UL 122701

STANDARD FOR SAFETY

Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids

UL Standard for Safety for Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids, UL 122701

Fourth Edition, Dated September 29, 2022

Summary of Topics

This new edition of ANSI/UL 122701 dated September 29, 2022 includes aligning temperature and fatigue cycling requirements with those found in IEC TS 60079-40 and related adoptions; 6.2.2.1, 6.2.3.1

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 12, 2022.

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UL 122701

Standard for Requirements for Process Sealing Between Electrical Systems and Flammable or Combustible Process Fluids

Second Edition – September, 2011
Third Edition – May, 2017

Fourth Edition

September 29, 2022

This ANSI/UL Standard for Safety consists of the Fourth Edition.

The most recent designation of ANSI/UL 122701 as an American National Standard (ANSI) occurred on September 29, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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Preface (UL)

The following people served as members of STP 60079 and participated in the review of this standard:

NAME	COMPANY
*B. Zimmermann, Chair	R Stahl Inc.
*T. Adam	FM Approvals LLC
R. Allen	Honeywell International Inc.
F. AlSahan	Saudi Aramco
J. Anderson	Thermon Mfg Co.
D. Ankele	UL LLC
Mike Barret	Nemko
P. Becker	nVent
S. Blais	Emerson/Appleton Group
K. Boegli	KBB Consulting
R. Brownlee	Pepperl + Fuchs Inc.
D. Burns	Shell P&T – Innovation / R&D
*J. Chambers	UL LLC
R. Chalmers	Industrial Scientific Corp.
*C. Coache	National Fire Protection Association
*M. Cole	Hubbell Canada LP
M. Coppler	LabTest Certification Inc.
*R. Deadman	UL LLC
*K. Dhillon	LabTest Certification Inc.
D. Mario	Beach Energy
T. Dubaniewicz	NIOSH
G. Edwards	Det-Tronics
M. Egloff	Montana Tech, University of Montana
M. Ehrmann	R Stahl Inc
D. El Tawy	Siemens Energy
A. Engler	Det Norske Veritas DNV
M. Fillip	National Oilwell Varco
W. Fiske	Intertek
Z. Fosse	DEKRA Certification Inc
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E. Hong	Solar Turbines Inc.
*B. Johnson	Thermon Mfg. Co.
R. Johnson	Source IEC
B. Keane	INNIO Waukesha Gas Engines
*P. Kelly	UL LLC
S. Kiddle	ABB Inc
*M. Kornitsky	FM Approvals LLC
S. Lambaz	Littelfuse Inc.

NAME	COMPANY
W. Lawrence	FM Approvals LLC
E. Leubner	Eaton's Crouse-Hinds Business
W. Lockhart	GE Gas Power
W. Lowers	WCL Corp.
*N. Ludlam	FM Approvals Ltd.
M. Marrington	Index
R. Martin	USCG
E. Massey	L E Massey
T. Michalski	Killark Electric Mfg. Co.
B. Miller	Mettler-Toledo LLC
*J. Miller	MSA Innovation LLC
N. Minquez	Proyelco
*O. Murphy	Honeywell International Inc.
D. Nedorostek	Bureau of Safety & Environmental Enforcement (BSEE)
A. Page	Bud Page Consulting Inc.
R. Parks	National Instruments Corp.
Igor Rakonjac	Eurofins North America (MET Labs)
L. Ricks	ExVeritas North America LLC
P. Rigling	MTL – Eaton Electric Ltd.
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J. Ruggieri	General Machine Corp.
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L. Vlagea	General Monitors
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R. Wigg	E-x Solutions International Pty Ltd.
*K. Wolf	Intertek
T. Woods	Bently Nevada
F. Young	Pinnacle Forensics
R. Zalosh	Firexplo

* Non-voting member

1 Scope

1.1 This document provides specific requirements for process sealing between electrical systems and flammable or combustible process fluids where a failure could allow the migration of process fluids directly into the electrical system.

NOTE 1: Some definitions differentiate the terms “flammable” and “combustible” liquids on the basis of their flashpoints. Combustible liquids under conditions of elevated pressure and/or temperature can lead to the formation of flammable mists and aerosols which are within the scope of this standard.

1.2 This document contains requirements for construction and testing of single seal equipment, dual seal equipment, and add-on secondary seals.

