



UL 1662

Underwriters Laboratories Inc. Standard for Safety

Electric Chain Saws



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UL Standard for Safety for Electric Chain Saws, UL 1662

Second Edition, Dated October 14, 1994

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Standard for Electric Chain Saws

First Edition – August, 1986

Second Edition

October 14, 1994

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PART 1 – ALL CHAIN SAWS

INTRODUCTION

1 Scope

1.1 These requirements cover electric chain saws rated not more than 250 V, for use in accordance with the National Electrical Code, NFPA 70.

1.2 In addition these requirements cover accessories and attachments for use with electric chain saws. Specific requirements are outlined in Sections 82 – 90.

1.3 These requirements cover double-insulated chain saws. Specific requirements are given in Sections 60 – 81.

1.4 These requirements cover accessories and attachments that are:

- a) Recommended by the manufacturer;
- b) Identified by catalog number (or equivalent product designation) in the instruction manual for a chain saw; or
- c) Packed with a chain saw.

1.4 revised April 1, 1996

1.5 These requirements do not cover accessories or attachments that:

- a) Are not provided with the chain saw; and
- b) Are not identified in the required instruction manual by catalog numbers or equivalent product designation – such as those mentioned in mini-catalogs or fliers that may or may not be provided with the chain saw.

1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 Glossary

2.1 For the purpose of these requirements, the following definitions apply.

2.2 ACCESSORY – A device such as a sprocket that is attached only to the spindle of the unit.

2.3 ATTACHMENT – A device attached to the housing or other component of the chain saw and may or may not be attached to the spindle. Attachments include replacement guards, guide bars, and saw chains.

2.4 LOW-KICKBACK SAW CHAIN – A chain intended for use on any saw for which it is sized to fit and that complies with the computed kickback angle requirements in Section 30, Kickback, when tested on representative samples, as described in the Safety Requirements for Gasoline Powered Chain Saws, ANSI B175.1-1991.

2.5 REPLACEMENT SAW CHAIN – A chain that, when used for field replacement on those specific listed chain saws identified on the chain reel or package marking, will provide protection against rotary kickback for the saw and chain combination conforming to the requirements for kickback in 30.3.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

3.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

3.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

4 Units of Measurement

4.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

CONSTRUCTION

5 General

5.1 A chain saw shall employ materials throughout that are acceptable for the particular use.

6 Frame and Enclosure

6.1 A chain saw shall be so formed and assembled that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

6.2 The minimum thickness of cast metal shall be in accordance with Table 6.1.

Table 6.1
Minimum thickness of cast metal

Metal	At surfaces that are reinforced by curving, ribbing, or the like (or are otherwise of a shape and/or size) to provide acceptable physical strength,		At unreinforced flat surfaces,	
	inch	(mm)	inch	(mm)
Die-cast metal	3/64	(1.2)	5/64	(2.0)
Cast malleable iron	1/16	(1.6)	3/32	(2.4)
Other cast metal	3/32	(2.4)	1/8	(3.2)

6.3 An enclosure of sheet metal shall be considered with respect to its size, shape, thickness of metal, and its acceptability for the particular application, including the intended use of the complete chain saw.

6.4 Among the factors taken into consideration when determining the acceptability of a nonmetallic enclosure or an enclosure of magnesium are each of the following:

- a) Mechanical strength;
- b) Resistance to impact;
- c) Moisture-absorptive properties;
- d) Combustibility;
- e) Resistance to distortion at temperatures to which the material may be subjected under conditions of intended use and reasonably foreseeable abuse; and
- f) Resistance to arcing.

6.5 **Deleted effective April 1, 1997**

6.6 **Deleted effective April 1, 1997**

6.7 During examination of a chain saw a part of the outer enclosure that is intended to be removed without the use of tools by the user of the chain saw (for the attachment of accessories, access to means for making operating adjustments, or other reasons) is to be disregarded – that is, such a part is not considered to reduce the risk of electric shock.

Revised 6.7 effective April 1, 1997

6.8 The enclosure of a chain saw shall exclude foreign matter (abrasive or electrically conductive particles and the like) likely to be present during operation that might adversely affect electrical insulation or otherwise result in a risk of electric shock, fire, or injury to persons.

Figure 6.1 Probe

Figure 6.1 deleted effective April 1, 1997

6A Accessibility Of Live Parts

6A.1 Electrical parts of a chain saw shall be located or enclosed to reduce the likelihood of unintentional contact with uninsulated live parts. Insulated brush caps do not require additional enclosure.

Added 6A.1 effective April 1, 1997

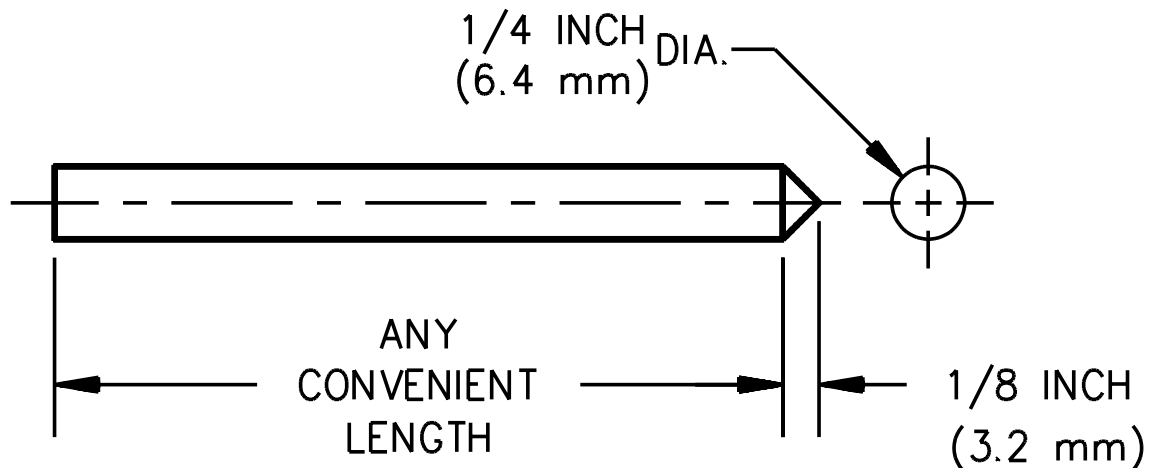
6A.2 An opening anywhere in the enclosure of a hand-supported appliance, or in the handle portion, (the area likely to be handled in guiding during normal operation) of an appliance that normally rests on the ground and is guided by the handle, is acceptable if the probe of Figure 6A.1, when inserted as far as possible into the opening:

- a) Does not enter the opening for a distance of more than 1/8 inch (3.2 mm); and
- b) Does not touch any uninsulated live part or film-coated wire.

