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NATIONAL STANDARD

ANSI/CAN/UL/ULC 1389:2023

STANDARD FOR SAFETY

Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations

Approved American National Standard
ANSI

ANSI/UL 1389-2023

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SCC FOREWORD

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UL Standard for Safety for Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations, ANSI/CAN/UL/ULC 1389

First Edition, Dated November 25, 2019

Summary of Topics

This revision of ANSI/CAN/UL/ULC 1389 dated April 20, 2023 includes the following changes in requirements:

– Additional Standard Reference for Storage Cylinders for Transportation; 9.1.
– Corrected Standard References for Industrial Control Equipment and Insulation Coordination; 18.1, 18B.1, 18B.2, 18C.1 and 18D.1.
– Correcting Explosion-Proof Equipment Standard References for Canada; 19.1.2 and 50.1.2.2.
– Revisions to Table 27.1.
– Terminology Clarifications and Corrections; 1.1, 19.1.3, 19.2.1, 19.3.1, 19.3.2, 37.1, 38.1, 46.3, 47.5, 49.2.1, 49.2.2, 49.3.1, 49.3.2, 50.1.2.1, 50.1.3.1, 50.4.1, 52.2 and 53.4.
– Miscellaneous Editorial Corrections; 48.1, 48.2, 48.4, Section 49 (title only), Section 52 (Advisory Note only) and 54.1.
– Update Table A1.1 – Safety Markings Translations.
– Update Annex A from Informative to Normative.
– Formatting Clause 1.1 for Consistency.

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

These new and revised are substantially in accordance with Proposal(s) on this subject dated November 4, 2022.

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(Title Page Reprinted: April 20, 2023)

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ANSI/CAN/UL/ULC 1389:2023

Standard for Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations

First Edition

November 25, 2019

This ANSI/CAN/UL/ULC Safety Standard consists of the First Edition including revisions through April 20, 2023.

The most recent designation of ANSI/UL 1389 as an American National Standard (ANSI) occurred on April 20, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on April 20, 2023.

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Preface

This is the First Edition of the ANSI/CAN/UL/ULC 1389, Standard for Safety for Plant Oil Extraction Equipment for Installation and Use in Ordinary (Unclassified) Locations and Hazardous (Classified) Locations.

ULSE is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO). ULC Standards is accredited by the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL/ULC 1389 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

Annex A, identified as normative, forms a mandatory part of this Standard.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

This First Edition Joint American National Standard and National Standard of Canada is based on, and now supersedes, the First Issue of UL 1389 Outline of Investigation and the First Edition of ULC/ORD-C1389-19.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at https://csds.ul.com.

Requests for interpretation of this Standard should be sent to ULC Standards. The requests should be worded in such a manner as to permit a "yes" or "no" answer based on the literal text of the requirement concerned.

This Edition of the Standard has been formally approved by the Technical Committee (TC) on Plant Oil Extraction Equipment, TC 1389.

This list represents the TC 1389 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

TC 1389 Membership

Name	Representing	Interest Category	Region
Casals, Tomas	Viridios Systems	Producer	USA
Chisholm, Jim	Toronto Fire Services	AHJ	Toronto
Cole, Marty	Hubbell Canada Inc.	Supply Chain	Ontario
Drage, Tyler	Front Range Fire Rescue	AHJ	USA
Haferkorn, James	Rockwell Automation	Supply Chain	USA
Havelick, Linn	HAL Extraction Technology Ltd.	Producer	USA
Kaiman, Sarah	Green Hygiene Consulting	Commercial / Industrial User	USA
Kwong, Philip	3 Carbon	General Interest	British Colombia
Laberge, Todd	TLB Fire Protection Engineering Inc.	General Interest	USA
Laidlaw, Edward	Arcata Fire Protection District	AHJ	USA
Laks, David	Hub International	General Interest	Ontario
Lohf, Lloyd	Spokane Industries	Producer	USA
Lowrey, David	Boulder Fire Rescue	AHJ	USA
Martin, John	Technical Safety BC	AHJ	British Columbia
Mega, Dan	Emerson Fluid & Motion Control	Supply Chain	USA
Monsour, John	Precision Extraction Solutions	Producer	USA
Naito, Jack	Luna Technologies	Producer	USA
Nicoletti, Megan	Codenext Inc.	Supply Chain	Ontario
Olmstead, David	YA Engineering Services LLC	General Interest	USA
Ricks, Luke	Exveritas North America LLC	Testing & Standards Org.	USA
Sasso, Nick	Clark County, Nevada	AHJ	USA
Sexton, Jeremy	Apeks Supercritical	Producer	USA
Watt, Stephen	Emergency Management BC	Government	British Columbia
Williams, Jason	Office of the Fire Marshal	Government	Ontario
Witherell, Christopher	Pressure Safety Inspectors LLC	General Interest	USA
Wolf, Kevin	Intertek	Testing & Standards Org.	USA
Wolff-Klammer, Edgar	UL Solutions	Testing & Standards Org.	USA
Wintonic, Gillian	ULC Standards	TC Chair (Non-Voting)	Canada
Werner, Laura	ULC Standards	TC Project Manager (Non-Voting)	Canada

International Classification for Standards (ICS): 29.260.20

This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE.

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INTRODUCTION

1 Scope

1.1 This Standard covers commercial and industrial plant oil extraction equipment for installation and use indoors in ordinary (unclassified) locations and hazardous (classified) locations. Hazardous locations are also referred to as explosive atmospheres. Based on the application, installation is in accordance with the manufacturer's installation instructions, together with the following, as applicable:

a) In Canada:

1) CSA C22.1, Canadian Electrical Code, Part 1 (CE Code);

2) ULC-S4400, Premises, Buildings and Equipment Utilized for the Cultivation, Processing and Production of Cannabis;

3) National Fire Code of Canada (NFC);

4) CSA B149.1, Natural Gas and Propane Installation Code.

b) In the United States:

1) NFPA 70, National Electrical Code (NEC);

2) International Fire Code (IFC);

3) NFPA 1, Fire Code;

4) NFPA 55, Compressed Gases and Cryogenic Fluids Code;

5) NFPA 58, Liquefied Petroleum Gas Code.

NOTE 1: For the purposes of this standard the terms "LP-Gas" and "Propane" are interchangeable.

NOTE 2: The term "Class I" was originally included as a prefix to Zone 0, Zone 1 and Zone 2 locations. Since both the term "Class I" and the terms "Zone 0, Zone 1 and Zone 2" only apply to flammable gases, vapors, or liquids, the "Class I" prefix was redundant and has been deleted in the CE Code and NEC. However, marking of "Class I" is left as an option for Zone 0, Zone 1 and Zone 2 locations within the NEC.

1.2 Plant oil extraction equipment includes:

a) Preparatory equipment, for preparing the plant material for extraction of the oil, such as trimming, deseeding, and drying/curing;

b) Extractors, for removing the oil from the plant material by the use of butane, ethanol, n-hexane, liquefied petroleum gas (LPG), pentane or propane (flammable solvents) and Carbon Dioxide (CO_2) (non-flammable solvent);

c) Extraction booths or pods, for enclosing/protecting plant oil extraction equipment; and

d) Post-processing equipment, for finalizing the plant oil extraction process such as vacuum ovens, rotary evaporators, and solvent recovery pumps.

1.3 This equipment, along with systems involving any combination of this equipment, is used for extracting oils from plants as instructed by the manufacturer.

1.4 The requirements in this standard do not cover the physiological or other attributes or effects that may result from the use of this equipment.

1.5 This standard does not apply to equipment involving the following risks of ignition:

a) Exothermic reactions, including self-ignition of dusts.

b) Mechanically generated sparks (generated intentionally).

c) Flames and hot gases (including hot particles).

1.6 This standard does not apply to mechanical means of extraction of plant oils that do not use solvents.

1.7 This standard does cover the connection to external solvent containers or external solvent sources to the plant oil extraction equipment.

Note: Equipment is a general term including apparatus, fittings, devices, components, and the like used as a part of, or in connection with, an installation.

1.8 This standard does not cover the extraction or processing of cannabis oil in dwelling units or in basements.

2 Units of Measurement

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

3 Undated References

3.1 *Deleted*

3A Referenced Publications

3A.1 The documents shown below are referenced in the text of this Standard. Unless otherwise stated elsewhere in this Standard, such reference shall be considered to indicate the edition and/or revisions of the document available at the date on which the Committee approved this Standard.

UL Standards

UL 21 *LP-Gas Hose*
UL 25 *Meters for Flammable and Combustible Liquids and LP-Gas*
UL 51 *Power-Operated Pumps and Bypass Valves for Anhydrous Ammonia, LP-Gas, and Propylene*
UL 109 *Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use*
ANSI/CAN/UL/ULC 125 *Flow Control Valves for Anhydrous Ammonia*
UL 132 *Safety Relief Valves for Anhydrous Ammonia*
UL 252 *Compressed Gas Regulators*
UL 252A *Compressed Gas Regulator Accessories*
UL 305 *Panic Hardware*
UL 330A *Hose and Hose Assemblies for Use With Dispensing Devices Dispensing Gasoline and Gasoline/Ethanol Blends With Nominal Ethanol Concentrations Up To 85 Percent (E0 – E85)*
UL 404 *Gauges, Indicating Pressure, for Compressed Gas Service*
UL 429 *Electrically Operated Valves*
UL 508 *Industrial Control Equipment*
UL 508A *Industrial Control Panels*
UL 536 *Flexible Metallic Hose*
UL 569 *Pigtails and Flexible Hose Connectors for LP-Gas*
UL 674 *Electric Motors and Generators for Use in Hazardous (Classified) Locations*
UL 698A *Industrial Control Panels Relating to Hazardous (Classified) Locations*

UL 779 *Electrically Conductive Floorings*
UL 783 *Electric Flashlights and Lanterns for Use in Hazardous (Classified) Locations*
UL 823 *Electric Heaters for Use in Hazardous (Classified) Locations*
ANSI/CAN/UL/ULC 842, *Valves for Flammable Fluids*
UL 842A *Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85)*
UL 844 *Luminaries for Use in Hazardous (Classified) Locations*
UL 873 *Temperature-Indicating and -Regulating Equipment*
UL 969 *Marking and Labeling Systems*
UL 1067 *Electrically Conductive Equipment and Materials for Use in Flammable Anesthetizing Locations*
UL 1203 *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*
UL 1477 *Outline for Compressed Gas Shutoff Valves*
UL 1836 *Electric Motors and Generators for Use in Class I, Division 2, Class I, Zone 2, Class II, Division 2 and Zone 22 Hazardous (Classified) Locations*
UL 1861 *Power Operated Chemical Pumps*
UL 1963 *Refrigerant Recovery/Recycling Equipment*
UL 2011 *Machinery*
UL 2755 *Modular Data Centers*
UL 60079 series (all parts) *Explosive Atmospheres*, specifically including:

- UL 60079-0 *Explosive Atmospheres – Part 0: Equipment – General Requirements*
- UL 60079-7 *Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety "e"*
- UL 60079-13 *Explosive Atmospheres – Part 13: Equipment Protection by Pressurized Room "p" and Artificially Ventilated Room "v"*
- UL 60079-29-2 *Explosive Atmospheres – Part 29-2: Gas Detectors – Selection, Installation, Use and Maintenance of Detectors for Flammable Gases and Oxygen*

UL 60730-1 *Automatic Electrical Controls – Part 1: General Requirements*
UL 60730-2 (all parts) *Automatic Electrical Controls for Household and Similar Use; Particular Requirements*
UL 121201 *Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*

ULC Standards

ULC/ORD-C25 *Meters for Flammable and Combustible Liquids and Propane*
ULC/ORD-C132 *Safety Relief Valves for Anhydrous Ammonia and Propane*
ULC/ORD-C252 *Gas Pressure Regulators*
ULC/ORD-C404 *Pressure Indicating Gauges for Compressed Gas Service*
ULC-S132 *Standard Method of Tests for Emergency Exit and Emergency Fire Exit Hardware*
ULC-S524 *Installation of Fire Alarm Systems*
ULC-S533 *Egress Door Securing and Releasing Devices*
ULC-S4400 *Premises, Buildings and Equipment Utilized for the Cultivation, Processing and Production of Cannabis*
ULC/ORD-C536 *Flexible Metallic Hose*

Other Standards

ASTM D471 *Standard Test Method for Rubber Property-Effect of Liquids*
ASME Boiler and Pressure Vessel Code (ASME/BPVC), Section VIII, Division 1, Rules for Construction of Pressure Vessels
ASME B31.3 *Process piping*
ASME B36.10M *Welded and Seamless Wrought Steel Pipe*
CGA S-1.1, *Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases*

