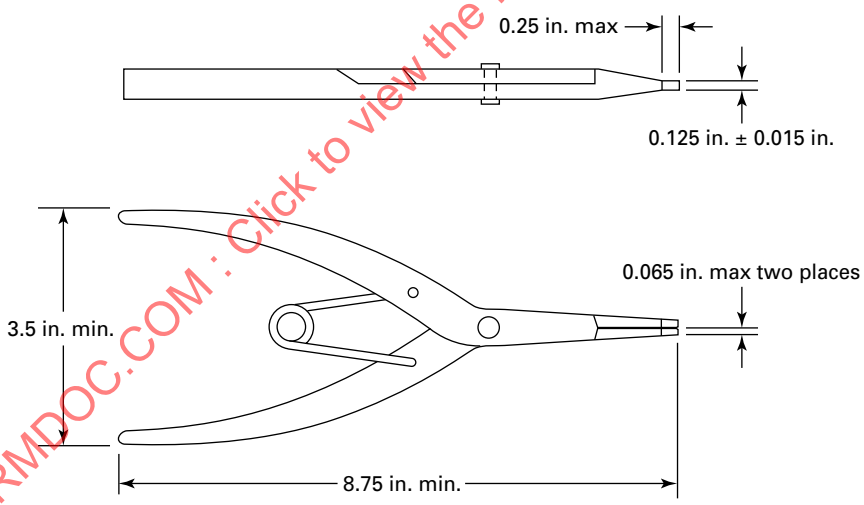


Figure 10.3.2-1 Category 19 External Retaining Rings (Lock Ring)

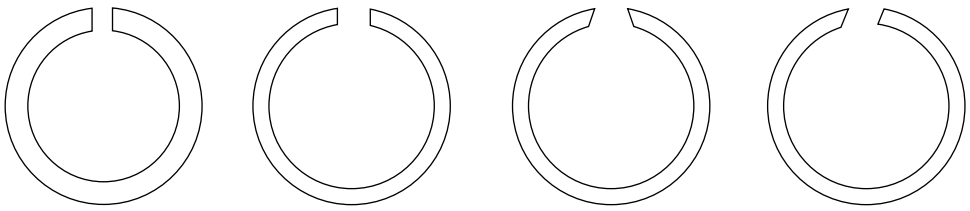


Table 10.3.2-1 Category 19 Type III, Class 2

Maximum Tip Width, *H*	Overall Length, *K*, ±1	Jaw Length, *P*, ±0.750	Jaw Opening, *C* [Note (1)]		Maximum Tip Notch Depth, *Q*	Maximum Jaw Height, *F*	Minimum Knurl Length, *G*	Maximum Pivot Height, *J*
			Min.	Max.				
0.10	8	2.5	0.7812	1.75	0.125	0.375	0.31	0.375

NOTE: (1) The *C* dimension shall be measured when the handles of the assembled tool are in a fully closed position.

Figure 10.3.2-2 Category 19 Type III, Class 2

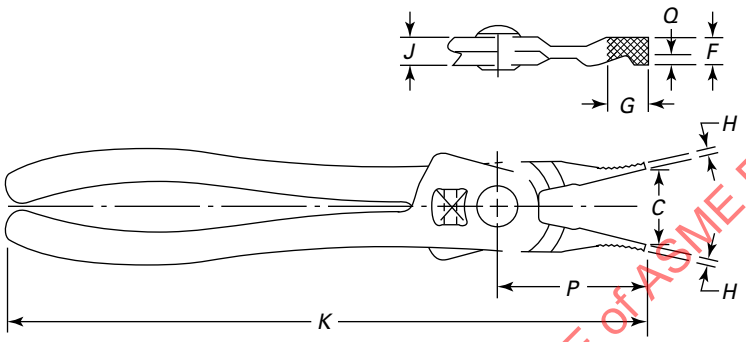
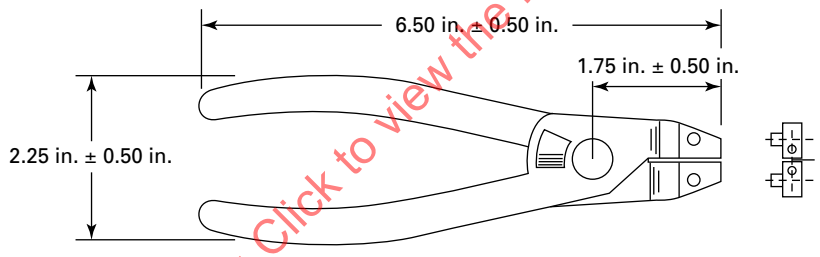
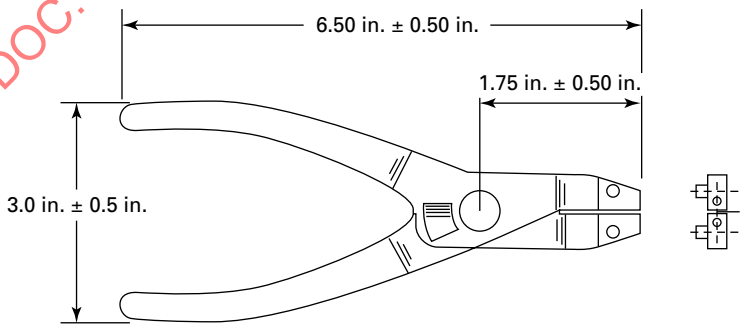


Figure 10.4.1-1 Category 19 Type IV, Class 1



Internal Retaining Ring Pliers
(Handles Are in Fully Closed Position)



External Retaining Ring Pliers

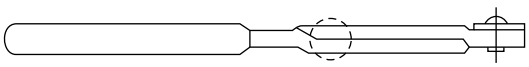
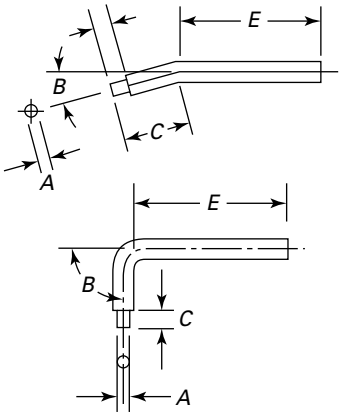


Table 10.4.1-1 Category 19 Replaceable Tips for Type IV, Class 1, and Type VI

Nominal Tip Size	Tip Diameter, *A*		Tip Angle, *B*, deg, ±5 [Note (1)]	Tip Length, *C*	Min. Length Bent Portion, *D*	Min. Length Straight Portion, *E*	Nominal Housing Diameter for Internal Rings [Note (2)]		Nominal Housing Diameter for External Rings [Note (2)]	
	Min.	Max.					Basic Type	Inverted Type	Basic Type	Inverted Type
0.039	0.030	0.037	0	0.059 (+0.01/−0.01)	...	1	0.375*–0.438	0.75–1.000*	0.250*–0.469	0.5–0.781*
			15		0.25	0.5				
			45		0.25	0.5				
			90		0.25	0.5				
0.047	0.039	0.046	0	0.074 (+0.01/−0.014)	...	1	0.453*–0.562	1.062–1.375*	0.500*–0.875	0.812–1.000*
			15		0.25	0.5				
			45		0.25	0.5				
			90		0.25	0.5				
0.074	0.065	0.072	0	0.086 (+0.022/−0.01)	...	0.875	1.062*–1.75	1.438–2.000*	0.938*–1.438	1.062–2.000*
			15		0.25	0.5				
			45 [Note (3)]		0.25	0.5				
			90 [Note (3)]		0.25	0.5				

NOTES:
(1) Tips with 15-deg and 45-deg angle exclude radius dimension. Tips with 90-deg angle include radius dimension.
(2) The asterisk (*) indicates test ring sizes.
(3) External only.

Figure 10.4.1-2 Category 19 Replaceable Tips



Hex Stock for Type IV, Classes 1 and 2 and Type VI

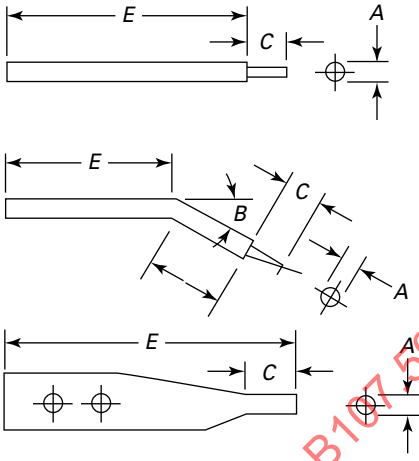


Plate Stock for Type IV, Classes 2 and 3

Figure 10.4.2-1 Category 19 Type IV, Class 2

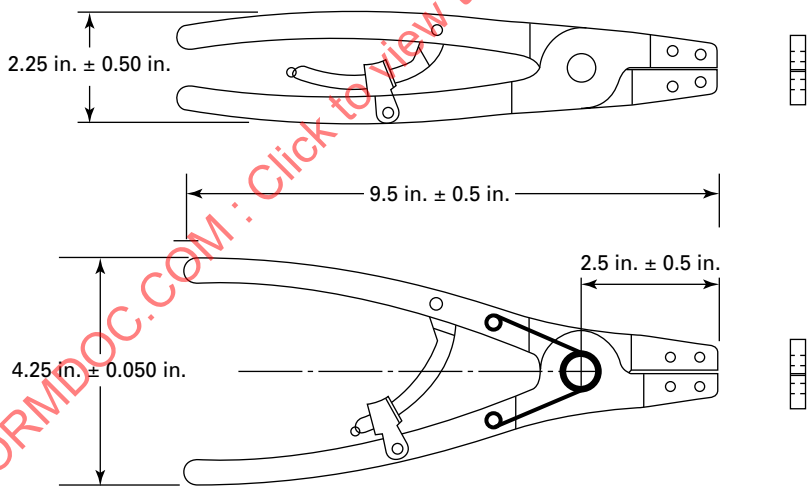


Table 10.4.2-1 Category 19 Replaceable Tips for Type IV, Classes 2 and 3, and Type VI

Nominal Tip Size	Tip Diameter, *A*		Tip Angle, *B*, deg, ±5	Tip Length, *C*, +0.024/−0.010	Min. Length Bent Portion, *D*	Min. Length Straight Portion, *E*	Nominal Housing Diameter for Internal Rings [Note (1)]		Nominal Shaft Diameter for External Rings [Note (1)]	
	Min.	Max.					Basic Type	Inverted Type	Basic Type	Inverted Type
Tips for Type IV, Classes 1 and 2; and Type VI: Hex Stock										
0.108	0.082	0.089	15	0.129	0.32	0.950	2.440*–3.125	2.625–3.000*	1.500*–3.500	2.125–3.346*
0.108	0.098	0.105	45	0.129	0.44	0.920	2.440*–3.125	2.625–3.000*	2.440*–3.125	2.440*–3.125
0.123	0.114	0.121	45	0.129	0.44	0.920	3.156*–4.000	3.156–4.000*	1.562*–3.750	3.500–3.750*
Tips for Type IV, Class 2: Plate Stock										
0.108	0.098	0.105	0	0.147	N/A	2.000	2.440*–3.125	2.625–3.000*	1.500*–3.500	2.125–3.346*
0.108	0.098	0.105	0	0.147	N/A	2.000	2.440*–3.125	2.625–3.000*	1.500*–3.500	1.500*–3.500
0.108	0.098	0.105	15	0.147	0.44	1.375	2.440*–3.125	2.625–3.000*	1.500*–3.500	1.500*–3.500
0.108	0.098	0.105	45	0.147	0.44	1.375	2.440*–3.125	2.625–3.000*	1.500*–3.500	1.500*–3.500
0.108	0.098	0.105	90	0.147	0.44	1.375	2.440*–3.125	2.625–3.000*	1.500*–3.500	1.500*–3.500
0.120	0.114	0.121	0	0.160	N/A	2.000	3.156*–4.000	3.156–4.000*	1.562*–3.750	3.500–3.750*
0.120	0.114	0.121	15	0.160	0.44	1.375	3.156*–4.000	3.156–4.000*	1.562*–3.750	3.500–3.750*
0.120	0.114	0.121	45	0.160	0.44	1.375	3.156*–4.000	3.156–4.000*	1.562*–3.750	3.500–3.750*
0.120	0.114	0.121	90	0.160	0.44	1.375	3.156*–4.000	3.156–4.000*	1.562*–3.750	3.500–3.750*
Tips for Type IV, Class 3: Plate Stock										
0.120	0.114	0.121	0	0.230	N/A	2.225	3.062–6.000*	3.156*–4.000*	3.543*–6.500*	3.500*–3.938*
0.120	0.114	0.121	45	0.230	0.61	1.500	3.062–6.000*	3.156*–4.000*	3.543*–6.500*	3.500*–3.938*
0.120	0.114	0.121	90	0.230	0.61	1.500	3.062–6.000*	3.156*–4.000*	3.543*–6.500*	3.500*–3.938*
0.150	0.173	0.180	0	0.230	N/A	2.875	6.250*–10.000*	N/A	N/A	N/A
0.150	0.173	0.180	45	0.230	1.14	3.000	6.250*–10.000*	N/A	N/A	N/A
0.150	0.173	0.180	90	0.230	1.14	3.000	6.250*–10.000*	N/A	N/A	N/A
0.170	0.173	0.180	0	0.230	N/A	3.375	N/A	N/A	6.750*–10.000*	N/A
0.170	0.173	0.180	45	0.230	1.14	3.625	N/A	N/A	6.750*–10.000*	N/A
0.170	0.173	0.180	90	0.230	1.14	3.625	N/A	N/A	6.750*–10.000*	N/A

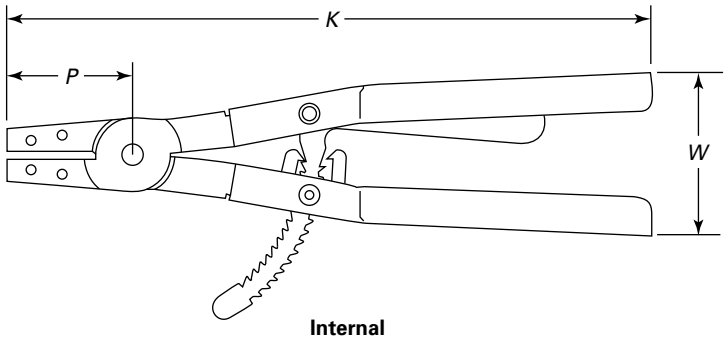
NOTE: (1) The asterisk (*) indicates test ring sizes.

Table 10.4.3-1 Category 19 Type IV, Class 3

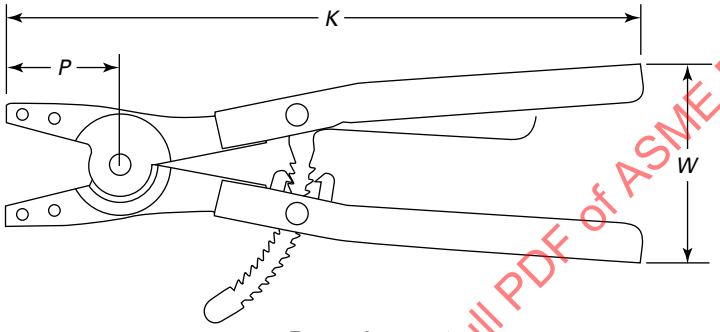
Design Type [Note (1)]	Dimensions (Less Tips)			To be Used With Replaceable Tip Diameter, in. (see Table 10.4.2-1)	Nominal Housing or Shaft Diameter for Internal or External Rings [Note (2)]	
	Overall Length, *K*, ±0.5 in.	Jaw Length, *P*, ±0.5 in.	Handle Span, *W*, ±0.5 in.		Basic	Inverted
Internal	15	3	3.9	0.12	3.062*–6.000*	3.156*–4.000*
External	15	2.8	4.8	0.12	3.543*–6.500*	3.500*–4.000*
Internal	27	3	6.8	0.15	6.250*–10.000*	N/A
External	17.5	2.8	5	0.17	6.750*–10.000*	N/A

NOTES:
(1) External type dimensions are with pawl in second ratchet notch as shown in Figure 10.4.3-1, and internal design type dimensions are in fully closed position.
(2) The asterisk (*) indicates test ring sizes.

Figure 10.4.3-1 Category 19 Type IV, Class 3



Internal



External

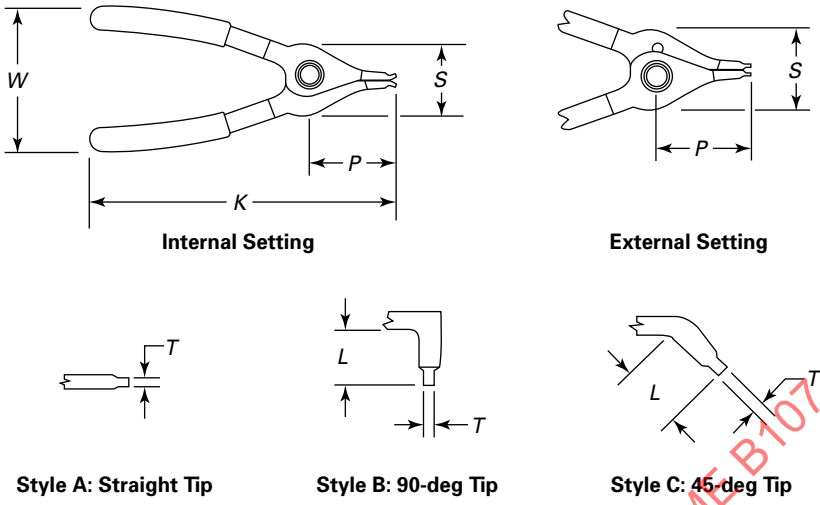
Table 10.5-1 Category 19 Type V

Internal Position Nominal Tip Size	Internal Position Tip, *T*		Overall Length, *K*, ±0.50 [Note (1)]	Jaw Length, *P*, ±0.25 [Note (1)]	Jaw Width, *S*, ±0.25	Handle Span, *W*, ±0.50	Bend Length, *L*, ±0.06	Housing Diameter for Internal Rings [Note (2)]	
	Min.	Max.						Basic, Bowed, or Beveled Type	Inverted Type
0.038	0.030	0.037	5.75	1.63	1.19	1.50	0.31	0.375*–0.562	0.750–1.000*
0.047	0.039	0.046	5.75	1.63	1.19	1.50	0.31	0.625*–1.023	1.062–1.375*
0.070	0.065	0.072	7.75	1.88	1.44	2.75	0.34	1.062*–1.750	1.438–2.000*
0.090	0.082	0.089	9.13	2.88	1.75	2.75	0.56	1.812*–3.000	2.062–3.000*

External Position Nominal Tip Size	External Position Tip, *T*		Overall Length, *K*, ±0.50 [Note (1)]	Jaw Length, *P*, ±0.25 [Note (1)]	Jaw Width, *S*, ±0.25	Handle Span, *W*, ±0.50	Bend Length, *L*, ±0.06	Shaft Diameter for Internal Rings [Note (2)]	
	Min.	Max.						Basic, Bowed, or Beveled Type	Inverted Type
0.038	0.030	0.037	5.75	1.63	1.25	2.75	0.31	0.250*–0.672	0.500–0.781*
0.047	0.039	0.046	5.75	1.63	1.25	2.75	0.31	0.688*–0.875	0.812–1.000*
0.070	0.065	0.072	7.75	1.88	1.63	3.75	0.34	0.938*–1.438	1.062–2.000*
0.090	0.082	0.089	9.13	2.88	1.88	4.00	0.56	1.500*–3.500	2.125–3.250*

NOTES:
(1) *K* and *P* dimensions shown are for Style A (Straight Tip) configuration.
(2) The asterisk (*) indicates test ring sizes.

Figure 10.5-1 Category 19 Type V



Internal Setting

External Setting

Style A: Straight Tip

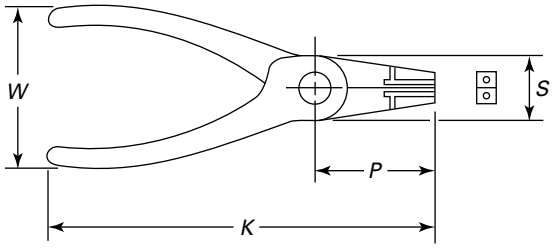
Style B: 90-deg Tip

Style C: 45-deg Tip

Table 10.6-1 Category 19 Type VI

Class	Overall Length, *K*, ±0.5	Jaw Length, *P*, ±0.38	Jaw Width, *S*, ±0.25	Handle Span, *W*, ±0.5	Features
1	6	1.50	1.0	3	With spring
2	7	1.75	1.3	5	With spring and adjustable jaw stop

Figure 10.6-1 Category 19 Type VI



11 CATEGORY 20 LINEMAN'S, IRONWORKER'S, GAS, GLASS, FENCE, AND BATTERY PLIERS

See Table 11-1 for classification of lineman's, ironworker's, gas, glass, fence, and battery pliers.

11.1 Type I, Lineman's and Ironworker's

Lineman's have matching handles as shown in Figure 11.1-1; ironworker's have differing handles as shown in Figure 11.1-2, to prevent the pliers from slipping through the hand during normal usage. Pliers may be supplied with a spring. Jaws shall have cutting edges on one side near the joint end. The cutting edges shall extend approximately one-half the length of the jaws. The remaining portions of the jaws shall have scored surfaces over some or all of the face. There shall be a recess in the jaws behind the side cutter to provide satisfactory cutting clearance. The crusher surfaces may be smooth or scored.

11.1.1 Type I, Class 1, Lineman's and Ironworker's, Square Head. Pliers shall have square heads and shall be similar to Figure 11.1-1. They shall conform to dimensions shown in Figure 11.1-1 and in Table 11.1.1-1.

11.1.2 Type I, Class 2, Lineman's and Ironworker's, Round Head. Pliers shall have round heads and shall be similar to Figure 11.1.2-1. They shall conform to dimensions shown in Figure 11.1.2-1 and in Table 11.1.1-1.

11.1.3 Type I, Class 3, Lineman's, Square Head With Wire Stripper. Pliers shall have square heads and one or more insulation stripping holes in the cutting edges; they shall be similar to Figure 11.1.3-1. They shall conform to dimensions shown in Figure 11.1.3-1 and Table 11.1.1-1.

11.2 Type IV, Combination Jaw

Pliers shall conform to the requirements shown in Table 11.2-1, and shall be similar to Figure 11.2-1. Pliers shall have combination jaws and one or more wire cutters. Pliers shall be of flat-nose construction. Combination jaws shall have straight scored gripping surfaces at the outer end, and curved scored gripping surfaces closer to the joint.

Curved surfaces shall grip a 0.25-in. diameter rod on nominal size 8-in. pliers, and 0.31-in. diameter rod on nominal size 10½-in. pliers, when the outermost end of the jaws is opened not more than 0.10 in. The crusher surfaces may be smooth or scored.

11.3 Type V, Gas

Pliers shall conform to the requirements shown in Table 11.3-1 and shall be similar to Figure 11.3-1. Jaws shall be of uniform width, and the outer end or nose shall be rounded. The pliers shall have a central longitudinal grip at the outer end of the jaw, and two elliptical transverse grips in the jaw body. The gripping surfaces shall have sharp pointed teeth. The longitudinal grip shall be suitable for gripping both flat and round objects. With the outermost ends of the jaws opened not more than 0.18 in., the smaller transverse grip shall securely hold a 0.34-in. diameter rod, and the larger transverse grip shall securely hold a 0.44-in. diameter rod, individually. The larger transverse grip shall have a capacity for holding a rod at least 1.50-in. diameter.

11.4 Type VI, Glass

Type VI pliers shall conform to the requirements shown in Table 11.4-1 and shall be similar to Figure 11.4-1. Pliers shall be suitable for firmly grasping plate glass along the full width of the jaw. With the pliers in a closed position, the jaws shall contact each other only at their outermost end. With the jaws of the pliers opened so that the jaw surfaces are parallel, the jaw opening shall be not less than 0.44 in. and not more than 0.50 in. The gripping surfaces of the jaws shall be smooth and without scoring.

