

UL 2208

ISBN 0-7629-0054-7

Solvent Distillation Units





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Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

UL Standard for Safety
for
Solvent Distillation Units, UL 2208

First Edition, Dated September 3, 1996

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New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

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SEPTEMBER 3, 1996

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UL 2208

Standard for

Solvent Distillation Units

First Edition

September 3, 1996

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

ISBN 0-7629-0054-7

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover solvent distillation units, with a maximum capacity of 60 gallons (227 l), used for recycling flammable or combustible liquids as indicated in the instruction manual provided with each unit.

1.2 These requirements cover solvent distillation units which utilize electricity, steam, or heated liquids to distill solvents.

1.3 These units are intended for installation and use in accordance with the National Electrical Code, NFPA 70, the Flammable and Combustible Liquids Code, NFPA 30, and the Uniform Fire Code, published by the International Fire Code Institute.

1.4 Solvent distillation units investigated for use in laboratories are only intended for installation in facilities that comply with requirements of the Standard for Fire Protection for Laboratories Using Chemicals, NFPA 45.

1.5 Solvent distillation units investigated for use in commercial dry cleaning plants are intended for installation in accordance with requirements of the Standard for Drycleaning Plants, NFPA 32.

1.6 Requirements additional to those specified in this standard are necessary as follows:

a) Electrically powered steam generating units having an electrical input power rating of more than 15 kW per steam generating vessel shall also comply with the applicable requirements in the Standard for Heating, Water Supply, and Power Boilers – Electric, UL 834;

b) Units intended for use in dry cleaning establishments shall also comply with applicable requirements of the Standard for Drycleaning Plants, NFPA 32;

c) Units intended for use in laboratory work areas shall also comply with applicable requirements of the following standards:

- 1) Medical and Dental Equipment, UL 544,
- 2) Laboratory Equipment, UL 1262,
- 3) Medical Electrical Equipment, Part 1: General Requirements for Safety, UL 2601-1,
- 4) Electrical Equipment for Laboratory Use, Part 1: General Requirements, UL 3101-1,
- 5) IEC Publication 1010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements,
- 6) Fire Protection for Laboratories Using Chemicals, NFPA 45, and
- 7) Health Care Facilities, NFPA 99;

d) Units intended for use in commercial garages shall comply with the applicable requirements of Article 511 of the National Electrical Code, NFPA 70, and of the Standard for Garage Equipment, UL 201;

e) Units intended for use in aircraft hangers shall comply with the applicable requirements of Article 513 of the National Electrical Code, NFPA 70; and

f) Units intended for use in dispensing and service stations shall comply with the applicable requirements of Article 514 of the National Electrical Code, NFPA 70.

1.7 These requirements do not apply to:

a) Carbon-bed units;

b) Units intended to be installed outdoors;

c) Units used to distill solvents classified as unstable or solvents used for nitrocellulose or other unstable reactives;

d) Units intended for high volume distillation processes or equipment typical of the petrochemical or distilled spirits industries;

e) The storage, use, and disposal of any flammable or combustible liquids or hazardous materials used with or produced by the equipment; or

f) The physiological effects of using the equipment with solvents or hazardous waste.

1.8 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involve a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable 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 cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, 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.

2.1.2 A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard or

b) Is superseded by a requirement in this standard.

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

2.1.4 Specific components are recognized as being 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 for which they have been recognized.

2.2 Units of measurement

2.2.1 If a value for measurement is followed by a value in other units in parentheses, the second value is only approximate. The first stated value is the requirement.

2.3 Undated references

2.3.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 AUTOIGNITION TEMPERATURE – The minimum temperature at which fuel-air mixtures will ignite spontaneously. This temperature is to be determined either at atmospheric pressure (14.7 psig) or at the maximum pressure present in the area of the fuel-air mixture, whichever is higher. At atmospheric pressure, the autoignition temperature of a solvent shall be determined in accordance with the Test Method for Autoignition Temperature of Liquid Chemicals, ASTM E 659.

3.3 BATCH TYPE UNIT – A unit that distills a single batch of solvent at a time. Dirty solvent is poured or otherwise manually introduced into the unit from a container, safety can, or similar vessel. After processing, the distilled solvent is discharged into a collection vessel. The unit does not connect directly to solvent utilization equipment.