CSA 8.1 *Elastomeric Composite Hose and Hose Couplings for Conducting Propane and Natural Gas*
CSA 8.3 *Thermoplastic Hose and Hose Couplings for Conducting Propane and Natural Gas*
CSA B51 *Boiler, Pressure Vessel and Pressure Piping Code*
CSA B149 *Natural Gas and Propane Installation Code*
CSA C22.1 *Canadian Electrical Code, Part I (CE Code)*
CSA C22.2 No. 14 *Industrial Control Equipment*
CSA C22.2 No. 30 *Explosion-Proof Enclosures for Use in Class I Hazardous Locations*
CSA-C22.2 No. 120 *Refrigeration Equipment*
CSA C22.2 No. 137 *Electric Luminaires for Use in Hazardous Locations*
CSA C22.2 No. 139 *Electrically Operated Valves*
CSA C22.2 No. 145 *Electric Motors and Generators for Use in Hazardous (Classified) Locations*
CSA C22.2 No. 157 *Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations*
CSA C22.2 No. 213 *Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*
CSA C22.2 No. 286 *Industrial Control Panels and Assemblies*
CSA C22.2 No. 60079 series (all parts) *Explosive Atmospheres*, specifically including:

- CSA C22.2 No. 60079-0 *Explosive Atmospheres – Part 0: Equipment – General Requirements*
- CSA C22.2 No. 60079-7 *Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety "e"*
- CSA C22.2 No. 60079-11 *Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i"*
- CSA C22.2 No. 60079-13 *Explosive atmospheres – Part 13: Equipment protection by pressurized room "p" and artificially ventilated room "v"*

International Fire Code (IFC)
International Mechanical Code (IMC)
NFPA 1 *Fire Code*
NFPA 10 *Portable Fire Extinguishers*
NFPA 13 *Installation of Sprinkler Systems*
NFPA 30 *Flammable and Combustible Liquids Code*
NFPA 33 *Spray Application Using Flammable or Combustible Materials*
NFPA 55 *Compressed Gases and Cryogenic Fluids Code*
NFPA 58 *Liquefied Petroleum Gas Code*
NFPA 70 *National Electrical Code (NEC)*
NFPA 72 *National Fire Alarm and Signaling Code*
NFPA 77 *Static Electricity*
NFPA 91 *Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids*
NFPA 496 *Purged and Pressurized Enclosures for Electrical Equipment*
NFPA 497 *Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*
National Building Code of Canada (NBC)
National Fire Code of Canada (NFC)
29 CFR 1926.153 *Liquefied Petroleum Gas (LP-Gas)*

Abbreviations

ANSI – American National Standards Institute
ASME – American Society of Mechanical Engineers
ASTM – American Society for Testing and Materials
CFR – United States Code of Federal Regulations
CGA – Compressed Gas Association
CSA – CSA Group
NFPA – National Fire Protection Association

4 Glossary

4.1 ASTM IRM 903/IRM 903 – A high-swelling petroleum base oil described in ASTM D471, Standard Test Method for Rubber Property-Effect of Liquids.

4.2 AUTHORITY HAVING JURISDICTION – The governmental body responsible for the enforcement of any part of this Standard or the official or agency designated by that body to exercise such a function.

4.3 CLOSED LOOP SYSTEM – A system in which the solvent is being used without evaporation or exposure to the atmosphere.

4.4 HOSE ASSEMBLY – A segment of flexible, usually nonmetallic, tubing and having a threaded fitting at each end for the purpose of connecting two components

4.5 LIQUEFIED PETROLEUM GAS (LP-GAS OR LPG) – Any material having a vapor pressure not exceeding that allowed for commercial propane, as defined in Standard Specification for Liquefied Petroleum (LP) Gases, ASTM D1835, that is composed predominantly of the following hydrocarbons, either by themselves (excluding propylene) or as mixtures: propane, propylene, butane (normal butane or isobutane) and butylenes.

5 Components

5.1 Except as indicated in 5.2, a component of a product covered by this standard shall comply with the requirements for that component. Section 6 includes Normative References that may be used in the products covered by this Standard.

5.2 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.

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

5.4 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.

6 Normative References

Section 6 revised and relocated as Section 3A

6A Schedule of Limitations on Components

6A.1 All conditions of acceptability associated with the components (sometimes referred to as the schedule of limitations) shall be addressed so as to determine compliance associated with the required risks of fire, electric shock, and injury to persons requirements, in addition to the risks of explosion requirements if applicable.

PART I – PLANT OIL EXTRACTORS

CONSTRUCTION

7 General

7.1 Plant oil extractors include the gas container, integral supports, and the necessary core components that allow the system to function as intended and in accordance with the installation instructions. Plant oil extractors fabricated of individual core components shall comply with the requirements of this standard.

7.2 All plant oil extractors shall utilize vessels designed and tested to meet or exceed ASME pressure standards for the application and have a maximum pressure rating labeled. For LPG the minimum pressure rating shall be 2.4 MPa (350 psig). These ratings apply as indicated to all parts of the system unless otherwise noted in this standard.

Exception: Atmospheric tanks and containers storing flammable and combustible liquids that do not meet or exceed ASME pressure standards shall meet the requirements of NFPA 30 Section 9.4, Acceptable Containers, or Section 21.4.2.1, Design Standards for Atmospheric Tanks, as applicable.

7.3 The plant oil extractor capacity shall be in accordance with NFPA 30, NFPA 55, NFPA 58 and 29 CFR 1926.153.

7.4 Extractors shall not involve any of the following risks of ignition:

a) Exothermic reactions, including self-ignition of dusts.

b) Mechanically generated sparks (generated intentionally).

c) Flames and hot gases (including hot particles).

7.5 Plant oil extraction equipment using flammable solvents that has its own potential source of release, either under normal or abnormal conditions, shall be provided with area classification documentation addressing the potential source of release. This classification documentation shall be in accordance with NFPA 497.

7.6 Control panels which form a portion of machines intended for General Use shall, either alone or in conjunction with the machinery, comply with the following requirements as applicable:

a) For CE Code-based installations: CSA-C22.2 No. 14 or CSA-C22.2 No. 286.

b) For NEC-based installations: UL 508A.

8 Pressure Vessels

8.1 Pressure vessels over 6 in (152 mm) inside diameter with a design pressure greater than 15 psig (103 kPa) shall be constructed, tested, inspected and marked to indicate compliance with the following, as applicable:

a) For CE Code-based installations: CSA B51; and

b) For NEC-based installations: ASME/BPVC, Section VIII, Division 1, Division 2, or Division 3.

8.2 Pressure vessels shall also be designed for a working pressure in compliance with the applicable performance requirements of this standard.

8.3 Pressure vessels bearing the ASME Code "U", "U2", "U3" or "UM" symbol complying with 8.1 are considered acceptable without tests.

8.4 The manufacturer shall submit evidence of compliance of these vessels with ASME Boiler and Pressure Vessel Code, Section VIII.

8.5 Valves employed on ASME marked pressure vessels that receive solvent during the recovery operation shall comply with the Standard for Cylinder Valves, UL 1769.

8.6 The minimum design pressure of LPG pressure vessels shall be in accordance with NFPA 58.

8.7 Atmospheric tanks and containers storing solvents that do not meet or exceed ASME pressure standards shall meet the requirements of NFPA 30 Section 9.4, Acceptable Containers, or Section 21.4.2.1, Design Standards for Atmospheric Tanks, as applicable. Atmospheric tanks and containers are not considered as pressure vessels in Section 26.

8.8 Pressure vessels 6 in (152 mm) and less inside diameter are not required to be designed, tested, and stamped in accordance with CSA B51 and the ASME Unfired Pressure Vessel Code and are subjected to the hydrostatic strength test Section 26.

9 Storage Cylinders

9.1 Removable storage cylinders, which are not ASME marked pressure vessels, that receive the solvent during the recovery operation shall comply with all of the following:

a) The storage cylinder shall comply with DOT specifications, 49CFR, or CSA B339, Cylinders, spheres, and tubes for the transportation of dangerous goods, and have a service pressure rating of at least 260 psig (1.79 MPa), but not less than 80 percent of the setting of the pressure limiting device.

b) The cylinder valve shall comply with the Standard for Cylinder Valves, UL 1769.

c) The pressure relief device shall comply with the Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases, Compressed Gas Association Standard S-1.1.

d) The storage cylinder shall be marked to indicate the first retest date, which shall be 5 years from date of manufacture. Also the marking shall indicate that retest must be performed every subsequent 5 years. The marking shall be in letters at least 1/4 in (6.4 mm) high . The storage cylinder shall also be marked with its service pressure.

e) Elastomeric materials employed on cylinder valves and relief devices that contact solvents shall comply with the tests specified in Tests for Synthetic Rubber Parts, Section 34.

f) The storage cylinder shall withstand, without rupture, a pressure of four times the maximum adjustable setting of the pressure limiting devices.

10 Piping, Hose, Tubing and Fittings

10.1 Piping, tubing and fittings shall be designed for at least 1.5 times of the operating pressure and shall be suitable for the solvent or cooling fluid. Suitability shall consider the following:

a) Material compatibility with the fluids.

b) Operating pressure.

c) Solvent fluid-containing parts other than a seal ring or gasket shall have a melting point (solidus temperature) of not less than 510°C (950°F).

d) The use of dissimilar metals in interconnecting piping, tubing, fittings and other components shall be avoided. Care should be taken to prevent contact between dissimilar metals to prevent electrolytic corrosion. Metal fittings should be compatible with metal tubing materials. If the use of materials from different galvanic groups are used, standard commercial corrosion mitigation methods shall be used.

e) Shall be secured and protected against damage.

f) Shall be run as directly as possible within the system, using the least amount of fittings as would be practical.

g) When in contact with the earth, a support member, or other corrosion causing substance it shall be protected against corrosion or shall be of corrosion resistant material.

h) ASME B31.3.

10.2 LP-Gas hose shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: CSA 8.1, CSA 8.3, or ULC/ORD C536; and

b) For NEC-based installations: UL 21, UL 536 or UL 569.

10.3 Ethanol, hexane and ethanol/hexane blends hose shall comply with the requirements in UL 330A.

10.4 Butane hose shall not exceed 6,894 Kpa (1,000 psig) and comply with Section 32.

10.5 Carbon dioxide hose shall comply with Section 32.

11 Gauges

11.1 Pressure Gauges for 6.9 MPa (1,000 psig) up to 34.5 MPa (5,000 psig) shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C404; and

b) For NEC-based installations: UL 404.

11.2 Gauges for pressure under 6.9 MPa (1,000 psig) shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C252; and

b) For NEC-based installations: UL 252A.

11.3 Pressure gauges above 34.5 Mpa (5,000 psig) shall withstand the Hydrostatic Strength Test – System.

12 Power-Operated Pumps and Bypass Valves

12.1 LPG Pumps and bypass valves that transfer liquid shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C125; and

b) For NEC-based installations: UL 51.

12.2 Pumps and compressors, other than for LPG service, shall comply with the requirements in UL 1861 or UL 1963.

12.3 A pump that can have a blocked outlet under normal operating conditions and can cause increased pressure shall be provided with a means to prevent damage to the system.

12.4 A pump with a bypass valve and the bypass valve shall have a flow capacity equal to or greater than the pump in the system, when operated at the differential pressures involved. Bypass valves shall discharge into the pump inlet or back into the container.

12.5 A pump shall be rated for a maximum outlet pressure that is compatible to the overall system rating. Bypass valves shall have a service pressure rating of 110% of this rating.

13 Meters

13.1 Meters in hazardous locations or being used with flammable solvents shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C25; and

b) For NEC-based installations: UL 25.

13.2 Meters shall be rated for a minimum service pressure equal to or greater than the pressure relief valve protecting them.

13.3 Meters shall be installed so that piping connections and the meter housing are not subject to strain from connected piping runs. Flexible connectors are a means to comply with this requirement.

13.4 Meters for extraction solvents in a vapor state or a liquid not addressed by UL 25 shall comply with the Hydrostatic Strength Test – Piping and Operating Parts, Section 27 and material requirements within this standard. If the meter incorporates a dynamic seal the endurance testing in UL 25 is applicable.

14 Valves

14.1 General

14.1.1 Equipment shall be constructed so that pressure due to fire, or other abnormal conditions, will be relieved.

14.1.2 There shall be no stop valve between the pressure-relief means and the parts or section of the system protected. A device other than a stop valve may be located between the pressure-relief means and the parts or sections being protected provided it allows the relief of these parts or sections as intended.

14.1.3 Pressure-relief valves shall be set to start to function at a pressure not to exceed the design pressure of the parts of the system protected.

14.1.4 All pressure-relief devices shall be connected as close as practicable, or directly, to the pressure vessel or parts of the system protected. Pressure relief devices shall be connected above the liquid the solvent level, installed so that they are accessible for inspection and repair, and arranged so that they cannot readily be rendered inoperative.