11.5 Type VII, Fence

Type VII pliers shall conform to the requirements shown in Table 11.5-1 and shall be similar to Figure 11.5-1. Pliers shall be suitable for maintaining and installing wire fence on metal or wood posts. Pliers shall have a hammer head on one jaw and a starting-and-pulling point on the other. Pliers shall be provided with one or more side wire cutters, and two transverse holes in the jaws for twisting and splicing wire. The crusher shall be scored.

11.6 Type VIII, Battery

Pliers shall conform to the requirements shown in Table 11.6-1 and shall be similar to Figure 11.6-1. Gripping surfaces shall be deeply scored the full length of the jaws. Jaws shall open and close in a uniform manner. Jaws shall be offset 15 deg to 40 deg as measured from the centerline of the jaws and the centerline of the handles. With the pliers gripping a 0.62-in. diameter rod, the maximum distance between the outsides of the handles at the gripping portion shall not exceed 4 in. (Pliers with a multiposition slip joint that otherwise meet the preceding requirements are a suitable alternative.)

11.7 Handle Hardness

Handles shall be hardened to 35 HRC to 50 HRC.

11.8 Joint

Category 20 pliers joint shall assure uniform smooth movement with minimal looseness and side play when opening the jaw as specified in para. 5.8.1 and shall not loosen or require adjustment.

11.9 Joint Fastener Hardness

Fastener hardness shall be from 25 HRC to 50 HRC, except when case hardened, when a maximum hardness equivalent to 60 HRC shall be permitted.

11.10 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

11.11 Jaw and Cutting-Edge Hardness

The jaw area shall have a hardness of 35 HRC to 65 HRC. On pliers with cutting edges, the jaw hardness, within 0.062 in. of the cutting edge, shall have a hardness from 55 HRC to 65 HRC. Button cutters on Category 20, Types IV and VII, shall have a hardness from 45 HRC to 65 HRC.

Table 11-1 Classification for Lineman's, Ironworker's, Gas, Glass, Fence, and Battery Pliers — Category 20

Type	Class
I — lineman's and ironworker's	1 — square head
	2 — round head
	3 — square head with wire stripper
II — discontinued	...
III — discontinued	...
IV — combination jaw	...
V — gas	...
VI — glass	...
VII — fence	...
VIII — battery	...

Figure 11.1-1 Category 20 Type I, Class 1, Lineman's, Square Head

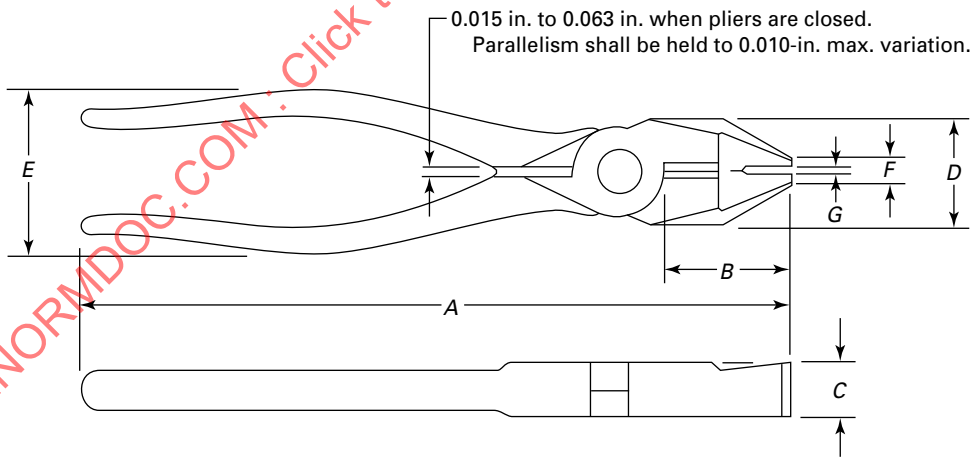


Figure 11.1-2 Category 20 Type I, Class 1, Ironworker's, Square Head

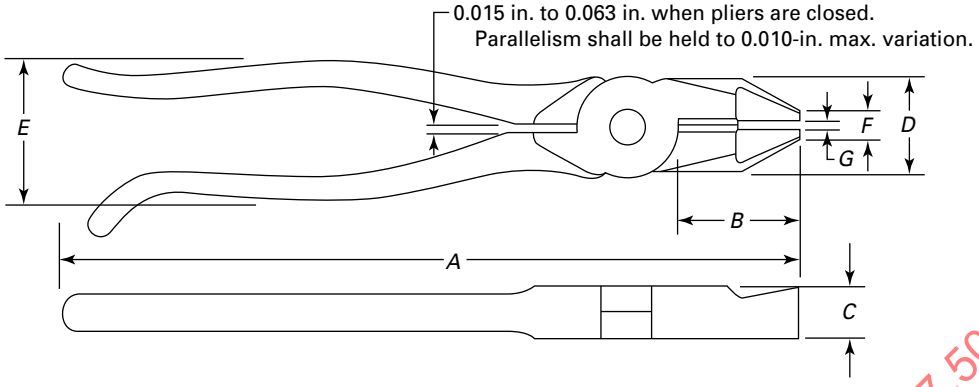


Table 11.1.1-1 Category 20 Type I, Class 1, Lineman's and Ironworker's

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Joint Thickness, *C*, ±0.13	Jaw Width, *D*, +0.18/−0.12	Handle Span, *E*, ±0.25 [Note (1)]	Nose Width, *F*, ±0.062	Maximum Jaw Gap, *G*	Minimum Jaw Opening
6	6.50	1.25	0.50	0.88	1.75	0.219	0.025	0.625
7	7.50	1.25	0.50	0.97	1.75	0.219	0.025	0.625
8	8.50	1.50	0.62	1.28	1.88	0.281	0.040	0.875
9	9.50	1.56	0.63	1.28	1.88	0.281	0.040	0.875
10	10.50	1.75	0.63	1.30	1.88	0.314	0.060	0.875

NOTE: (1) *A* and *E* dimensions in the table are without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in. and dimension *E* by more than 0.50 in.

Figure 11.1.2-1 Category 20 Type I, Class 2, Lineman's, Round Head

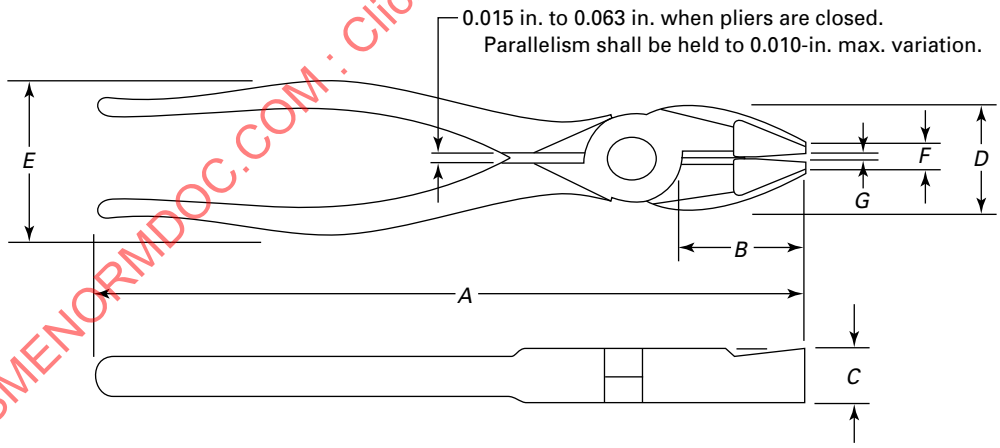


Figure 11.1.3-1 Category 20 Type I, Class 3, Lineman's, Square Head With Wire Stripper

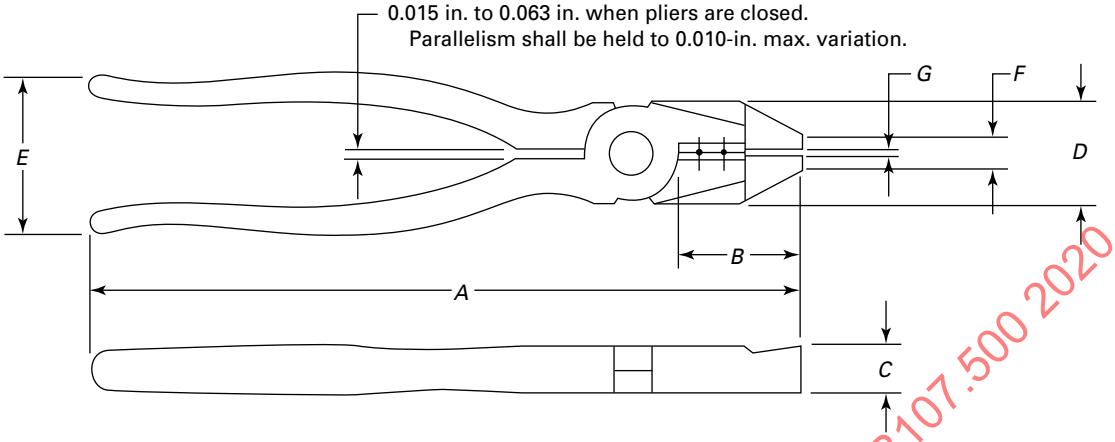


Table 11.2-1 Category 20 Type IV, Combination Jaw

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Joint Thickness, *C*, ±0.125	Jaw Width, *D*, ±0.19	Handle Span, *E*, ±0.25 [Note (1)]	Nose Width, *F*, +0.19/−0.07	Minimum Jaw Opening
8	8.00	1.38	0.625	1.19	1.88	0.25	0.875
10½	10.50	1.50	0.625	1.38	1.94	0.31	0.875

NOTE: (1) *A* and *E* dimensions in the table are without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in. and dimension *E* by more than 0.50 in.

Figure 11.2-1 Category 20 Type IV, Combination Jaw

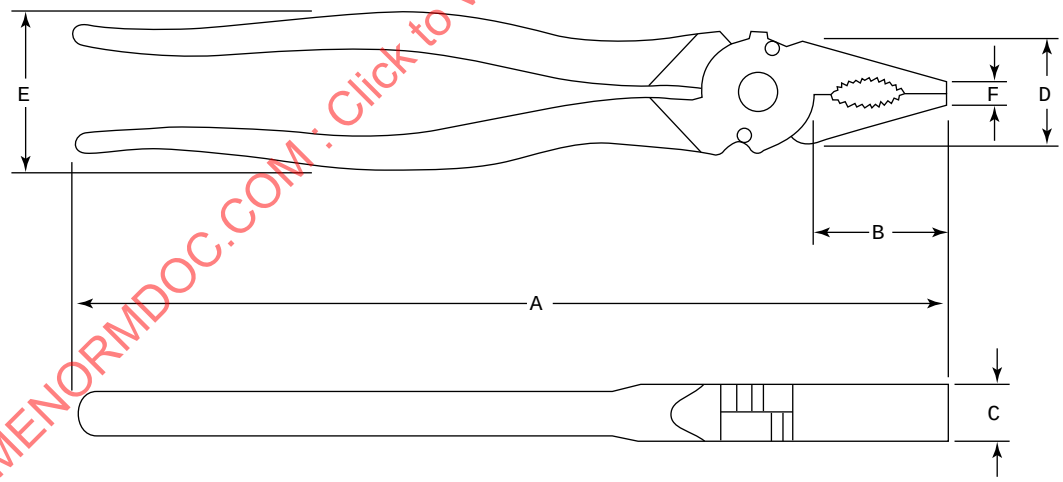


Table 11.3-1 Category 20 Type V, Gas

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Joint Thickness, *C*, ±0.062	Jaw Width, *D*, ±0.125	Handle Span, *E*, ±0.375 [Note (1)]	Minimum Jaw Opening
8	8.00	1.38	0.625	1.19	1.88	0.875
10½	10.50	1.50	0.625	1.38	1.94	0.875

NOTE: (1) *A* and *E* dimensions in the table are without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in. and dimension *E* by more than 0.50 in.

Figure 11.3-1 Category 20 Type V, Gas

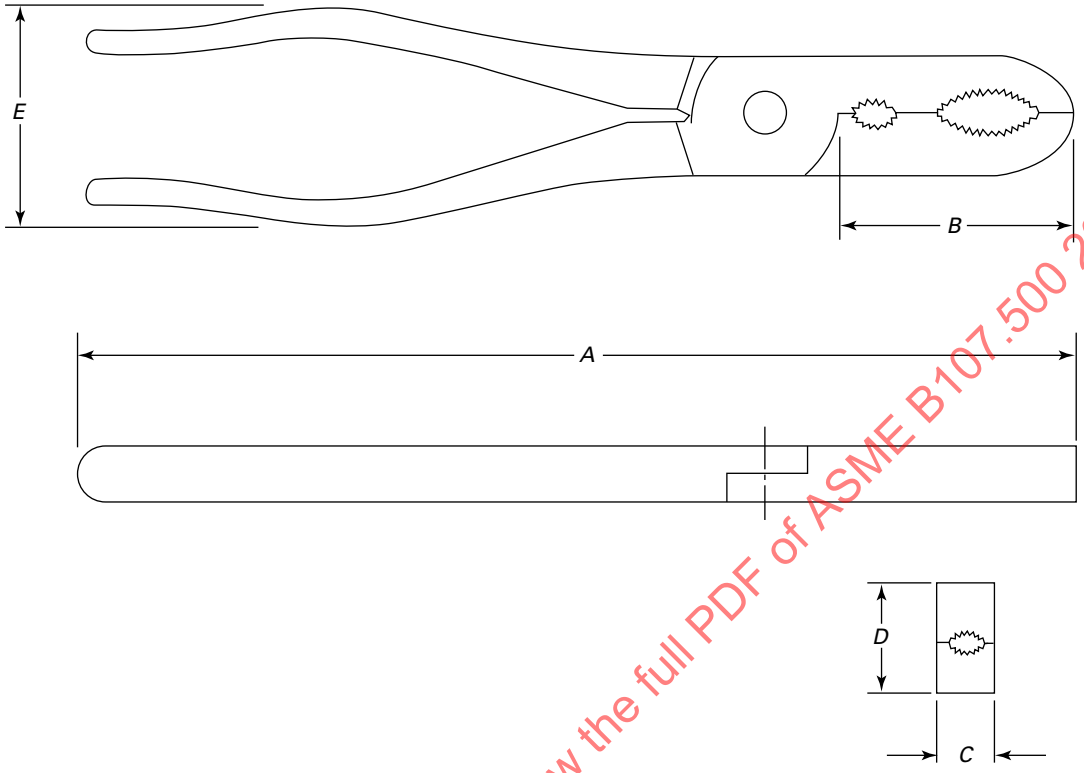


Table 11.4-1 Category 20 Type VI, Glass

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Joint Thickness, *C*, ±0.13	Jaw Width, *D*, ±0.13	Handle Span, *E*, ±0.25 [Note (1)]	Nose Thickness, *F*, ±0.38	Nose Width, *H*, ±0.25	Minimum Jaw Opening
7	7.00	1.13	0.50	1.13	1.88	0.25	0.88	1
8	8.00	1.38	0.50	1.25	1.88	0.31	0.88	1

NOTE: (1) *A* and *E* dimensions in the table are without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in. and dimension *E* by more than 0.50 in.

Figure 11.4-1 Category 20 Type VI, Glass

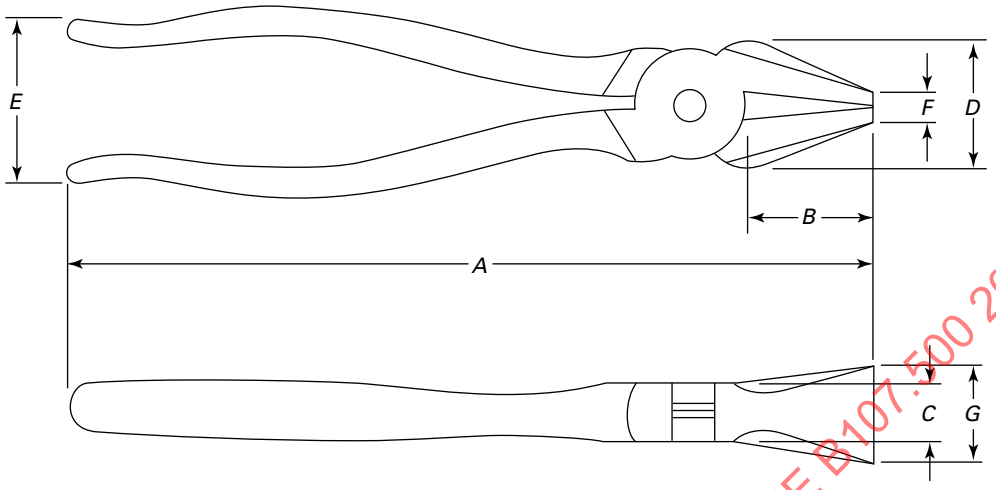


Table 11.5-1 Category 20 Type VII, Fence

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Joint Thickness, *C*, ±0.06	Head Width, *D*, ±0.50	Handle Span, *E*, ±0.25 [Note (1)]
10	10.38	0.75	0.56	3.25	2.00

NOTE: (1) *A* and *E* dimensions in the table are without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in. and dimension *E* by more than 0.50 in.

Figure 11.5-1 Category 20 Type VII, Fence

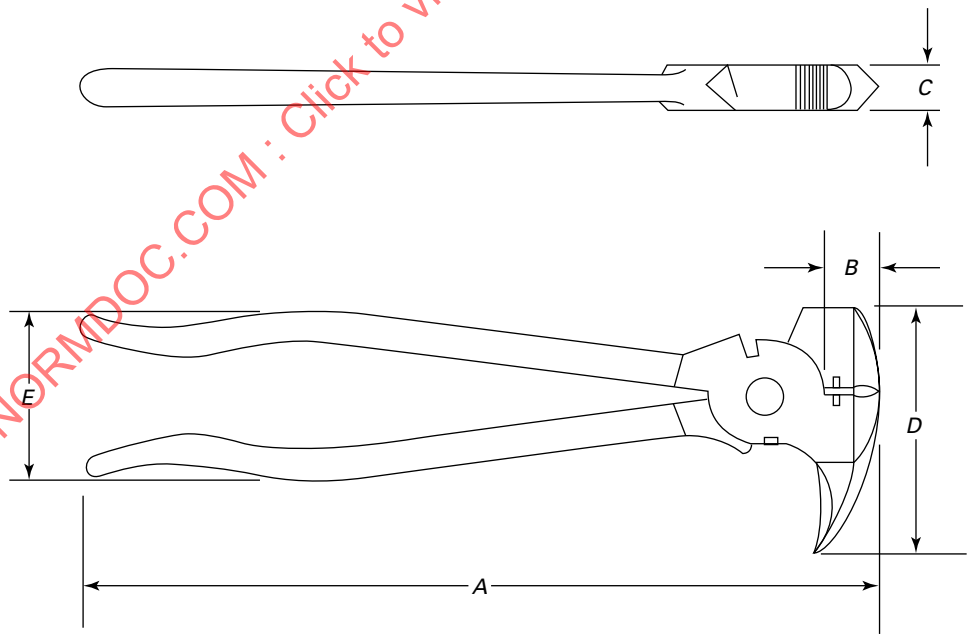
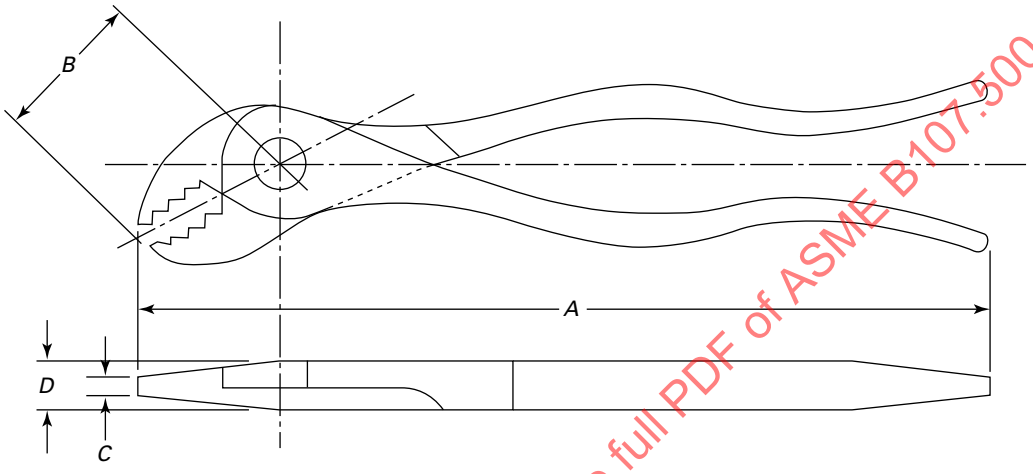


Table 11.6-1 Category 20 Type VIII, Battery

Nominal Size	Overall Length, *A*, ±0.50 [Note (1)]	Jaw Length, *B*, ±0.25	Jaw Tip Thickness, *C*, ±0.06	Joint Thickness, *D*, ±0.13	Minimum Jaw Opening
7	7.50	1.38	0.22	0.38	0.63

NOTE: (1) *A* dimension in the table is without comfort grips. Comfort grips shall not increase dimension *A* by more than 0.25 in.

Figure 11.6-1 Category 20 Type VIII, Battery



12 CATEGORY 22 ELECTRONIC CUTTERS AND PLIERS

(a) General. Cutting edges shall be designed to produce one of the severed wire profiles illustrated in Figure 6-1 using wire specified in Table 12-1.

(b) Classification. See Table 12-2.

12.1 Type I, Cutters

12.1.1 Type I, Style A, Oval Head. Cutting edges shall have an angle of 15 deg ± 5 deg from the plane of the handles. One side of the jaw shall be recessed to provide a suitable cutting edge clearance. The cutters shall be similar to Figure 12.1.1-1 and shall conform to dimensions in Table 12.1.1-1. Cutters may have a wire-holding device or other means to capture the cut wire.

12.1.2 Type I, Style B, Relieved Oval Head. Cutting edges shall have an angle of 15 deg ± 5 deg from the plane of the handles. One side of the jaw shall be relieved to permit cutting in limited access areas. Cutters shall be similar to Figure 12.1.2-1 and shall conform to dimensions in Table 12.1.1-1.

12.1.3 Type I, Style C, Tapered Head. Cutters have a tapered head that improves visibility for cutting in confined areas where accessibility is limited. Cutters shall be similar to Figure 12.1.3-1 and conform to dimensions in Table 12.1.1-1.

12.1.4 Type I, Class 2, Offset Nippers (Oblique). Cutters shall have an angled cutting edge that is used when space or angle of wire prohibits the use of other cutters. Cutters shall be similar to Figure 12.1.4-1 and conform to dimensions in Table 12.1.1-1.

12.1.5 Type I, Class 3, Transverse Cutters (End). Jaws shall taper uniformly from near the joint to the outermost end. Cutters shall be similar to Figure 12.1.5-1 and conform to dimensions in Table 12.1.1-1.

12.1.6 Type I, Class 4, End Cutters (Angle). Cutters have an angled cutting edge on the end of the nose. Jaws are relieved and tapered uniformly from near the joint to the outermost end. Cutters shall be similar to Figure 12.1.6-1 and conform to dimensions in Table 12.1.1-1.

12.2 Type II, Pliers

12.2.1 Type II, Class 1, Flat Nose. Pliers shall be suitable for manipulating and pulling small objects, reaching into small openings, gripping and holding flat or square objects securely, and making angular bends and similar forming operations. The jaws shall taper in thickness from near the joint to the outermost end. Jaws shall contact each other at the outermost end when the pliers are in a closed position. Pliers shall be similar to Figure 12.2.1-1 and conform to dimensions shown in Table 12.1.1-1.

12.2.2 Type II, Class 2, Chain Nose

12.2.2.1 Type II, Class 2, Style A, Long Nose Without Side Cutter. Pliers shall be suitable for making bends, loops, and similar forming operations on wire and sheet metal and for gripping, manipulating, pulling objects, and reaching into small openings. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in a closed position. Jaw tips shall be half-elliptical and shaped so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.2.1-1 and conform to dimensions shown in Table 12.1.1-1.

12.2.2.2 Type II, Class 2, Style B, Long Nose With Side Cutter. In addition to the requirements of Type II, Class 2, Style A, the jaws of the pliers shall be provided with cutting edges, adjacent to the joint. There shall be a recess behind the cutters to provide clearance for the cutting edges. Pliers shall be similar to Figure 12.2.2.2-1 and conform to dimensions shown in Table 12.1.1-1.