3.4 COMBUSTIBLE LIQUID – A material that has a fluidity greater than 300 penetration asphalt when tested in accordance with the Test for Penetration for Bituminous Materials, ASTM D 5, and that has a closed cup flash point at or above 37.8°C (100°F). Combustible liquids are subdivided as follows:

- a) Class II liquids include those having flash points at or above 37.8°C and below 60°C (140°F).
- b) Class IIIA liquids include those having flash points at or above 60°C and below 93°C (200°F).
- c) Class IIIB liquids include those having flash points at or above 93°C.

3.5 FLAMMABLE LIQUID – A material that has a fluidity greater than 300 penetration asphalt when tested in accordance with the Test for Penetration for Bituminous Materials, ASTM D 5, and that has a closed cup flash point below 37.8°C (100°F) and a vapor pressure not exceeding 2068 mm Hg (40 psia). Flammable liquids are Class I liquids, and are subdivided as follows:

- a) Class IA liquids include those having flash points below 22.8°C (73°F) and having a boiling point below 37.8°C.
- b) Class IB liquids include those having flash points below 22.8°C and having a boiling point at or above 37.8°C.

c) Class IC liquids include those having flash points at or above 22.8°C and below 37.8°C.

3.6 FLASH POINT – The minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid within the vessel as specified by the appropriate test procedure and apparatus as follows:

a) The flash point of a liquid having a viscosity less than 45 Saybold Universal Seconds (SUS) at 37.8°C (100°F) and a flash point below 93°C (200°F) as determined in accordance with the Standard Method of Test for Flash Points by the Tag Closed Cup Tester, ASTM D 56.

b) The flash point of a liquid having a viscosity of 45 SUS or more at 37.8°C or a flash point of 93°C or higher as determined in accordance with the Standard Method of Test for Flash Points by the Pensky-Martens Closed Cup Tester, ASTM D 93.

c) The Standard Method of Tests for Flash Points of Liquids by Setaflash Closed Tester, ASTM D 3278, may be used for paints, enamels, lacquers, varnishes, and related units and their components having flash points between 0°C (32°F) and 110°C (230°F) and having a viscosity lower than 150 centistokes at 25°C (77°F).

d) The Standard Test Methods for Flash Point by Setaflash Closed Tester, ASTM D 3243, may be used for materials other than those for which specific setaflash methods exist.

3.7 FLOW THROUGH UNIT – A solvent distillation unit that connects to equipment that utilizes the solvent being distilled. Dirty solvent is pumped or otherwise introduced into the unit, and the distilled solvent is returned to the equipment, or a reservoir associated with the equipment.

3.8 IGNITABLE MIXTURE – A vapor-air, gas-air, dust-air mixture or combinations of these mixtures that can be ignited by a static spark.

3.9 INTRINSICALLY SAFE CIRCUIT – A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions.

3.10 LINE-VOLTAGE CIRCUIT – A line-voltage circuit is one involving a potential of not more than 600 V and having circuit characteristics in excess of those of a low-voltage circuit.

3.11 LOW-VOLTAGE CIRCUIT – A low-voltage circuit is one involving a potential of not more than 30 V (42.4 volts peak) and supplied by a primary battery, by a standard Class 2 transformer, or by an impedance which, as a unit, complies with all of the performance requirements for a Class 2 transformer.

3.12 LOWER FLAMMABILITY LIMIT (LFL) – The minimum concentration of vapor in air at which propagation of flame will occur in the presence of an ignition source. LFL is sometimes referred to as LEL, or lower explosive limit.

3.13 SAFETY CAN – A container of not more than 5 gallons (18.9 l) capacity, having a spring closing lid and spout cover and constructed so that it will safely relieve internal pressure when subjected to fire exposure.

3.14 SEMICONDUCTIVE HOSE – A hose with an electrical resistance great enough to limit the flow of stray electric currents to a safe level, yet not so high as to prevent relaxation of static charges to ground.