14.1.5 A handle, knob, or other operating means provided for manual manipulation that could release solvent to atmosphere shall be protected from unintentional manipulation. The hazard and position of such operating means shall be marked, if necessary, as a guide for proper operation. Controls that are to be adjusted only at the time of installation, during servicing, or seasonally, shall be judged with respect to the foregoing requirement. A handle, knob, or other operating means provided for manual manipulation that is provided with a locking mechanism or within an enclosure that is only tool accessible is considered protected from unintentional manipulation. The handle, knob, or other operating means shall also be marked “Do Not Open, Under Pressure” or equivalent.

14.2 Safety relief valves

14.2.1 Pressure vessels shall be provided with one or more safety relief devices with sufficient flow capacity and relief pressure to safeguard against excessive pressure. The system shall be provided with additional safety relief devices as needed to reduce the risk of rupture of any part of the system. The devices shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based hazardous location installations: ULC/ORD-C132;

b) For NEC-based hazardous location installations: UL 132;

c) In accordance with UL 1963, comply with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII. Valves of 1/2 in (12.7 mm) iron pipe size and larger shall bear the authorized code "UV" symbol together with the set pressure and capacity. Valves of less than 1/2 in (12.7 mm) iron pipe size shall be similarly marked, except that where the size does not permit a nameplate, the code symbol may be omitted and the set pressure and capacity may be stamped on the valve or on a metal plate attached to it. Manufacturers of valves that do not bear the code symbol shall provide evidence of certification of the valve and its pressure and capacity rating by appropriate code authorities; or

d) A pressure relief device shall comply with the Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases, Compressed Gas Association Standard S-1.1.

14.2.2 For non-hazardous location installations: ASME Boiler and Pressure Vessel Code (ASME/BPVC) Section VIII. The relief device shall be stamped "ASME" and can be clearly shown by ASME calculations to have the flow capacity and relief pressure sufficient for the application.

14.2.3 If extraction solvent can be trapped between shutoff valves, a hydrostatic relief valve shall be provided to relieve pressures that may result from thermal expansion. The valve shall be rated between 2.8 MPa (400 psig) and 3.5 MPa (500 psig) per 14.4.1.

14.3 Excess flow/backflow/check valves

14.3.1 LPG excess flow valves and backflow valves, with or without a check valve function, and actuated liquid withdrawal excess flow valves shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ANSI/CAN/UL/ULC 125; and

b) For NEC-based installations: ANSI/CAN/UL/ULC 125.

14.3.2 Any line containing an excess flow or excess flow check valve shall have a flow capacity greater than the rated flow of the excess flow valve.

14.3.3 An excess flow check valve is required to be installed at the point where the transfer hose is attached to piping.

14.3.3A An excess flow check valve is required to be installed when a clamp connects pressurized piping, hose or tubing to other piping, hose or tubing.

Exception: If the clamp requires a tool to disconnect, an excess flow check valve is not required if the clamp connection point is marked "Do Not Unclamp, Under Pressure" or the equivalent.

14.3.4 For excess flow or excess flow check valves installed outside the container, installation shall be as such that strain downstream of the valve will not cause breakage between the container and the valve.

14.3.5 Valves installed between the container and shut-off valves shall be internal valves or shall be located immediately outside the container.

14.4 Hydrostatic relief valves

14.4.1 Hydrostatic relief valves are required in each location where liquid LP-Gas or liquid CO_2 can be trapped between shutoff valves including transfer hose. For LP-Gas the valve shall be rated between 2.8 MPa (400 psig) and 3.5 MPa (500 psig) and shall be installed in fixed piping only. The valve shall relieve pressure to the atmosphere or back to the container.

14.4.2 The LP-Gas hydrostatic relief valve shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C132; and

b) For NEC-based installations: UL 132.

The CO_2 hydrostatic relief valve shall be stamped "ASME" and have a relief pressure sufficient for the application.

14.4.3 With reference to venting to atmosphere in 14.4.1, the venting shall be directed outside the building.

14.5 Positive shutoff valves

14.5.1 An LPG manually operated positive shutoff valve shall be provided with an attached hand wheel, lever, handle, or the like. The valve shall have a service pressure rating of 2.4 MPa (350 psig) and shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ANSI/CAN/UL/ULC 125; and

b) For NEC-based installations: ANSI/CAN/UL/ULC 125.

14.5.2 Compressed gas shutoff valves shall be provided with an attached hand wheel, lever, handle, or the like. The valve shall comply with the requirements in UL 1477.

14.5.3 Ethanol, hexane and ethanol/hexane blends shutoff valves shall be provided with an attached hand wheel, lever, handle, or the like. The valve shall comply with the requirements in UL 842A. Stainless steel positive shutoff valves with polytetrafluoroethylene seals shall comply with the requirements in ANSI/CAN/UL/ULC 125, ANSI/CAN/UL/ULC 842 or UL 842A.

14.5.4 A manually operated positive shutoff valve shall be connected directly into the service outlet in the vessel, or directly into a fitting which in turn is mounted on the vessel when it is provided in an unused opening. The valve shall be readily accessible for operation.

14.5.5 Positive shutoff valves shall not be installed between pressure relief valves and the container, or at the outlet of pressure relief valves.

14.5.6 A quick acting, manually operated positive shutoff valve shall be provided at the end of each transfer hose. The valve shall be provided with an adapter to mate with the intended container to which the solvent is to be transferred.

14.6 Pressure-limiting device

14.6.1 A pressure-limiting device designed to automatically stop the operation of the compressor or pump shall:

a) Be installed on all equipment with a system containing more than 22 pounds-mass (10 kg) of solvent;

b) Be able to withstand not less than 100,000 cycles of operation under load; and

c) Comply with the refrigeration pressure-limiting controls requirements in UL 60730-1 as well as the applicable UL 60730-2 particular requirements..

14.6.2 The adjustable cutout pressure setting of a pressure-limiting device shall not exceed one-third the ultimate strength of high-side solvent parts, provided this setting does not exceed ninety percent of the setting of the pressure-relief device.

Exception: Storage container assemblies intended to receive solvent during the recovery operation that comply with Section (DOT Storage Cylinders) are considered to comply with this requirement.

14.6.3 There shall be no stop valves between the pressure-limiting device and the pressure imposing element of the hermetic compressor.

15 Regulators

15.1 Regulators shall comply with the requirements in the following standards, as applicable:

a) For CE Code-based installations: ULC/ORD-C252; and

b) For NEC-based installations: UL 252.

16 Tube Fittings

16.1 Tube Fittings shall comply with the requirements in UL 109 as applicable.

17 Wiring

17.1 External factory-installed wiring that interconnects hazardous locations electrical parts of the overall extractor shall comply with 19.2 or 19.3, as applicable. External factory-installed wiring that interconnects electrical parts of the overall extractor in ordinary locations shall comply with the CE Code or NEC, as applicable.

18 Grounding and Bonding

18.1 All exposed dead-metal parts that are capable of becoming energized, and all dead-metal parts within the enclosure that are exposed to contact during normal operation or during operator servicing and

that are capable of becoming energized, shall be reliably bonded together and to the grounding means in accordance with the following requirements, as applicable:

a) For CE Code-based installations: CSA C22.2 No. 14.

b) For NEC-based installations: UL 508.

18A Support and Securement of Live Parts

18A.1 Provisions shall be made for securely mounting components to a supporting surface. A bolt, screw, or other fastener used to secure a part of a component shall not also be used to secure the component or another component to the supporting surface.

18A.2 A live screwhead or nut on the underside of an insulating base shall be prohibited from loosening by means of a star or lock washer and shall be insulated from the mounting surface by an insulating barrier that complies with Section 18C, Insulating Barriers, or by through air and over surface spacings specified in Section 18B, Spacings.

18A.3 An uninsulated live part, including a terminal, or a component with uninsulated live parts shall be secured to its supporting surface by a method other than friction so that it is prohibited from turning or shifting in position. Turning or shifting of a live part is able to be prohibited by the use of:

a) Two or more screws or rivets securing the component or part to the mounting surface;

b) Non-circular shoulders or mortises that abuts an adjacent part or mechanical stop member such as a mounting rail;

c) Non-circular shoulders or mortises that fit through an opening of the same shape cut into the mounting surface for a panel-mounted component or part;

d) A dowel, pin, lug, or offset that mates with a hole, recess or offset in the mounting surface; or

e) A connecting strap or clip fitted into an adjacent part.

18A.4 For a live part or a component with uninsulated live parts that are secured by means other than as in 18A.3, the part or component shall comply with the following:

a) The mounting screw or nut, when provided, is loosened (one component or part at a time) to allow movement;

b) Is subjected to typical operation of the device, such as switch operation, replacing a lamp or fuse replacement operation, or rotated to the extent limited by the mounting screw or other means; and

c) As a result of (a) and (b), the spacings between the uninsulated live parts shall not be reduced below the requirements in Section 18B, Spacings, and the internal wiring shall not be damaged, or cause strain to be transmitted to the terminals due to operation or rotation.

18B Spacings

18B.1 The electrical spacings in machinery for line-voltage parts shall comply with the spacings requirements in the following as applicable:

a) For CE Code-based installations: CSA C22.2 No. 14.

b) For NEC-based installations: UL 508.

18B.2 As an alternative to the spacing requirements specified in 18B.1, clearances and creepage distances may be evaluated in accordance with the following requirements as applicable:

a) For CE Code-based applications: CSA C22.2 No. 0.2.

b) For NEC-based installations: Clearance and Creepage Distances, in UL 508, together with the requirements in UL 840.

18C Insulating Barriers

18C.1 Insulating barriers in machinery shall comply with the insulating barriers requirements in UL 508.

18D Insulating Materials

18D.1 Insulating materials in machinery shall comply with the insulating materials requirements in UL 508.

18E Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

18E.1 To reduce the risk of unintentional contact that may involve a risk of electric shock from an uninsulated live part or film-coated wire or injury to persons from a moving part, an opening in an enclosure shall comply with either (a) or (b):

a) For an opening that has a minor dimension (see 18E.5) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 18E.1.

b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in Table 18E.1.

Exception: A motor other than one used in either a hand-held product or a hand-supported portion of a product need not comply with these requirements when it complies with the requirements in 18E.2.

Figure 18E.1

Articulate probe with web stop

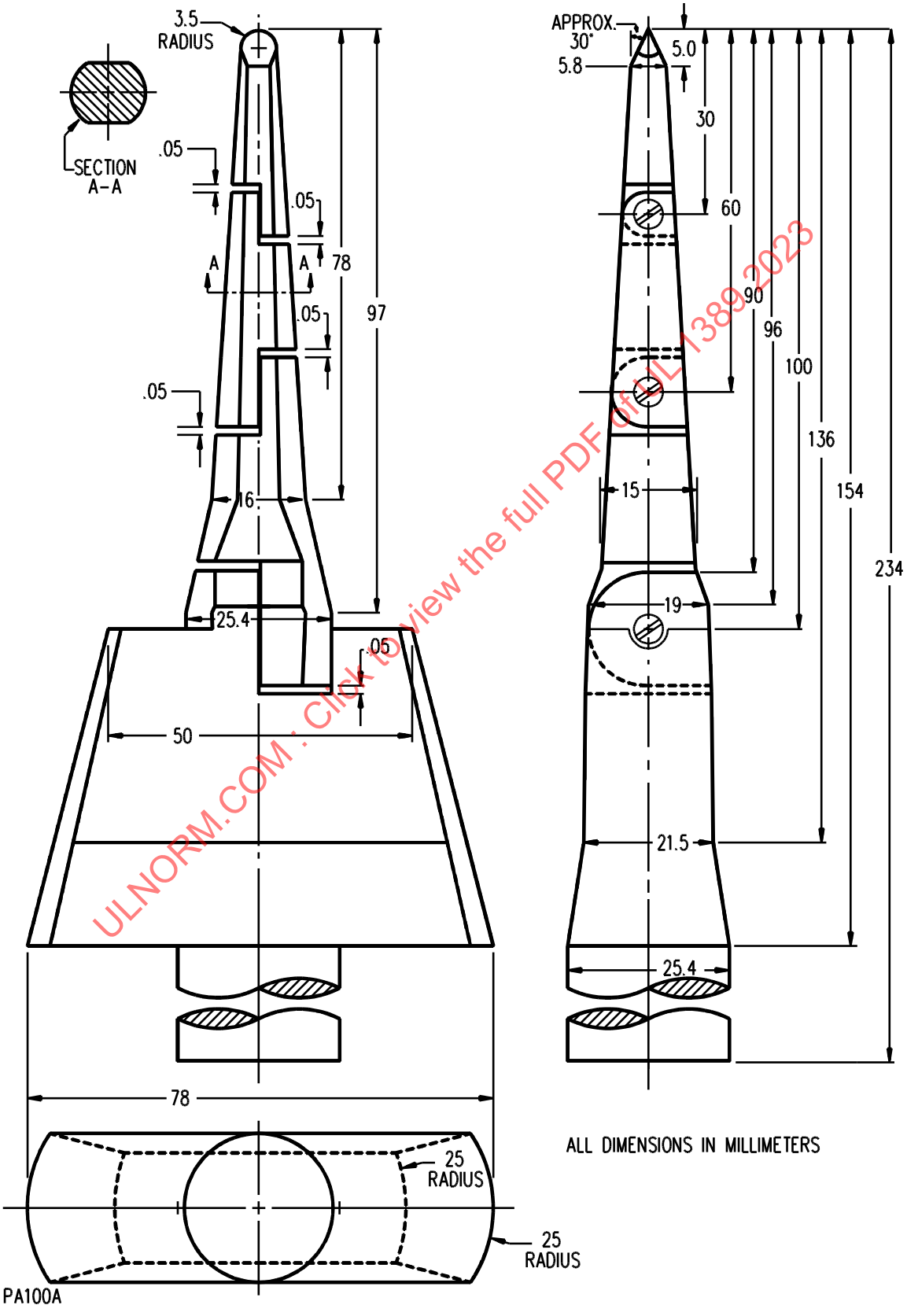


Table 18E.1
Minimum distance from an opening to a part that may involve a risk of electric shock or injury to persons

Minor dimension of opening[a]		Minimum distance from opening to part	
inches[b]	(mm)[b]	inches[b]	(mm)[b]
3/4[c]	(19.1)	4-1/2	(114.0)
1[c]	(25.4)	6-1/2	(165.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.6)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(444.0)
d	d	30	(762.0)

[a] See 18E.5.