12.2.2.3 Type II, Class 2, Style C, Curved Nose. Pliers' jaws are curved for easier access in confined places. Pliers shall be suitable for gripping, manipulating, pulling objects, and reaching into small openings. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in a closed position. Jaw tips shall be half-elliptical in shape so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.2.3-1 and conform to dimensions shown in Table 12.1.1.-1.

12.2.2.4 Type II, Class 2, Style D, Short Nose. Pliers shall be suitable for fine, close work in making bends, loops, and similar forming operations on wire and sheet metal and for gripping, manipulating, pulling objects, and reaching into small openings. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in a closed position. Jaw tips shall be half-elliptical in shape so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.2.4-1 and conform to dimensions in Table 12.1.1-1.

12.2.2.5 Type II, Class 2, Style E, Subminiature. Pliers shall have a fine point and be suitable for delicate work in making bends, loops, and similar forming operations on small wire and for gripping, manipulating, and pulling objects in very confined places. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in a closed position. Jaw tips shall be half-elliptical in shape so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.2.5-1 and conform to dimensions in Table 12.1.1-1.

12.2.3 Type II, Class 3, Long Nose With Tip Cutter. Pliers shall have a cutting edge and be suitable for making some bends or loops on wire and for gripping, manipulating, or pulling small objects and reaching into small openings. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in the closed position. Jaw tips shall be half-elliptical in shape so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.3-1 and conform to dimensions in Table 12.1.1-1.

12.2.4 Type II, Class 4, Needle Nose. Pliers shall be suitable for assembly work in hard-to-reach areas. Outside surfaces of the jaws shall have a reduced cross-sectional area immediately after the joint and taper uniformly to the jaw tips. Inside surfaces of the jaws shall taper uniformly from the joint area to the tips. Jaw edges shall be radiused to prevent nicking and marring. Tips shall be half-elliptical in shape so that the gripping surfaces are planar and straight. Pliers shall be similar to Figure 12.2.4-1 and conform to dimensions in Table 12.1.1-1.

12.2.5 Type II, Class 5, Round Nose. Pliers shall be suitable for bending and shaping wire. The jaws are round in cross section so that the gripping surfaces are circular. The inside and outside surfaces of the jaws shall taper uniformly from the joint area to the tips. Tips shall contact each other at the outermost end when the pliers are in a closed position and have a maximum gap of 0.03 in. at the joint. Pliers shall be similar to Figure 12.2.5-1 and shall conform to dimensions shown in Table 12.1.1-1.

12.3 Handle Hardness

Handles shall have a hardness of 35 HRC to 60 HRC or equivalent.

12.4 Joint Fastener Hardness

Fastener hardness shall be from 25 HRC to 50 HRC except when the fastener receives a case-hardening treatment in addition to through hardening, where a maximum hardness equivalent to 60 HRC shall be permitted.

12.5 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

All Category 22 cutters and pliers shall have a spring.

12.6 Jaw and Cutting-Edge Hardness

Cutting edges (within 0.06 in. of the cutting edge shoulder) shall have a hardness equivalent to 55 HRC to 65 HRC. The balance of the jaw shall have a minimum hardness of 35 HRC.

12.7 Smooth Jaws

Pliers with smooth jaws (Type II, Design A) shall have a minimum gripping surface length of 0.25 in. from the outermost end of the jaw and shall be chamfered or radiused to prevent marring or nicking of the material being held.

12.8 Serrations

Pliers with scored jaws (Type II, Design B), except Class 3, long nose with tip cutter, shall have 0.25 in. to 0.50 in. of the gripping surface scored back from the outermost end of the jaw. Class 3 pliers shall have serrations within 0.032 in. of the cutting edge from the outermost edge.

Table 12-1 Wire Cut Test Specifications

Category	Type	Class	Nominal Size	Cutting Style	Wire Tensile Strength, psi		Wire Diameter		Number of Cuts	Maximum Moment, lbf-in.	Wire Type	Maximum Jaw Opening Force, lbf
					Min.	Max.	Min.	Max.				
11	All	1	4	...	180,000	...	0.032	0.036	9	100	Steel	0.75
11		1	4½	...	180,000	...	0.045	0.049	9	265	Steel	0.75
11		1	5	...	180,000	...	0.060	0.064	9	500	Steel	1.50
11		1	5½	...	180,000	...	0.060	0.064	9	600	Steel	1.50
11		1	6	...	180,000	...	0.078	0.082	9	700	Steel	2.25
11		1	7	...	180,000	...	0.078	0.082	9	750	Steel	2.25
11		1	8 to 11	...	180,000	...	0.078	0.082	9	775	Steel	2.25
11		2, 3	4	...	...	...	0.032	0.036	9	50	Steel	0.75
11		2, 3	4½	...	...	...	0.032	0.036	9	133	Steel	0.75
11		2, 3	5	...	...	...	0.032	0.036	9	250	Steel	1.50
11		2, 3	5½	...	...	...	0.032	0.036	9	300	Steel	1.50
11		2, 3	6	...	...	...	0.032	0.036	9	350	Steel	2.25
11		2, 3	7	...	...	...	0.032	0.036	9	375	Steel	2.25
11		2, 3	8 to 11	...	...	...	0.032	0.036	9	388	Steel	2.25
11	All	2	...	...	90,000	...	...	...	...	...	...	...
11		3	...	...	70,000	...	...	...	...	...	...	...
13	I	3B	4	A	180,000	...	0.060	0.064	9	300	Steel	1
			6	A	180,000	...	0.060	0.064	9	300	Steel	3
13	III	1B, 3B, 4B	4.5	A	180,000	...	0.060	0.064	9	300	Steel	1
			5	A	180,000	...	0.060	0.064	9	300	Steel	2
			6	A	180,000	...	0.060	0.064	9	300	Steel	3
			6.5	A	180,000	...	0.060	0.064	9	300	Steel	3
			7	A	180,000	...	0.060	0.064	9	300	Steel	3
			8	A	180,000	...	0.060	0.064	9	300	Steel	3
18	I	1, 2	6	A	296,000	328,000	0.020	0.023	3	570	302 SS	2
	I	1, 2	6	A	282,000	310,000	0.032	0.036	3	570	302 SS	2
	I	1, 2	6	A	272,000	300,000	0.041	0.045	3	570	302 SS	2
18	II	1, 2	9	A	296,000	328,000	0.020	0.023	3	660	302 SS	2
	II	1, 2	9	A	272,000	300,000	0.041	0.045	3	660	302 SS	2
	II	1, 2	9	A	265,000	293,000	0.051	0.055	3	660	302 SS	2
18	III	1, 2	12	A	180,000	...	0.020	0.023	3	560	302 SS	2
	III	1, 2	12	A	180,000	...	0.041	0.045	3	560	302 SS	2
	III	1, 2	12	A	180,000	...	0.051	0.055	3	560	302 SS	2
20	I	...	6	...	180,000	...	0.078	0.082	9	600	Steel	3
		...	7	...	180,000	...	0.078	0.082	9	875	Steel	3
		...	8 to 11	...	180,000	...	0.089	0.093	9	1,020	Steel	3
20	IV	...	8	...	180,000	...	0.078	0.082	3	500	Steel	3
		...	10½	...	180,000	...	0.089	0.093	3	500	Steel	3
20	VII	...	10	...	120,000	...	0.089	0.093	3	1,275	Steel	3
22	All except Type II Class 3	...	...	Style A — Standard	108,000	132,000	0.032	0.036	...	100	Steel	...
			...	Style B — Semi-Flush	81,000	99,000	0.032	0.036	...	50	Steel	...
			...	Style C — Flush	63,000	77,000	0.032	0.036	...	50	Steel	...
22	II	3	...	...	30,043	36,719	0.032	0.036	...	100	Copper	...
23	II	...	4	...	150,000	...	0.033	0.037	...	...	...	...
		...	6	...	150,000	...	0.083	0.087	...	...	...	...
		...	8	...	150,000	...	0.096	0.100	...	...	...	...
		...	10	...	150,000	...	0.112	0.116	...	...	...	...

GENERAL NOTE: 302 SS = double twist wire see ASTM A313

Table 12-2 Classification for Electronic Cutters and Pliers — Category 22

Type	Class	Style
I — cutters	1 — diagonal	A — oval head
		B — relieved oval head
		C — tapered head
	2 — offset nippers (oblique)	...
	3 — transverse cutters (end)	...
	4 — end cutters (angle)	...
II — pliers	1 — flat nose	...
	2 — chain nose	A — long nose without side cutter
		B — long nose with side cutter
		C — curved nose
		D — short nose
		E — subminiature
	3 — long nose with tip cutter	...
	4 — needle nose	...
	5 — round nose	...

Figure 12.1.1-1 Category 22 Type I, Class 1, Style A, Oval Head

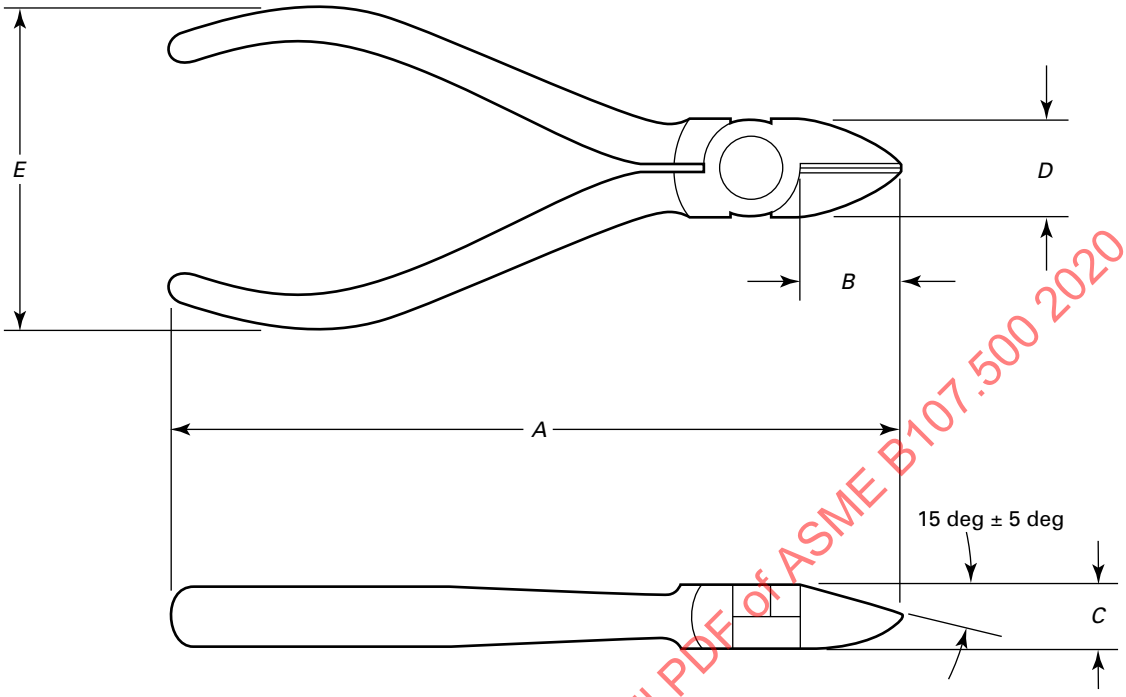


Table 12.1.1-1 Category 22 Dimensional Requirements

Nominal Size	Overall Length, *A* [Note (1)]		Jaw Length, *B*		Joint Thickness, *C*		Jaw Width, *D*		Handle Span, *E* [Note (1)]		Tip Width, *F*		Tip Thickness, *G*		Bend Height, *H*, ±0.062	Jaw Angle, *J*, deg, ±20	Cutter Length, *K*		Min. Jaw Opening
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.			Min.	Max.	
4	3.875	4.312	0.343	0.531	0.210	0.290	0.391	0.469	1.688	2.000	...	...	...	...	...	...	...	...	0.156
4½	4.375	4.812	0.406	0.594	0.241	0.321	0.422	0.500	1.688	2.000	...	...							0.156
4	3.875	4.312	0.343	0.531	0.210	0.290	0.391	0.469	1.688	2.000	0.017	0.047	...	...	...	...	...	...	0.156
4½	4.375	4.812	0.406	0.594	0.241	0.321	0.422	0.500	1.688	2.000	0.017	0.047	...	...	...	...	...	...	0.156
4	3.875	4.312	0.343	0.531	0.210	0.290	0.391	0.469	1.688	2.000	0.017	0.047	...	0.124	...	...	...	...	0.156
4½	4.375	4.812	0.406	0.594	0.241	0.321	0.422	0.500	1.688	2.000	0.017	0.047	...	0.124	...	...	...	...	0.156
4	3.938	4.312	0.375	0.499	0.218	0.282	0.405	0.469	1.750	2.000	0.017	0.047	...	...	...	...	0.343	0.531	0.156
4½	4.500	4.874	0.750	1.125	0.218	0.282	0.405	0.469	1.750	2.000	0.093	0.157	0.155	0.219					0.375
5	4.875	5.249	0.812	1.062	0.249	0.313	0.468	0.532	1.750	2.000	...	...					0.218	0.282	0.375
4½	4.688	5.062	1.062	1.312	0.218	0.282	0.405	0.469	1.750	2.000	...	...	0.058	0.098					0.500
5½	5.438	5.812	1.375	1.625	0.249	0.313	0.468	0.532	1.750	2.000	...	...	0.058	0.098	...	...	...		0.500
4½	4.688	5.062	1.093	1.281	0.188	0.282	0.405	0.469	1.625	2.125	...	...	0.058	0.098	...	...	...	...	0.500
5½	5.438	5.812	1.593	1.781	0.219	0.313	0.468	0.532	1.625	2.125	...	...	0.058	0.098	...	...	0.229	0.239	0.500
4½	4.688	5.062	1.125	1.249	0.218	0.282	0.405	0.469	1.625	2.125	...	...	0.063	0.093	...	...	0.310	0.410	0.375
5½	5.438	5.812	1.625	1.749	0.249	0.313	0.468	0.532	1.625	2.125	...	...	0.063	0.093	...	...	...	...	0.500
4½	4.438	4.812	0.875	0.999	0.218	0.282	0.405	0.469	1.750	2.000	...	...	0.063	0.093	0.500	40	...	...	0.375
5½	5.500	5.874	1.500	1.624	0.249	0.313	0.468	0.532	1.750	2.000	...	...	0.063	0.093	0.312	45	...	...	0.500
4½	4.438	4.812	0.812	1.062	0.218	0.282	0.405	0.469	1.688	2.062	...	...	0.032	0.079	...	...	...	...	0.375
5	5.000	5.374	1.125	1.375	0.249	0.313	0.468	0.532	1.688	2.062	...	...	0.047	0.094	...	...	...	...	0.500
4	3.813	4.187	0.750	0.874	0.218	0.282	0.343	0.407	1.625	1.875	...	...	0.032	0.062	...	...	...	...	0.375
4½	4.625	5.125	1.125	1.249	0.156	0.344	0.405	0.469	1.688	2.062	...	...	0.063	0.093	...	...	0.155	0.219	0.500
5	5.000	5.500	1.188	1.312	0.187	0.375	0.468	0.532	1.688	2.062	...	...	0.079	0.109	...	...	0.218	0.282	0.500
4½	4.438	4.812	1.125	1.249	0.218	0.282	0.390	0.469	1.625	2.125	...	...	0.058	0.098	...	...	...	...	0.500
5½	5.438	5.812	1.625	1.749	0.249	0.313	0.453	0.532	1.625	2.125	...	...	0.058	0.098	...	...	...	...	0.500
4½	4.375	4.749	0.813	0.937	0.218	0.282	0.405	0.469	1.688	2.062	...	...	0.063	0.157	...	...	...	...	0.375

NOTE: (1) Comfort grips shall not increase dimension *A* by more than 0.25 in. nor dimension *E* by more than 0.50 in.

Figure 12.1.2-1 Category 22 Type I, Class 1, Style B, Relieved Oval Head

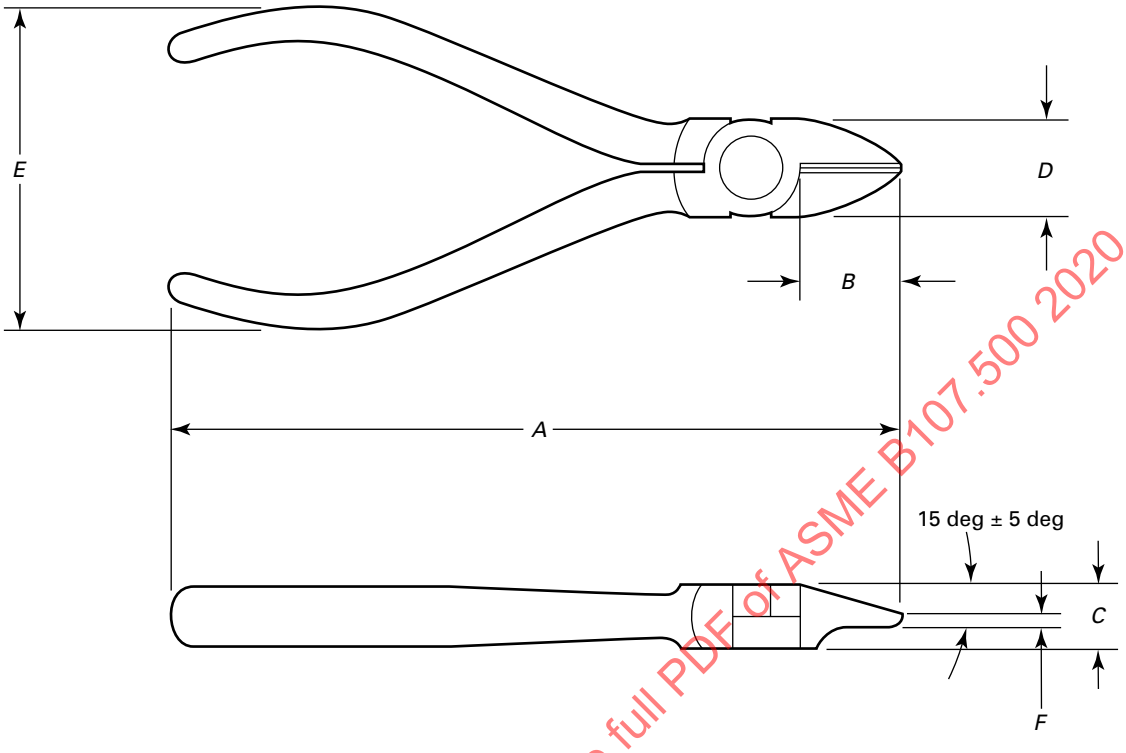


Figure 12.1.3-1 Category 22 Type I, Class 1, Style C, Tapered Head

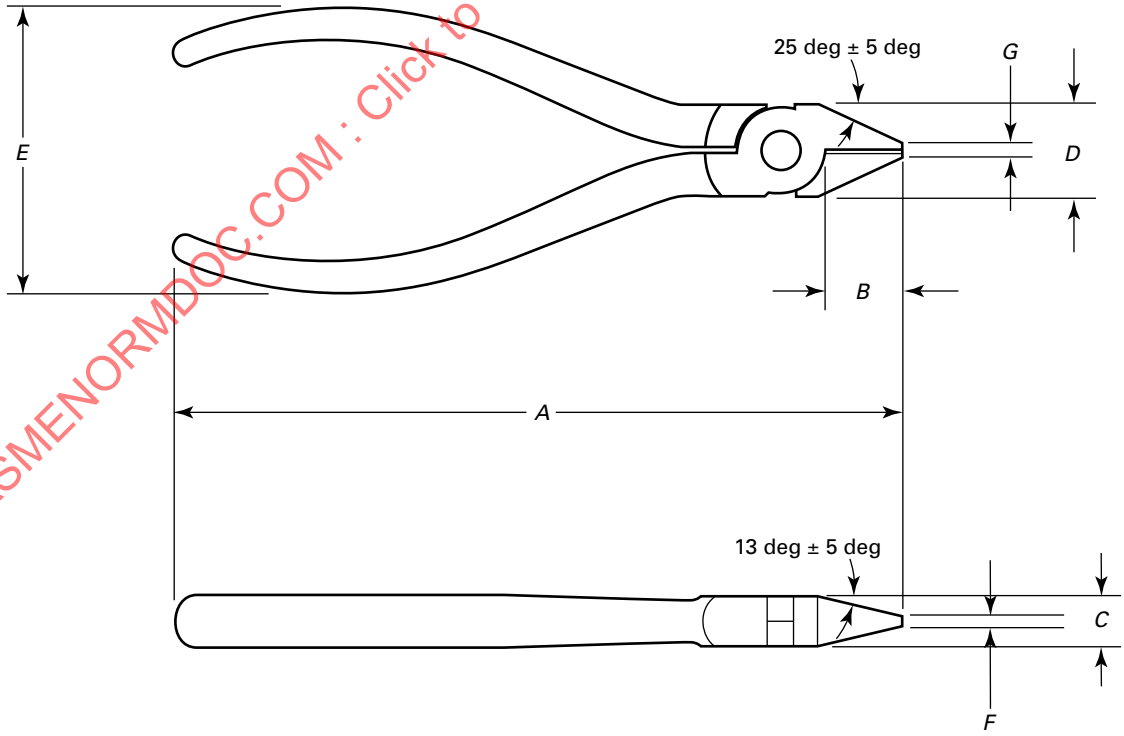


Figure 12.1.4-1 Category 22 Type I, Class 2, Offset Nippers (Oblique)

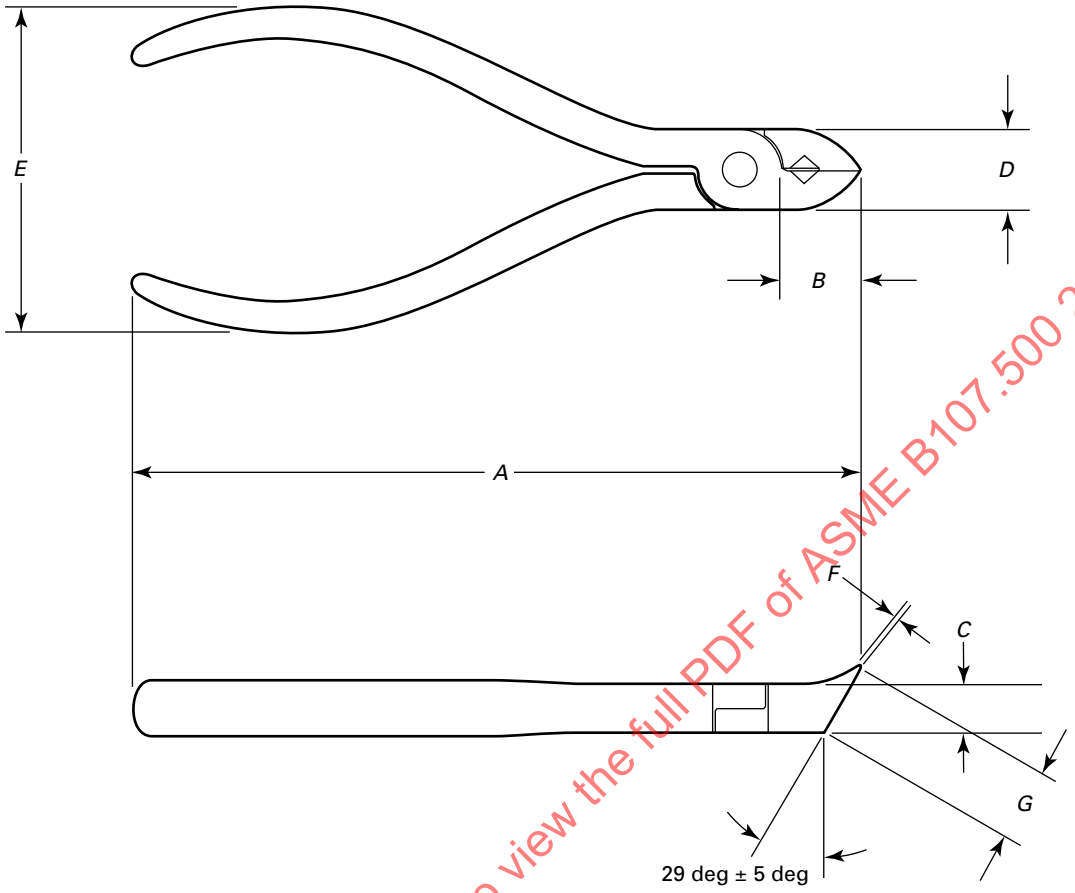


Figure 12.1.5-1 Category 22 Type I, Class 3, Transverse Cutters (End)