3.15 SOLVENT – A flammable or combustible liquid capable of dissolving another substance to form a uniformly dispersed mixture at the molecular or ionic level.

3.16 SOLVENT DISTILLATION UNIT – A unit that receives contaminated flammable or combustible liquid and distills the contents to remove the contaminants and recover the solvent.

3.17 STATIC ELECTRICITY – An electrical charge that is significant only for the effects of its electrical field component and that manifests no significant magnetic field component.

3.18 STATIC SPARK – An impulsive discharge of electricity across a gap between two points not in contact.

3.19 UNSTABLE LIQUID – A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature.

3.20 VESSEL – A container, safety can, portable tank, tank, or other receptacle intended to contain contaminated solvent, distilled solvent, or other liquids.

CONSTRUCTION

4 General

4.1 All constructions

4.1.1 Units that do not produce mixtures above 25 percent of the lower flammability limit (LFL) at potential sources of ignition under normal and single fault conditions shall comply with the requirements of this standard for non-hazardous locations.

4.1.2 The following shall comply with the requirements of this standard for non-hazardous locations and Class I, Division 2 Hazardous Locations:

- a) Units that produce mixtures above 25 percent of the lower flammability limit (LFL) at potential sources of ignition only under single fault conditions, and
- b) Units intended to be installed in Class I, Division 2 locations.

Exception: Units intended for use in a laboratory work area in accordance with requirements of the Standard on Fire Protection for Laboratories Using Chemicals, NFPA 45, need not be evaluated for Class I, Division 2 locations provided they are marked in accordance with 47.3.

4.1.3 The following shall comply with the requirements of this standard for non-hazardous locations and Class I, Division 1 Hazardous Locations:

- a) Units that produce mixtures above 25 percent of the lower flammability limit (LFL) at potential sources of ignition under normal conditions, and
- b) Units intended to be installed in Class I, Division 1 locations.

Exception: Units intended for use in a laboratory work area in accordance with requirements of the Standard on Fire Protection for Laboratories Using Chemicals, NFPA 45, need not be evaluated for Class I, Division 1 locations provided that they are marked in accordance with 47.3.

4.1.4 Only materials determined to be acceptable for the particular use shall be used. All nonmetallic components and polymeric materials likely to be exposed to flammable liquids or vapors during normal operation of the unit and that are required to comply with other requirements of this standard shall be investigated and determined compatible with the solvents to which they are exposed.

4.1.5 If the operation of a unit involves the generation and confining under pressure of steam or other gas, consideration is to be given to the possibility of risk of explosion incident to such operation. This applies in the case of a unit having immersed electrodes, where the electrolysis of water may result in the accumulation of oxygen and hydrogen. The unit is not acceptable unless its strength has been investigated with respect to any risk of explosion that may be involved.

4.2 Class I, Division 1 hazardous (classified) location construction

4.2.1 The requirements for Class I, Division 1 locations supersede those for non-hazardous locations, where any conflict exists.

4.2.2 The unit shall be evaluated for use in a Class I, Division 1 hazardous location per Articles 500 and 501 of the National Electrical Code, ANSI/NFPA 70.

4.2.3 Components used in Hazardous (Classified) locations shall comply with the applicable requirements of the following standards:

- a) Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations, UL 674.
- b) Industrial Control Equipment for Use in Hazardous (Classified) Locations, UL 698.
- c) Electric Heaters for Use in Hazardous (Classified) Locations, UL 823.
- d) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations, UL 886.
- e) Switches for Use in Hazardous (Classified) Locations, UL 894.
- f) Electrically Operated Valves for Use in Hazardous (Classified) Locations, UL 1002.
- g) Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations, UL 1203.

4.3 Class I, Division 2 hazardous (classified) location construction

4.3.1 The requirements for Class I, Division 2 locations supersede those for non-hazardous locations, where any conflict exists.

4.3.2 The unit shall be evaluated for use in a Class I, Division 2 hazardous location per Articles 500 and 501 of the National Electrical Code, ANSI/NFPA 70.

4.3.3 If the unit uses an electric heater, it shall comply with the applicable requirements of the Standard for Electric Heaters for Use in Hazardous (Classified) Locations, UL 823.