[b] Between 3/4 and 2-1/8 inches (19.1 and 54 mm), interpolation is to be used to determine a value between the values specified in the table.

[c] Any dimension less than 1 inch (25.4 mm) applies to a motor only.

[d] More than 2-1/8 inches, but not more than 6 inches (152.0 mm).

18E.2 With respect to a part or wire as mentioned in 18E.1, in an integral enclosure of a motor as specified in the Exception to 18E.1:

a) An opening that has a minor dimension (see 18E.5) less than 3/4 inch (19.1 mm) may be used when:

1) A moving part cannot be contacted by the probe illustrated in Figure 18E.2;

2) Film-coated wire cannot be contacted by the probe illustrated in Figure 18E.3;

3) In a directly accessible motor (see 18E.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 18E.4; or

4) In an indirectly accessible motor (see 18E.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 18E.2.

b) An opening that has a minor dimension of 3/4 inch or more may be used if a part or wire is spaced from the opening as specified in Table 18E.1.

Figure 18E.2

Probe for moving parts and uninsulated live parts

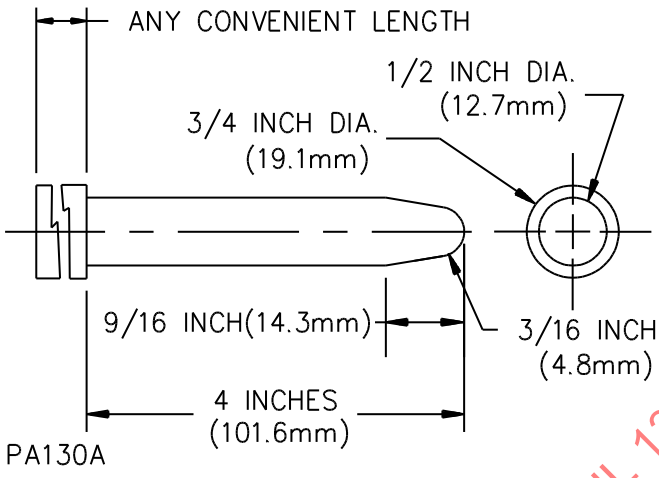


Figure 18E.3

Probe for film-coated wire

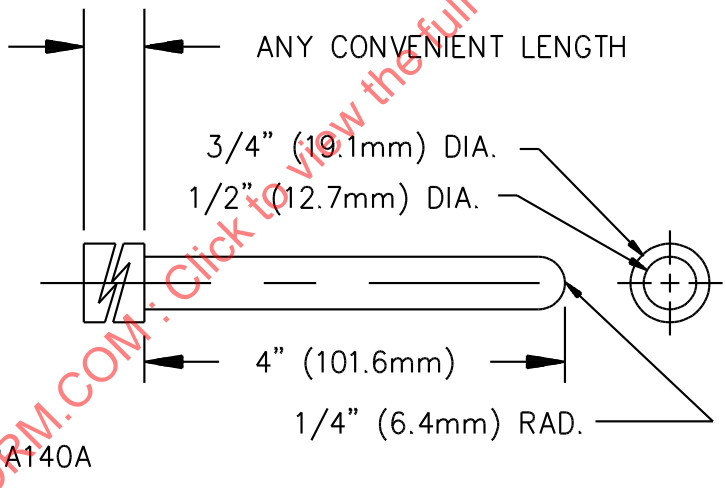
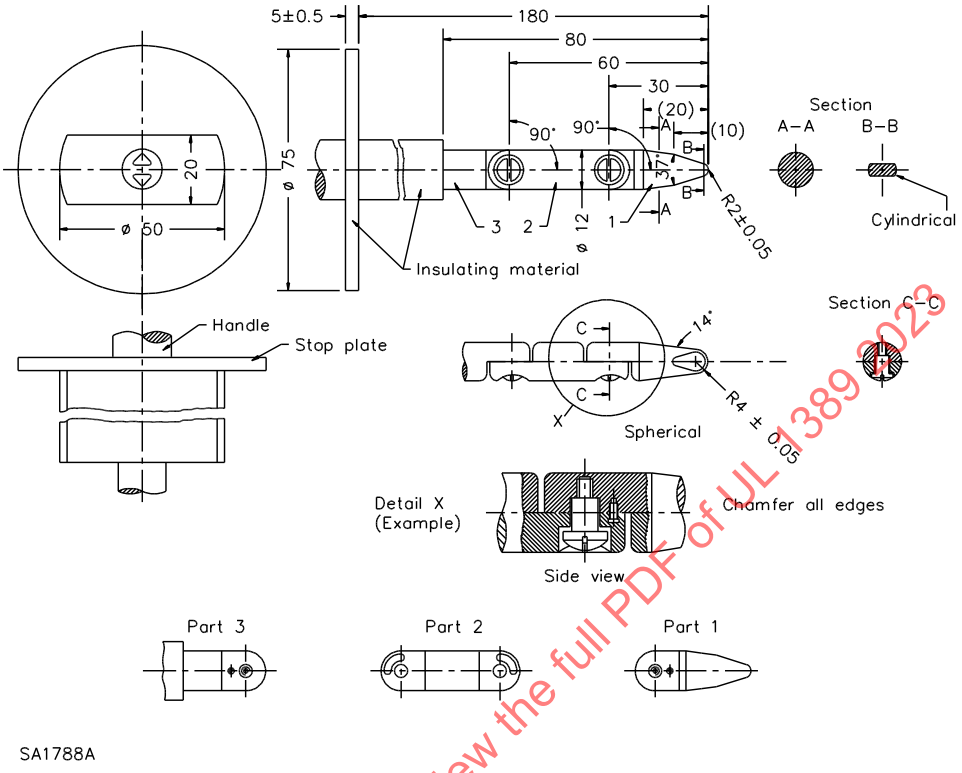


Figure 18E.4

Articulate probe



18E.3 The probes mentioned in 18E.1 and 18E.2 and illustrated in Figure 18E.1 – Figure 18E.4 shall be applied to any depth that the opening will permit; and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figure 18E.1 and Figure 18E.4 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

18E.4 The probes mentioned in 18E.3 and 18E.5 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

18E.5 With reference to the requirements in 18E.1 and 18E.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

18E.6 With reference to the requirements in 18E.2, an indirectly accessible motor is:

a) Accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool or

b) Located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

c) A directly accessible motor is that which can be contacted without opening or removing any part, or is that which is located so as to be accessible to contact.

18E.7 During the examination of a product to determine whether it complies with the requirements in 18E.1 or 18E.2, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) or a part that is opened to collect coins is to be opened or removed.

18E.8 With reference to the requirements in 18E.1 and 18E.2, insulated brush caps are not required to be additionally enclosed.

18F Guards

18F.1 A guard shall be provided over a part that is in motion during servicing and that presents a risk of injury, such as pinching, snagging, cutting, or the like, to maintenance or service personnel when a cover, door, panel, or other closure is opened or removed during servicing.

18G Protection Against Risk of Fire, Electric Shock, or Injury to Persons

18G.1 If the normal operation involves a risk of fire, electric shock, or injury to persons, means shall be provided to reduce such a risk.

18G.2 Whether a guard, a safety release, a pressure relief valve, an interlock, or the like is required and whether such a device is adequate shall be determined from an investigation of the complete appliance, its operating characteristics, and the likelihood of a risk of fire, electric shock, or injury to persons resulting from a cause other than gross negligence. The investigation shall include consideration of the results of breakdown or malfunction of any one component, but not more than one component at a time, unless one breakdown contributes to another malfunction. When the investigation shows the breakdown or malfunction of a particular component is capable of resulting in a risk of injury to persons, a risk assessment shall be performed and the guard, safety release, pressure relief valve, interlock, or the like shall be modified to adequately mitigate the risk per the risk assessment.

18G.3 A risk of injury to persons is considered to exist if one or more of the conditions in (a) – (d) applies:

a) A power-operated moving part such as a gear and linkage is accessible during intended operation and can cause a cut or laceration;

b) A sharp edge, burr, or projection is present that can cause injury during intended use or maintenance;

c) The stability of an appliance is such that it can cause injury to persons (see the Tip Stability Test, Section 33); and

d) The risk that a part of the body could be endangered or that clothing could be entangled by the moving part, resulting in a risk of injury to persons.

18G.4 With reference to 18G.3, the accessibility of power-operated moving parts such as gears and linkages is to be investigated using the applicable accessibility requirements in Section 18E.

18G.5 If a moving part involving a risk of injury to persons is accessible through a maintenance access door, means shall be provided so that when the door or panel is opened, the movement of the part is reduced within 5 seconds to a speed that will not involve a risk of injury to persons.

18G.6 If complete guarding of a moving part involving a risk of injury to the maintenance person is not possible without defeating the intended function of the appliance, a switch or other control device to deenergize the part shall be provided at a readily accessible location on the appliance.

18G.7 A manually-operated control for moving parts located in a maintenance area that may result in injury to persons shall be:

a) Located or guarded that it is unlikely to be switched on unintentionally and

b) Capable of being switched off by a single, straight-line motion.

18H Sharp Edges

18H.1 An edge, a projection, a corner, an opening, a frame, a guard, a handle, or the like shall be smooth and not be sufficiently sharp to constitute a risk of injury to persons during intended use or servicing of the appliance.

Exception: This requirement does not apply to a part or portion of a part that is sharp in order to perform a working function.

19 Specific Risk of Ignition Requirements for Hazardous Locations Rated Equipment

19.1 General

19.1.1 Electrical and non-electrical parts that comprise the overall extractor shall have a maximum surface temperature in accordance with 30.7.

19.1.2 External non-metallic parts that can be subjected to electrostatic charging due to their movement, or due to the movement of the flammable solvent across them, shall comply with the requirements for the accumulation of static electricity in the following standards, as applicable:

a) For CE Code-based installations: CSA C22.2 No. 30 or CSA C22.2 No. 60079-0; and

b) For NEC-based installations: UL 1203, UL 60079-0, UL 779 or UL 1067.

19.1.3 In addition to the requirements of this standard, electrical parts that comprise the overall extractor shall comply with the applicable Division and Zone system hazardous locations standards in accordance with the CE Code and NEC, based on the intended installation. The following are some examples of Division and Zone system hazardous locations standards for the electrical parts of the overall extractor:

a) Electric Heaters:

1) For CE Code-based Division installations: CSA C22.2 No. 30 or CSA C22.2 No. 213; and

2) For NEC-based Division installations: UL 823.

b) Lighting:

1) For CE Code-based Division installations: CSA C22.2 No. 137; and

2) For NEC-based Division installations: UL 844.

c) Motors:

1) For CE Code-based Division installations: CSA C22.2 No. 145; and

2) For NEC-based Division installations: UL 674.

d) Motors (Division 2 only):

1) For CE Code-based Division installations: CSA C22.2 No. 213; and

2) For NEC-based Division installations: UL 1836.

e) Industrial Control Panels:

1) For CE Code-based Division installations: NFPA 496 or CSA C22.2 No. 30; and

2) For NEC-based Division installations: NFPA 496 or UL 1203.

f) Industrial Control Panels (Division 2 only):

1) For CE Code-based Division installations: CSA C22.2 No. 213; and

2) For NEC-based Division installations: UL 121201.

g) Industrial Control Panels (Relating to hazardous locations):

1) For CE Code-based Division installations: CSA C22.2 No. 157 or CSA C22.2 No. 60079-11 and 60079-0; and

2) For NEC-based Division installations: UL 698A.

h) Electrically Operated Valves:

1) For CE Code-based Division installations: CSA C22.2 No. 30; and

2) For NEC-based Division installations: UL 1203.

i) Electrically Operated Valves (Division 2 only):

1) For CE Code-based Division installations: CSA C22.2 No. 213; and

2) For NEC-based Division installations: UL 121201.

j) Flashlights – UL 783.

k) Zone System Equipment:

1) For CE Code-based Zone installations: CSA C22.2 No. 60079 series (all parts); and

2) For NEC-based Zone installations: UL 60079 series (all parts).