Added 6A.2 effective April 1, 1997

Figure 6A.1 Probe for hand-supported enclosure

Figure 6A.1 revised April 8, 1998



PA190

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6A.3 With reference to the requirement in 6A.1 and except as indicated in 6A.2:

a) An opening that will not permit entrance of a 3/4 inch (19.1 mm) diameter rod is capable of being used when:

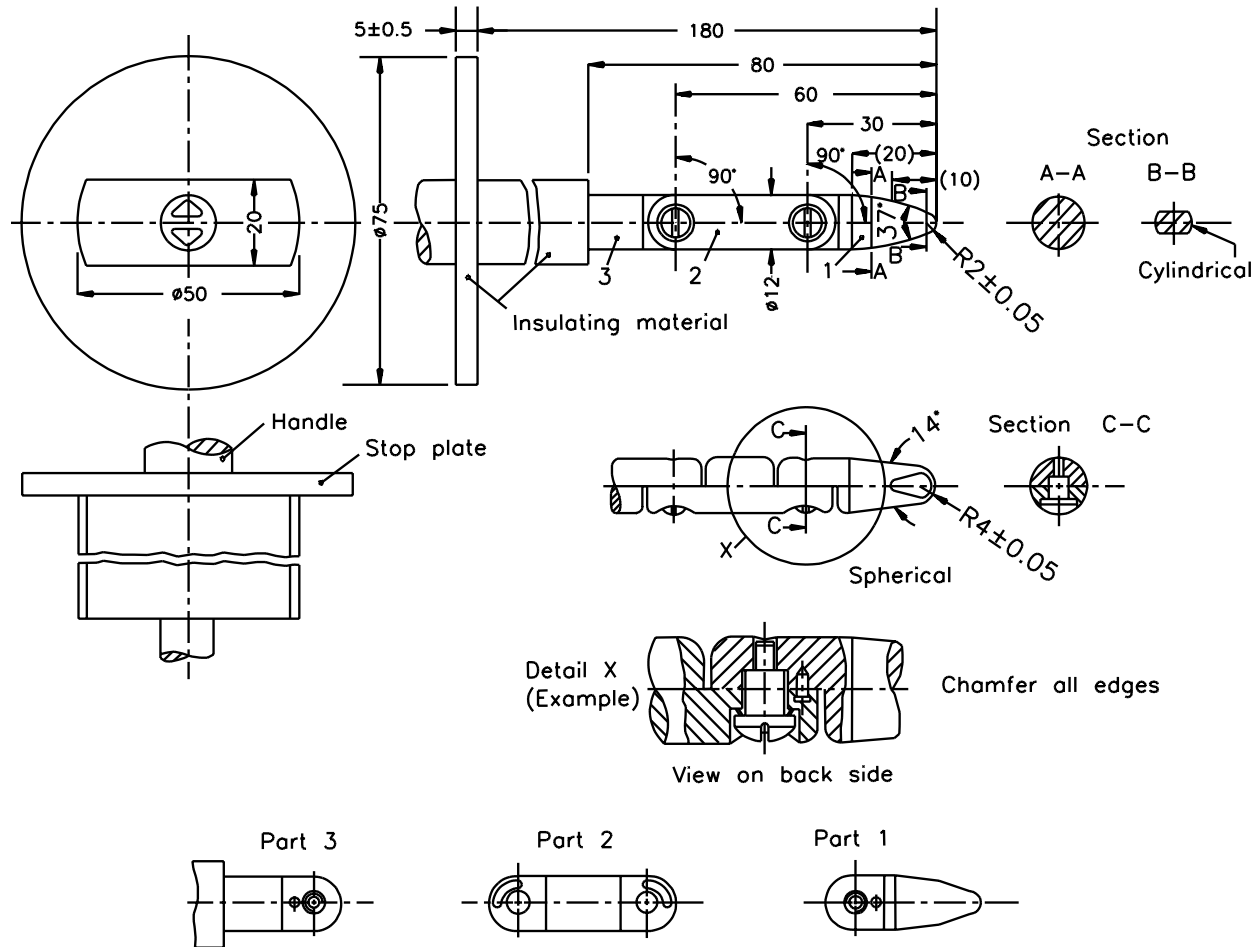
- 1) A probe as illustrated in Figure 6A.2 cannot be made to touch any uninsulated live part or any film-coated wire when inserted through the opening in any possible direction using no appreciable force; and
- 2) A probe as illustrated in Figure 6A.3 cannot be made to touch any uninsulated live part when inserted through the opening in any possible direction using no appreciable force.

b) An opening that will permit entrance of a 3/4 inch diameter rod is capable of being used under the conditions described in 6A.4 and illustrated in Figure 6A.4.