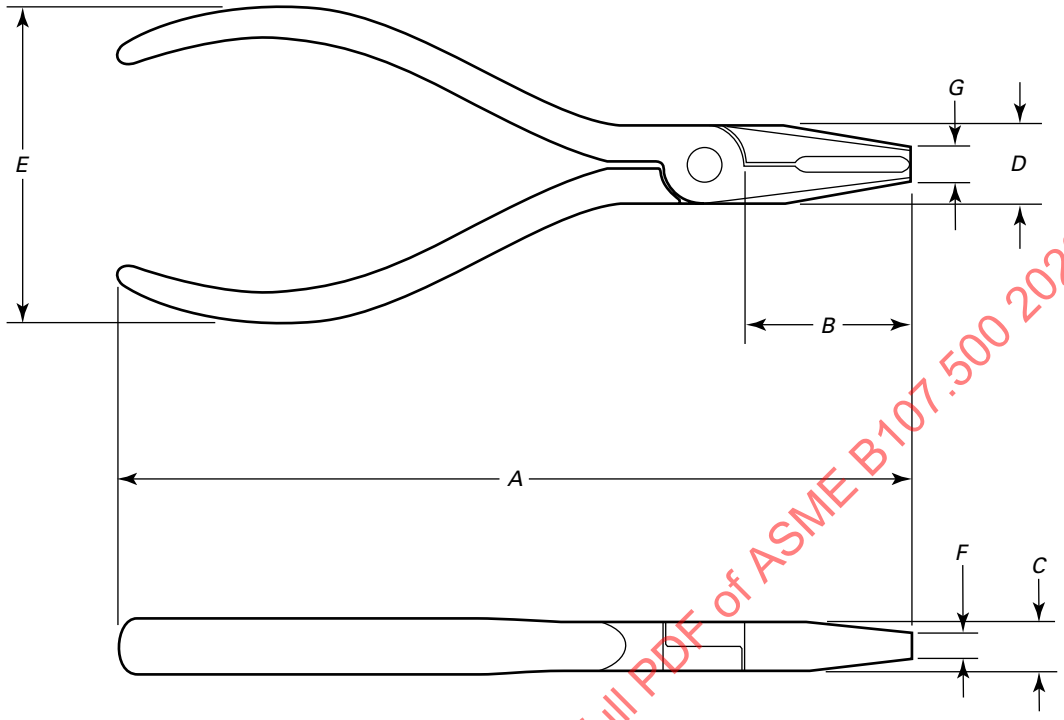


Figure 12.1.6-1 Category 22 Type I, Class 4, End Cutters (Angle)

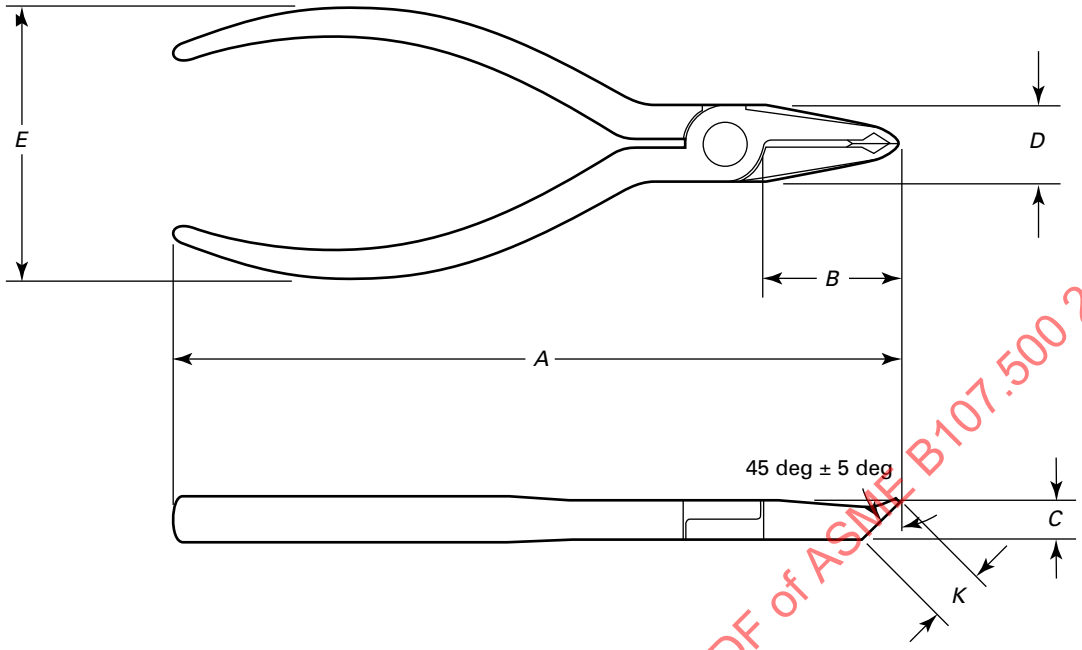


Figure 12.2.1-1 Category 22 Type II, Class 1, Flat Nose

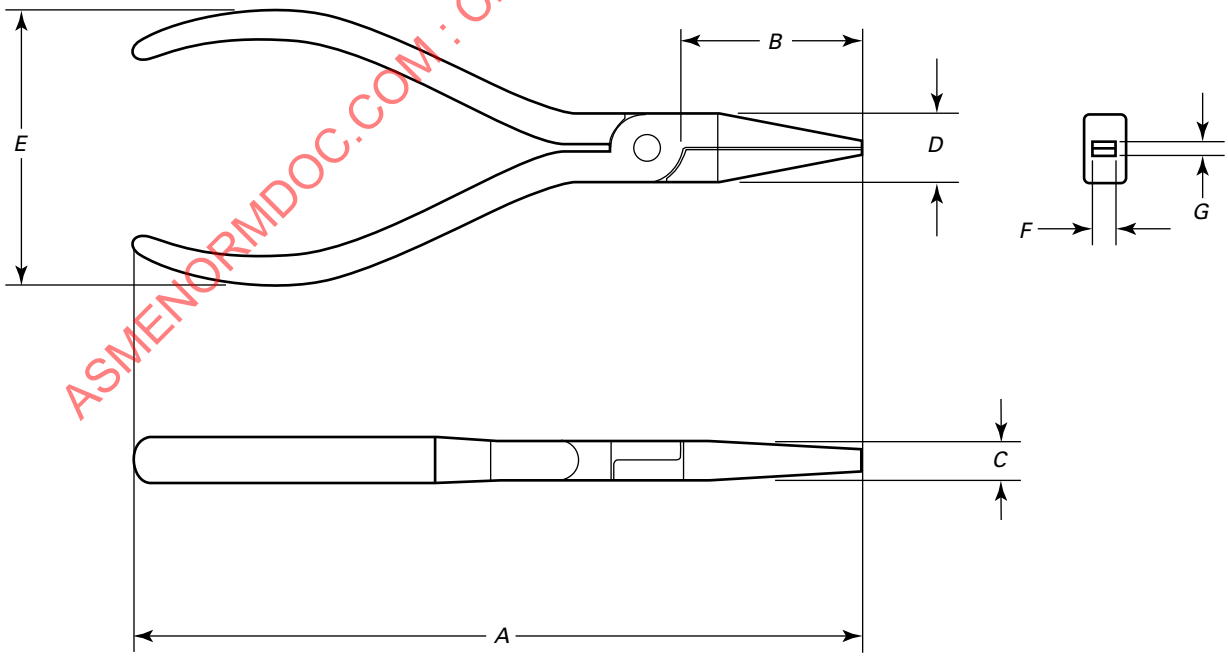


Figure 12.2.2.1-1 Category 22 Type II, Class 2, Style A, Long Nose Without Side Cutter

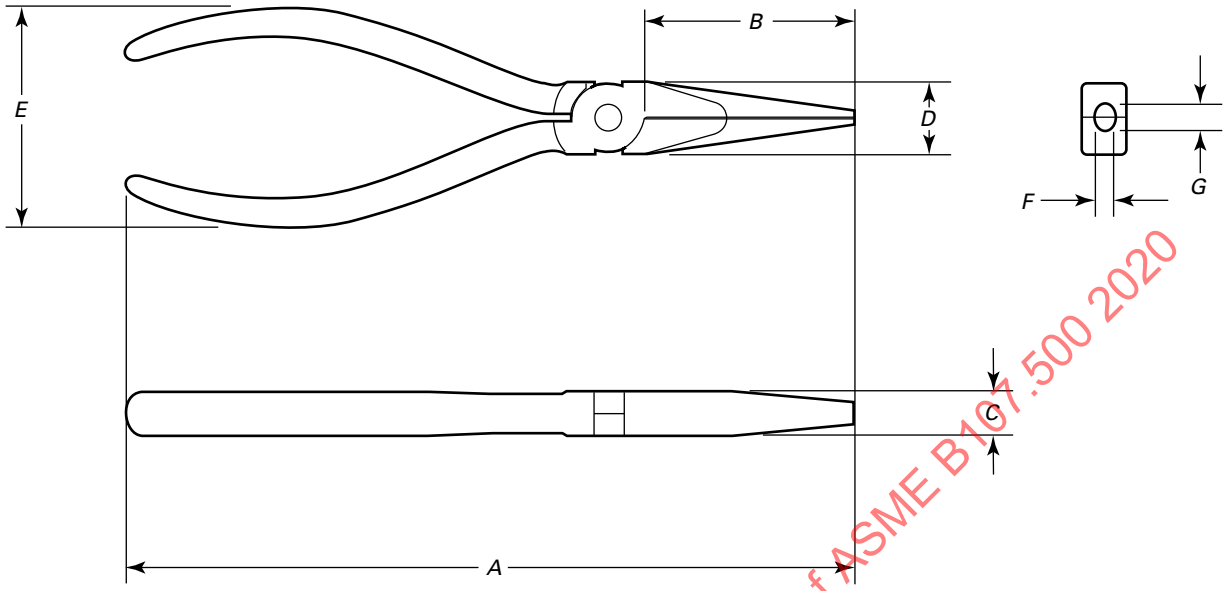


Figure 12.2.2.2-1 Category 22 Type II, Class 2, Style B, Long Nose With Side Cutter