19.2 Zone 1 or Class I, Division 1

19.2.1 Extractors for use in Zone 1 or Class I, Division 1 locations, in addition to complying with the requirements of 19.1, external factory-installed wiring that interconnects electrical parts of the overall extractor shall comply with the following requirements, as applicable:

a) For CE Code-based Zone 1 installations: Section 18 of the CE Code.

b) For CE Code-based Class I, Division 1 installations: Annex J18 of the CE Code.

c) For NEC-based Zone 1 installations: Article 505 of the NEC.

d) For NEC-based Class I, Division 1 installations: Article 501 of the NEC.

19.3 Zone 2 or Class I, Division 2

19.3.1 Extractors for use in Zone 2 or Class I, Division 2 locations, in addition to the extractor complying with the requirements of 19.1, shall comply with the following requirements:

a) Flammable solvent shall not be released during the extraction process, except during the disconnection or opening of vessels that contain the solvents or the plant material exposed to the solvents;

b) Each vessel that meets all of the following criteria shall be provided with check valves positioned to minimize solvent vapor release during vessel disconnection:

1) The vessel contains flammable solvents, or contains plant material exposed to flammable solvents; and

2) The vessel is intended to be disconnected.

c) Testing regarding the release of solvent vapor during vessel disconnection or opening of vessels that contain the solvents or the plant material exposed to the solvents shall be performed in accordance with Sections 37 and 38;

d) Markings shall be included on the overall extractor in accordance with Section 46, as applicable; and

e) Installation manual information shall be included with the overall extractor in accordance with Section 47, as applicable.

19.3.2 External factory-installed wiring that interconnects electrical parts of the overall extractor shall comply with the following requirements, as applicable:

a) For CE Code-based Zone 2 installations: CSA C22.2 No. 60079-7 for factory wired connections between enclosures, or Section 18 of the CE Code.

b) For CE Code-based Class I, Division 2 installations: CSA C22.2 No. 213 for connections on exterior of enclosure, or Annex J18 of the CE Code.

c) For NEC-based Zone 2 installations: UL 60079-7 for factory wired connections between enclosures, or Article 505 of the NEC.

d) For NEC-based Class I, Division 2 installations: UL 121201 for connections on exterior of enclosure, or Article 501 of the NEC.

20 Materials

20.1 Materials in contact with the solvents anticipated by these requirements, shall be resistant to the action of the solvents if degradation of the material will result in leakage of the solvent or if it will impair the function of the device.

20.2 A synthetic rubber part shall not show any signs of cracking or other damage following exposure to minus 40°F (minus 40°C). See the Low Temperature Test, Section 35.

20.3 All elastomeric materials shall be subjected to:

a) 34.2, Volume change test;

b) 34.3, Weight loss test.

20.3A A synthetic rubber part shall not show any signs of cracking or other damage following exposure to minus 40°F (minus 40°C). See the Low Temperature Test, Section 35.

20.4 Seals made from Acetal polymers, chlorotrifluorethylene polymers, tetrafluorethylene, fluorinated ethylene propylene polymers and polyamides of composition polyhexamethylene adipamide or polycaproamide polymers (nylon 6, 6/6 or 6/16) shall only be subjected to the Accelerated Aging Test.

20.5 The exposed surfaces of metallic parts shall be resistant to atmospheric corrosion if this corrosion will lead to leakage of the fluid or if it will impair the function of the device. Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means. This applies to all springs and other parts required for proper mechanical operation.

Exception: This requirement does not apply to:

a) Bearings, thermal elements, sliding surfaces of a hinge, shaft, or similar part, where such protection is impracticable;

b) Small parts of iron or steel, such as washers, screws, bolts, or similar parts, when the parts are not current carrying or relied upon to support or maintain the relative position of uninsulated live parts or components; and

c) Parts made of stainless steel.

20.6 A part in contact with the solvent to be handled shall be resistant to the action of the solvent being used. In addition, metallic materials, used internally in fluid confining parts, that are required to operate in some manner to address safety (e.g. plunger on a valve) shall be resistant to corrosion caused by these solvents. This requirement also applies to all tubing, piping, or other interconnection means between components of the equipment.

20.7 Table 20.1 shows the galvanic series for metallic materials exposed to a conductive solution of sea water. The most active material in a given combination will experience increased levels of corrosion, while the most passive material in the combination will experience reduced levels of corrosion. The greater the separation of the materials are in the galvanic series of Table 20.1, the more pronounced the effects would

be. Table 20.1 serves as a guide in selecting the appropriate test conditions based on manufacturer specified material combinations.

Table 20.1
Galvanic series of metal materials

Most passive	Platinum
	Gold
	Graphite
	Silver
	Stainless Steel Type 316 (Passive)
	Stainless Steel Type 304 (Passive)
	Titanium
	13% Chromium Stainless Steel (Passive)
	76 Ni – 16 Cr – 7 Fe Alloy (Passive)
	Nickel (Passive)
	Silver Solder
	M-Bronze
	G-Bronze
	70:30 Cupro Nickel
	Silicon Bronze
	Copper
	Red Brass
	Aluminum Brass
	Admiralty Brass
	Yellow Brass
	60 Ni – 30 Mo – 6 Fe – 1 Mn
	76 Ni – 16 Cr – 7 Fe Alloy (Active)
	Nickel (Active)
	Manganese Bronze
	Tin
	Stainless Steel Type 316 (Active)
	Stainless Steel Type 304 (Active)
	13% Chromium Stainless Steel (Active)
	Cast Iron
	Wrought Iron
	Mild Steel
	Aluminum 2024
	Cadmium
	Alclad
	Aluminum 6053
	Aluminum 1100
	Galvanized Steel
	Zinc
	Magnesium Alloys
Most active	Magnesium
Note – Reprinted with permission from NACE. Based on table titled "Galvanic Series of Metals Exposed to Seawater" from NACE Corrosion Engineer's Reference Book, Third Edition ©NACE International 2002.	

21 Cooling Systems

21.1 Aqueous systems

21.1.1 These requirements cover cooling systems other than convection or forced air. These requirements do not cover refrigeration system intended to directly cool the solvents but may include one side of heat exchangers that contact the refrigerants for this purpose.

21.1.2 The cooling medium used in a cooling system shall be water, glycol, a mixture of water and glycol, oil, or other water based cooling medium investigated for the purpose. The temperature of the cooling medium shall not exceed 70 °C during normal operation.

21.1.3 All tubing, tanks, and other cooling system components integral to or included with the drive shall be constructed of corrosion resistant material and shall be suitable for use with the cooling medium.

Note – Suitability of the cooling medium with materials in which it is in contact with can be accessed by original equipment manufacturers declarations.

21.1.4 Tubing used to connect cooling medium-containing components shall comply with the minimum wall thickness requirements of Table 75.1 and with the Hydrostatic Pressure Test requirements of 76.2 of UL 508C.

21.1.5 There shall be no leakage of the cooling medium onto live parts as a result of:

a) Normal operation, including expected condensation;

b) Servicing of the equipment; or

c) Loosening or detachment of hoses or other cooling system parts over time.

21.2 Refrigerant base cooling systems

21.2.1 Refer to UL 1995, Standard For Heating and Cooling Equipment or UL 60335-2-89, Household and Similar Electrical Appliances – Safety – Part 2-89: Particular Requirements for Commercial Refrigerating Appliances with an Incorporated or Remote Refrigerant Unit or Compressor.

PERFORMANCE

22 Deformation Test

22.1 Joints in a pump that supply solvents shall not leak, nor shall there be evidence of damage resulting from the turning effort exerted on pipe-threaded sections that have been tested as described in 22.2 and 22.3.

22.2 The sample pump used in this test is to be rigidly anchored or otherwise supported. A length of NPT Schedule 80 pipe sufficient to provide for wrench engagement, is to be connected to each female pipe threaded section of the body. The male threads shall have pipe joint sealing compound or polytetrafluoroethylene (PTFE) tape applied to them first or be coated as specified by the manufacturer. Each pipe is then to be tightened across the valve body to the torque specified by the manufacturer or in Table 22.1.

Table 22.1
Torque requirements for pipe connections

Pipe size ANSI B36.10M, nominal inches	Outside diameter		Torque	
	mm	(in)	N·m	(lb-in)
1/8	10.29	(0.405)	17	(150)
1/4	13.72	(0.540)	28	(250)
3/8	17.15	(0.675)	51	(450)
1/2	21.34	(0.840)	90	(800)
3/4	26.67	(1.050)	113	(1000)
1	33.40	(1.315)	137	(1200)
1-1/4	42.16	(1.660)	164	(1450)
1-1/2	48.26	(1.900)	175	(1550)
2	60.33	(2.375)	186	(1650)
2-1/2	73.03	(2.875)	198	(1750)
3	88.90	(3.500)	203	(1800)
4	114.30	(4.500)	215	(1900)

22.3 After the torque force has been applied to each connected pipe or fitting, the pump is to be subjected to the Leakage Test, Section 23.

22.4 If external leakage is noted at the thread joint between the pipe and body, the joint is to be remade using a pipe joint sealing material and retested for leakage.

23 Leakage Test – Pneumatically-Powered Pump

23.1 Before being subjected to the Endurance Test, Section 24, the liquid confining parts of a pump shall withstand an internal hydrostatic pressure of 1.5 times the maximum discharge or inlet pressure without leakage to the outside, to air confining parts of the pump, and without evidence of casting porosity. This test is to be conducted as described in 23.3.

23.2 The air-confining parts of a pneumatically-powered pump shall not leak externally at a rate in excess of 42,500 cm^3 (1.5 ft^3) per hour when tested with air or nitrogen at the maximum rated pressure.

23.3 The test pump is to be connected to a source of hydrostatic pressure. A positive shutoff valve and a pressure indicating device are to be installed in the supply piping. The pressure indicating device is to be installed in the piping between the shutoff valve and the test pump. The pressure indicating device shall comply with one of the following.

a) An analog gauge having a pressure range such that the test pressure is between 30 and 70 percent of the maximum scale reading of the gauge;

b) A digital pressure transducer, or other digital gauge, that is calibrated over a range of pressure that includes the test pressure; or

c) Other device that is equivalent to the devices in (a) or (b).

23.4 While the pump is under the applied test pressure, the drive shaft or an operating shaft stuffing box or seal, and all joints are to be examined for evidence of leakage. Water or kerosene is to be used for developing the required pressure in a leakage test of liquid confining parts. The pressure is to be maintained for at least 10 minutes.

24 Endurance Test

24.1 Mechanical and pneumatically-powered pumps

24.1.1 The pump assembly shall not leak after the pump has been subjected to the test described in 24.1.2 and 24.1.3.

24.1.2 This test is to be conducted on a sample previously subjected to the Deformation Test, Section 22, and the Leakage Test, Section 23. The test pump is to be connected to an air inlet liquid source at the maximum inlet pressure and flow capacity to enable operation of the pump under the following conditions. The pump is to be operated continuously for 300 hours at the maximum discharge pressure developed by the pump.

24.1.3 During this test, operating parts of a pump are to be kept "wet" by a continuous flow of liquid. Other conditions of the test are to simulate, insofar as practicable, those of intended end-use application.

24.1.4 A test for leakage, as described in the Leakage Test, Section 23, is to be conducted on the pump assembly immediately after completion of the Endurance Test. The pump assembly shall comply with the applicable requirements in Section 22.

24.2 Pressure vessel body and cover locking mechanism

24.2.1 An ordinary user shall not be capable of manually defeating the holding action of the clamping device without a tool unless there is no pressure in the pressure vessel. The body and a removable cover of a pressure vessel assembly shall not leak after the vessel has been subjected to the test described in 24.2.2.

24.2.2 The body and cover locking mechanism is to be operated through 6000 cycles. Each cycle shall completely lock and unlock the cover. The cover does not need to be opened or removed from the body if the locking mechanism can be cycled without preforming this function.

24.2.3 A test for leakage, as described in the Leakage Test, Section 23, is to be conducted on the pressure vessel assembly immediately after completion of the Endurance Test. The pressure vessel assembly shall comply with the applicable requirements in Section 26.

24.2.4 A lid or a cover shall have a means to prevent unintentional closing.

25 Leakage Test – System

25.1 The liquid confining and pneumatic-handling parts of the container, piping and other operating parts shall not leak when subjected to a hydrostatic pressure as specified in ASME Section VIII-1, UG-99.