Added 6A.3 effective April 1, 1997

Figure 6A.2
IEC articulate probe

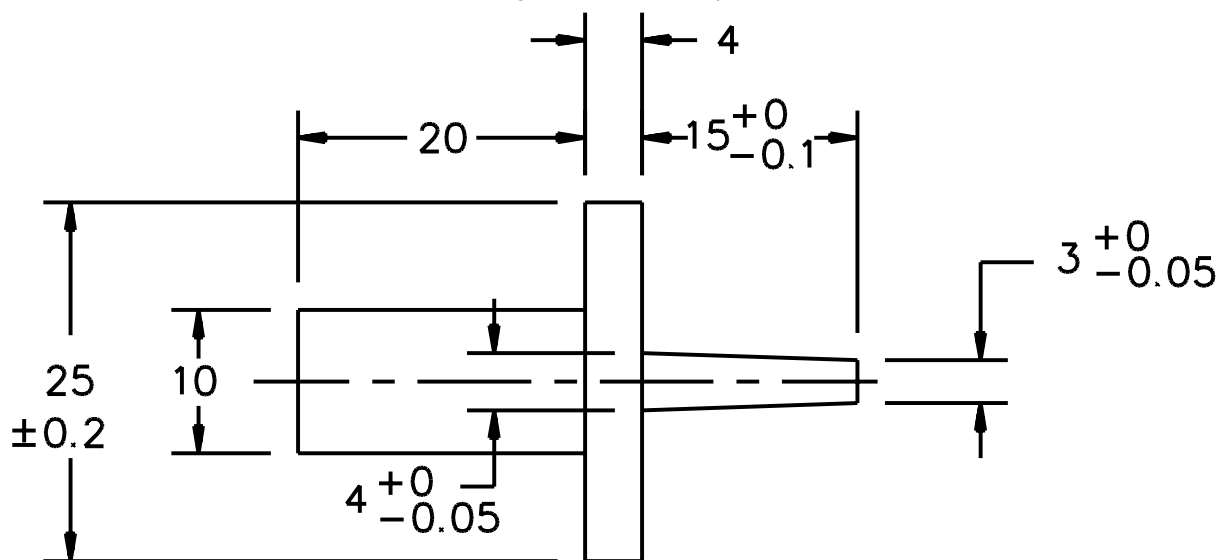
Figure 6A.2 revised April 8, 1998



S3404

Figure 6A.3
IEC test pin

Added Figure 6A.3 effective April 1, 1997



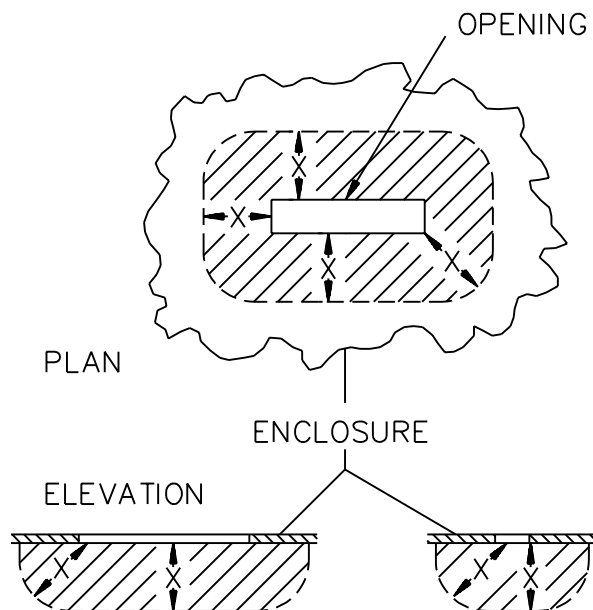
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Dimensions in millimeters

Figure 6A.4
Opening in enclosure

Proportions exaggerated for clarity

Added Figure 6A.4 effective April 1, 1997



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6A.4 The opening illustrated in Figure 6A.4 is capable of being used when, within the enclosure, there is no uninsulated live part or film-coated wire:

- a) Less than X distance from the perimeter of the opening; and
- b) Within the volume generated by projecting the perimeter distance X normal to its plane.

X equals five times the diameter of the largest round rod that can be inserted through the opening, and not less than 4 inches (102 mm). In evaluating an opening, any barrier located within the volume is to be ignored unless it intersects the boundaries of the volume in a continuous, closed line.

Added 6A.4 effective April 1, 1997

6A.5 During the examination of an appliance to determine compliance with the requirements in 6A.1, a part of the outer enclosure that is capable of being removed without the use of a tool by the user of the appliance, to permit the attachment of accessories, to allow access to means for making operating adjustments, or for another reason, is to be disregarded – that is, it will not be assumed that the part in question reduces the risk of electric shock.

Added 6A.5 effective April 1, 1997

6A.6 A latch or fastener that is intended to be opened by use of a coin or the like is determined to be capable of being opened without the use of a tool.

Added 6A.6 effective April 1, 1997

7 Mechanical Assembly

7.1 A chain saw shall be so assembled that it will not be adversely affected by the vibration of intended operation.

7.2 A brush cap shall be tightly threaded or otherwise so constructed such that it does not loosen.

7.3 A switch, a motor attachment plug, and a plug connector shall be mounted securely and shall be prevented, by means other than friction between surfaces, from turning or shifting to the extent of:

- a) Reducing spacings below the minimum acceptable values;
- b) Applying stress to connections; or
- c) Flexing leads.

7.4 A lock washer, properly applied, is acceptable as a means to prevent turning of a switch or other device having single-hole mounting means.

7.5 A chain saw shall be so constructed that user-maintenance can be accomplished without the likelihood of:

- a) Pinching leads;
- b) Reducing spacings to values less than those indicated in Table 17.1;
- c) Mislocating or damaging the means for accomplishing strain relief; and
- d) Mislocating or damaging a guard or other similar device.

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7.6 User-maintenance shall consist of inspection of or replacement of motor brushes or fuses and other service that is recommended in the instruction manual to be performed by the user. It does not include maintenance that the instruction manual recommends to be done by authorized service personnel.

7.7 Compliance with the requirement in 7.5 may be accomplished by routing of wires, provision of wire channels, provision of locating wells for components, use of barriers, use of restraints, securing of components, and other means.

7.8 Routing, as mentioned in 7.7 is acceptable if the construction is such that after the wire has been put into the intended position preparatory to the reassembling of the chain saw, that the reassembly procedure will not result in the wire contacting a moving part or being pinched. This does not mean that the wire must be of such length or so clamped that it cannot reach the pinch point or the moving part.

7.9 A chain saw employing a soft rubber, neoprene, or polyvinyl chloride pressure pad to hold down or maintain permanent position of an electrical part, such as a motor, to provide proper functioning of the chain saw shall be tested in accordance with 42.1. If the pressure pad is exposed to grease, it shall also be tested in accordance with 42.2.

Exception: The test is not required if a risk of fire or electric shock does not result from deterioration of the pad as determined by an abnormal operation test in which the chain saw is operated without the pressure pad.

8 Protection Against Corrosion

8.1 Except as noted in 8.2, iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if deterioration or breakage of such parts would be likely to result in a risk of fire, electric shock, or injury to persons.

8.2 If the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable – thickness of metal and temperature also being factors – the surfaces of sheet steel and cast-iron parts in an enclosure may not be required to be protected against corrosion. The requirement in 8.1 does not apply to bearings, laminations, and minor parts of iron or steel, such as washers, screws, and the like.

9 Power-Supply Cords

9.1 Cords and plugs

9.1.1 A chain saw shall be provided with a motor-attachment plug or a permanently attached flexible cord not more than 18 inches (457 mm) in length and shall comply with one of the following:

- a) The manufacturer shall make an acceptable outdoor-use extension cord available and shall include a statement, marked on the tool, indicating the availability of such an extension cord, or include a statement indicating the availability of such an extension cord in the instruction manual or the like regularly furnished with the tool; or
- b) The manufacturer shall furnish an acceptable detachable cord set, 6 ft (1.8 m) or more in length, with the tool.

9.1.2 The permanently attached flexible cord mentioned in 9.1.1 shall be of such a length that it cannot be damaged or impaired by any cutting edges or rotating parts.

9.1.3 A three-to-two-wire grounding-type adapter shall not be provided with a chain saw unless an acceptable 3-wire grounding-type extension cord set is also provided.

9.1.4 A permanently attached flexible power-supply cord or a detached cord set provided with a chain saw shall be the outdoor use type, either hard-service (such as Type SJ) or extra-hard-service cord (such as Type S), identified by W-A suffix type designation on the cord.

Exception: The suffix type W is an acceptable alternative designation for W-A.

9.1.4 revised April 11, 1996

9.1.5 The flexible cord shall be rated for use at a voltage not less than the rated voltage of the tool, and shall have an ampacity, as given in the National Electrical Code, ANSI/NFPA 70-1993, not less than the current rating of the chain saw.

9.1.5 revised October 14, 1994

9.1.6 The attachment plug shall be acceptable for use with a current not less than the rated current, and at the rated voltage of the chain saw.