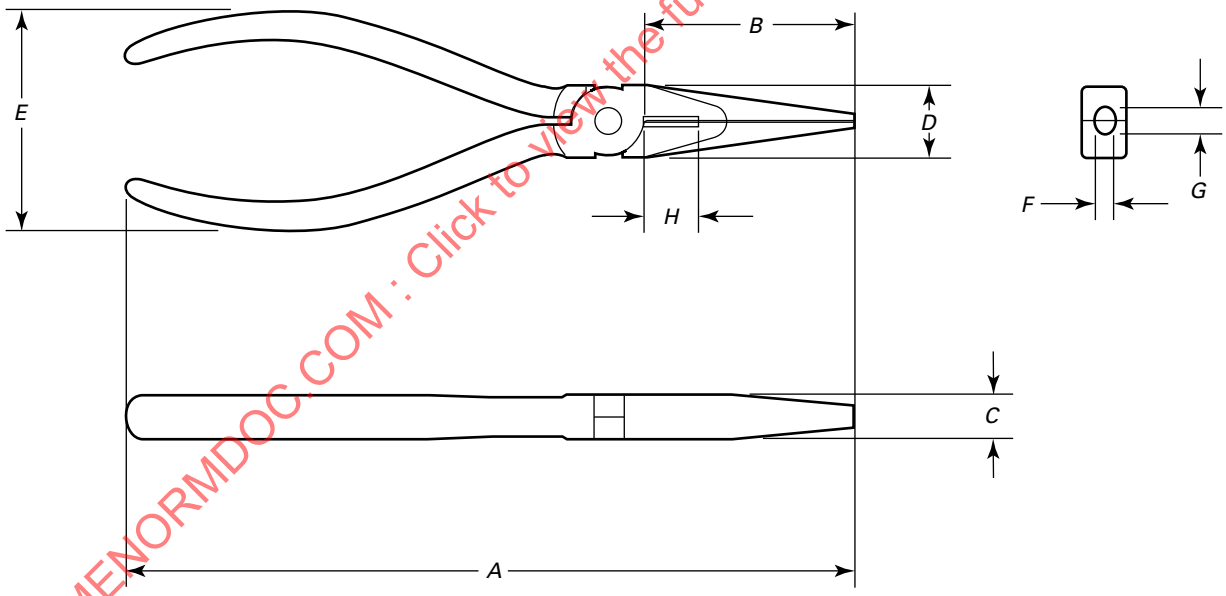


Figure 12.2.2.3-1 Category 22 Type II, Class 2, Style C, Curved Nose

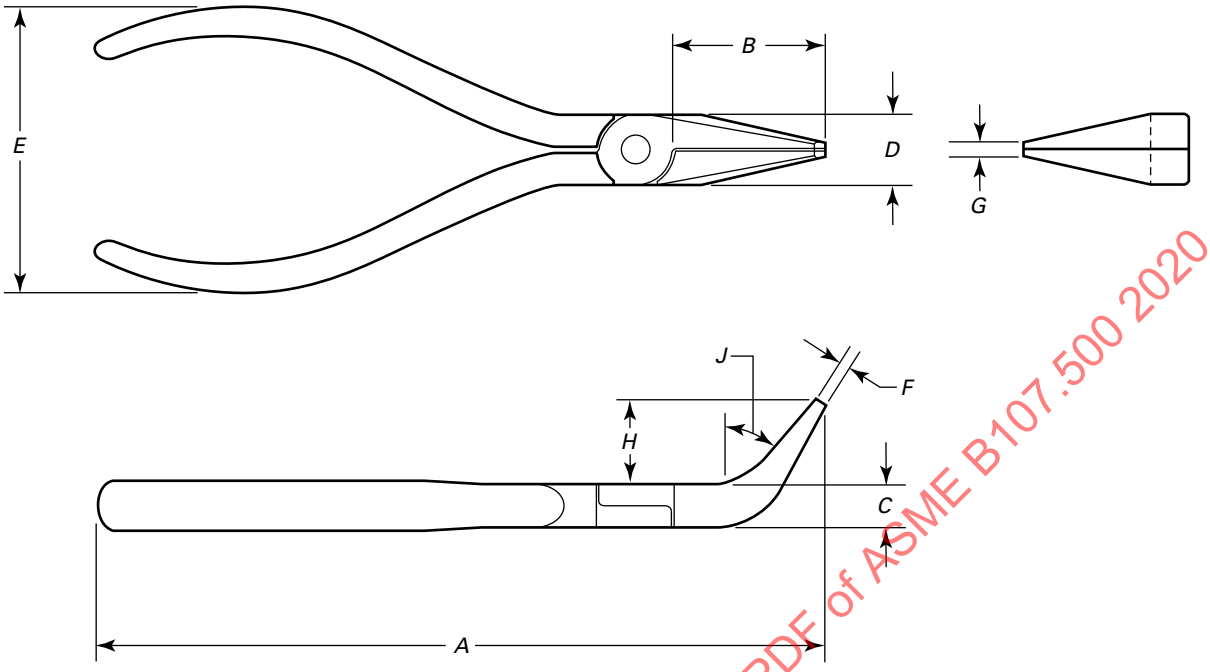


Figure 12.2.2.4-1 Category 22 Type II, Class 2, Style D, Short Nose

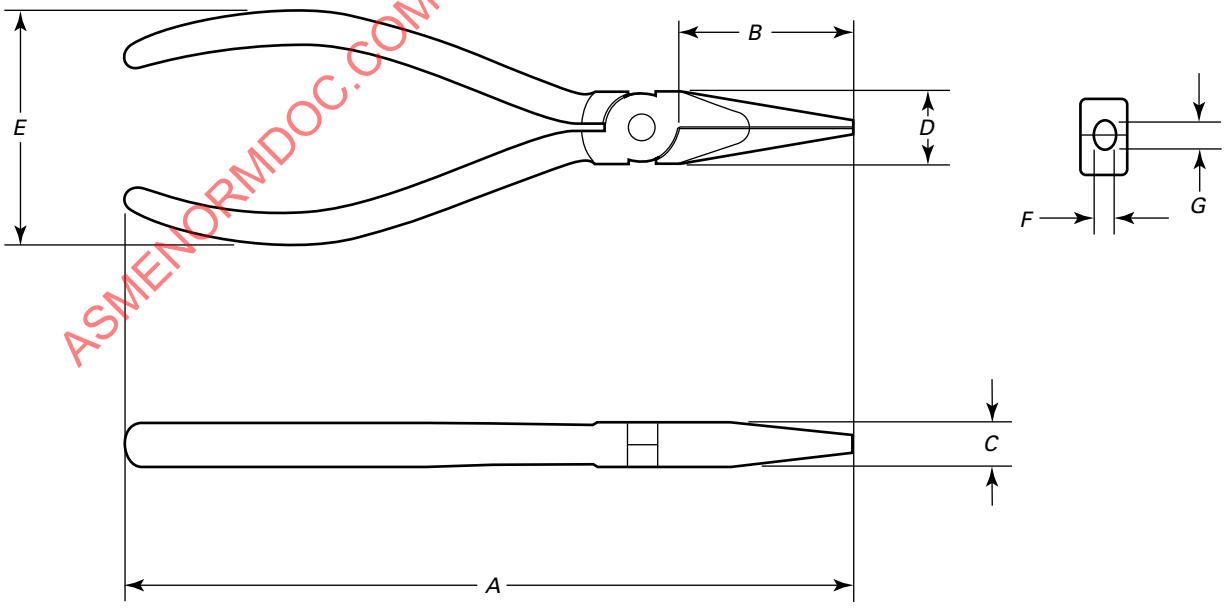


Figure 12.2.2.5-1 Category 22 Type II, Class 2, Style E, Subminiature

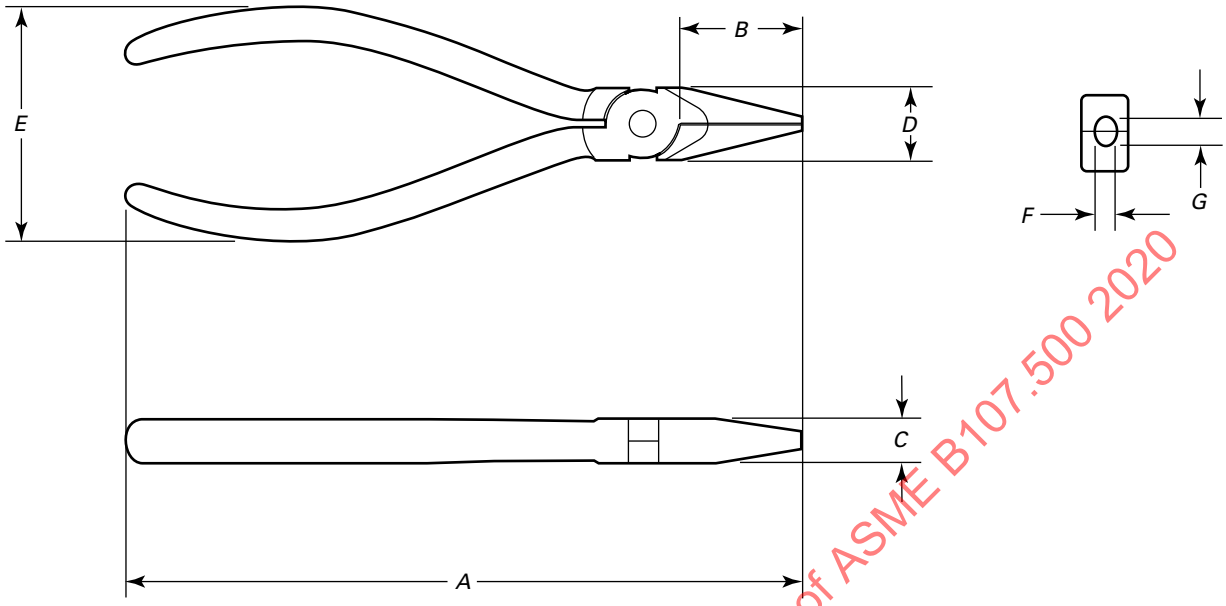


Figure 12.2.3-1 Category 22 Type II, Class 3, Long Nose With Tip Cutter

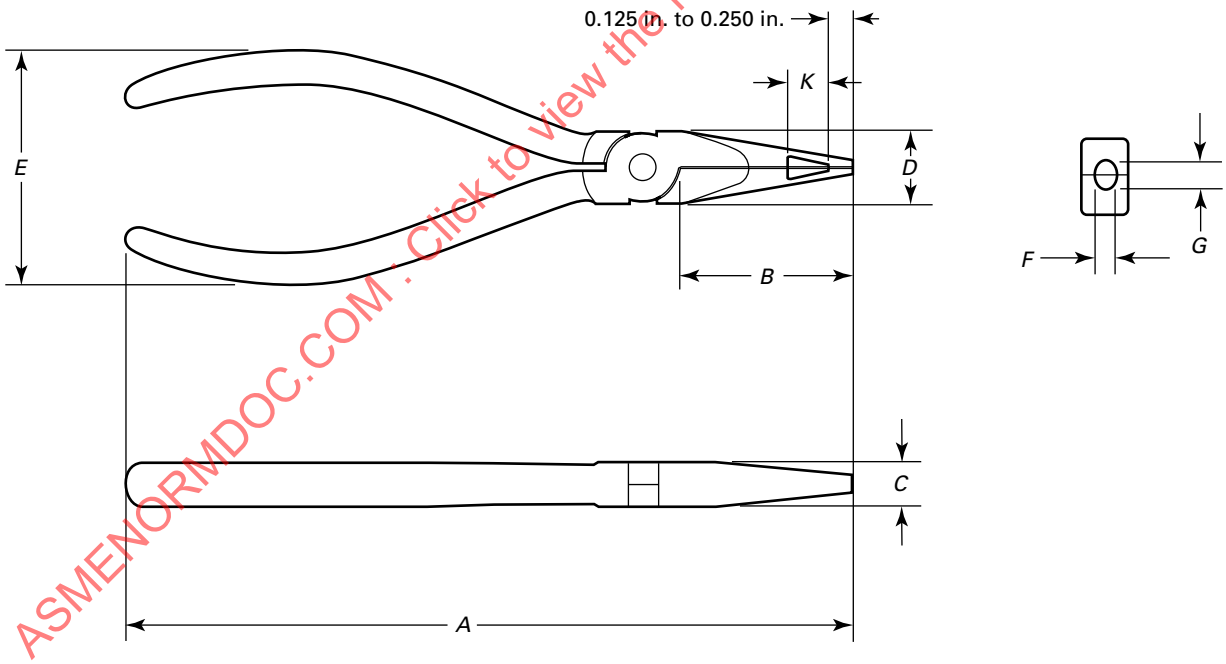


Figure 12.2.4-1 Category 22 Type II, Class 4, Needle Nose

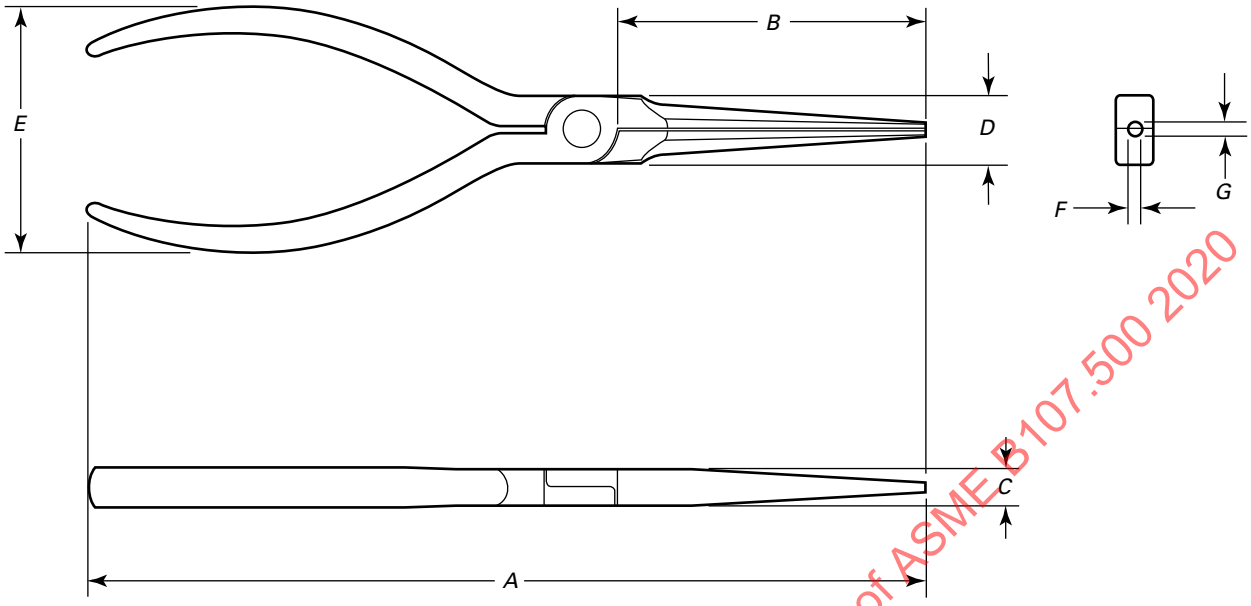
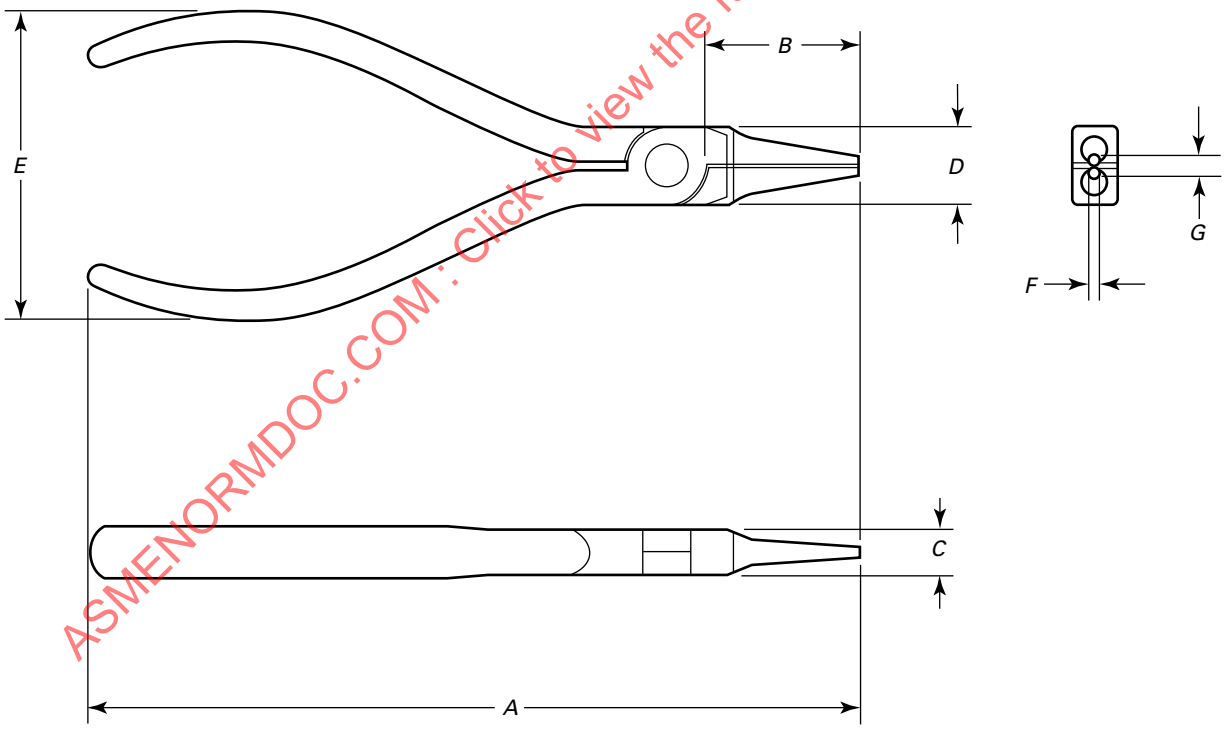


Figure 12.2.5-1 Category 22 Type II, Class 5, Round Nose



13 CATEGORY 23 MULTIPLE POSITION ADJUSTABLE PLIERS

(a) General. Figures are shown without comfort grips and with pivot adjusted to minimum capacity.

(b) Classification. See Table 13-1.

13.1 Type I, Adjustable Joint, Angle Nose

Type I pliers shall have jaws offset 37 deg to 56 deg as measured between the centerline of the jaws and the centerline of the handles. The gripping surfaces shall have sharp, crosswise grooves the full length of the jaws, except for Style D pliers, which shall have smooth gripping surfaces. With the jaws parallel in any of the operating positions, the maximum distance between the outsides of the handles at their point of widest separation shall not exceed the values in Table 13.1-1 or Table 13.1-2. With the jaws parallel in the outermost operating position, the work capacity of the jaws shall not be less than the minimum work capacity specified in Table 13.1-1 or Table 13.1-2. Handles shall not contact each other when the jaws are parallel in any of the operating positions.

13.1.1 Class 1, Multiple Grooves. Pliers shall have a number of grooves on one pliers' half, and a tongue or other feature on the other pliers' half to facilitate multiple positions. The two pliers' halves shall be held together by a joining member (i.e., fastener, rivet, or other). Changes in jaw capacity shall be made by sliding the joining member in a centrally located slot in the grooved pliers' half.

(a) Style A, Straight, Serrated Jaws. Pliers shall conform to the requirements shown in Table 13.1-1 and be similar to Figure 13.1.1-1.

(b) Style B, Curved, Serrated Jaws. Pliers shall conform to the requirements shown in Table 13.1-1 and be similar to Figure 13.1.1-2.

(c) Style C, Parrot Nose Jaws. Pliers shall conform to the requirements shown in Table 13.1-2 and be similar to Figure 13.1.1-3.

(d) Style D, Straight, Smooth Jaws. Pliers shall conform to the requirements shown in Table 13.1-1 and be similar to Figure 13.1.1-4.

(e) Style E, Combination Jaws. Pliers shall conform to the requirements shown in Table 13.1-1 and be similar to Figure 13.1.1-5.

13.1.2 Class 2, Multiple Hole. Pliers shall have a number of openings or teeth on one pliers' half, and a joining member (i.e., fastener, rivet, or other device) to join the two pliers' halves. The joining member shall permit adjustment of the two halves of the pliers and shall not disengage under load. Changes in jaw capacity shall be made by sliding the multiple-hole side of the pliers relative to the other pliers' half or otherwise disengaging and re-engaging the joining device. Pliers shall conform to the requirements shown in Table 13.1.2-1 and shall be similar to Figure 13.1.2-1.

13.2 Type II, Slip Joint, Combination Jaw

Pliers shall have multiple pivot positions on one pliers' half, and a stationary joining member (i.e., fastener, rivet, or other) on the other pliers' half. They may have a wire cutter. Combination jaws shall have straight and curved serrated gripping surfaces.

13.2.1 Class 1, Straight Nose. Pliers shall have a straight nose.

(a) Style A, Regular. Pliers shall conform to the requirements shown in Table 13.2.1-1 and shall be similar to Figure 13.2.1-1.

(b) Style B, Thin. Pliers shall conform to the requirements shown in Table 13.2.1-2 and shall be similar to Figure 13.2.1-2.

13.2.2 Class 2, Bent Nose. Pliers shall have a nose bent to an angle of 20 deg to 30 deg. The pliers shall conform to the requirements shown in Table 13.2.2-1 and be similar to Figure 13.2.2-1.

13.3 Handle Hardness

Handles shall have a hardness from 35 HRC to 60 HRC or equivalent.

13.4 Joint Fastener Hardness

Fastener hardness shall be from 25 HRC to 50 HRC except when case hardened; a maximum hardness equivalent to 60 HRC shall be permitted.

13.5 Jaw and Cutting-Edge Hardness

Jaw hardness within 0.06 in. of the root of the groove form and wire cutter, as applicable, shall be 45 HRC to 60 HRC.

Table 13-1 Classification for Multiple Position Adjustable Pliers — Category 23

Type	Class	Style
I — adjustable joint, angle nose	1 — multiple grooves	A — straight, serrated jaws
		B — curved, serrated jaws
		C — parrot nose jaws
		D — straight, smooth jaws
		E — combination jaws
	2 — multiple hole	...
II — slip joint, combination jaw	1 — straight nose	A — regular
		B — thin
	2 — bent nose	...

Table 13.1-1 Category 23 Type I, Class 1, Styles A, B, D, and E: Adjustable Joint, Angle Nose, Multiple Grooves, Tongue

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Jaw Thickness, *C* [Note (1)]	Maximum Distance Between Outside of Handles With Jaws Parallel, *D*	Minimum Work Capacity With Jaws Parallel	Minimum Number of Adjustment Positions
	Min.	Max.					
4½	4.0	5.3	0.31	0.25	3.2	0.5	3
6½	6.0	7.2	0.69	0.41	3.2	0.7	4
8	7.5	8.5	0.87	0.57	3.2	1.0	4
9½	9.0	10.0	1.00	0.57	3.2	1.2	4
10	9.5	10.5	1.06	0.57	3.2	1.7	5
12	11.0	13.0	1.44	0.63	4.3	2.1	5
13	12.0	14.0	1.56	0.64	4.3	2.6	5
14	13.0	15.0	1.50	0.66	4.3	1.7	6
14½	13.5	15.5	1.63	0.66	4.3	2.8	7
16	15.0	17.0	2.12	0.66	5.5	3.7	8
20	19.0	21.0	2.87	0.66	5.5	5.3	10

NOTE: (1) Measured 0.25 in. from the tip of jaw to provide for acceptance of tapered jaw.

Table 13.1-2 Category 23 Type I, Class 1, Style C: Adjustable Joint, Angle Nose, Multiple Grooves, Tongue

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Jaw Thickness, *C* [Note (1)]	Maximum Distance Between Handles With Jaws Parallel, *D*	Minimum Work Capacity With Jaws Parallel	Minimum Number of Adjustment Positions
	Min.	Max.					
10	9.5	10.5	1.0	0.56	4.3	1.0	4
14	13.0	15.0	1.5	0.66	4.3	1.7	6

NOTE: (1) Measured 0.25 in. from the tip of jaw to provide for acceptance of tapered jaw.

Figure 13.1.1-1 Category 23 Type I, Class 1, Style A, Adjustable Joint, Angle Nose, Multiple Grooves, Tongue, Straight, Serrated Jaws

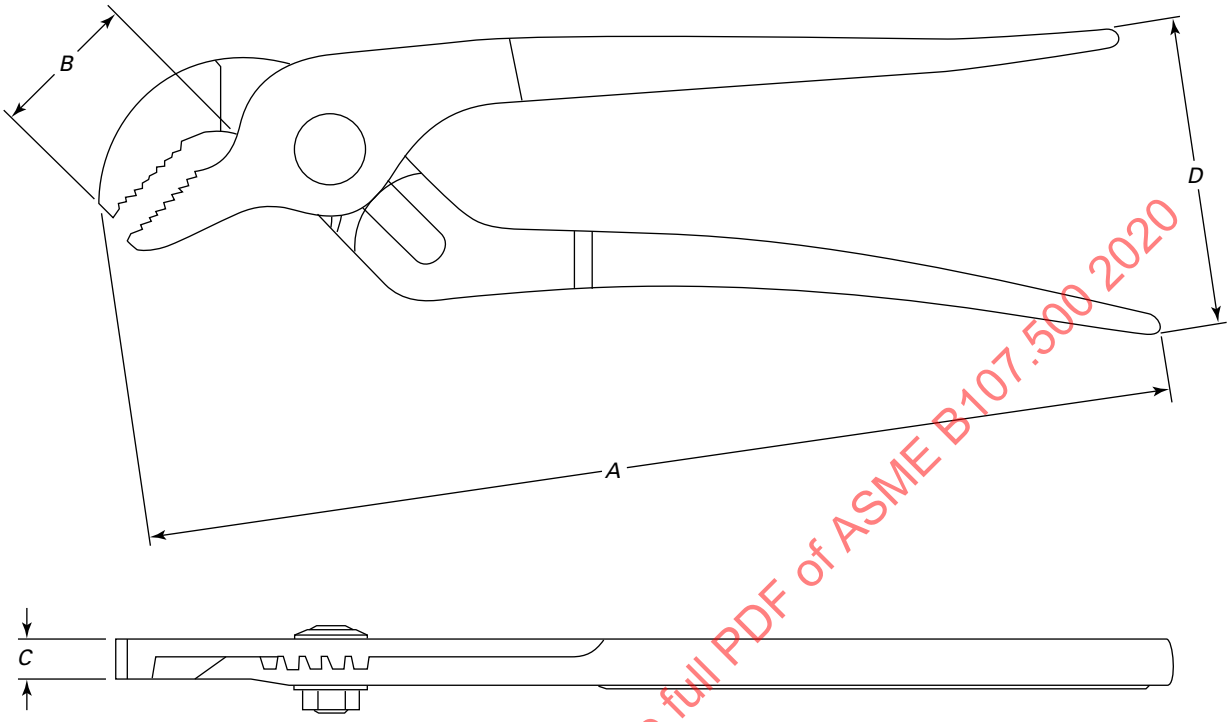


Figure 13.1.1-2 Category 23 Type I, Class 1, Style B, Adjustable Joint, Angle Nose, Multiple Grooves, Tongue, Curved, Serrated Jaws

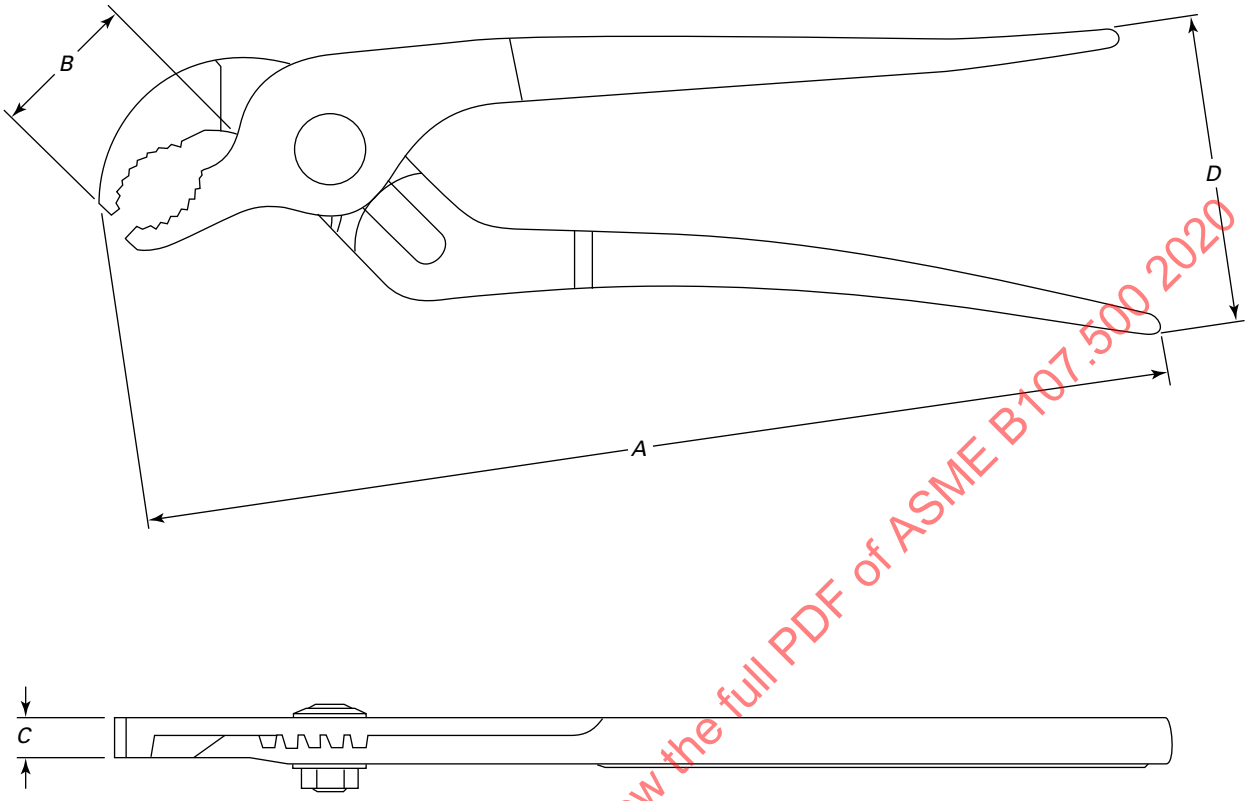


Figure 13.1.1-3 Category 23 Type I, Class 1, Style C, Adjustable Joint, Angle Nose, Multiple Grooves, Tongue, Parrot-Nosed Jaws

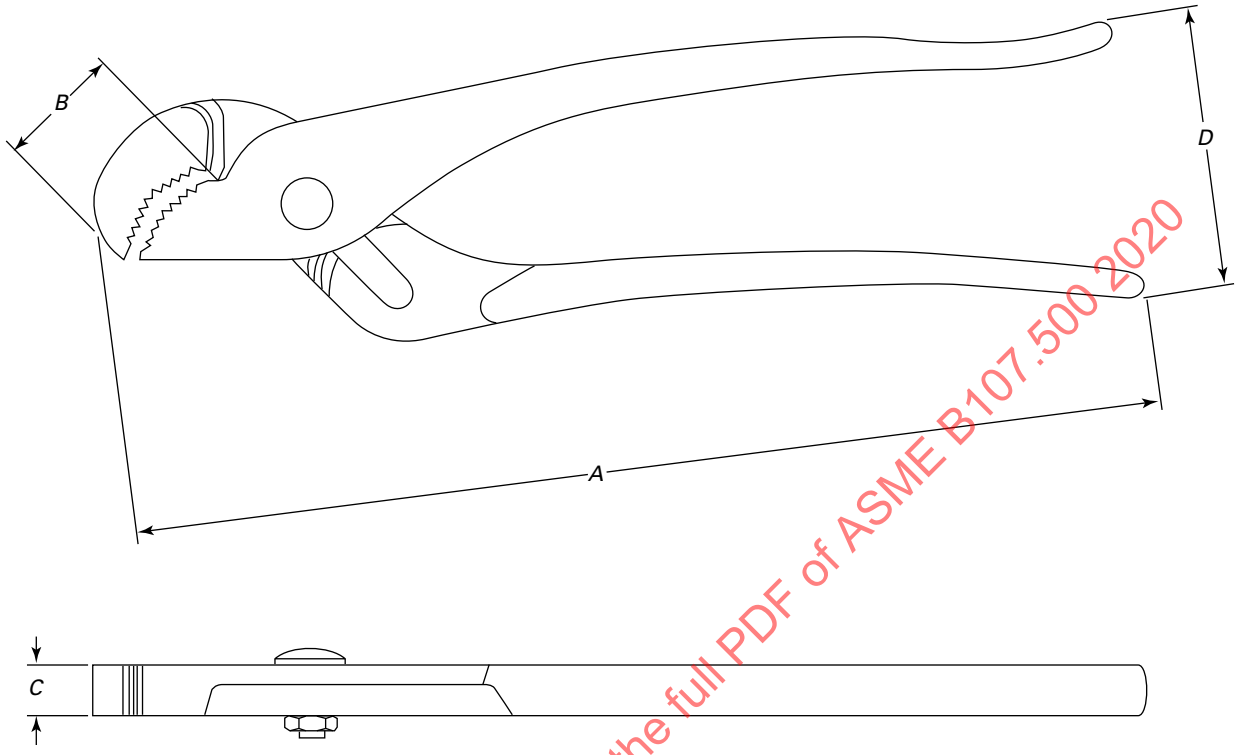


Figure 13.1.1-4 Category 23 Type I, Class 1, Style D, Adjustable Joint, Angle Nose, Multiple Grooves, Tongue, Straight, Smooth Jaws

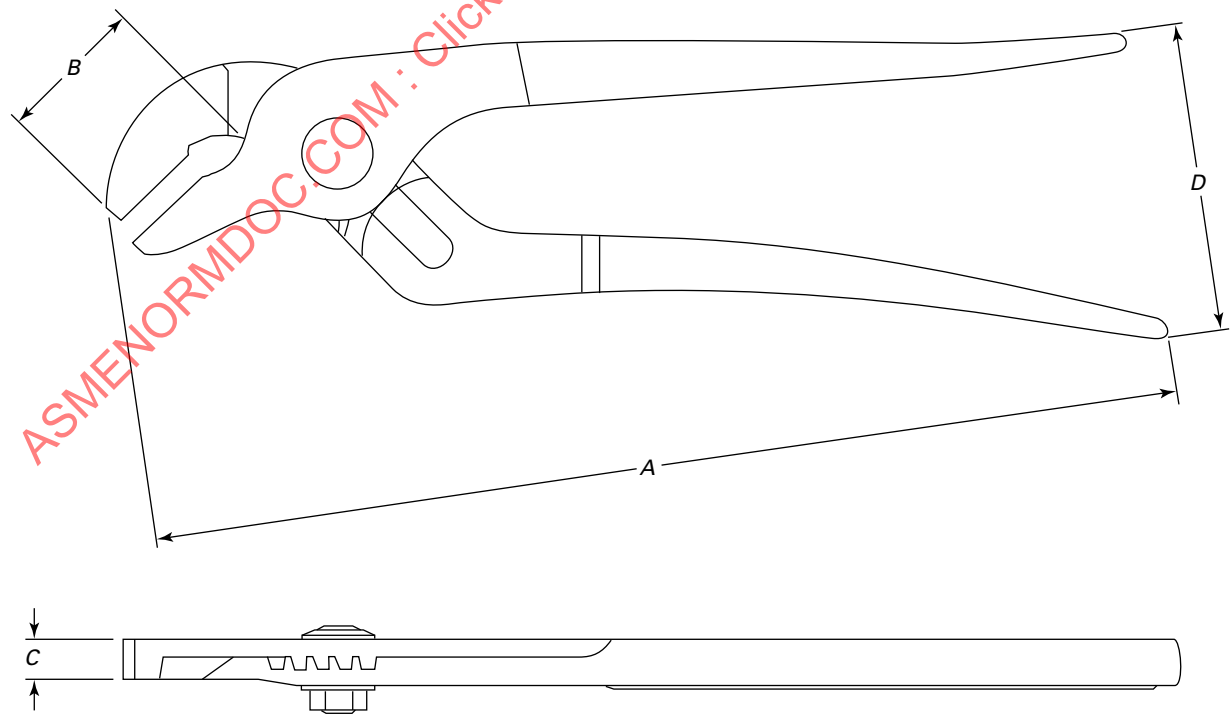


Figure 13.1.1-5 Category 23 Type I, Class 1, Style E, Adjustable Joint, Angle Nose, Multiple Grooves, Tongue, Combination Jaws