4.3.4 The unit shall comply with the applicable requirements of the Standard for Electrical Equipment for Use in Class I and Class II, Division 2, and Class III Hazardous (Classified) Locations, UL 1604.

4.4 Intrinsically safe circuits and components

4.4.1 Circuits and components that are to be considered intrinsically safe shall comply with requirements of the Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous (Classified) Locations, UL 913.

4.4.2 When determined acceptable for use in any hazardous location, the use of intrinsically safe components and wiring shall be permitted.

4.4.3 Wiring of intrinsically safe circuits shall be separated at least 2 inches (50.8 mm) from wiring of all other circuits that are not intrinsically safe.

4.4.4 Intrinsically safe conductors shall be secured so that any conductor that might come loose from a terminal cannot come in contact with another terminal.

4.4.5 Terminals connected to and wiring of intrinsically safe circuits shall be identified as "Intrinsically Safe Circuits" in accordance with the National Electrical Code, ANSI/NFPA 70.

5 Frame and Enclosure

5.1 The frame and enclosure of a unit shall be strong and rigid to resist the abuses to be encountered during intended use. The degree of resistance inherent in the unit shall preclude total and partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other defects which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

5.2 A unit shall be provided with an enclosure of material determined to be acceptable for the application. The enclosure shall house all electrical parts that may result in risk of electric shock or injury to persons under any condition of use. If a unit is for permanent installation (intended for permanent connection to the power supply), the enclosure shall be provided with means for mounting in the intended manner and shall be furnished with any necessary fittings, such as brackets or hangers.

5.3 If openings for ventilation are provided in the enclosure of a unit or in an externally mounted component intended for permanent connection to the power supply, they shall be located so that they will not vent into concealed spaces of a building structure, such as into a false-ceiling space or hollow spaces in the wall, when the unit is installed.

5.4 Among the factors used to determine the suitability of an enclosure are:

- a) Physical strength,
- b) Resistance to impact,
- c) Moisture-absorptive properties,
- d) Combustibility,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of use.

For a nonmetallic enclosure, all of these factors are to be considered with respect to thermal aging.

5.5 Cast- and sheet-metal portions of the enclosure shall not be thinner than indicated in Table 5.1 unless the enclosure complies with 5.4 and 5.6.

5.6 In addition to the factors in 5.4, an enclosure of sheet metal is to be considered with respect to its size and shape, the thickness of metal and the intended use of the unit.

Table 5.1
Minimum thickness of enclosure material

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, and the like or are otherwise of a shape and/or size to provide physical strength,		At surfaces to which a wiring system is to be connected in the field,		At relatively large unreinforced flat surfaces,	
	inch	(mm)	inch	(mm)	inch	(mm)
Die-cast	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
Uncoated sheet steel	0.026 ^a	0.66 ^a	0.032	0.81	0.026	0.66
Galvanized sheet steel	0.029 ^a	0.74 ^a	0.034	0.86	0.029	0.74
Nonferrous sheet metal	0.036 ^a	0.91 ^a	0.045	1.14	0.036	0.91
^a Thinner sheet metal may be used if it is determined to be acceptable when the enclosure is evaluated under considerations such as those mentioned in 5.4.						

5.7 Electrical parts of a unit shall be located or enclosed so that protection against unintentional contact with uninsulated live parts will be provided. Insulated motor brush caps do not require an additional enclosure.

5.8 The enclosure shall be such that molten metal, burning insulation, or flaming particles, are not likely to fall on combustible materials, including the surface upon which the enclosure is supported.

5.9 The requirement in 5.8 necessitates the use of a barrier of metal, phenolic, urea, ceramic, or similar material:

a) Under a motor unless:

1) The structural parts of the motor or of the unit provide the equivalent of such a barrier.