9.1.7 A chain saw intended for use with a detachable power-supply cord shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

9.1.8 If a chain saw incorporates a disconnecting means, such as a cord connector in the power-supply cord, the arrangement shall be such that no live parts will be exposed under any normal conditions.

9.1.9 An attachment plug on the supply cord of an appliance shall be constructed so that, when inserted in the connector of an extension cord, the blades will not be energized until they are inaccessible to contact by persons. See Attachment Plug Test, Section 49A.

Added 9.1.9 effective April 1, 1997

9.2 Strain relief

9.2.1 Strain relief shall be provided to prevent a mechanical stress on a flexible cord from being transmitted to terminals, splices, or internal wiring. See Section 40, Strain Relief Test.

9.2.2 Means shall be provided to prevent the supply cord or lead from being pushed into the enclosure of a chain saw through the cord-entry hole when such displacement results in:

- a) Subjecting the supply cord or lead to mechanical damage;
- b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;
- c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or
- d) Damaging internal connections or components.

To determine compliance, the supply cord or lead shall be tested in accordance with Section 40A, Push-Back Relief Test.

Revised 9.2.2 effective December 26, 1998

9.2.3 If a knot in a flexible cord serves as strain relief, the surface against which the knot may bear or with which it may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, that may cause abrasion of the cord jacket or the insulation on the conductors.

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9.2.4 The strain relief provided on the power-supply cord shall be independent of any rubber cord guard unless the guard is molded on the cord or has been determined to be acceptable for the particular application.

9.3 Bushings

9.3.1 At a point at which a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall be acceptably constructed and secured in place, and shall have a smooth, round surface on which the cord may bear.

9.3.2 If the cord-entry hole is in porcelain, phenolic composition, or other equivalent insulating material, a smooth, round surface is considered to be equivalent to a bushing.

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9.3.3 Ceramic materials and some molded compositions are acceptable for insulating bushings. Separate bushings of wood or of so-called hot-molded shellac and tar compositions are not acceptable.

9.3.4 Vulcanized fiber may be employed if the bushing is not less than 3/64 inch (1.2 mm) thick, and if it is so formed and secured in place that it will not be affected adversely by conditions of ordinary moisture.

9.3.5 An acceptable separate soft-rubber, neoprene, or polyvinyl chloride bushing may be employed in the frame of a motor or in the enclosure of a capacitor attached to a motor (but not elsewhere in the chain saw) if:

- a) The bushing is not less than 1/16 inch (1.6 mm) thick; and
- b) The bushing is so located that it will not be exposed to oil, grease, oily vapor, or any other substance that may deteriorate the compound employed.

9.3.6 If a bushing of one of the materials mentioned in 9.3.5 is used, the edges of the hole in which the bushing is mounted shall be smooth and free from fins, burrs, and the like.

9.3.7 At any point in a chain saw, a bushing of the same material as, and molded integrally with, the supply cord is acceptable if the built-up section is not less than 1/16 inch (1.6 mm) thick at the point where the cord passes through the enclosure. An insulating metal grommet may be accepted in place of an insulated bushing if the insulating material used is not less than 1/32 inch (0.8 mm) thick and completely fills the space between the grommet and the metal in which it is mounted.

10 Live Parts

10.1 Metal employed for a current-carrying part shall be silver, copper, a copper alloy, or other metal that is acceptable for the particular application.

10.2 Iron or steel with a corrosion-resistant coating may be used for a current-carrying part:

- a) If permitted in accordance with 3.1; or
- b) Within a motor or associated governor. The use of unprotected iron or steel for current-carrying parts elsewhere in a chain saw is not acceptable.

10.3 An uninsulated live part shall be so secured to the surface on which it is mounted, and supporting insulating materials shall be so secured in place, that it will be prevented from turning or shifting in position, if such motion may result in a reduction of spacing below the minimum acceptable values. A brush-holder connector shall be acceptably captivated independently of the brush.

10.4 Friction between surfaces is not acceptable as a means to prevent turning or shifting of uninsulated live parts. A lock washer is acceptable for this purpose.

11 Internal Wiring

11.1 The wiring and the connections between parts of a chain saw shall be protected or enclosed.

11.2 With reference to exposure to internal wiring through an opening in the enclosure of a chain saw, the protection of the wiring required by 11.1 is considered to exist if, when considered as though it were film-coated wire, the wiring would be acceptable according to Section 6A, Accessibility of Live Parts. Internal wiring not so protected may be acceptable if it is so secured within the enclosure that it is unlikely to be subject to stress or mechanical damage.

11.3 Internal wiring of a chain saw shall consist of wires that are acceptable for the particular application when considered with respect to:

- a) The temperature and voltage to which the wire is likely to be subjected;
- b) Exposure to oil, grease, or other substances likely to deteriorate the insulation; and
- c) Other conditions of service to which it is likely to be subjected.

11.4 Thermoplastic-insulated, neoprene-insulated, or rubber-insulated wire used for internal wiring shall be standard building wire or appliance wiring material and shall comply with Table 11.1.

Table 11.1
Characteristics of internal wiring

Insulation	Nominal wall thickness of insulation,		Braid or jacket required	Nominal thickness of braid or jacket,	
	inch	(mm)		inch	(mm)
Thermoplastic or neoprene	0.030 ^a	(0.76)	No ^a	—	
Rubber	0.030 ^b	(0.76)	Yes ^b	0.015	(0.038)
Cross-linked synthetic polymer	0.015	(0.38)	No	—	
^a The wall thickness may not be less than 0.015 inch (0.38 mm) if the wire is provided with a braid or jacket not less than 0.015 inch. ^b For heat-resistant rubber (other than a silicone type), the wall thickness is to not be less than 3/64 inch (1.2 mm) and no braid is required.					

11.5 Appliance-wiring material having heat-resistant rubber insulation, of other than a silicone type, not less than 3/64 inch (1.2 mm) thick and not provided with a braid is acceptable.

11.6 Insulating tubing employed instead of wire insulation shall be acceptable for the application and shall have a wall thickness of not less than 1/32 inch (0.8 mm).

11.7 Wiring shall be protected from sharp edges (including screw threads), burrs, moving parts, and other agencies that might cause abrasion of the insulation of conductors.

11.8 A hole through which insulated wires pass in a sheet-metal wall within the overall enclosure shall be provided with a smooth, rounded bushing or shall have smooth, well-rounded surfaces upon which the wires may bear to prevent abrasion of the insulation. A flexible cord used for external interconnection shall be provided with a bushing and strain relief in accordance with 9.2.1 – 9.3.7 and Section 40, Strain Relief Test, unless the construction is such that the cord will be protected from stress and motion.

11.9 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure.

11.10 Film-coated wire employed as a jumper between a coil and a brush holder or switch shall be secured in place unless there is no likelihood of its contacting other live parts or dead metal parts if breakage occurs.