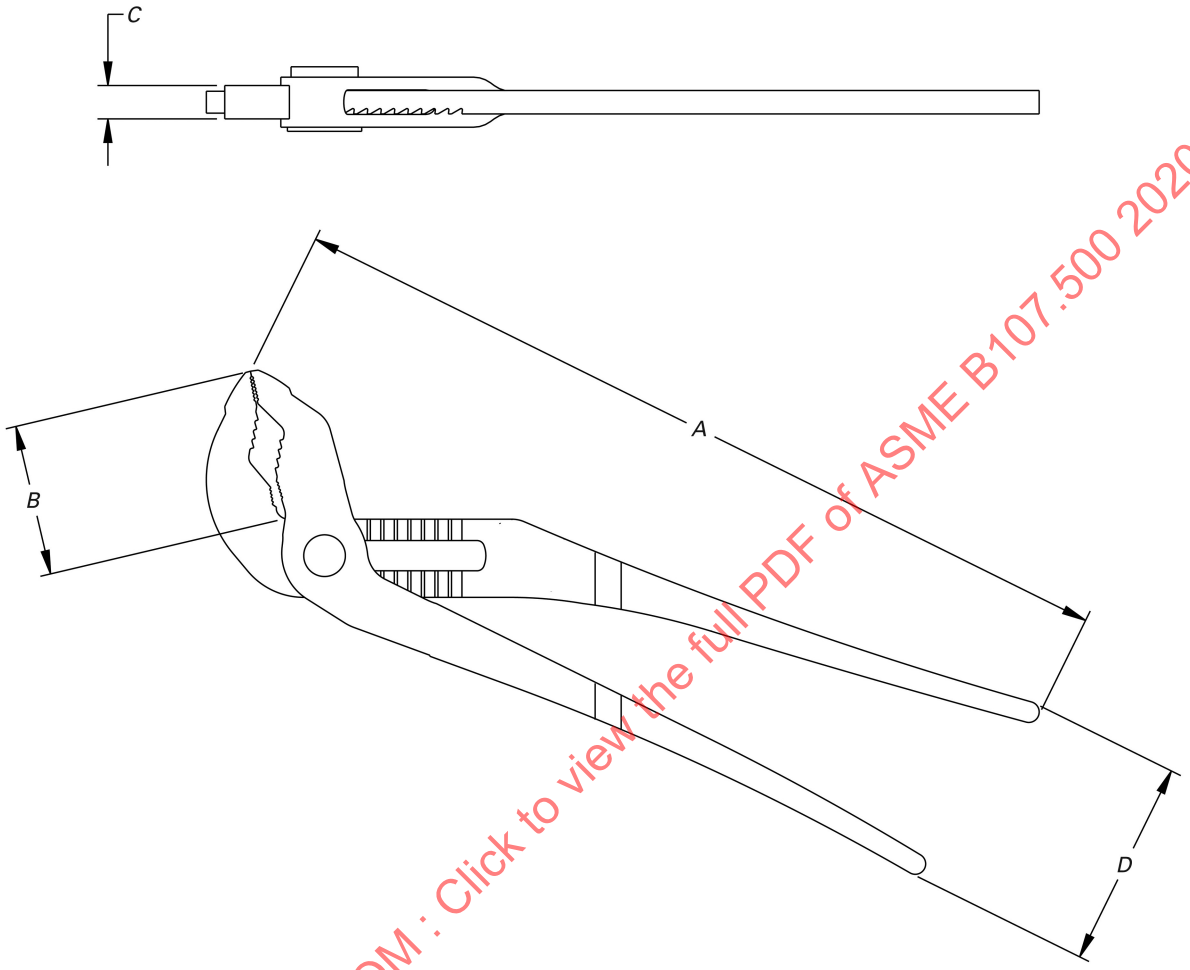
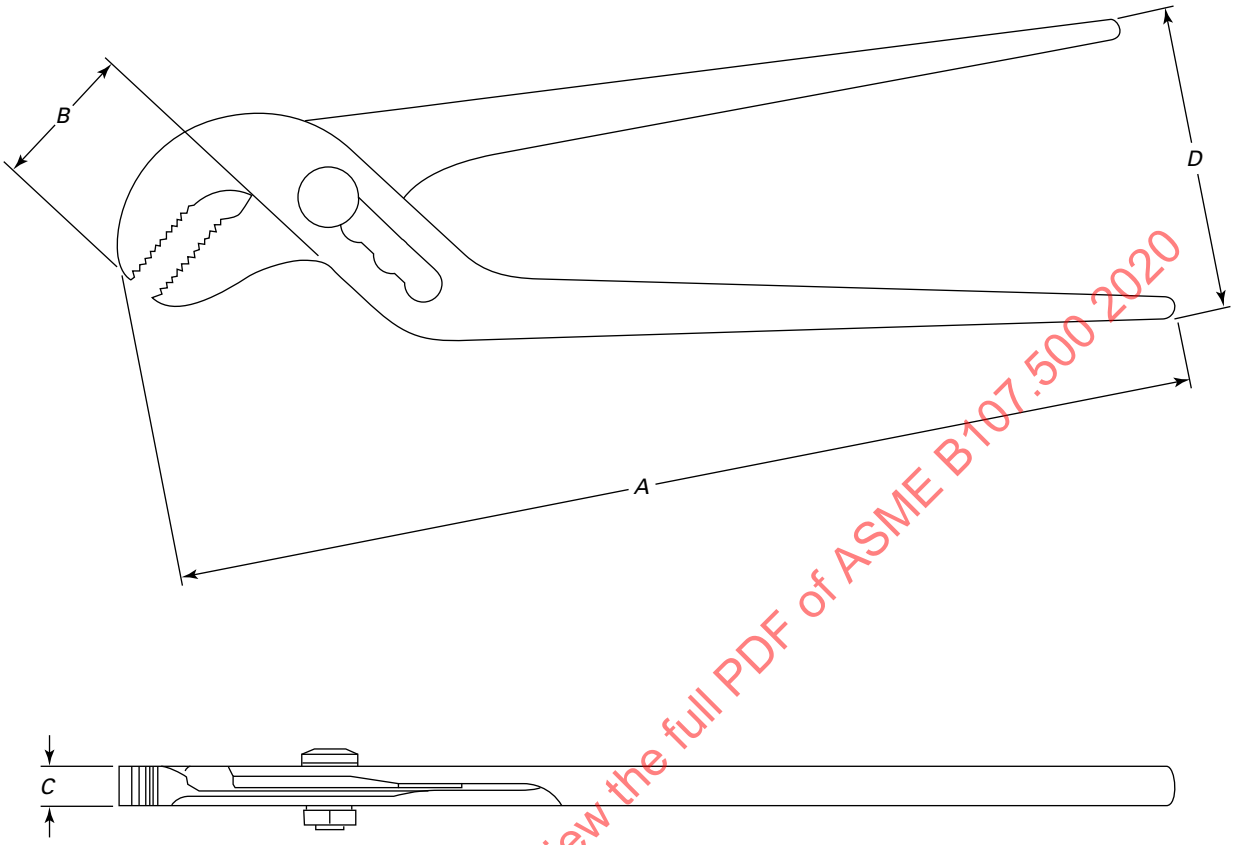


Table 13.1.2-1 Category 23 Type I, Class 2, Adjustable Joint, Angle Nose, Multiple Holes

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Jaw Thickness, *C*	Maximum Distance Between Handles With Jaws Parallel, *D*	Minimum Work Capacity	Minimum Number of Adjustment Positions
	Min.	Max.					
5	4.5	5.5	0.3	0.25	3.2	0.37	2
7	6.5	7.5	0.6	0.50	3.2	0.63	3
8	7.8	8.5	1.0	0.50	3.2	1.00	4
10	9.0	11.0	1.2	0.56	3.2	1.37	4

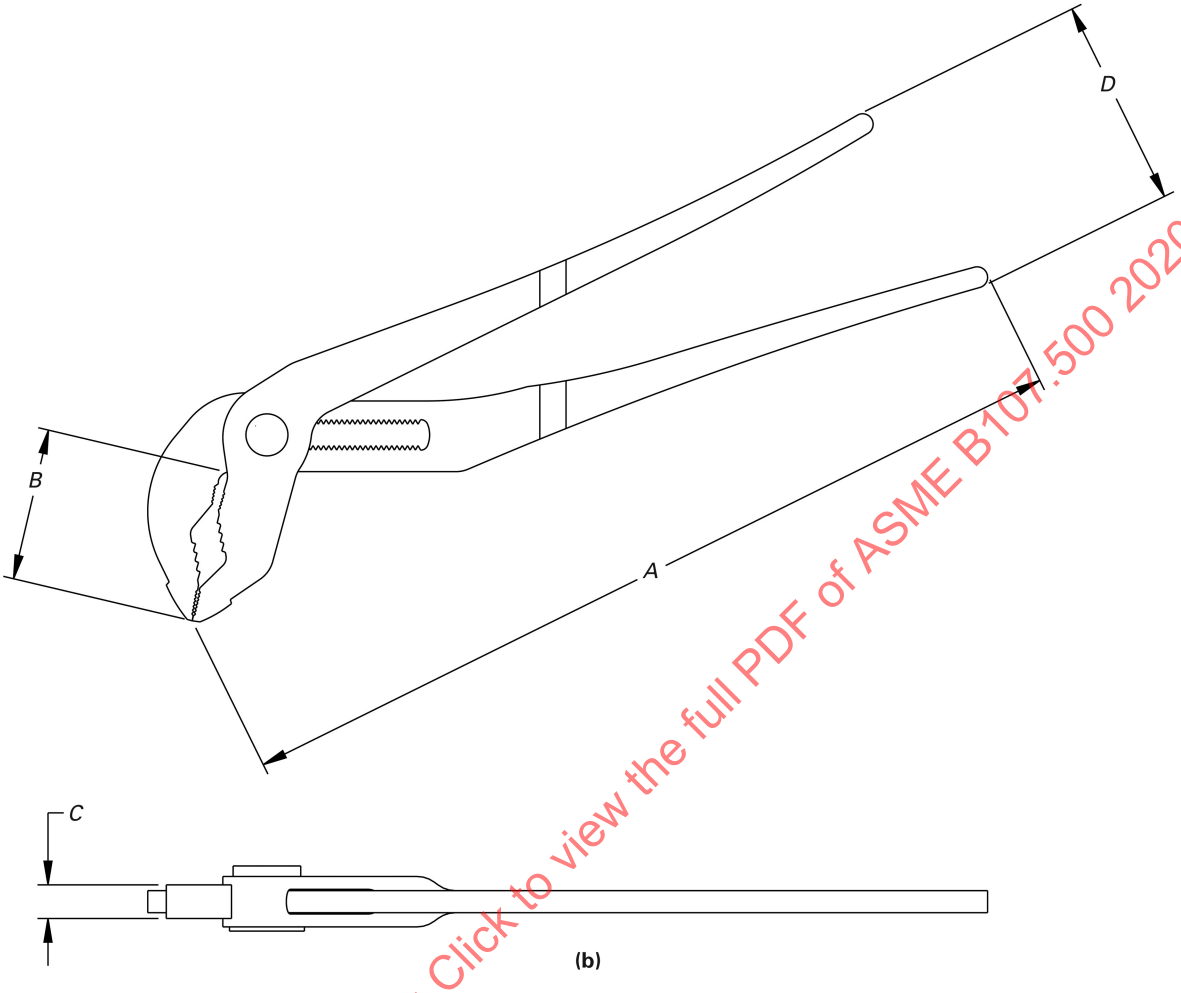
GENERAL NOTE: For plain handles without comfort grips.

Figure 13.1.2-1 Category 23 Type I, Class 2, Adjustable Joint, Angle Nose, Multiple Holes



(a)

Figure 13.1.2-1 Category 23 Type I, Class 2, Adjustable Joint, Angle Nose, Multiple Holes (Cont'd)



(b)

Figure 13.1.2-1 Category 23 Type I, Class 2, Adjustable Joint, Angle Nose, Multiple Holes (Cont'd)

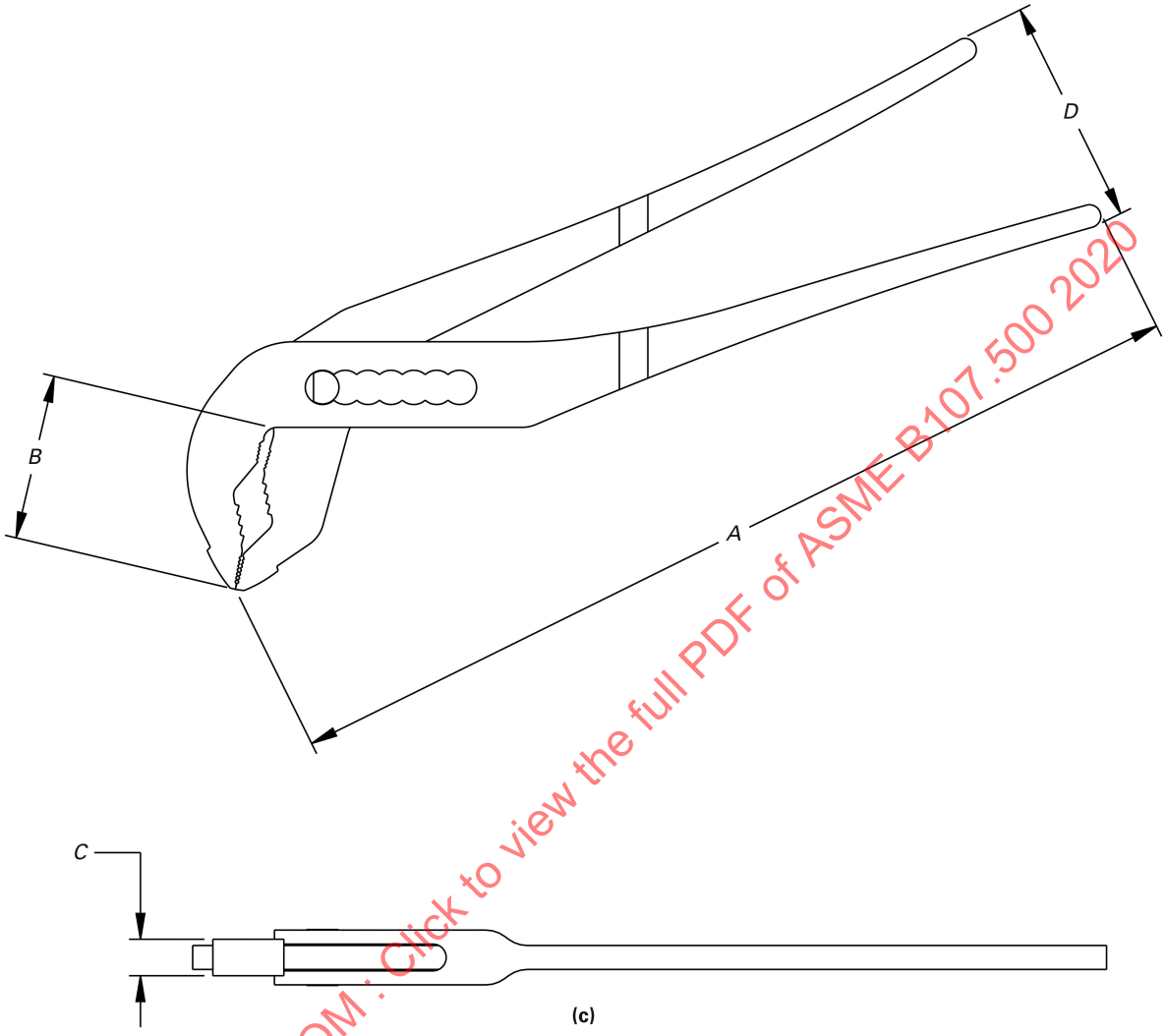


Table 13.2.1-1 Category 23 Type II, Class 1, Style A: Slip Joint, Combination Jaw, Straight Nose, Regular

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Jaw Thickness, *C*	Handle Width, *D*	
	Min.	Max.			Min.	Max.
4	3.0	5.0	0.7	0.41	1.1	1.8
6	5.0	7.0	1.1	0.50	1.3	2.2
8	7.0	9.0	1.1	0.50	1.5	2.3
10	9.0	11.0	1.7	0.66	1.7	2.5

Figure 13.2.1-1 Category 23 Type II, Class 1, Style A: Slip Joint, Combination Jaw, Straight Nose, Regular

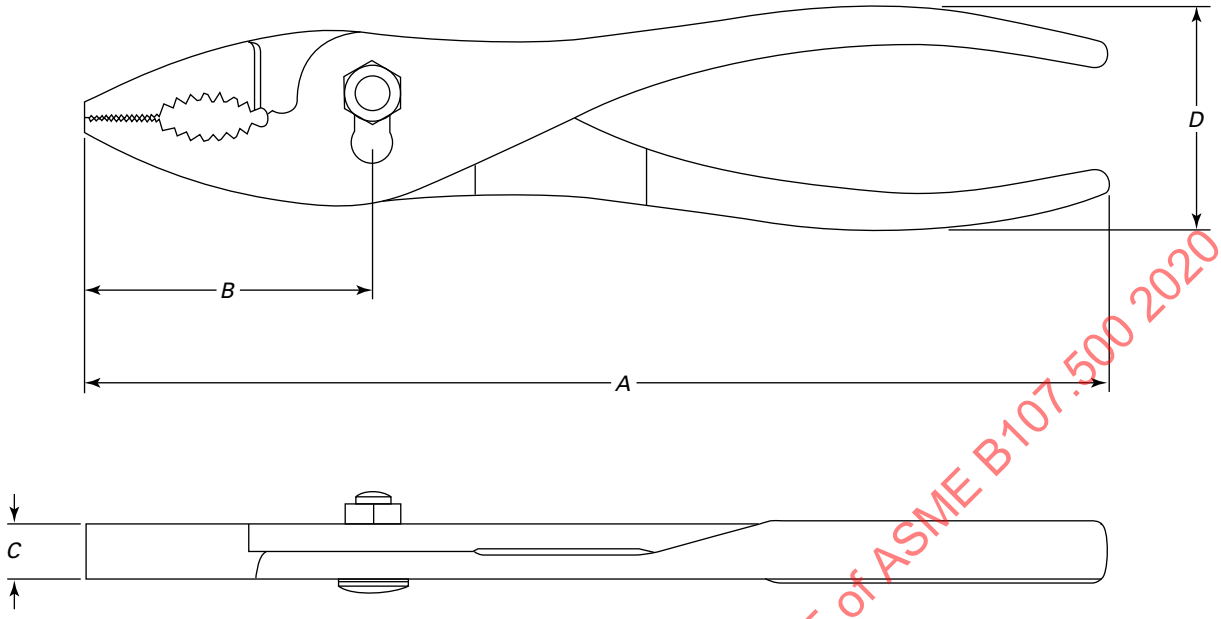


Table 13.2.1-2 Category 23 Type II, Class 1, Style B: Slip Joint, Combination Jaw, Straight Nose, Thin

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Nose Thickness, *C*	Handle Width, *D*	
	Min.	Max.			Min.	Max.
6	5.7	6.8	1.5	0.25	1.3	2.2
8	7.7	8.8	1.6	0.25	1.5	2.3

Figure 13.2.1-2 Category 23 Type II, Class 1, Style B: Slip Joint, Combination Jaw, Straight Nose, Thin

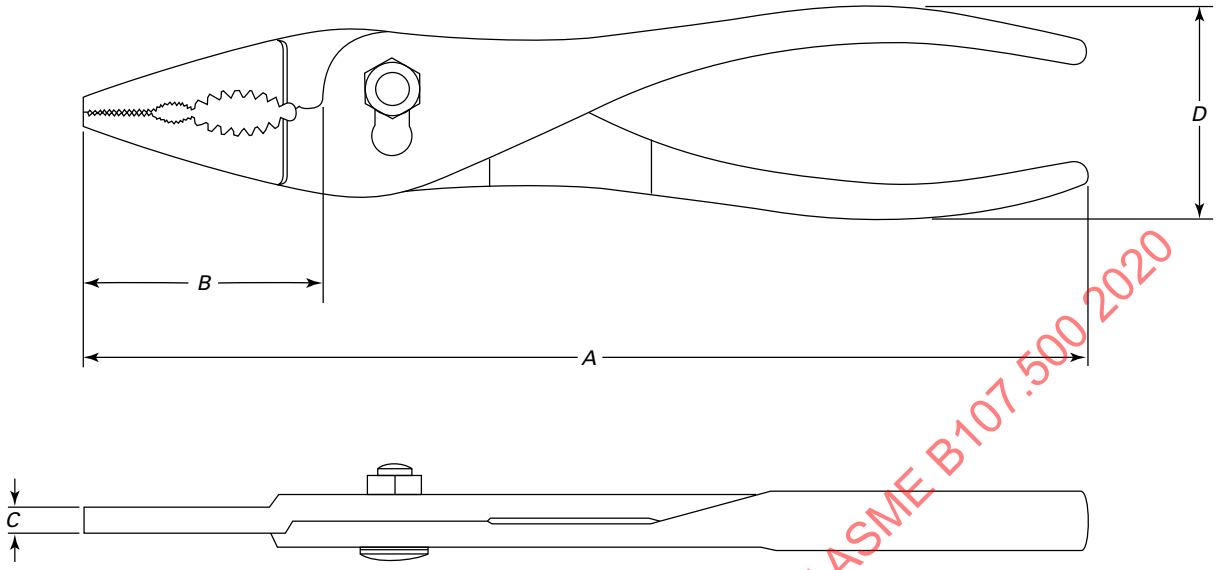
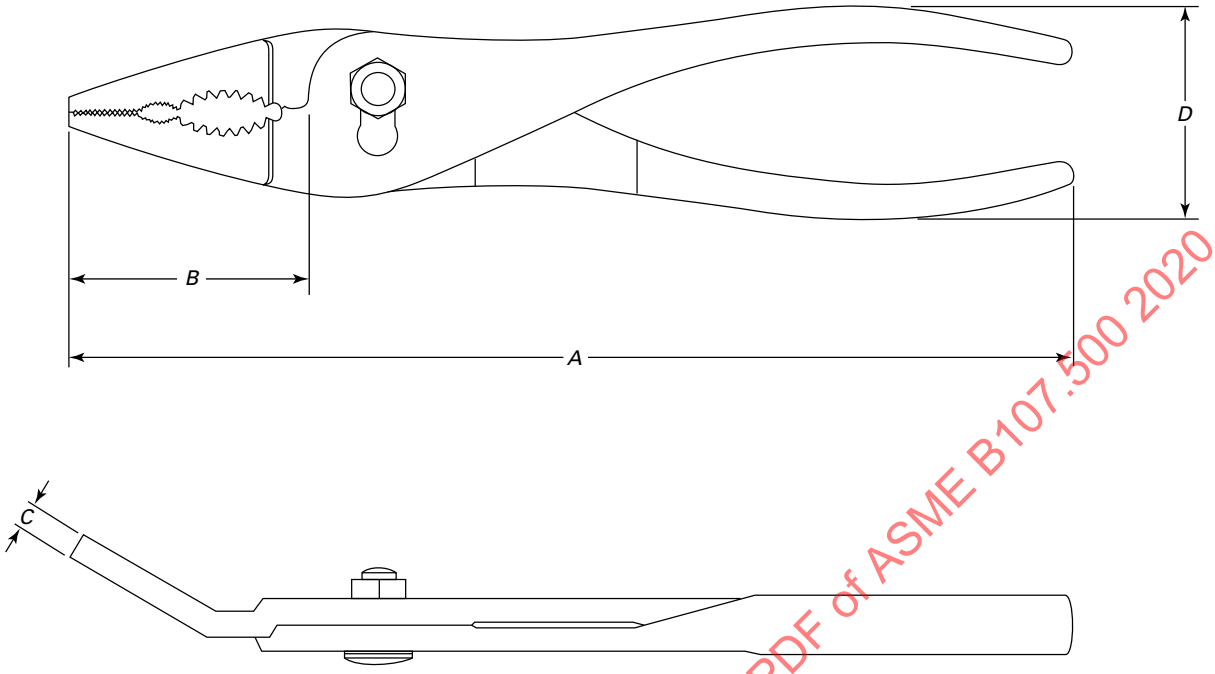


Table 13.2.2-1 Category 23 Type II, Class 2, Slip Joint, Combination Jaw, Bent Nose

Nominal Size	Overall Length, *A*		Minimum Jaw Length, *B*	Maximum Nose Thickness, *C*	Handle Width, *D*	
	Min.	Max.			Min.	Max.
6	5.7	6.8	1.4	0.25	1.3	2.2
8	7.7	8.8	1.5	0.25	1.5	2.3

Figure 13.2.2-1 Category 23 Type II, Class 2, Slip Joint, Combination Jaw, Bent Nose



14 CATEGORY 24 LOCKING, CLAMP, AND TUBING PINCH-OFF PLIERS

(a) General. Pliers shall be suitable for gripping, clamping, pinching, and wrenching. They shall be provided with a toggle or cam device having an adjustable mechanism designed so that the jaws can be clamped and locked. Pliers shall be released by hand anywhere within the capacity of the pliers by any release mechanism similar to Figure 14-1. The overall length measurement shall include the adjusting screw.

(b) Classification. See Table 14-1.