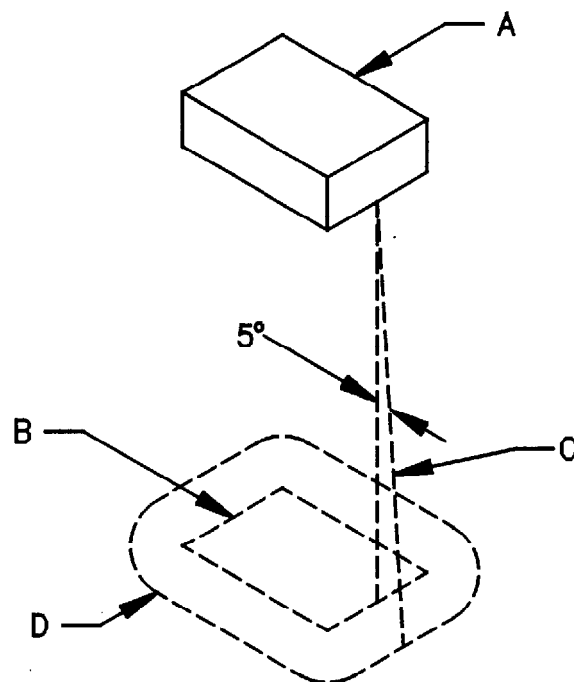
2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the unit when the motor is energized under each of the following fault conditions:

- i) Open main winding,
- ii) Open starting winding, and
- iii) Starting switch short-circuited.

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to both temperature and current) that restricts the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor runs without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked.

- 4) The motor complies with the requirements for impedance-protected motors.
- b) Under wiring, unless it complies with the VW-1 flame test in accordance with the Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581.
- 5.10 The requirement in 5.8 also necessitates that a switch, transformer, relay, solenoid, or similar device be individually and completely enclosed except at terminals, unless it can be shown that malfunction of the component is not likely to result in a fire, or unless there are no openings in the bottom of the enclosure. An opening in the bottom of the enclosure shall not be located directly below field- or factory-made splices or overload or overcurrent protective devices.
- 5.11 The barrier mentioned in 5.9 shall be horizontal, located as indicated in Figure 5.1, and shall not have an area less than that described in that illustration. Openings for drainage and ventilation may be used provided molten metal, burning insulation, or similar materials, are not likely to fall through the opening onto combustible material.
- 5.12 The criteria for judging an enclosure other than as described in 5.4 are given in 5.14 and in the following items and related illustrations:
- a) An opening in the enclosure complies when the probe (illustrated in Figure 5.2) inserted into the opening cannot touch any uninsulated live part or film-coated wire that involves a risk of electric shock. The probe is to be applied to any depth that the opening will permit and shall be rotated and articulated in all possible configurations before, during, and after insertion.
- b) An opening that will not prevent entrance of the probe as mentioned in (a) complies under the conditions described in Figure 5.3.
- 5.13 The opening illustrated in Figure 5.3 complies if, within the enclosure, there is no uninsulated live part or enamel-insulated wire:
- a) Less than X distance from the perimeter of the opening, as well as
- b) Within the volume generated by projecting the perimeter X distance perpendicular to its plane. X equals five times the diameter of the largest diameter rod which can be inserted through the opening, but not less than 4 inches (102 mm).
- In evaluating an opening, any barrier located within the volume usually is ignored unless it intersects the boundaries of the volume in a continuous, closed line.
- 5.14 When a marking draws the user's attention to a hole of any size in the enclosure for the adjustment of a thermostat or for a similar activity, it shall not be possible to damage insulation or contact uninsulated live parts through the hole with a 1/16-inch (1.6-mm) diameter rod.
- 5.15 During the examination of a unit in connection with the requirements in 5.7 – 5.12, a part of the outer enclosure that may be removed without the use of tools by the user of the unit (for the attachment of accessories, for access to make operating adjustments, or for other reasons) is to be disregarded – it is not to be assumed that the part in question affords protection against risk of electric shock. A warning marking, such as that specified in 47.11, is not considered to eliminate this risk of electric shock.
- 5.16 Any moving parts, such as rotors of motors, chains, pulleys, belts, and gears, shall be enclosed or guarded to reduce the risk of injury to persons.