11.11 All splices and connections shall be mechanically secure and shall provide effective electrical contact. A soldered connection shall be made mechanically secure before being soldered.

11.12 A chain saw shall be so constructed that if a wire breaks, loosens, or otherwise becomes free to move at a switch termination, the enclosure will not be made live and no live part will project from the enclosure.

11.13 Compliance with the requirement in 11.12 may be accomplished by use of barriers, by relative placement of parts, by mechanical restraint of the conductor in addition to that resulting from its electrical connections, or by other equivalent means.

11.14 An open-end spade lug is not acceptable unless additional means (such as upturned ends on the lug, bosses, shoulders, and the like) are provided to hold the lug in place should the wire-binding screw or nut become slightly loosened.

11.15 A wire-binding screw shall thread into metal.

11.16 A splice shall be provided with insulation if permanence of spacings between the splice and other metal parts may not be maintained.

11.17 The thickness of insulation on a splice shall be 1/32 inch (0.8 mm) or more. In determining if splice insulation consisting of coated-fabric, thermoplastic, or other tubing is acceptable, consideration shall be given to such factors as its dielectric properties, heat-resistant and moisture-resistant characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

11.18 Stranded internal wiring shall be so connected to a wire-binding screw that loose strands of wire will not contact other uninsulated live parts not always of the same polarity as the wire, and from contacting dead metal parts. This may be accomplished by use of pressure terminal connectors, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

12 Insulating Material

12.1 Material for the mounting of uninsulated live parts shall be phenolic composition, cold-molded composition, or other material that is acceptable for the particular application.

12.2 Vulcanized fiber may be used for insulating bushings, washers, separators, brush-holder liners, and barriers, but not as the direct support for uninsulated live parts where shrinkage, current leakage, or warpage may introduce a condition likely to result in a risk of fire or electric shock. Thermoplastic materials may be employed for direct support of uninsulated live parts only if found to have mechanical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric properties, resistance to arc tracking, and other properties that are acceptable for the application.

12.3 A molded part shall be so constructed that it will have mechanical strength and rigidity to withstand stresses likely to occur in service. A brush cap shall be protected from mechanical damage, by recessing or other means, that might occur unless the part has the strength necessary to withstand the abuses to which it is likely to be subjected as demonstrated by an impact test described in 46.1.1.

13 Motors

13.1 The motor of a chain saw shall drive its maximum intended load without introducing a risk of fire, electric shock, or injury to persons.

13.2 A motor winding shall resist the absorption of moisture and shall be formed and assembled in a workmanlike manner.

13.3 A brush-holder assembly shall be constructed so that when a brush is worn out – no longer capable of performing its function – the brush, spring, and other parts of the assembly shall be retained to the degree necessary to prevent:

- a) An accessible dead metal part from becoming energized; and
- b) A live part from becoming accessible.

14 Switches and Controls

14.1 A switch or other control device shall be acceptable for the application, with a voltage rating and current rating not less than the corresponding values of the load that it controls.

14.1 revised April 1, 1996

14.2 A chain saw shall not employ a through-cord switch.

14.3 A single-pole switch employed in a chain saw having a nominal rating of 120 V shall be connected in the ungrounded circuit conductor.

15 Thermal Cutoffs

15.1 If a thermal cutoff is used as noted in 76.1.2, it shall comply with the applicable requirements in this standard and those in the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

15.1 revised March 31, 2006

16 Capacitors

16.1 A capacitor provided as a part of a capacitor motor, and a capacitor connected across the line, such as a capacitor for radio-interference elimination or power-factor correction, shall be housed within an enclosure or a container that will protect the plates against mechanical damage and will prevent the emission of flame or molten material resulting from malfunction of the capacitor. The container shall be of metal providing strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

16.2 The individual container of a capacitor may be of sheet metal thinner than that mentioned in 16.1 or may be of material other than metal if the capacitor is mounted in an enclosure that houses other parts of the chain saw and if such a box, case, or the like, is acceptable for the enclosure of live parts.

16.3 The total capacitance of capacitors connected from one side of the line to the frame or enclosure of a chain saw shall not be such as to permit the flow of more than 0.5 mA in the grounding conductor when the frame or enclosure is connected to ground. See also 32.1.

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17 Spacings

17.1 Except as noted in 17.2, the spacing between uninsulated live parts of opposite polarity, and between an uninsulated live part and a dead metal part, shall not be less than the value indicated in Table 17.1. If an uninsulated live part is not rigidly fixed in position by means other than friction between surfaces or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the spacing will not be reduced to less than the minimum acceptable value.

17.2 The spacing requirements given in Table 17.1 do not apply to the inherent spacings of a component such as a snap switch; such spacings are considered on the basis of the requirements covering the component in question. Any uninsulated conductor of the rotor circuit is regarded as a dead metal part with respect to the stator circuit, and the appropriate spacing is required between uninsulated rotor and stator conductors.

Table 17.1
Minimum spacings in inches (mm)

Potential involved, volts	Motor diameter 7 inches (178 mm) or less ^c		Motor diameter more than 7 inches (178 mm) ^c	
	Over surface	Through air	Over surface	Through air
0 – 125	3/32 (2.4)	3/32 (2.4)	1/4 ^{a,b} (6.4)	1/8 ^{a,b} (3.2)
126 – 250	3/32 (2.4)	3/32 (2.4)	1/4 ^{a,b} (6.4)	1/4 ^{a,b} (6.4)

^a Spacings of not less than 3/32 inch are acceptable throughout a universal motor.

^b Film-coated wire is considered to be an uninsulated live part. However, a spacing of not less than 3/32 inch – over surface and through air – between film-coated wire, rigidly supported and held in place on a coil, and a dead metal part is acceptable.

^c The diameter, measured in the plane of a lamination, of the circle circumscribing the stator frame excluding lugs, boxes, and the like used solely for motor mounting, assembly, or connection.

17.3 At terminal screws and studs to which connection may be made in the field by wire connectors, eyelets, and the like, and at garter springs of brushes, the spacings shall not be less than those shown in Table 17.1 when such connectors, eyelets, and similar parts are in such a position that minimum spacings (opposite polarity and to dead metal) exist.

17.4 An insulating liner or barrier of vulcanized fiber or similar material employed where a spacing would otherwise be less than the minimum acceptable value shall not be less than 1/32 inch (0.8 mm) thick, and shall be so located or of such material that it will not be affected adversely by arcing; except that vulcanized fiber not less than 1/64 inch (0.4 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

17.5 A printed-wiring board with spacings between opposite polarity circuits less than those required is acceptable provided that the spacings:

- a) Are located on a portion of the printed-wiring board provided with a conformal coating that complies with the requirements in UL 746C, Polymeric Materials – Use in Electrical Equipment Evaluations, and the dielectric voltage-withstand test in 36.6;
- b) Are located on a portion of the printed-wiring board with an epoxy coating not less than 1/32 inch (0.8 mm) thick; or
- c) Are connected to the load side of a resistor where a short circuit at that point does not result in the resistor wattage exceeding the resistor rating.