14.1 Type I, Locking Pliers

Adjustments in the jaw opening shall be made by the adjusting screw. Pliers shall have straight, curved, long nose, or bent nose jaws. Pliers shall be capable of withstanding the locking load test specified in para. 17.18. Pliers shall have one fixed jaw and one adjustable jaw. The jaws shall be integral with or securely fixed to the pliers. There shall be no motion of the gripping surface of either jaw other than that produced by manual operation of the pliers. The design of the toggle or cam mechanism shall be such that when the movable handle is released from the closed and locked position, the jaw tips shall move apart to the full open position.

14.1.1 Class 1, Straight Jaws. The gripping surface of Class 1 jaws shall be serrated with sharp teeth of such form as to securely hold a work object with a positive grip. Pliers shall be capable of withstanding the grip test of para. 17.8.1. Style A pliers shall have two straight jaws and conform to the requirements shown in Table 14.1.1-1 for the size specified and shall be similar to Figure 14.1.1-1.

14.1.2 Class 2, Curved Jaws. Class 2 pliers shall have straight, serrated gripping surfaces at the outer end of the jaws suitable for gripping flat surfaces and curved gripping jaws with sharp teeth at the center of the jaw suitable for gripping round surfaces. Pliers shall be capable of withstanding the grip test of para. 17.8.1.

(a) Style A, Without Cutter. Pliers shall conform to the requirements shown in Table 14.1.1-1 for the size specified and shall be similar to Figure 14.1.2-1.

(b) Style B, With Cutter. Pliers shall be identical to Style A pliers except that the pliers shall be provided with cutting edges near the joint. Pliers shall cut wire in accordance with para. 17.2.2. Pliers shall conform to the requirements shown in Table 14.1.1-1 for the sizes specified and shall be similar to Figure 14.1.2-1.

14.1.3 Class 3, Long Nose

(a) Style A, Without Cutter. Pliers shall have straight, serrated gripping surfaces at the outer end of the jaws suitable for gripping flat surfaces. The balance of the gripping surfaces may be straight or with curved gripping jaws with sharp teeth at the center of the jaw suitable for gripping round surfaces. Class 3, Style A pliers shall conform to the requirements shown in Table 14.1.1-1 and shall be similar to Figure 14.1.3-1.

(b) Style B, With Cutter. Pliers shall have straight, serrated gripping surfaces at the outer end of the jaws suitable for gripping flat surfaces. The balance of the

gripping surfaces may be straight or with curved gripping jaws with sharp teeth at the center of the jaw suitable for gripping round surfaces and shall be provided with cutting edges near the joint end. Pliers shall cut wire, as specified in para. 17.2.2. Class 3, Style B pliers shall conform to the requirements shown in Table 14.1.1-1 and be similar to Figure 14.1.3-1.

14.1.4 Class 4, Smooth Jaws. Class 4 pliers shall have smooth jaw surfaces and shall be capable of holding, without marring the surface, parallel-sided material of a thickness up to the minimum jaw opening size. Pliers shall conform to the requirements shown in Table 14.1.1-1 and shall be similar to Figure 14.1.4-1. Pliers shall be capable of withstanding the grip tests of para. 17.8.2.

14.2 Type II, Clamp

Pliers shall be capable of withstanding the load test specified in para. 17.18. The design of the toggle or cam mechanism shall be such that when the movable handle is released from the closed and locked position, the jaw tips shall move apart to the full open position.

14.2.1 Class 1, "C" Clamp, Style A, Fixed Without Swivel Pads. Jaws shall have radiused or lightly serrated clamping surfaces. Class 1, Style A pliers shall conform to the dimensions of Table 14.2.1-1 and shall be similar to Figure 14.2.1-1. With the jaws closed and locked, a rectangular block of a size equal to dimensions *B* and *C* shall pass freely through the throat.

14.2.2 Class 1, "C" Clamp, Style B, Fixed With Swivel Pads. Jaws shall have smooth clamping surfaces that are movable to facilitate parallel clamping throughout the clamping range. The clamp shall conform to the requirements in Table 14.2.1-1 and shall be similar to Figure 14.2.2-1. With clamp jaws closed and locked, a rectangular block of a size equal to dimensions *B* and *C* shall pass freely through the throat.

14.2.3 Class 2, Sheet Metal Clamp. Jaws shall have enlarged clamping surfaces suitable for firmly holding sheet metal. The clamp shall conform to the requirements in Table 14.2.1-1 and shall be similar to Figure 14.2.3-1.

14.2.4 Class 3, Welding Clamp. Jaws shall be "U" shaped and constructed with an open area in the center to permit welding, soldering, riveting, and similar operations, while the work is clamped. Class 3 clamps shall conform to the requirements in Table 14.2.1-1 and shall be similar to Figure 14.2.4-1.

14.3 Type III, Tubing Pinch-Off

Pliers shall be capable of withstanding testing in accordance with para. 17.19. With the pliers in the closed and locked position, the jaw tips shall make contact, and the remainder of jaw contact surface shall be such that a 0.005-in. thickness gage cannot be inserted through the closed jaws. The throat depth shall be a minimum of 0.750 in. Pliers shall conform to Table 14.3-1 and shall be similar to Figure 14.3-1.

14.4 Handle Characteristics

Minimum handle clearance between the fixed and movable handle shall be as specified in the appropriate tables, when the pliers are locked in any position of the jaws.

14.5 Handle Hardness

Handles shall be through hardened from 30 HRC to 50 HRC or case hardened from 75 HR15N to 86 HR15N with a case depth of a minimum of 0.010 in.

14.6 Adjusting Screw

An adjusting screw located at the end of the handle shall have a minimum hardness of 30 HRC.

14.7 Joint Fastener Hardness

Joint fasteners shall be through hardened from 25 HRC to 50 HRC. Where fasteners receive a case-hardening treatment in addition to the through hardening, a maximum hardness of 60 HRC or equivalent will be permitted.

14.8 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

14.9 Jaw Opening

Ends of jaws shall open, when adjusted by the screw, to the respective minimum distance specified in Table 14.1.1-1 for Type I pliers and through the clamping range in Table 14.2.1-1 for Type II pliers.

14.10 Jaw and Cutting-Edge Hardness

Jaws of Type I pliers shall be through hardened from 45 HRC to 60 HRC or case hardened from 83 HR15N to 90 HR15N with a case depth minimum of 0.010 in. Jaws of Type II pliers shall be through hardened from 35 HRC to 50 HRC or case hardened from 83 HR15N to 90 HR15N with a case depth minimum of 0.010 in. Swivel pads need not be hardened.

14.11 Serrations

Serrated surfaces for Type I, Classes 1, 2, and 3 shall have continuous and uniform sharp projections.

Table 14-1 Classification for Locking, Clamp, and Tubing Pinch-Off Pliers — Category 24

Type	Class	Style
I — locking pliers	1 — straight jaws	...
	2 — curved jaws	...
	3 — long nose	...
	4 — smooth jaws	A — without cutter
		B — with cutter
II — clamp	1 — “C” clamp	A — fixed without swivel pads
		B — fixed with swivel pads
	2 — sheet metal clamp	...
	3 — welding clamp	...
III — tubing pinch-off	...	...

Figure 14-1 Category 24 Typical Release Mechanisms for Locking Pliers

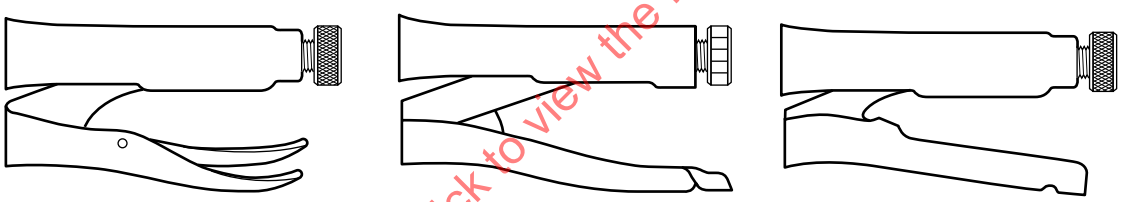


Table 14.1.1-1 Category 24 Type I Dimensional Requirements

Class	Style	Nominal Size	Overall Length, *A*		Maximum Jaw Thickness, *C*	Maximum Handle Width, *D*	Minimum Handle Clearance, *E*	Top Width, *G*, ±0.10	Minimum Jaw Opening Tip-to-Tip	Jaw Opening at Parallel Position, ±0.13
			Min.	Max.						
1	A	5½	4.87	6.13	0.57	2.00	0.09	...	1.13	0.38
1	A	7	6.37	7.63	0.57	2.38	0.16	...	1.31	0.56
1	A	8½	7.87	9.13	0.76	2.50	0.16	...	1.75	0.63
1	A	10	9.37	10.63	0.76	2.63	0.019	...	1.88	0.69
2	A	5½	4.87	6.13	0.35	1.88	0.09	...	1.13	...
2	A	7	6.37	7.63	0.38	2.26	0.16	...	1.50	...
2	A	8½	7.87	9.13	0.48	2.38	0.16	...	1.88	...
2	A	10	9.37	10.63	0.56	2.50	0.19	...	2.00	...
2	B	4¼	3.62	4.88	0.29	1.69	0.09	...	1.00	...
2	B	5½	4.87	6.13	0.35	1.88	0.09	...	1.13	...
2	B	7	6.37	7.63	0.38	2.26	0.16	...	1.50	...
2	B	8½	7.87	9.13	0.48	2.38	0.16	...	1.88	...

Table 14.1.1-1 Category 24 Type I Dimensional Requirements (Cont'd)

Class	Style	Nominal Size	Overall Length, *A*		Maximum Jaw Thickness, *C*	Maximum Handle Width, *D*	Minimum Handle Clearance, *E*	Top Width, *G*, ±0.10	Minimum Jaw Opening Tip-to-Tip	Jaw Opening at Parallel Position, ±0.13
			Min.	Max.						
2	B	10	9.37	10.63	0.56	2.50	0.19	...	2.00	...
3	A and B	5¼	4.75	5.75	0.41	1.56	0.09	0.13	1.50	...
3	A and B	6½	6.00	7.00	0.47	1.75	0.09	0.16	2.00	...
3	A and B	8½	8.00	9.00	0.56	2.13	0.16	0.19	2.75	...
3	A and B	10	9.50	10.50	0.60	2.50	0.16	0.25	3.00	...
4	A	5½	4.87	6.13	0.57	2.00	0.09	...	1.13	0.38
4	A	7	6.37	7.63	0.57	2.38	0.16	...	1.31	0.56
4	A	8½	7.87	9.13	0.76	2.50	0.16	...	1.75	0.63
4	A	10	9.37	10.63	0.76	2.63	0.019	...	1.88	0.69

Figure 14.1.1-1 Category 24 Type I, Class 1, Style A, Straight Jaw Without Cutter

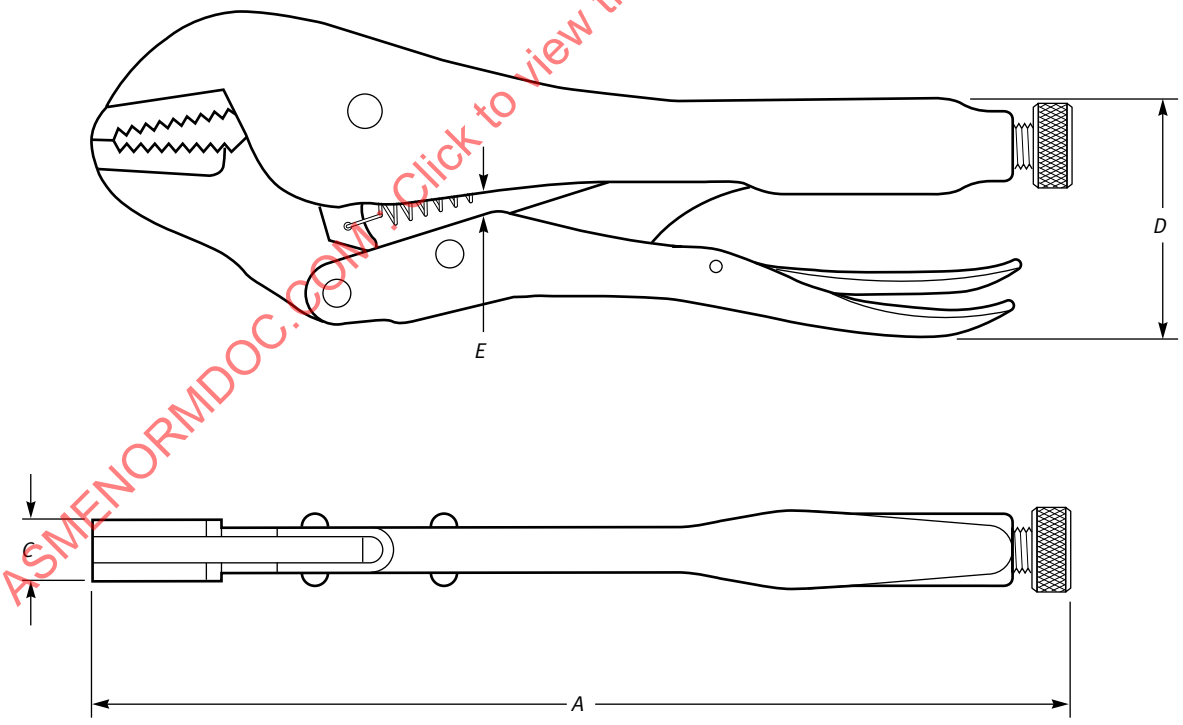


Figure 14.1.2-1 Category 24 Type I, Class 2, Styles A and B, Curved Jaw Without and With Cutter (Style B Shown)

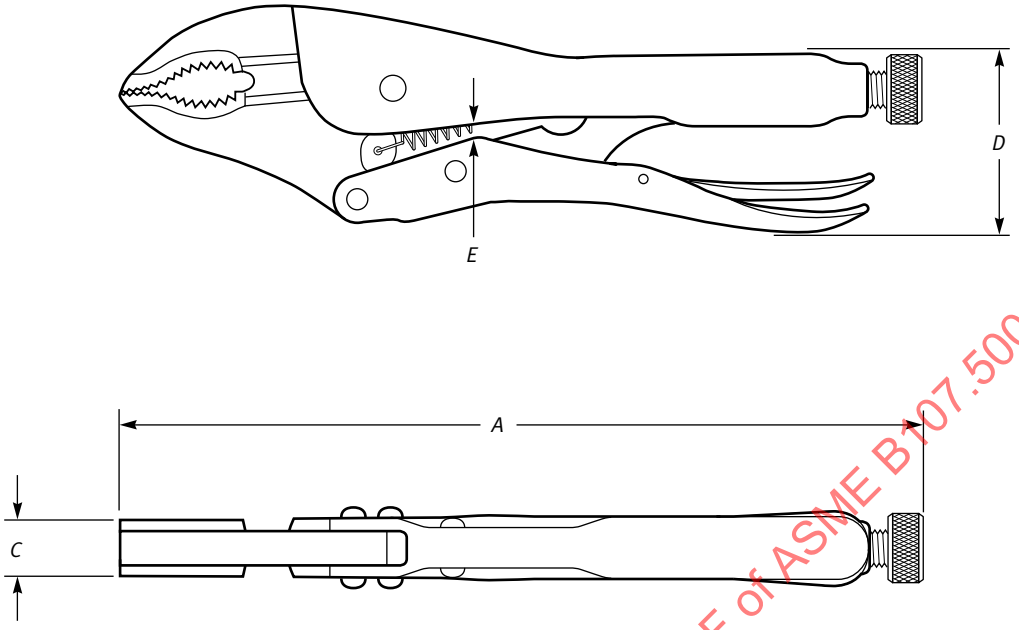


Figure 14.1.3-1 Category 24 Type I, Class 3, Styles A and B, Long Nose With and Without Cutter (Style B Shown)

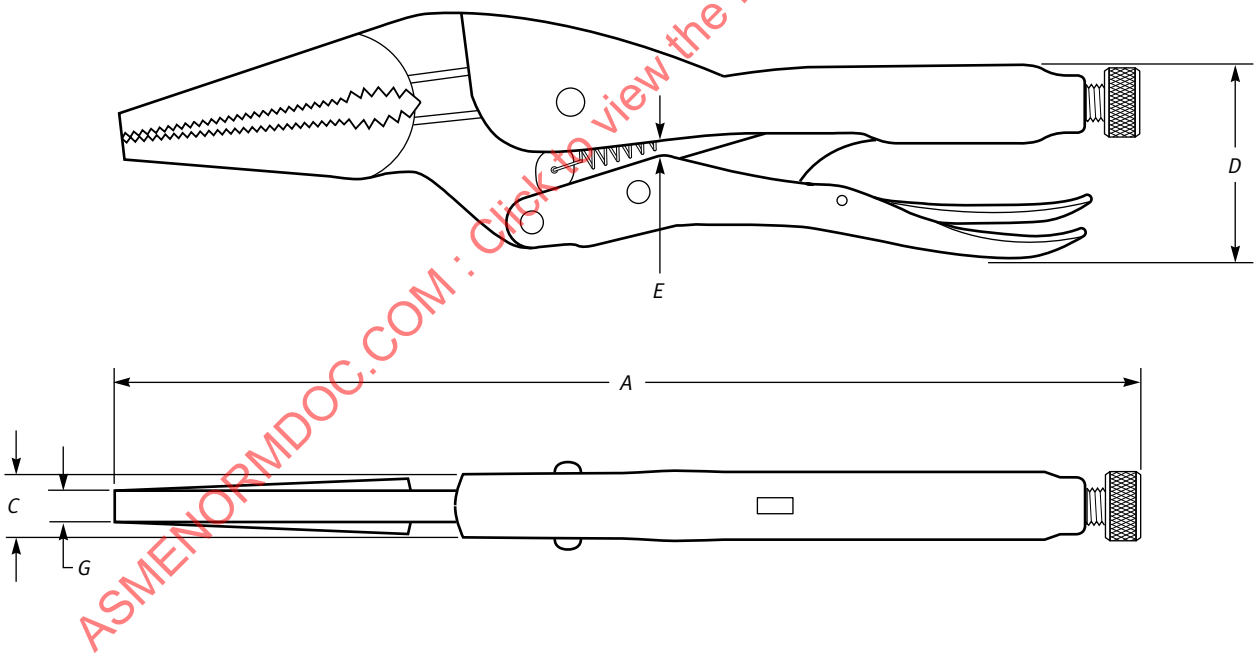


Figure 14.1.4-1 Category 24 Type I, Class 4, Style A, Smooth Jaws Without Cutter

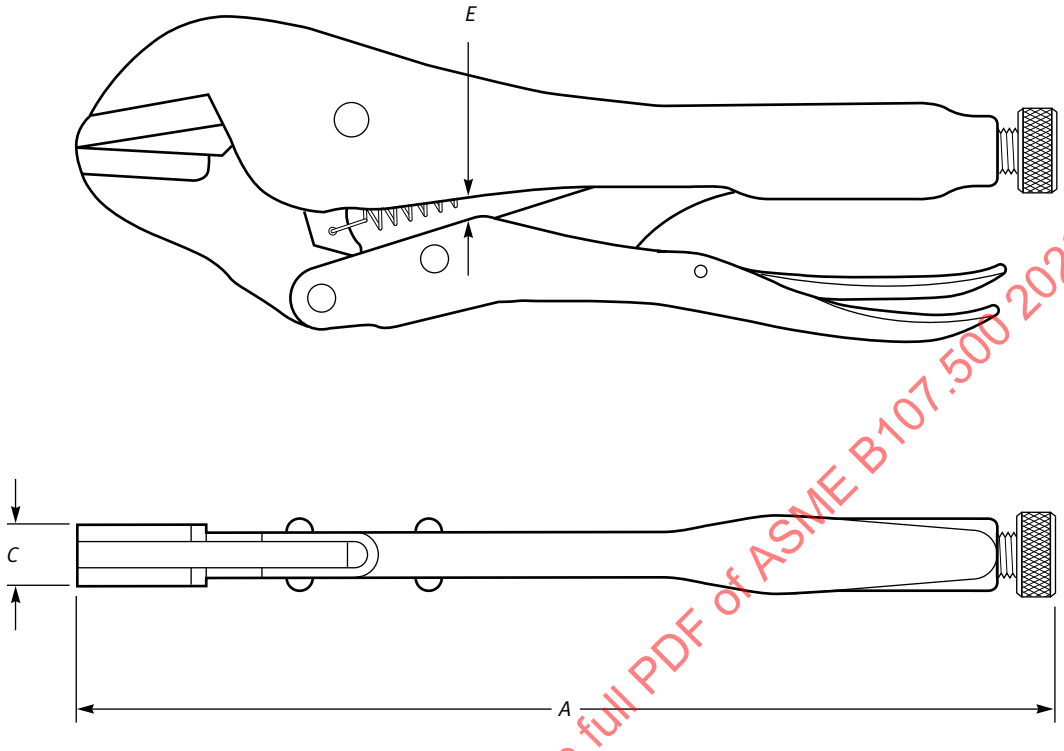


Table 14-2.1-1 Category 24 Type II

Class	Style	Nominal Size	Overall Length, *A*		*B*			*C*		Handle Width, *D*		Minimum Handle Clearance, *E*	*F*			Height, *G*, ±1.00	Minimum Clamping Range
			Min.	Max.	Minimum Throat Width	Clamp Width, ±0.13	Inside Width, ±0.13	Minimum Throat Depth	Inside Height, ±0.13	Min.	Max.		Jaw Width, ±0.13	Clamp Depth, ±0.50	Inside Depth, ±0.50		
1	A	6	5.50	7.50	1.5	...	...	1.25	...	1.25	1.75	0.09	0.38	...	...	3.50	0–2.00
1	A	11	9.50	11.50	3.0	...	...	2.25	...	1.75	2.25	0.16	0.50	...	...	5.50	0–3.38
1	B	5	4.25	6.25	1.38	...	...	0.90	...	1.06	1.56	0.09	0.63	...	...	2.75	0–1.50
1	B	6	5.50	7.50	1.5	...	...	1.13	...	1.25	1.75	0.09	0.88	...	...	3.50	0–2.00
1	B	11	9.50	11.50	3.00	...	...	2.25	...	1.75	2.25	0.16	1.13	...	...	5.50	0–3.38
2	...	8	7.12	8.38	...	3.13	...	...	...	1.37	2.13	0.16	...	1.75	...	2.25	0–0.50
3	...	9	8.50	9.50	...	...	1.00	...	1.00	1.38	2.38	0.16	...	...	3.00	2.75	0–1.63

Figure 14.2.1-1 Category 24 Type II, Class 1, Style A, "C" Clamp, Fixed Without Swivel Pads

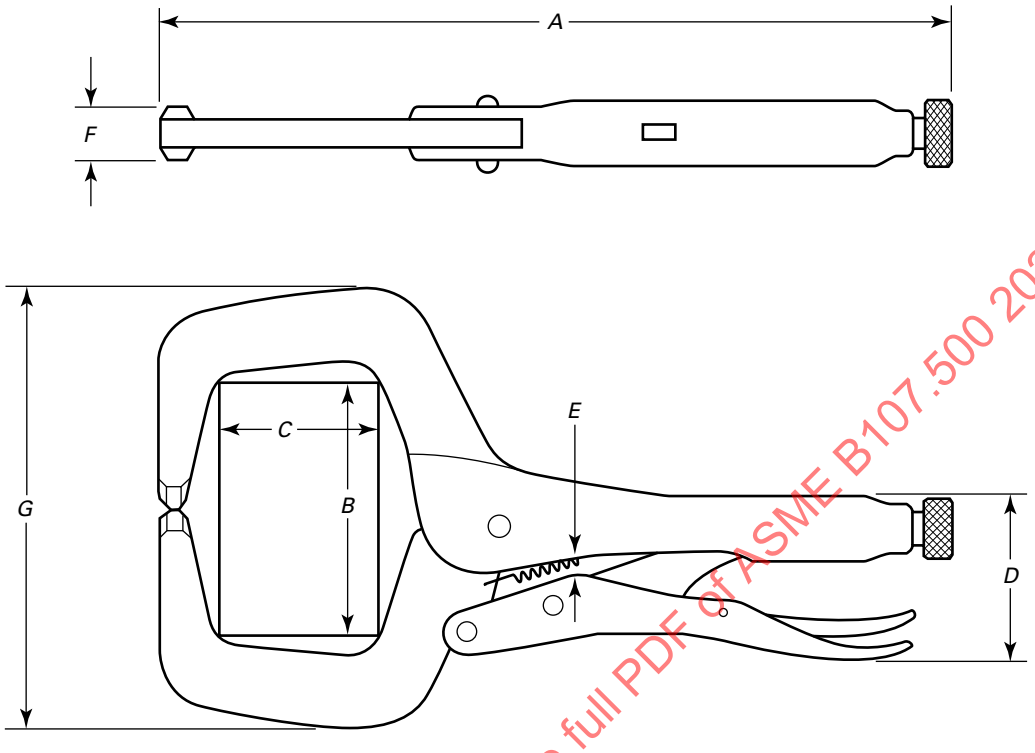


Figure 14.2.2-1 Category 24 Type II, Class 1, Style B, "C" Clamp, Fixed With Swivel Pads