25.2 Water is to be used for developing the required pressure. The pressures are to be maintained for at least 10 minutes.

26 Hydrostatic Strength Test – Vessel

26.1 With reference to Section 8, the pressure vessel shall withstand for 1 minute, without rupture, a proof test pressure as specified in 26.2.

26.2 With reference to the requirement of 26.1, the proof test pressure is to be determined as follows:

a) For a pressure vessel that is not tested and marked in accordance with the specifications of the DOT, the proof test pressure is to be in accordance with Table 27.1.

b) For a pressure vessel that is tested and marked in accordance with the specifications for shipping containers of the DOT, the proof test pressure is to be as specified in the applicable DOT specification.

c) For a pressure vessel that is tested and marked in accordance with ASME specifications, the proof test pressure is to be as specified in Section VIII, Pressure Vessels, of the ANSI/ASME Boiler and Pressure Vessel Code.

26.3 Pressure vessels bearing the ASME Code "U" or "UM" symbol and having a design pressure not less than required by 26.1 or 26.4, as applicable, are acceptable without test.

26.4 The sample is to be connected to a source of hydrostatic pressure. A positive shutoff valve and a pressure indicating device, are to be installed in the hydrostatic pressure supply piping. The pressure gauge is to be installed in the piping between the shutoff valve and the vessel under test. The pressure indicating device shall comply with one of the following:

a) An analog gauge having a pressure range such that the test pressure is between 30 and 70 percent of the maximum scale reading of the gauge;

b) A digital pressure transducer, or other digital gauge, that is calibrated over a range of pressure that includes the test pressure; or

c) Other device that is equivalent to the devices in (a) or (b).

27 Hydrostatic Strength Test – Piping and Operating Parts

27.1 The liquid confining parts of the piping and other operating parts shall withstand, without rupture or permanent distortion, a hydrostatic pressure as specified in Table 27.1 for one minute.

Table 27.1
Hydrostatic test pressures

Rated service pressure, psig	Test pressures
Up to and including 2,000	Five times the rated service pressure.
Over 2,000 to 3,000	10,000 psig
Over 3,000	Two times the rated service pressure but not less than 12,000 psig.

27.2 Pneumatic-handling parts of the system or component shall comply with one of the following:

a) Withstand, without rupture, a hydrostatic pressure of five times the maximum air inlet pressure applied for one minute; or

b) Comply with ASME Section VIII Div 1.

27.3 The sample is to be connected to a source of hydrostatic pressure as described in 26.4.

28 Mechanical Strength Tests for Sight Glass

28.1 A visible signaling device enclosure, including the lens, shall be of sufficient mechanical strength to withstand abuse anticipated in shipping, installation and service.

28.2 A sample shall be tested as it is normally mounted on the system. A push force of 110 N shall be gradually applied and maintained for 1 min by means of a 12.7 mm (1/2 in) diameter steel hemisphere to the external surface most likely to impair the operation of the device, or create leakage. If the sight glass is small enough that the 12.7 mm (1/2 in) diameter steel sphere cannot contact the visible signaling device, the test is not conducted.

28.2A A sample shall be tested as it is normally mounted on the system. One impact of 7 J (5 ft-lb) shall be applied by means of a solid, smooth, steel sphere 50 mm (2 in.) in diameter, with a mass of 540 g (1.19 lb) onto or into the signaling device or the covering that protects the signaling device from impacts. The sphere shall be dropped from a sufficient height (usually 1300 mm from the bottom of the ball to the surface to be impacted) or swung through a pendulum arc from a sufficient height to apply an impact force of 7 J (5 ft-lb) of energy to the external surface most likely to impair the operation of the device, or create leakage. If the sight glass is small enough that the 50 mm (2 in) diameter steel sphere cannot contact the visible signaling device, the test is not conducted.

Note: Unless specified, the same sample may be reused for each of the above applied forces. It is not prohibited to use a different sample for the application of each force.

28.3 When the visible signaling device is intended for indoor use, the impacts specified in 28.2 are to be conducted at room temperature.

29 Overflow Test

29.1 Plant oil extractors that incorporate a reservoir or liquid-storage chamber that is likely to be over-filled in intended service shall not wet electrical insulation that is likely to be adversely affected by the liquid used in the reservoir or chamber.

29.2 To determine whether plant oil extractors comply with the requirement in 29.1, it is to be tested as follows: water is to be used for the test. The reservoir is to be filled to the level recommended by the manufacturer if such level is plainly marked; otherwise, the reservoir is to be filled to maximum capacity. Then additional water, equal to 50 percent of the volume just mentioned (but not more than 1 pint), is then to be poured into the reservoir, or If another vessel or object is to be placed into the reservoir or chamber it shall be slowly lowered into it. Plant oil extractors are considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA.

29.3 Plant oil extraction that incorporates ventilation or other openings through which liquid may enter, liquid entering the openings shall not wet uninsulated live parts or film-coated wires, and shall not wet electrical insulation that is likely to be adversely affected by the liquid entering the openings. Plant oil extractors are considered to involve a risk of electric shock if the current measured through a 500 ohm resistor between an accessible part and ground is more than 5 mA.

30 Temperature Test

30.1 Temperature testing shall consider all parts of the overall extractor.

30.2 To address the potential risk of personal injury from hot surfaces, under all applicable modes of operation based on the intended application, external surfaces shall not attain a temperature in excess of the limits specified in Table 30.1.

30.3 The maximum measured temperature of any parts that comprise the overall extractor shall be in accordance with Table 30.1 or in accordance with the applicable standard for the part. If no maximum temperature is specified by Table 30.1 or by any applicable component standard, the maximum temperature shall not exceed the manufacturer's specification for the part.

Table 30.1
Temperature rises

	Surface	°C	°F
1.	Inaccessible parts of the enclosure (for example, the back of wall mounting enclosure) or accessible surfaces not subject to casual contact (for example, without parts intended to be touched) [a]	50	122
2.	Accessible parts of the enclosure subject to casual contact (for example, enclosure surfaces containing parts intended to be touched)		
	Nonmetallic[a]	40	104
	Metal[a]	30	86
3.	Parts intended to be touched (for example, operating knobs or handles of power switches and similar parts)		
	Nonmetallic[a]	25	77
	Metal[a]	15	59

[a] The temperature rise of an accessible surface of an enclosure is able to be exceeded when provided with the marking indicated in 46.2(k).

Note – All values of temperature rise in Table 30.1 are based on an assumed ambient temperature of 25°C (77°F). Tests that are conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F) meet the intent of this requirement.

30.4 Temperatures are to be measured by thermocouples consisting of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2).

30.5 Thermocouples are to be located at the hottest points on the outside of the parts that comprise the overall plant oil extractor.

30.6 A thermocouple junction and the adjacent thermocouple lead wires are to be securely held in thermal contact with the surface of the material, the temperature of which is being measured. Methods of obtaining adequate thermal contact include:

a) Drilling a small, bottomed hole in the metal, inserting the thermocouple junction and securing it in place by prick-punching the metal adjacent to the drilled hole; or

b) Placing the thermocouple junction against the surface being measured and securing it in position with a mixture of sodium silicate (water glass) and kaolin.

30.7 The temperature of any surface of an extractor for use in a hazardous location that might be exposed to the explosive atmosphere, for both electrical and non-electrical parts of the overall extractor, shall be considered. The maximum measured temperature on any such surface shall not exceed the auto ignition temperature of the marked flammable solvents as noted below:

a) Butane – 288°C (Temperature classification – T2).

b) Ethanol – 363°C (Temperature classification – T1).

c) n-Hexane – 225°C (Temperature classification – T2 or T2C).

d) LP Gas – 405°C (Temperature classification – T1).

e) Pentane – 243°C (Temperature classification – T2 or T2B).

f) Propane – 450°C (Temperature classification – T1).

31 Dielectric Voltage-Withstand Test

31.1 The equipment shall withstand, without breakdown, the application of a test potential of 1000 V plus twice rated voltage applied for 1 minute between high-voltage live parts and dead metal parts and between live parts of high- and extra-low-voltage circuits. The test potential shall be at any frequency between 40 and 70 hertz.

Exception No. 1: The test potential for motors rated at not more than 1/2 horsepower (373 W output) shall be 1000 V.

Exception No. 2: If the steady-state voltage developed in a motor circuit through the use of capacitors exceeds 500 V, as measured during the temperature and pressure test, the test potential for the parts affected shall be 1000 V plus twice the developed capacitor voltage.

31.2 Equipment employing an extra-low-voltage circuit shall withstand, without breakdown, the specified test potential applied for 1 minute between extra-low-voltage live parts and dead metal parts. The test potential shall be:

a) A dc potential of 700 V; or

b) An ac potential of 500V at any frequency between 40 and 70 Hz.

31.3 A 500 VA or larger transformer, the output voltage of which is essentially sinusoidal and can be varied, is to be used to determine compliance with 31.1 and 31.2. The applied potential is to be increased gradually from zero until the required test value is reached and is to be held at that value for 1 minute.

Exception: The requirement of a 500 VA or larger transformer can be waived if the high potential testing equipment maintains the specified high potential voltage at the equipment during the duration of the test.

31.4 When the charging current through a capacitor or capacitor-type filter connected across the line, or from line to earth ground, is large enough so the required alternating-current test potential is unable to be maintained, the capacitors and capacitor-type filters may be tested as described in 31.5.

31.5 The capacitors and capacitor-type filters mentioned in 31.4 are to be subjected to a direct-current test potential of 1414 V for equipment rated 250 V or less or 1414 V plus 2.828 times the rated circuit voltage for equipment rated at more than 250 V. The direct-current test potential is to be maintained for 1 min without breakdown.

31.6 Components providing a d.c. path in parallel with the insulation to be tested, such as discharge resistors for filter capacitors and voltage limiting devices (transient voltage suppressors), may be disconnected during the test.

32 Tests for Butane and Carbon Dioxide Hoses

32.1 General

32.1.1 Reinforced rubber and reinforced thermoplastic hose or hose assemblies, shall be subjected to the following tests.

32.2 Exposure test

32.2.1 Three 18 in (457 mm) long samples of the hose assembly are required for this test. The inner tube is to be exposed for 30 days at 176 ±4°F (80 ±2°C) to the end use solvent. After exposure, one of the hose assemblies is to be subjected to the Pull Test specified in 32.7. The remaining two samples shall withstand

without failure the pressure indicated in the Hydrostatic Strength Test – Piping and Operating Parts, Section 27. See 32.2.2 for fill limits.

32.2.2 Each sample hose assembly subjected to the test shall not be filled more than 70 percent full by volume at 70°F (21°C).

32.2.3 When exposed as specified in 32.5, the hose assemblies subjected to the pull test shall be subjected to a pull test using the test methods and apparatus described in Standard Test Methods for Rubber Hose, ASTM D380.

32.3 Hydrostatic strength test

32.3.1 The hose assembly shall withstand, without failure, the pressure indicated in the Hydrostatic Strength Test – Piping and Operating Parts, Section 27.

32.4 Thermal cycling test

32.4.1 Two sample hose assemblies are to be placed in an air circulating oven maintained at 176 ±5°F (80 ±3°C) for 23 hours. Each hose assembly is then to be removed and allowed to cool to to 77 ±5°F (25 ±3°C) for 1 hour. Each hose is then placed in a cold chamber at minus 22 ±5°F (minus 30 ±3°C) for 23 hours and allowed to return to to 77 ±5°F (25 ±3°C) for 1 hour. The cycle is to be repeated five times. Following this test, the hose assemblies shall withstand, without failure, the pressure indicated in the Hydrostatic Strength Test – Piping and Operating Parts, Section 27.

32.5 Oil aging test

32.5.1 Three hose assemblies shall be immersed in IRM 903 oil at 176°F (80°C) for 168 hours. Following this test, the hose shall be subjected to the pull test specified in 32.7 and withstand, without failure, the pressure indicated in the Hydrostatic Strength Test – Piping and Operating Parts, Section 27.

32.6 Vibration test

32.6.1 A single sample hose assembly shall be mounted to a vibration machine and connected to an air line maintained at 50 ±5 psig (345 ±35kPa). The room ambient temperature is to be 77 ±5°F (25 ±3°C). The amplitude of vibration shall be 0.125 ±0.06 in (3.18 ±1.5 mm) and the frequency of vibration shall be 1000 ± 20 vibrations per minute. The test shall be conducted for 30 hours with no leakage or failure.

32.7 Pull test

32.7.1 The hose assembly shall be mounted to a test apparatus having a crosshead speed of 1.0 in per min to determine the force necessary to separate the hose from the fitting or to pull the hose apart. Starting from zero, the force shall be gradually increased until the fitting separates and/or the hose pulls apart. The force measured shall not be less than 120 lb.

32.8 Permeation tests

32.8.1 Hose and hose assemblies shall not permit effusion of the end use solvent at a rate greater than 2.0 lbs/ft^2/yr (9.8 kg/m^2/yr).