18 Grounding

18.1 The power-supply cord of a chain saw shall include an equipment-grounding conductor.

Exception: A double-insulated chain saw shall not be provided with an equipment-grounding conductor.

18.2 An equipment-grounding conductor in a flexible cord shall be:

- a) Finished to show a green color with or without one or more yellow stripes;
- b) Connected to the grounding member of an attachment plug of the grounding type; and
- c) Conductively connected to:
 - 1) All exposed dead metal parts that are likely to become energized; and
 - 2) All dead metal parts within the enclosure that are exposed to contact during user servicing and that are likely to become energized.

The grounding conductor shall be connected by means of a screw or equivalent means not likely to be removed during any servicing operation. Solder alone shall not be used for securing this conductor.

18.3 The screw mentioned in 18.2(c) shall be of corrosion-resistant metal or shall be protected against corrosion. A lock washer or other equivalent means shall be employed to keep the screw from being loosened by vibration.

19 Insulating Surfaces

19.1 A chain saw shall have outer surfaces of insulating material for the two surfaces most likely to be grasped during operation of the tool.

Exception: The outer surface of a handle or other area likely to be grasped may be of electrically conductive material provided it is:

- a) Separated from internal live parts by at least two separate insulating systems;
- b) Spaced not less than 3/32 inch (2.4 mm) from any dead metal part insulated from a live part by basic insulation only; and
- c) Isolated from the cutting tool.

19.2 A stick type auxiliary handle that is provided as an insulated gripping surface shall be:

- a) Provided with a flange of insulating material located on the chain saw side of the grasping surface, unless the chain saw housing serves as an insulating flange;
- b) Provided with a flange height not less than 3/4 inch (19 mm) above any point around the circumference of the handle at the flange base; and
- c) Insulated along the full length of the grasping surface to the flanges, or housing.

19.3 A bolt, screw, or other handle mounting hardware in the area of the handle likely to be grasped during operation and that threads into, or clamps onto, an accessible metal enclosure shall be:

- a) Of insulating material;
- b) Provided with a layer of insulation between the hardware and metal enclosure equivalent to supplementary insulation; or
- c) In compliance with 19.6.

19.4 The insulating material mentioned in 19.1 – 19.3 shall be acceptable for the intended application.

19.5 If the insulating material mentioned in 19.1 – 19.3 overlies dead metal, the material shall be tested as described in 46.3.1.

19.6 An assembly screw in an area likely to be grasped that secures a covering of insulating material to a metal enclosure and threads into a metal enclosure containing an electrical component or into a metal enclosure that contacts another metal enclosure containing electrical components:

- a) Shall not be accessible to a probe having a diameter of 3/4 inch (19.1 mm), when inserted to a depth of 1 inch (25.4 mm); or
- b) If the opening will not admit a 3/8-inch (9.5 mm) diameter cylindrical rod, shall be recessed not less than 1/8 inch (3.2 mm) below the outer surface of the insulating material.

Revised 19.6 effective April 1, 1997

PROTECTION AGAINST INJURY TO PERSONS

20 General

20.1 During examination of a chain saw with respect to risk of injury to persons, the general requirements for such features as materials, enclosures, guards, and the like will be applied, along with appropriate requirements for tests, construction, markings, guards, and the like, that apply to the chain saw. Features of chain saws that are not contemplated herein will be given consideration.

21 Accessories and Attachments

21.1 Operation of the chain saw with an accessory or an attachment (see 1.4, 1.5, 2.2, and 2.3) shall not increase the risk of injury to persons to an unacceptable degree. See Sections 82 – 89 for specific requirements regarding accessories and attachments.

22 Materials

22.1 The material of a part such as an enclosure, a frame, or a guard, the breakdown of which might result in a risk of injury to persons, shall have such properties as to meet the demand of expected loading conditions.

23 Enclosures and Guards

23.1 A moving part shall be so enclosed or guarded as to acceptably reduce the likelihood of injury to persons, except only as such part is necessarily exposed during intended operation of the chain saw.

23.2 Among the factors to be considered in determining the acceptability of an exposed moving part are:

- a) The degree of exposure;
- b) The sharpness of the moving part;
- c) The likelihood of unintentional contact therewith;
- d) The speed of the moving part; and
- e) The likelihood that fingers, arms, feet, or clothing would be endangered by the moving part.

These factors are to be considered with respect to the intended operation of the chain saw and also during setting of any adjustment.

23.3 Features of guards that will be considered include each of the following:

- a) Removability of the guard without the use of tools;
- b) Removability for servicing and the need for replacement;
- c) Strength and rigidity;
- d) Completeness; and
- e) Creation of additional risks, such as pinch points, and the necessity for additional handling because of increased need for servicing, such as cleaning and unjamming.

23.4 Except for an opening for the cutting edge of the chain saw, an opening in a guard or enclosure around a moving part capable of causing injury, such as a fan pulley, gear, or saw chain, shall have a baffle to prevent contact with that part or the opening shall have a minor dimension less than 1 inch (25.4 mm).

23.5 The unobstructed distance from the opening to the moving part mentioned in 23.4 shall not be less than $8D - 1.5$ inches ($8D - 38.1$ mm), in which D is the minor dimension of the opening in inches (mm), except that a fan is considered to be acceptably guarded if it cannot be contacted with a probe having a diameter of $1/2$ inch (12.7 mm).

Revised 23.5 effective April 1, 1997

23.6 The enclosure or guard around a moving part shall be complete from the standpoint of number and size of openings provided, and shall have such strength as to contain a member or part of a member, such as a saw chain, that, because of breakage or other reason, might become loose or separate from the rotating member and strike the guard.

23.7 A cover or guard shall be provided over the drive sprockets. The cover or guard shall be capable of preventing throwing of the chain if it should become disengaged from the sprockets.

23.8 The sprocket, drum, and clutch shall be guarded on the top, sides, and rear. See 23.5. If the chain saw is equipped with a wrap around front handle, the sprocket guard shall extend 1/2 inch (12.7 mm) below the chain saw cutter teeth. The 1/2 inch (12.7 mm) dimension would be a measure of the shortest distance between the cutter teeth and the bottom of the guard.

24 Switches and Controls

24.1 A device that automatically starts a chain saw, such as a timer, an automatically reset overload-protective device, or the like, shall not be employed.

24.2 An on-off switch or control shall be provided on a chain saw.

24.3 If unintentional operation of a switch can result in risk of injury to persons, the switch shall be located or guarded such that unintentional operation is unlikely.