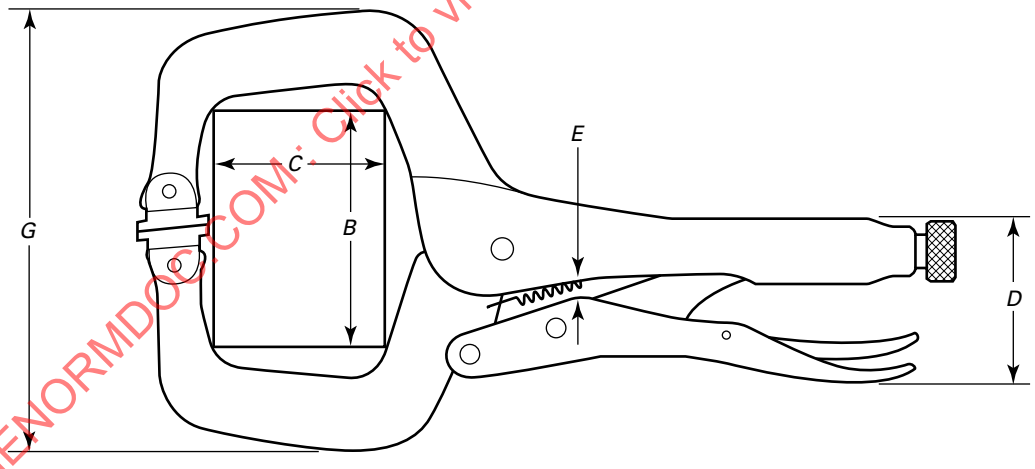


Figure 14.2.3-1 Category 24 Type II, Class 2, Sheet Metal Clamp

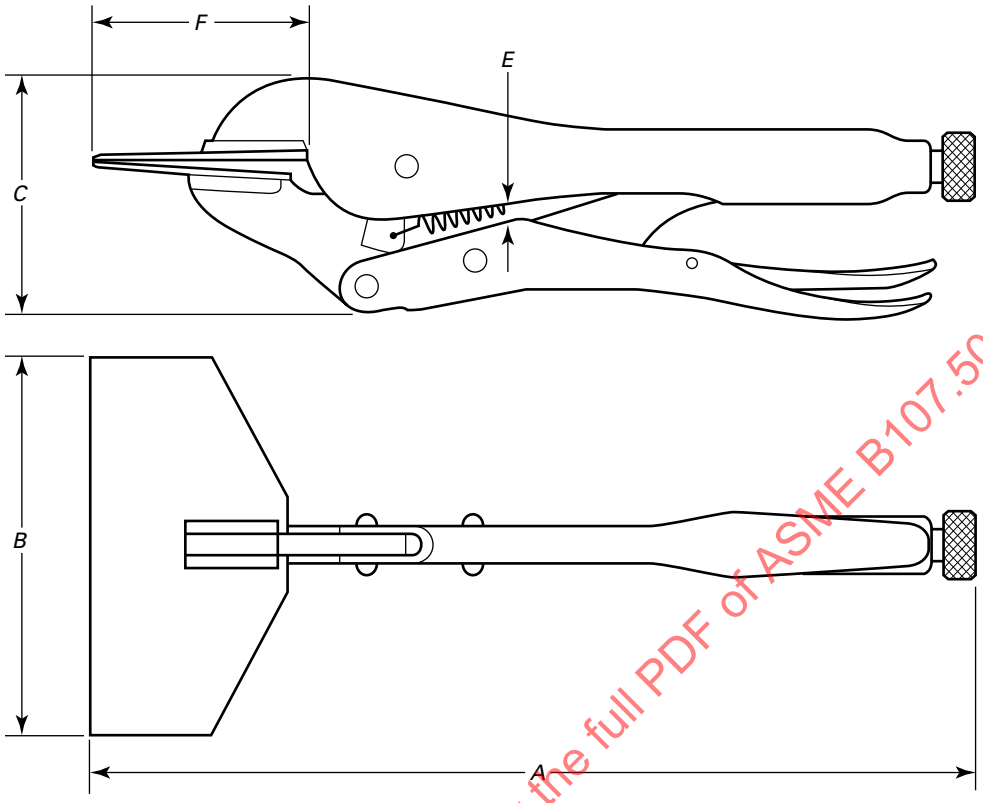


Figure 14.2.4-1 Category 24 Type II, Class 3, Welding Clamp

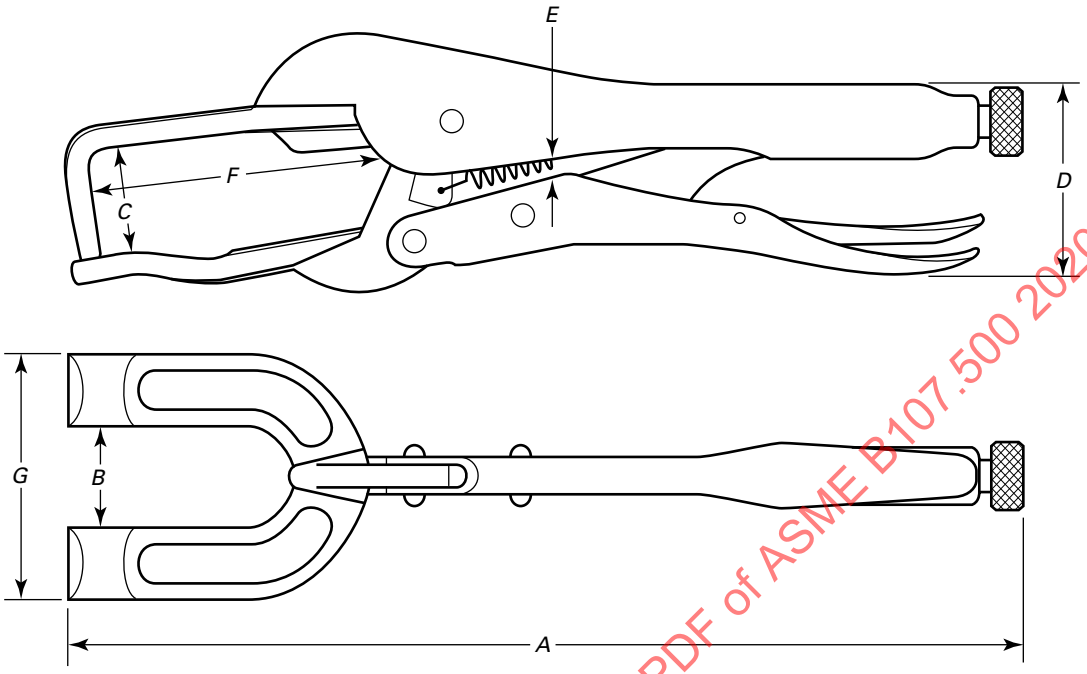
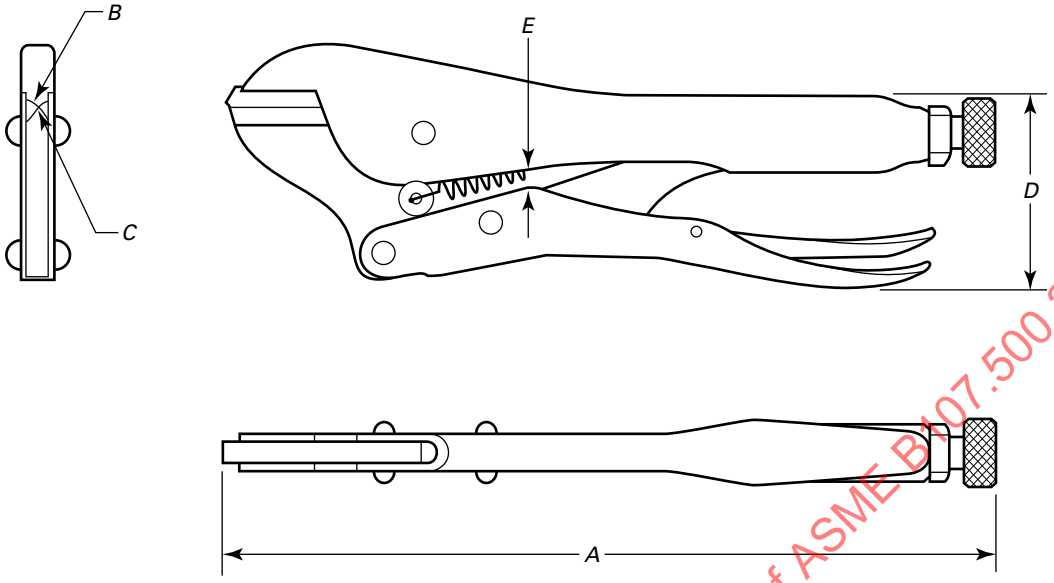


Table 14.3-1 Category 24 Type III

Nominal Size	Overall Length, *A*, ±0.63	Top Jaw Radius, *B*, ±0.016	Bottom Jaw Radius, *C*, ±0.016	Handle Width, *D*, ±0.038	Minimum Handle Clearance, *E*
7	7.00	0.130	0.60	1.75	0.16

Figure 14.3-1 Category 24 Type III, Tubing Pinch-Off



15 CATEGORY 27 MULTIPLE POSITION, ELECTRICAL CONNECTOR PLIERS

15.1 Design

Pliers shall be suitable for loosening and tightening threaded lock collars of electrical connectors. Jaw sleeves or inserts shall be used to prevent marring of the gripping surface of collars. Jaw capacity shall be adjustable through a range of 0.75 in. to 2.5 in. Pliers shall meet the dimensional requirements as shown in Figures 15.1-1 and 15.1-2.

15.2 Handle Hardness

Handles shall have a hardness of 38 HRC to 48 HRC.

15.3 Joint Fastener Hardness

The fastener shall have a hardness of 25 HRC to 38 HRC, except when case hardened when a maximum hardness equivalent to 60 HRC shall be permitted.

15.4 Jaw Opening

Jaws shall open to the required gripping range of 0.75-in. to 2.5-in. diameter, through which distance the tool shall operate in a smooth and uniform manner.

15.5 Jaw Hardness

Jaws shall have a hardness of 38 HRC to 48 HRC.

15.6 Sleeve/Insert

The jaw sleeve/insert shall be made from a polymer of vinyl, nylon, or other durable composition with a durometer hardness of 73 to 95 on the Shore "A" scale per ASTM D2240 and shall pass the tests per paras. 17.4 and 17.10.

Figure 15.1-1 Category 27 Pliers, Multiple Position, Minimum Capacity Position

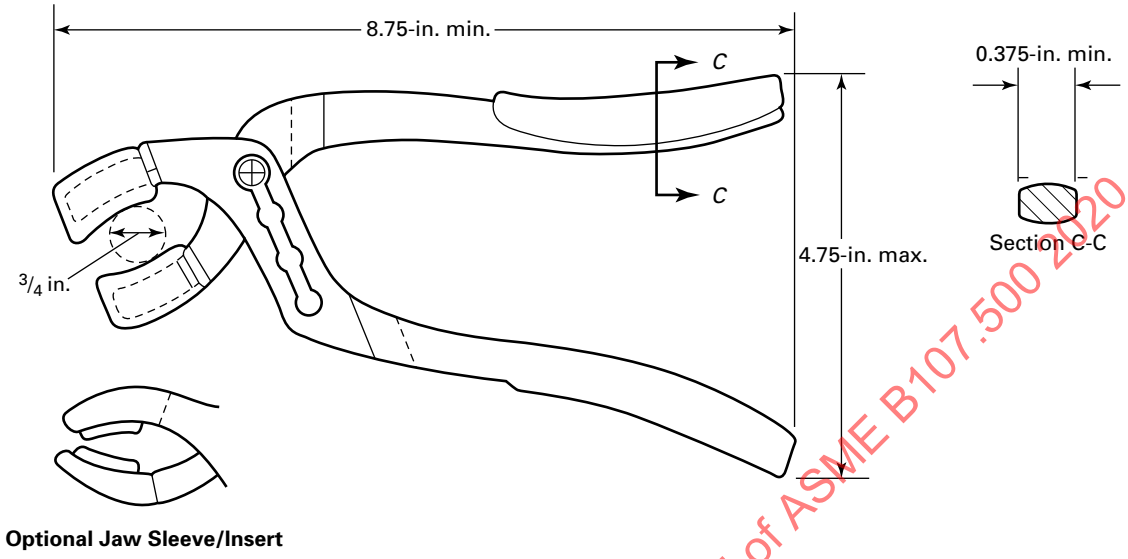
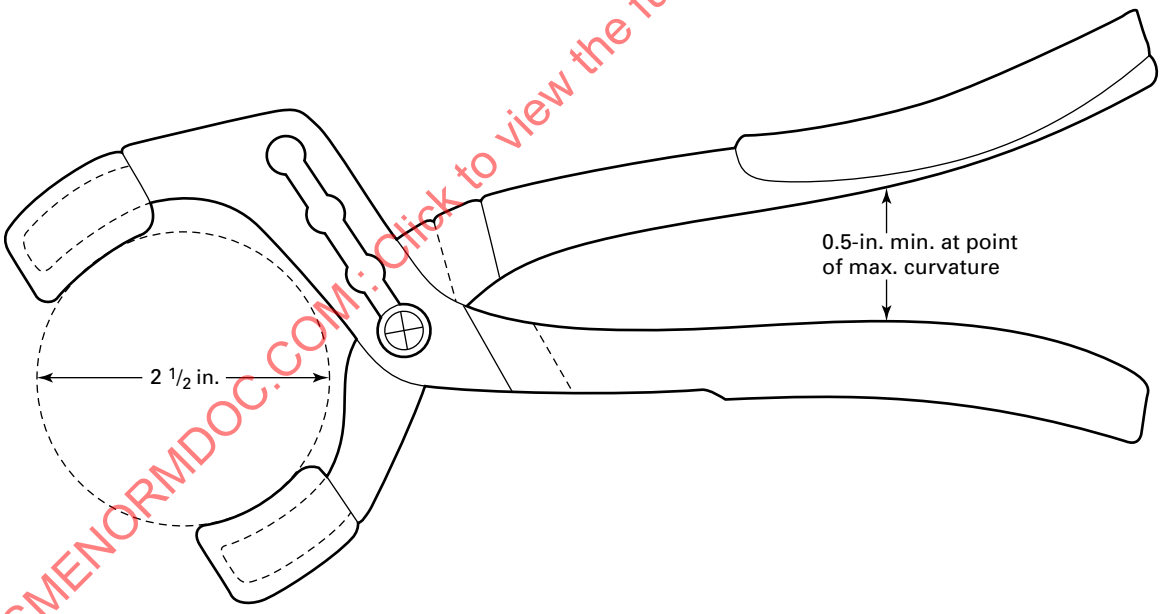


Figure 15.1-2 Category 27 Pliers, Multiple Position, Maximum Capacity Position



16 CATEGORY 37 WIRE CUTTERS/STRIPPERS

(a) General. Strippers shall remove insulation in a neat and uniform manner without damaging idthe conductor, with a maximum of 35 lbf applied at the point of maximum handle curvature, or at the intended load point if there is no curvature.

(b) Classification. See Table 16-1.

16.1 Type I, Wire Strippers, Pivoting Handles

Type I pliers shall strip the insulation from the wire on the compression stroke, leaving the wire either fully or partially stripped and free from damage of any sort.

16.1.1 Class 1, General-Purpose Insulation. Class 1, for general-purpose insulation, shall be capable of removing a minimum of 0.75 in. of insulation from general-purpose solid and stranded copper wire. Strippers shall consist essentially of a body, handles, stripping blades, serrated gripping jaws, and automatic stop return and be similar to Figure 16.1.1-1. Pliers shall be equipped with blades conforming to one of the sizes specified in Table 16.1.1-1.

The stripping blades shall have a sufficient number of adequately spaced grooves to accommodate the range of wire sizes specified in Table 16.1.1-1 without the necessity of making adjustments in any way.

Pliers shall be provided with a device to stop return of the arms until after the stripped wire is removed. The stripper shall release the wire from the gripping jaws on partial release of compression and simultaneously hold the stripping jaws open to prevent crushing of the wire. Stripping and gripping jaws shall automatically return to the original stripping position as release of the compression is completed. Action shall be such that fine and stranded wires shall not be bent or mushroomed.

16.1.2 Class 2, Polytetrafluoroethylene Insulation. Class 2 shall be designed for removal of polytetrafluoroethylene (Teflon®) insulation, MIL-W-16878 Types E (200°C, 600 V) and EE (200°C, 1,000 V), which requires an unusual amount of precision and rigidity in the stripping operation. Pliers shall consist essentially of a body, handles, stripping blades, gripping jaws, an automatic stop return, an optional short latch, and a stripping length stop and be similar to Figure 16.1.2-1. Pliers shall be equipped with blades conforming to one of the sizes specified in Table 16.1.2-1.

NOTE: Teflon is a registered trademark of E.I. DuPont de Nemours and Co.

Stripping blades shall have a sufficient number of adequately spaced grooves to accommodate the range of wire sizes specified in Table 16.1.2-1 without the necessity of making adjustments in any way. The blades shall be installed in matched pairs (upper and lower). Support and guidance shall be provided to ensure proper blade alignment when the upper and lower blades are closed on the wire. The stripping blades shall be designed to both cut and accurately position the insulation immediately surrounding the particular place on the wire that is being stripped. The applicable size of blades shown in Table 16.1.2-1 shall also be permanently and legibly marked in a plainly visible place on the blades for each stripper.

The stationary gripping jaw shall lie in a plane approximately parallel to the centers of the stripping holes so that the wire to be stripped will be properly aligned with the applicable groove.

The automatic stop return shall be in accordance with para. 16.1.1.

Strippers may be provided with a short stop latch, which shall be easily engaged or disengaged at the option of the user. When engaged, this short stop latch shall limit the strippers' length of stroke to approximately 0.25 in., so that the portion of the insulation on a wire usually stripped off may be severed but only partially removed. This separated piece of insulation may be left to temporarily protect the stripped end of the wire from damage and may be removed by the operator's fingers when it is no longer needed. This short stop latch shall also incorporate a device that shall function within the limited stroke imposed by the short stop latch and shall be similar to, but independent of, the automatic stop return described in para. 16.1.1. When the short stop latch is disengaged, it shall in no way interfere with or hinder the operation of the wire stripper.

A stripping length stop may be provided so that the ends of the wires may be repeatedly stripped to a predetermined length. This stop shall be adjustable so that any desired stripping length from 0.25 in. to 1.0 in. may be selected and easily set. This stop shall be constructed or designed so that no position in its range will obstruct the operator's view of the grooves and markings on the stripping blades as they close on the wire.

16.2 Type II, Wire Cutters/Strippers, Flat Jaws and Handles, Classes 1, 2, 3, and 4

Type II pliers shall be fabricated by joining two halves using flat, one-piece, jaw/handle construction. The joint shall serve as a pivot point, holding both halves of the strippers together. These strippers shall strip general-purpose solid and/or stranded copper wire. The wire to be stripped shall be placed in the applicable groove size, the pliers closed against a positive stop (Class 4 excluded), and the insulation slug pulled off the conductor. Type II strippers shall consist essentially of jaws and handles with comfort grips and be similar to Figures 16.2-1 through 16.2-4.

Classes 1, 2, and 3 stripping edges shall provide various sizes of grooves suitable for stripping the type and range of wire sizes specified in Table 16.2-1. A groove size shall be provided for applicable wire gage sizes. Each groove shall be accurate for the size marked. Pliers shall also provide a

straight, smooth cutting or shearing surface that shall be at least 0.30 in. long. A hole approximately 0.13 in. in diameter and suitably located for loop bending of stripped conductors may be provided.

Class 4 stripping edges are forward of the pivot and shall have an adjustable groove suitable for stripping the type and range of wire sizes specified in Table 16.2-1. Pliers shall also provide a straight, smooth cutting or shearing surface that shall be at least 0.30 in. long. A hole approximately 0.13 in. in diameter and suitably located for loop bending of stripped conductors may be provided.

16.3 Finish

Ground surfaces shall have a maximum surface roughness of 150 µin. *Ra* (arithmetic average), with a cutoff length of 0.03 in. Surfaces shall be tested in accordance with ASME B46.1.

16.4 Marking

Pliers shall have the gage size of the applicable wires permanently and legibly marked and plainly visible on the face of the blade or jaw, just above or adjacent to the applicable stripping area (except for Type II, Class 4 strippers).

16.5 Joint Fastener Hardness

The fastener hardness shall be from 25 HRC to 55 HRC, except that when the fastener receives a case-hardening treatment, a maximum hardness equivalent to 60 HRC shall be permitted.

16.6 Springs

Spring(s) shall open the jaws to minimum jaw opening as specified in tables for the individual type and class of pliers.

When a spring is furnished on Category 37 pliers, it shall open the jaws to allow insertion of maximum rated unstripped wire size.

16.7 Jaw Opening

Jaws shall open to allow insertion of maximum rated unstripped wire size.

16.8 Cushion Grip Throat

Type I, Classes 1 and 2 jaws shall have continuous and uniform projections and shall be designed to firmly grip but not damage the wire insulation.

16.9 Jaw and Cutting-Edge Hardness

Stripping and cutting surface hardness shall be 50 HRC to 59 HRC. Hardness determination shall be taken within 0.125 in. of stripping/cutting edges.

Table 16-1 Classification for Wire Cutters/Strippers — Category 37

Type	Class
I — wire strippers/pivoting handles	1 — for general-purpose insulation
	2 — for polytetrafluoroethylene (Teflon®) insulation, MIL-W-16878 Types E and EE [Note (1)]
II — wire cutters/strippers, flat jaws and handles	1 — small frame, strippers forward of pivot, nonadjustable, with spring and lock optional
	2 — large frame, strippers forward of pivot
	3 — large frame, strippers rear of pivot
	4 — small frame, strippers forward of pivot, adjustable size, with spring and lock optional

NOTE: (1) Teflon is a registered trademark of E.I. DuPont de Nemours and Co.

Figure 16.1.1-1 Category 37 Type I, Class 1, Wire Cutter/ Stripper, Pivoting Handle

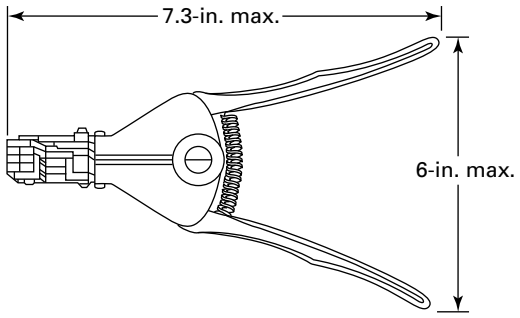


Table 16.1.1-1 Category 37 Type I, Class 1, Blade Sizes and Capacity

Blade Size	Wire Sizes (AWG)	Wire Type
1	8, 10	Solid and stranded
4	8	Solid
4	10, 12, 14, 16, 18, 20, 22	Solid and stranded
5	14, 16, 18, 20, 22, 24, 26, 28, 30	Solid and stranded

Table 16.1.2-1 Category 37 Type I, Class 2, Blade Sizes and Capacity

Blade Size, 600-V Insulation	Blade Size, 1,000-V Insulation	Wire Sizes (AWG)	Wire Type
1E	1EE	10, 12, 14	Stranded
2E	2EE	16, 18, 20, 22, 24, 26	Stranded
3E	3EE	26, 28, 30	Stranded