32.8.2 The apparatus required consists of canisters with internal volumes of at least 29 to 32 in^3 (475 to 525 cm^3) and a 3000 psig (21 MPa) minimum burst pressure with appropriate fittings to connect to the hose assemblies, halogen detector, circulating air oven capable of maintaining uniform test temperature throughout the test periods, and a weighing scale capable of mass measurements to 0.1 g accuracy.

32.8.3 Four hose assemblies, having a free hose length of 1 m (3.28 ft) are to be tested. Three of the hose assemblies shall be used for determining the loss of the end use solvent and the fourth assembly shall be run as an empty plugged blank to be used as a means of determining the mass loss of the hose body alone.

32.8.4 The free length of hose in each assembly is to be measured at zero gage pressure to the nearest 0.04 in (1 mm). Each of the four hose assemblies is to be connected to a canister and obtain the total mass of each test unit including end plugs to the nearest 0.1 gram.

32.8.5 Three of the test units are to be loaded with 0.6 mg of the end use solvent per cubic millimeter of each test unit's volume to a total variance of ±5 g. The loaded test units are to be checked with a halogen detector at a sensitivity of 1 lb (453.6 g) per 40 years (11.34 g per year) to be sure that they do not leak. Any suitable method for loading may be used.

32.8.6 The three loaded and one blank test units are to be placed in the air oven at the specified test temperature for a period of 30 ±5 min to drive off surface moisture. The hoses are not to be bent in a curve with a diameter smaller than 20 times the outside diameter of the hose while in the oven. The loaded test units are to be checked for leakage and all test units weighed not less than 15 min or more than 30 min after removal from the oven. The mass is to be obtained and recorded as the original mass.

32.8.7 The test units are to be placed back in the air oven at the specified temperature for 24 hours. At the end of the 24 hour period, the test units are to be removed, weighed in the same manner as previously specified, and returned to the oven. When a loss of 20 g or more occurs, discontinue the test, check for leaks, and repeat test procedure.

32.8.8 The first 24 hour period is considered the preconditioning period. The mass loss during this period is to be disregarded in final calculations. Seventy-two hours after the preconditioning weighing, the samples are to be weighed in the same manner as previously described. The 72 hours mass loss is to be calculated. The effusion rated is to be determined by subtracting the corresponding mass loss of the blank from that of the loaded test unit. The effusion rate is to be expressed in kg/m^2/yr or pound per square foot per year. The rate of loss of the end use solvent mass for the loaded test units is calculated as follows:

$$R = \left[\frac{(A - B)}{L_1} - \frac{(C - E)}{L_2} \right] \cdot \frac{K}{D}$$

In which:

A is the initial mass after preconditioning period of loaded test unit, g.

B is the final mass after 72 hour period of loaded test unit, g.

C is the initial mass after preconditioning period of blank test unit, g.

D is the nominal hose inside diameter, mm.

E is the final mass after 72 hour period of blank test unit, g.

K is 38.7

R is the rate of the end use solvent mass loss, kilograms per square meter (inner tube area of free hose length) per year.

L_1 is the free hose length (between hose fittings) of loaded test unit, m.

L_2 is the free hose length of blank test unit, m.

Or in which:

D is the nominal hose inside diameter, in.

K is 12.3

R is the Rate of the end use solvent mass loss, pounds per square foot per year.

L_1 is the Free hose length of loaded test unit, in.

L_2 is the Free hose length of blank test unit, in.

33 Tip Stability Test

33.1 If the system is provided with casters this test shall be conducted. When the sample is placed at the center of a plane inclined to make an angle of 10 ±0.2 degrees with the horizontal, it is not to tip over.

33.2 The test is to be conducted on a fully assembled system using water or solvent, under the following conditions:

a) With the legs, wheels, casters, or similar means of support arranged in the position most likely to result in tip-over such as turning the caster so that the caster axle is under the frame versus outside of the frame area.

b) With the legs, wheels, casters, or similar means of support blocked by means of a steel bar 1/4 in (6.4 mm) thick, 1 in (25.4 mm) wide, that extends 2 in (50.8 mm) beyond each leg and/or caster placed under one or more of the wheels so that the system does not roll or slide on the inclined plane.

34 Tests for Synthetic Rubber Parts

34.1 General

34.1.1 A synthetic rubber part in contact with one of the liquids indicated in Table 34.1 shall not show excessive volume change or loss of weight, when considered on the basis of its intended function, following immersion, in the specified test liquid. See the volume change test described in 34.2.1 – 34.2.3, the weight loss test described in 34.3.1 and 34.3.2 and the Accelerated Aging Test in Section 36.

Table 34.1
Test liquids for synthetic rubber materials

Liquid in contact with part	Test fluid
LP-Gas, Butane, n-Hexane	n-Hexane
CO_2	CO_2
Ethanol	Ethanol
Pentane	Pentane

34.1.2 A change in volume of not more than 25 percent swelling or 1 percent shrinkage, and a weight loss (extraction) of not more than 10 percent is considered to be in compliance with 34.1.1.

34.2 Volume change test

34.2.1 The volume change test for synthetic rubber specified in 34.1.1 is to be conducted in a manner similar to that described in ASTM D471, with variations as noted in 34.2.2 and 34.2.3.

34.2.2 The test using n-hexane, ethanol or pentane are to be conducted at a temperature of 23 ±2°C (73.4 ±3.6°F). Three specimens are used in each test. Each specimen is to be placed on a small diameter wire hook. Its volume is then to be determined by weighing first in air (M_1) and then in water (M_2). The specimens are then to be wiped dry and placed in the test liquid. After 70 hours, the specimens are to be removed from the liquid one at a time, immediately wiped dry, and weighed in air while on the same hook (M_3). The weight is to be obtained within 30 seconds after removal from the test liquid. The final weight in water (M_4) is to be determined immediately thereafter. Before obtaining the weights in water (M_2 and M_4), each specimen is to be dipped in ethyl alcohol, then dipped in water, in order to eliminate surface air bubbles. The percent change in volume is to be calculated as follows, with the results reported as the average of the three specimens tested:

$$Percent\ Volume\ Change = \frac{(M_3 - M_4) - (M_1 - M_2)}{(M_1 - M_2)} \times 100$$

34.2.3 Tests using liquid CO_2 are to be conducted at a temperature of 23 ±2°C (73.4 ±3.6°F). The volume of each of three specimens is to be determined by weighing as described in 34.2.2. For application where the CO_2 is only in the gaseous state the testing can be conducted using CO_2 gas. The volume of each of three specimens is to be determined by weighing as described in 34.2.2. After weighing, the specimens are to be wiped dry and placed in a closed chamber (bomb) having its inlet connected to a cylinder of anhydrous ammonia. With the discharge valve from the bomb open, liquid anhydrous ammonia is allowed to flow through the bomb until the air is displaced. The discharge valve is then to be closed. With the inlet connection to the cylinder open, exposure is to be continued for 70 hours. The specimens are then to be removed from the bomb and immediately placed in a stoppered flask. The specimens are to be removed one at a time and weighed in air (M_3). The weight is to be obtained within 30 seconds after removal from the flask. The final weight in water (M_4) is to be determined immediately thereafter. The percent change in volume is to be calculated as described in 34.2.2.

34.3 Weight loss test

34.3.1 The weight loss test for synthetic rubber specified in 34.1.1 is to be conducted in a manner similar to that described in ASTM D471, with variations as noted in 34.3.2.

34.3.2 The test is to be conducted at the same time and using the same specimens as for the volume change test described in 34.2.1 – 34.2.3. For this test, the specimens are each to be weighed on a balance pan, in air, to the nearest milligram (M_1) prior to immersion in the test liquid. After 70 hours immersion, and following the weight determinations needed for the volume change calculation (see 34.2.1 – 34.2.3), the specimens are allowed to reach constant weight by conditioning in air at a temperature of 23 ±2°C (73.4 ±3.6°F) for a period of at least 70 hours. The specimens are then to be weighed in air (M_2). The loss in weight is to be calculated as follows, with the results reported as the average of the three specimens tested:

$$Percent\ Weight\ Loss = \frac{(M_1 - M_2) \times 100}{M_1}$$

35 Low Temperature Test

35.1 An elastomeric part in contact with the liquid shall not show any cracking or other damage after being subjected for 24 hours to air having a temperature of minus 40 ±1°C (minus 40 ±2°F) and then wrapped around a steel mandrel having a diameter of 6.4 mm (0.25 in). The steel mandrel is to also have been subjected for 24 hours to air having a temperature of minus 40 ±1°C (minus 40 ±2°F).

35.2 Three samples are to be subjected to this test. While still at the temperature of the cold chamber, each sample is to be bent around the mandrel until the segments of the sample touch. The operator is to wear gloves while handling the samples and the mandrel so as to reduce heat transfer to the samples.

36 Accelerated Aging Test

36.1 An elastomeric or polymeric part shall be subjected to oven conditioning as described in 36.2. After conditioning, the part shall not crack or show visible evidence of deterioration.

36.2 Elastomeric parts are to be exposed for 70 hours at 100°C (212°F) in an air-circulating oven. A polymeric part is to be conditioned for 7 days in an air-circulating oven at a temperature of 87°C (189°F).

37 Solvent Vapor Release Test – Vessel Disconnection

37.1 Each vessel that meets all of the following criteria shall be subjected to the solvent vapor release test during vessel disconnection as described in 37.2 and 37.3:

a) For use in Zone 2 or Class I, Division 2 locations;

b) Can contain flammable solvents, or can contain plant material exposed to flammable solvents; and

c) Is intended to be disconnected.

37.2 The maximum release shall be based on the positioning of the check valve(s) required to prevent backward flow of the flammable solvent, and converting the liquid volume to volume of vapor at standard temperature and pressure conditions, as applicable.

37.3 The maximum release shall be included in the markings and instructions in accordance with Section 46 and 47, as applicable.

38 Solvent Vapor Release Test – Vessel Opening

38.1 Each vessel that meets all of the following criteria shall be subjected to the solvent vapor release test during vessel opening as described in 38.2 – 38.6:

a) For use in Zone 2 or Class I, Division 2 locations;

b) Can contain flammable solvents, or can contain plant material exposed to flammable solvents; and

c) Is intended to be opened.

38.2 The maximum release by volume of plant material shall be based on the quantity of flammable solvent lost from the source vessel during each process cycle.

38.3 For extractors intended for only one plant material (in accordance with the instructions), this test shall be performed with that one intended material under each intended processing condition.

38.4 For extractors intended for more than one plant material (in accordance with the instructions), this test shall be performed with the one intended material that has the highest absorption properties under each intended processing condition if such properties can be established, Alternatively, this test shall be performed with each intended material.

38.5 All releases shall be converted from liquid volume to volume of vapor at standard temperature and pressure conditions, as applicable.

38.6 The maximum release(s) shall be included in the markings and instructions in accordance with Sections 46 and 47, as applicable.

39 Moist Ammonia Air Stress Cracking Test

39.1 After being subjected to the conditions described in 39.2 – 39.4, a pressure-confining brass part containing more than 15 percent zinc shall:

a) Show no evidence of cracking, delamination, or degradation, or

b) Perform as intended when tested as described in 39.4.

39.2 One test sample of each size is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Samples with female tapered pipe threads, intended to be used for installing the product in the field are to have the threads engaged and tightened to the torque specified in Table 22.1. Samples with female threads other than tapered pipe threads shall be torqued as specified by the manufacturer. Polytetrafluoethylene (PTFE) tape or pipe compound are not to be used on any threads. Samples with male threads are evaluated as received.

39.3 The samples are then to be tested in accordance with Apparatus, Section 6, Reagents and Materials, Section 7, Test Media, Section 8, Test Sample Preparation (9.3 – 9.4), Test Procedure (10.1 – 10.4) of the Standard Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys, ASTM B858-06, except the pH level of the test solution shall be High 10.5 ±0.1 and the exposure temperature shall be 25 ±1°C.

39.4 After the exposure period, the samples are to be examined for cracks or other signs of stress corrosion using a microscope having a magnification of 25X. Pressure-confining parts exhibiting degradation as indicated in 39.1 as a result of the test exposure described in 39.2 and 39.3 shall withstand, without rupture, a hydrostatic test pressure of five times the rated pressure of the valve, for 1 minute.

PERFORMANCE TESTS FOR HYDRAULIC PUMPS

40 Directional Valve Endurance Test

40.1 The hydraulic pump directional valve is to be subjected to the directional valve endurance test specified in the Standard on Powered Rescue Tool Systems, NFPA 1936, except that the number of cycles is to be 6000.

41 Pressure Relief and Automatic Limiting Device Endurance Test

41.1 The pressure relief and automatic limiting device are to be subjected to the pressure relief and automatic limiting device test specified in the Standard on Powered Rescue Tool Systems, NFPA 1936, except that the number of cycles is to be 6000 and the system input at which the device operates need only be recorded prior to and after the cycling.