24.4 The on-off switch shall be of the momentary-contact type with no provision for being locked in the on position and shall be constructed to meet at least one of the following:

- a) The switch shall be guarded completely around the switch in the plane of the switch motion. A continuous loop formed by the handle and body of the chain saw is an acceptable construction;
- b) The switch shall be equipped with a device that automatically locks it in the off position when that actuator is released so that two motions are required to energize the tool; or
- c) The equivalent.

25 Handles

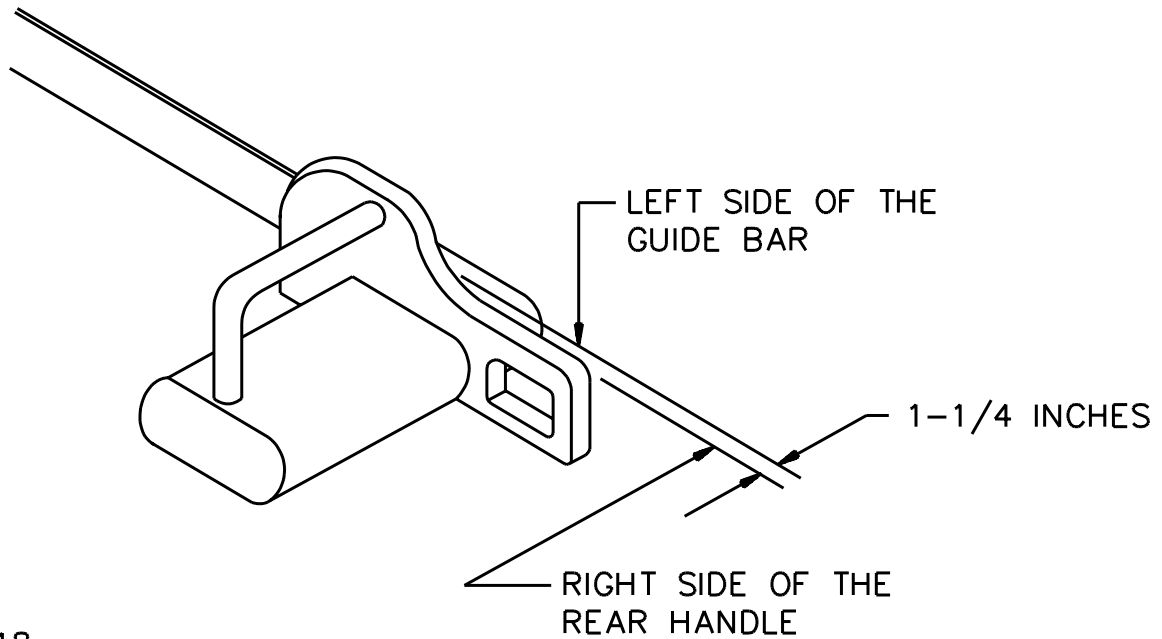
25.1 A handle or tool grip shall be so positioned or guarded in order to prevent unintentional contact with the chain, operating mechanism, or other moving part likely to cause injury if contacted.

25.2 A chain saw shall be constructed with handles that enable the operator to operate the chain saw with two hands. Each handle shall be constructed so that no brackets or obstructions are located in the handle grip area. The portion of the handle intended to be grasped during the operation of the chain saw shall have a means of differentiating the grasping area from the remainder of the handle.

25.3 The rear handle shall be so constructed or positioned so that at least one of the following conditions exist:

- a) The right side of the rear handle is to be located a minimum of 1-1/4 inches (31.8 mm) from the left side of the guide bar as illustrated in Figure 25.1; or
- b) A rear hand guard shall be provided.

Figure 25.1
Guide bar placement



SA1918

25.4 The handle clearances and handle dimensions shall not be less than the values specified in Table 25.1. The physical dimensions are illustrated in Figure 25.2. See 29.1.

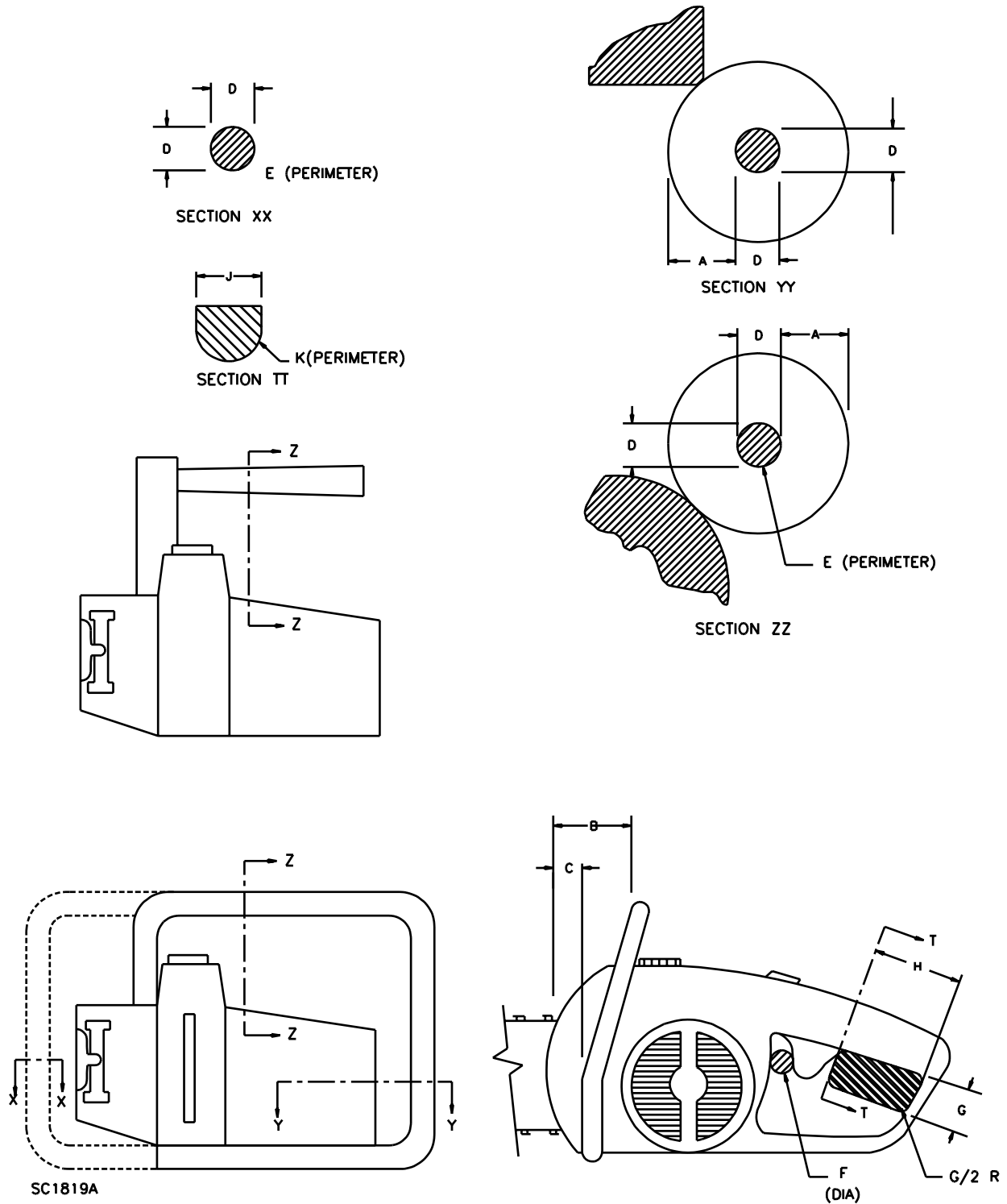
Table 25.1
Handle clearance and dimensions