Figure 5.1
Location and extent of barrier



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A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

- a) Tangent to the component,
- b) 5 degrees from the vertical, and
- c) Oriented so that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

Figure 5.2
Articulate probe with web stop

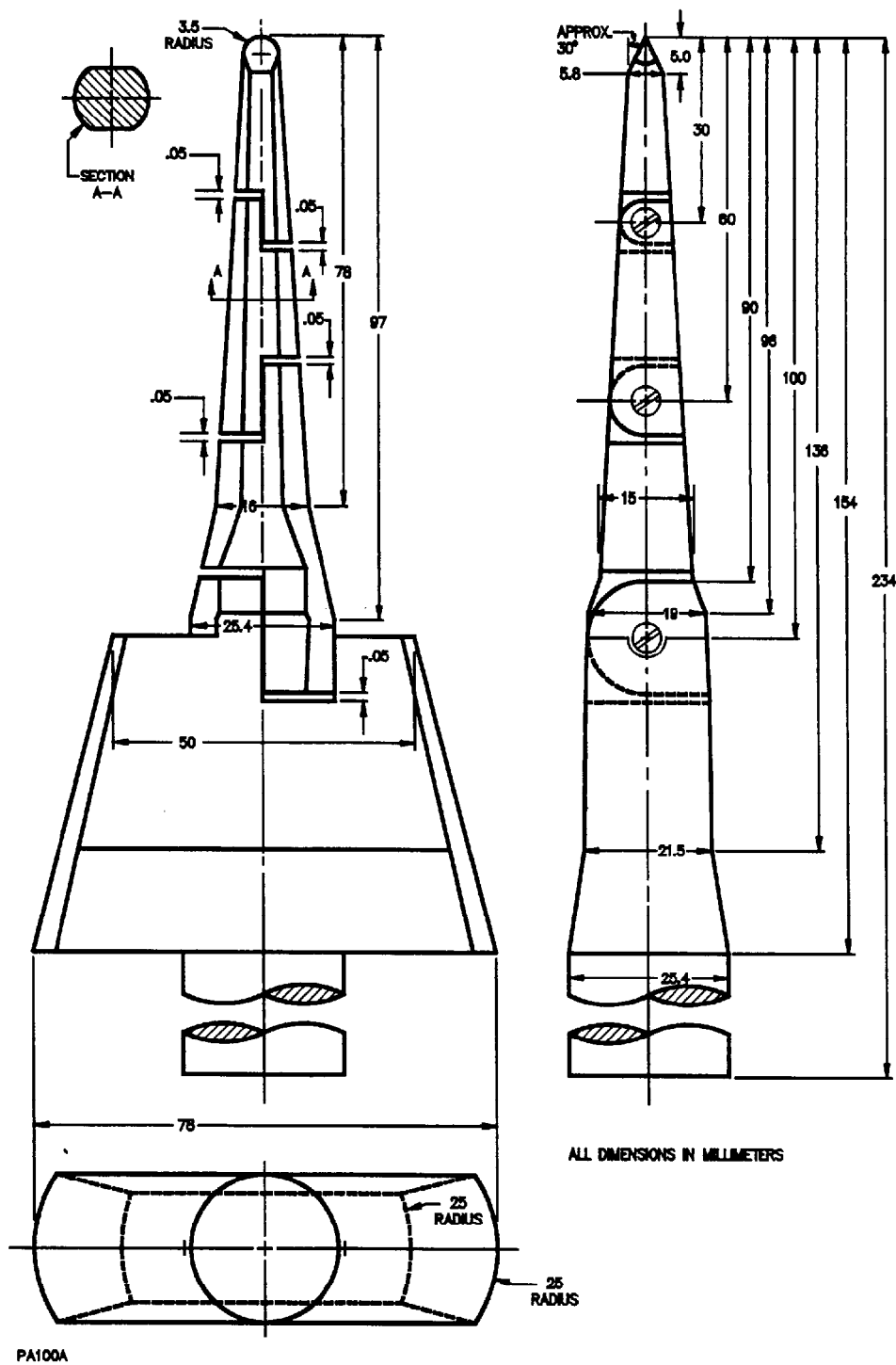
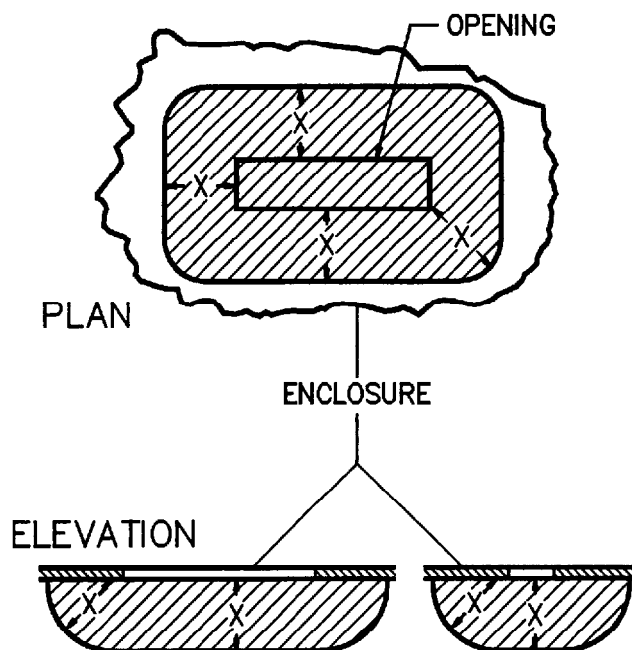