42 Hydraulic Pump Endurance Tests

42.1 Hydraulic pump endurance test No. 1

42.1.1 Hydraulic pumps using gasoline engines are to be subjected to a 100-hour endurance test, operated as intended, while maintaining rated system input. The pump shall operate normally without leakage during and after the test.

42.2 Hydraulic pump endurance test No. 2

42.2.1 Hydraulic pumps using electric and air motors are to be subjected to a 300-hour endurance test, operated as intended, while maintaining rated system input. The pump shall operate normally without leakage during and after the test.

43 Fitting Pull Test

43.1 All hose fittings attached directly to the pumps, and hoses, are to be subjected to a 200-lb pull test. The load is to be increased at a uniform rate until reaching the test value. The fittings shall withstand the pull without breaking, cracking, splitting or separation.

44 Hydrostatic Strength Test

44.1 All the pressure confining parts are to be subjected to a hydrostatic test pressure, equal to two times the rated pressure, for one minute. The samples shall sustain the test pressure without rupture.

MANUFACTURING AND PRODUCTION TESTS

45 General

45.1 To verify compliance with these requirements in production, the manufacturer shall provide the necessary production control, inspection, and tests. The program shall include at least the External leakage test:

a) On each assembled plant oil extractor, an aerostatic pressure of not less than minimum service pressure rating maintained for at least 1 minute; or

b) On each assembled plant oil extractor, a hydrostatic pressure of not less than 1-1/2 times minimum service pressure rating maintained for at least 1 minute.

MARKINGS

46 Details

Advisory Note: In Canada, there are two official languages. Therefore, it is necessary to have CAUTION, WARNING, and DANGER instructions and markings in both English and French. Annex A lists acceptable French translations of the CAUTION, WARNING, and DANGER instructions and markings specified in this Standard. When a product is not intended for use in Canada, instructions and markings may be provided in English only.

46.1 All required markings shall be legible and shall be located on a main part of the overall extractor, unless a specific location on the overall extractor is indicated. Also, these markings shall be in a location that is likely to be visible after installation of the extractor.

46.1A A marking that is required to be permanent shall be:

a) Molded,

b) Die-stamped,

c) Stamped or etched metal that is permanently secured (such as, with screws or rivets) to the surface to which it is affixed,

d) Indelibly stamped lettering, or

e) Printed on a pressure-sensitive label.

46.1B For markings required by this section, a pressure-sensitive label, or a label secured by cement or adhesive, shall comply with the applicable requirements for indoor specified in the following, as applicable:

a) For CE Code-based installations: CSA C22.2 No. 0.15.

b) For NEC-based installations Standard for Marking and Labeling Systems, UL 969, as appropriate to the installation location of the device, and, when required, the exposure conditioning described for Class I, Division 1 applications.

46.2 The overall extractor shall be marked with the following, or equivalent:

a) The manufacturer's name, trade name, trademark or other descriptive markings by which the organization responsible for the product is capable of being identified.

b) A distinctive catalog number or the equivalent to specifically identify the overall extractor.

c) For pneumatic powered pumps, the maximum air pressure.

d) Electrical equipment ratings, as applicable.

e) The date or other dating period of manufacturer not exceeding any three consecutive months and not repeating in less than 20 years.

Exception: The date of manufacturer is not prohibited from being abbreviated or appearing in an established or otherwise acceptable code.

f) For Indoor Use Only.

g) Read and Follow Instruction Manual.

h) WARNING – RISK OF INJURY: Do not open the pressure vessel until all internal pressure has been released. If the handles are difficult to open, this may indicate that the pressure vessel is still pressurized – do not force it open. Any pressure in the pressure vessel can be hazardous.

i) WARNING – MAY CAUSE BURNS: Liquefied gases are normally stored under pressure. When these liquids are released to atmospheric pressure; rapid evaporation occurs resulting in reduced temperatures at the point of evaporation. Exposure of tissue to evaporating liquid can result in freezing. Precautions should be taken to avoid contact of liquid with eyes, skin, or respiratory system. Tissue damaged by exposure to evaporating liquid should be treated as frozen tissue (Frostbite). Reference a Safety Data Sheet (SDS) for more detailed information.

j) WARNING – RISK OF INJURY: Check that all components are secured before operating the extraction system.

k) Each accessible enclosure surface in excess of the maximum temperatures specified in Table 30.1 shall be marked "WARNING – RISK OF BURN: Do not touch due to hot surface."

l) For Use Only With (insert evaluated flammable solvents).

m) Extractors that use non-odorized gas shall be marked "NOT ODORIZED."

n) The statement “Instructions Available At ___” where the internet link to instructions is identified for compliance with 47.1A(c)(ii).

46.3 Extractors for hazardous locations applications shall additionally include the following markings, as applicable:

a) For CE Code-based Zone installations: Ex * IIA; Class I, Division 1, Group D or Class I, Division 2, Group D, as applicable.

a1) For NEC-based Zone installations: Zone 1, AEx * IIA; Zone 2, AEx * IIA; Class I, Division 1, Group D or Class I, Division 2, Group D, as applicable.

Where the * appears in the marking above, it is replaced by each of the involved Ex or AEx types of protection for the electrical parts of the extractor in accordance with the requirements of the following standards as applicable:

1) For CE Code-based Zone installations: CSA C22.2 No. 60079-0, e.g. "Ex d e m IIA"; and

2) For NEC-based Zone installations: UL 60079-0, e.g. "Zone 1, AEx d e m IIA".

b) Maximum temperature classification or operating temperature as specified in Table 46.1 following the marked gas group. The maximum temperature class or operating temperature shall be based on the following:

1) The lowest temperature class (e.g. T3 is lower than T6) or highest maximum operating temperature of any of parts assessed as part of the overall extractor, as long as the parts are operating within their specified ambient temperature range; and

2) Other attributes of the overall extractor construction that may affect the temperature classification or operating temperature marking (e.g. hot surfaces).

c) For Zone applications, the associated EPL following the maximum temperature classification, i.e. "Gb" for Zone 1 applications or "Gc" for Zone 2 applications based on the involved types of protection in accordance with the requirements of the following standards, as applicable:

1) For CE Code-based Zone installations: CSA C22.2 No. 60079-0; and

2) For NEC-based Zone installations: UL 60079-0.

d) The ambient temperature range, when other than -25°C to +40°C for Division applications or -20°C to +40°C for Zone applications.

e) For Zone 2 or Class I, Division 2 applications, on vessels that can contain flammable solvents, or that can contain plant material exposed to flammable solvents, the following as applicable:

1) For vessels intended to be disconnected,

i) The maximum solvent vapor release by volume at standard temperature and pressure conditions during disconnection of the vessel; and

ii) The level of release to be maintained below 25% of LFL without ventilation in accordance with NFPA 497.

2) For vessels intended to be opened,

i) The maximum solvent vapor release by volume at standard temperature and pressure conditions during opening of the vessel; and

ii) The level of release to be maintained below 25% of LFL without ventilation in accordance with NFPA 497.

3) For extractors intended for only one plant material (in accordance with the instructions), these values shall be based on that one intended material.

4) For extractors intended for more than one plant material (in accordance with the instructions), these values shall be based on the one intended material with the highest release. Alternatively, values can be marked for each intended material.

f) For Zone 2 or Class I, Division 2 applications, one of the following Warning markings:

1) WARNING – RISK OF EXPLOSION: Vessels containing flammable solvents, or material exposed to flammable solvents, only to be opened in a location that is documented for the release of the solvent.

2) WARNING – RISK OF EXPLOSION: Vessels containing flammable solvents, or material exposed to flammable solvents, only to be opened in an NFPA 496 Type X or Y pressurized room.

3) For CE Code-based Class I, Division 2 installations, or EPL Gc installations: WARNING – RISK OF EXPLOSION: Vessels containing flammable solvents, or material exposed to flammable solvents, only to be opened in a CSA C22.2 No. 60079-13 Type of Protection “Ex v” or “Ex pv”.

4) For NEC-based Class I, Division 2 installations, or Class I, Zone 2 installations: WARNING – RISK OF EXPLOSION: Vessels containing flammable solvents, or material exposed to flammable solvents, only to be opened in a UL 60079-13 Type of Protection “AEx v” or “AEx pv”.

NOTE: The 2020 edition of the National Electrical Code, NFPA 70, does not recognize Type of Protection “p” or “v” for pressurized rooms under UL 60079-13.

g) WARNING – RISK OF EXPLOSION: Flammable solvents being used. Avoid open flames, smoking materials, electrical sparks, and static electricity.

h) In place of 46.2(g) above, WARNING – RISK OF EXPLOSION: Qualified personnel shall install and operate the extractor in accordance with the instructions.

i) On vessels intended to be opened that can contain flammable solvents, or that can contain plant material exposed to flammable solvents, "WARNING – RISK OF EXPLOSION: Means to prevent charge accumulation on personnel shall be in accordance with NFPA 77".

Table 46.1
Classification of maximum surface temperature

Maximum operating temperature		Temperature class
°C	(°F)	
450	(842)	T1
300	(572)	T2
280	(536)	T2A

Table 46.1 Continued on Next Page

Table 46.1 Continued

Maximum operating temperature		
°C	(°F)	Temperature class
260	(500)	T2B
230	(446)	T2C
215	(419)	T2D
200	(392)	T3
180	(356)	T3A
165	(329)	T3B
160	(320)	T3C
135	(275)	T4
120	(248)	T4A
100	(212)	T5
85	(185)	T6

INSTRUCTIONS

47 Manual

47.1 Plant oil extractors shall be provided with an instruction manual that has legible installation, operation, and user-maintenance instructions. The manual shall specifically warn against each potential risk of injury to persons; and state the precautions that should be taken to reduce each risk. The safety instructions shall be a permanent part of the manual, but separated in format from the other instructions. They shall appear before the operating instructions in the manual. In the text and illustrations of the safety instructions:

a) Upper case letters shall not be less than 2.0 mm (5/64 in) in height;

b) Lower case letters shall not be less than 1.6 mm (1/16 in) in height; and

c) The phrases "IMPORTANT SAFEGUARDS" and "SAVE THESE INSTRUCTIONS" shall be in letters not less than 4.8 mm (3/16 in) in height.

47.1A The instructions mentioned in 47.1 shall be:

a) In separate manuals, or

b) Combined in one or more manuals when the instructions pertaining to a risk of fire, electric shock, or injury to persons are separated in format and emphasized to distinguish them from the rest of the text; and

c) Available in the following formats:

1) Hard/printed copy, or

2) Electronic files accessible via the manufacturer's website only (full public access with no user restrictions) if in compliance with the markings required by 47.1B.

47.1B When the required instructional material is provided by electronic media it shall meet the following conditions:

a) Where all required instructional material is provided by electronic media, there shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

b) Where only some of the required instructional material is provided by electronic media and some is printed:

1) There shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode); and

2) The printed instructions provided with the apparatus shall clearly identify that additional information is available electronically, along with the document number, revision level and location of this electronic documentation (e.g. URL, QRcode).

Exception: For small electrical apparatus where some or all of the instructional material is to be provided by electronic media, and where there is limited space for both the international symbol ⚠ (Reference No. 0434B of ISO 7000) and the document number, revision level and location of the electronic documentation (e.g. URL, QRcode):

a) The international symbol ⚠ (Reference No. 0434B of ISO 7000) shall be marked on the apparatus; and

b) Printed instructions shall be provided with the apparatus that, as a minimum, indicates the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

NOTE: When electronic documentation is referenced either on the device or on the printed instructions, the location given can be the specific location for the required instructions (e.g. direct link to the specific instructions), or can be a more general location. (e.g. the URL for the overall manufacturer's website). It is the manufacturer's responsibility to assure that the location of the required instructions is accessible by the user.

47.1C Alternatively, the reference to the document number and revision level on the marking can be excluded if the location of the electronic documentation marked on the apparatus (e.g. URL, QRcode) involves an electronic search feature that makes the required documentation available by entering specific information that is required to be marked on the apparatus, such as any combination of model number, part number, serial number, date code, or other unique identifier.

47.1D Where a QRcode is used to provide the required instructional material, and the QRcode contains all the required instructional material (as opposed to merely referencing a URL that contains the required instructional material), a document number and revision level need not be indicated.

47.1E Where some or all of the required instructional material is provided by electronic media, the required instructional material shall be available in printed format upon request of the user.

NOTE 1: Where required instructional material, especially drawings, is provided in an electronic documentation format, consideration should be given by the manufacturer to its viewability and print capability by the user.

NOTE 2: Electronic medium is permitted for required instructions as part of standards supported by the NEC and CE Code.

47.2 *Deleted*

47.3 Specific information shall include recommended leak test procedures with details for conducting the leak test, use of safety devices and cautionary or safety information for expected problems associated with pressure testing, and what to do if leaks are detected.