Table 25.1 revised December 26, 1997

Handle	Description	Dimension in Figure 25.2	Minimum size	
			inches	(mm)
Front	Finger clearance in the handle grip area	A	1.00	(25.4)
Front	Clearance between the front of the chain saw and the handle at the top	B	1.50	(38.1)
Front	Clearance between the front of the chain saw and the handle at the motor center-line	C	1.00	(25.4)
Front	Projected thickness	D	0.44	(11.2)
Front	Handle perimeter	E	2.35	(59.7)
Rear	Finger clearance at the released control trigger	F	1.00	(25.4)
Rear	Finger clearance behind the control trigger	G	1.00	(25.4)
Rear	Hand width clearance	H	2.50	(63.5)
Rear	Projection thickness	J	0.75	(19.1)
Rear	Handle perimeter	K	2.35	(59.7)

Figure 25.2
Handle clearance and dimensions

Figure 25.2 revised April 8, 1998



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26 Construction

26.1 A chain saw shall be so constructed such that the main stream of wood chips and sawdust are not directed above the operator's waist when cutting in a horizontal bucking position.

26.2 A chain saw shall be so constructed as to pull into the log being sawed, and stops shall be provided to help hold the saw in position.

26.3 If provided, a manual actuating means intended to lubricate the chain shall be located so that it is possible to lubricate the chain without releasing the encircling grip around the front handle and without releasing the grip on the rear handle.

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26.4 An oil tank filler opening, if provided, shall have a minimum diameter of 0.50 inch (13 mm), and shall be so located that it can be easily filled by a flexible spout or funnel. In addition, the chain saw shall not require additional support to remain in a stable position for filling on a level surface.

26.5 The balance of the saw shall be such that when it is supported by its carrying handle, the saw guide bar will remain stationary and not tend to rotate about the carrying handle more than 15 degrees above or 30 degrees below the horizontal when imbalanced.

27 Guide Bar

27.1 The chain saw shall be provided with means for adjusting the guide bar to obtain proper saw tension.

27.2 The guide bar shall not have an opening within the cutting area of the guide bar with a dimension greater than 0.40 inch (10.2 mm).

28 Carrying Case

28.1 A chain saw shall be provided with a guide bar scabbard or chain saw carrying case.

29 Chain Brake or Hand Guard

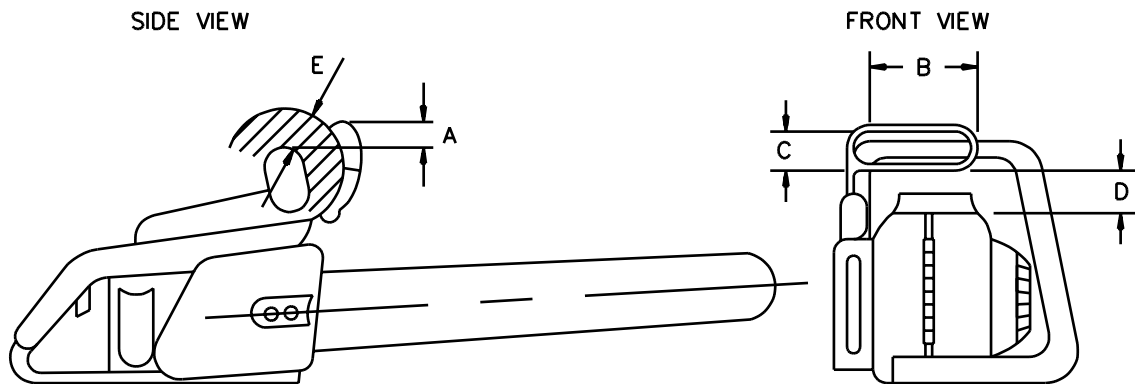
29.1 A chain brake or front hand guard shall be provided that meets the requirements specified in Table 29.1 and those illustrated in Figure 29.1. All dimensions shall be taken parallel or perpendicular to the center line of the guide bar.

Table 29.1
Chain brake or hand guard

Dimension in Figure 29.1	Description	Dimension,	
		Inches	(mm)
A	Minimum guard height	0.79	(20.1)
B	Minimum guard working length	4.00	(102)
C	Maximum guard opening	2.20	(55.9)
D	Maximum projected clearance, guard to saw housing	2.20	(55.9)
E	Minimum radial zone between brake and front handle of saw	1.60	(40.6)
	Maximum radial zone between brake and front handle of saw	2.20	(55.9)

Figure 29.1
Chain brake or hand guard

Figure 29.1 revised April 8, 1998



SA1857

30 Kickback

30.1 At least two features for a chain saw that meet the acceptance criteria of 30.3 – such as a bar tip guard, chain brake, low-kickback saw chain, reduced-kickback guide bar, or other feature – and that significantly reduce significantly the risk of injury to persons from kickback shall be provided on chain saw.

30.2 A chain saw shall comply with the requirements in 30.3.

30.3 When evaluated in accordance with the kickback test requirements in Safety Requirements for Gasoline Powered Chain Saws, ANSI B175.1-1991, either the chain saw shall not exceed a 45° Computed Kickback Angle, or the moving chain shall be stopped before the chain saw exceeds a 45° Computed Kickback Angle.

30.3 revised October 14, 1994

30.4 The supply voltage is to be adjusted to 120 V or 240 V, depending upon the chain saw rating.

30.5 The weight, center of gravity, and polar moment of inertia measurements are to be made with no extension cord plugged into the saw. Any length of cord attached to the saw is to be rolled back over the rear handle in a direction perpendicular to the front handle and taped or tied in position.

30.6 When the saw is to be energized, the cord is to be secured and routed from the front handle so as to closely follow the axis of rotation in a manner that it will not impede the free rotation of the chain saw.

PERFORMANCE

31 General

31.1 If the chain saw has a single frequency rating, the test is to be made at that frequency. A chain saw rated ac/dc or dc – 60 Hz is to be tested on direct current or on 60-Hz alternating current, whichever results in higher temperatures. A chain saw rated 25 – 60 Hz or 50 – 60 Hz is to be tested on 60-Hz alternating current.

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