Figure 5.3
Opening in enclosure



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NOTE – Proportions exaggerated for clarity

5.17 With reference to the requirement in 5.16, the degree of protection required of the enclosure depends upon the general construction and intended use of the unit. The factors to be taken into consideration in judging the acceptability of exposed moving parts are:

- The degree of exposure,
- The sharpness of the moving parts,
- The likelihood of unintentional contact with the moving parts,
- The speed of movement of those parts, and
- The likelihood of fingers, arms, or clothing being drawn into the moving parts – such as at points where gears mesh, where belts travel onto a pulley, or where moving parts close in a pinching or shearing action.

5.18 The door or cover of an enclosure shall be provided with a means for securing it in place in the closed position.

5.19 The door or cover of an enclosure shall be hinged or otherwise attached in a similar manner if it gives access to any overload protective device whose functioning requires renewal, or if it is necessary to open the cover in connection with the operation of the protective device. Such a door or cover shall be provided with a latch or similar device, and shall be tight-fitting or overlap the surface of the enclosure around the opening.

5.20 A component of a unit that is likely to need inspection, replacement, cleaning, or other servicing shall be as accessible as possible. The component shall be readily accessible without the use of special tools – tools not available to other than service personnel – if it is intended to be manually operated or adjusted or periodically serviced.

5.21 The bulb and capillary tube of a thermostat shall be protected from physical damage when such damage of the tube or bulb results in a risk of fire.

5.22 The sheath used to enclose the heating element of an immersion-type heater for use with fuel oil shall be of steel, stainless steel, or other metal resistant to corrosion in fuel oil; brass, bronze, or copper is not considered acceptable for this application. The sheath used to enclose the heating element of an immersion-type water heater shall be of a metal resistant to corrosion in water.

6 Assembly

6.1 A switch, lampholder, attachment-plug receptacle, or plug-type connector provided as a part of a unit shall be secured so that it is not likely to turn.

6.2 Uninsulated live parts shall be secured to the base or surface so that they are not likely to turn or shift in position as the result of stresses if such motion results in a reduction of spacings below the minimum required in Table 25.1.

6.3 Friction between surfaces is not acceptable as a means to keep live parts or components from shifting or turning. A lock washer, properly applied, is acceptable for this purpose.

7 Corrosion Protection

7.1 Except as noted in 7.2, iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other means if the deterioration of such unprotected parts would be likely to result in risk of fire or electric shock.

7.2 In certain equipment where the oxidation of steel is not likely to be accelerated due to the exposure of metal to air and moisture or other oxidizing influence – thickness of metal and temperature also being factors – surfaces of sheet steel within an enclosure may not be required to be protected against corrosion. Cast-iron parts are not required to be protected against corrosion. A sheath used on a heating element operating in air and terminal parts attached directly to the heating element need not be protected against corrosion.

8 Supply Connections

8.1 Permanently-connected units

8.1.1 General

8.1.1.1 A unit intended for fixed installation to the building or permanent connection electrically to the power supply shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA 70, would be acceptable for the unit.