1.3 The requirements of this document apply to process seals as described in the process sealing sections of NFPA 70 in the United States or CSA C22.1 in Canada but does not address the additional requirements for electrical conduit and cable seals as addressed in UL 1203 (CSA C22.2 No. 30) and UL 2225 (CSA C22.2 No. 174). Requirements for basic electrical safety and explosion protection are not addressed by this document, but may apply to equipment under investigation. The secondary effects of leakage to the environment are not addressed by this standard.

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

ASME/PTC 19.3 TW, *Thermowells Performance Codes*

ANSI/ISA 60079-10-1, *Explosive Atmospheres – Part 10-1: Classification of Areas – Explosive Gas Atmospheres*

CAN/CSA C22.2 No. 60079-0, *Explosive Atmospheres – Part 0: Equipment – General Requirements*

CAN/CSA C22.2 No. 60079-2, *Explosive Atmospheres – Part 2: Equipment Protection by Pressurized Enclosure "p"*

CAN/CSA C22.2 No. 61010-1, *Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements*

CSA C22.1, *Canadian Electrical Code, Part I*

CSA C22.2 No. 30, *Explosion-proof Enclosures for Use in Class I Hazardous Locations*

CSA C22.2 No. 174, *Cables and Cable Glands for Use in Hazardous Locations*

IEC 60079-10-1, *Explosive Atmospheres – Part 10-1: Classification of Areas – Explosive Gas Atmospheres*

NFPA 70, *National Electrical Code®*

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

UL 1203, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*

UL 2225, *Cables and Cable-Fittings for Use in Hazardous (Classified) Locations*

UL 60079-0, *Explosive Atmospheres – Part 0: Equipment – General Requirements*

UL 60079-2, *Explosive Atmospheres – Part 2: Equipment Protection by Pressurized Enclosure "p"*

UL 61010-1, *Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements*

4 Glossary

4.1 For the purpose of this standard, the following definitions specific to process sealing of electrical equipment apply. See Figure 4.1 and Figure 4.2 for a graphical representation of the various process seal components.

Figure 4.1

Equipment Process Sealing Components – Dual Seal

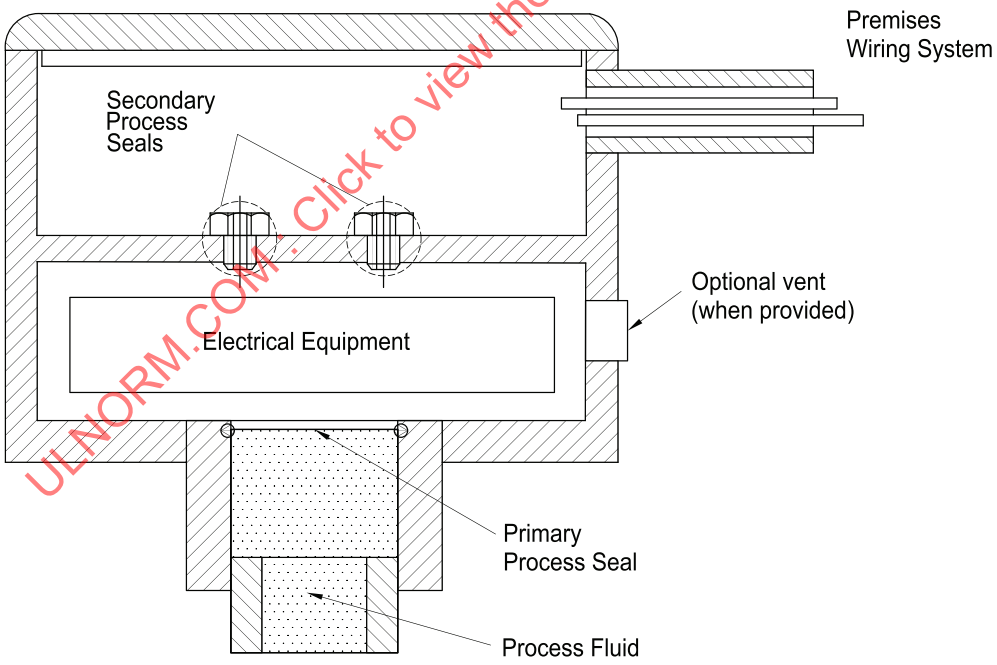

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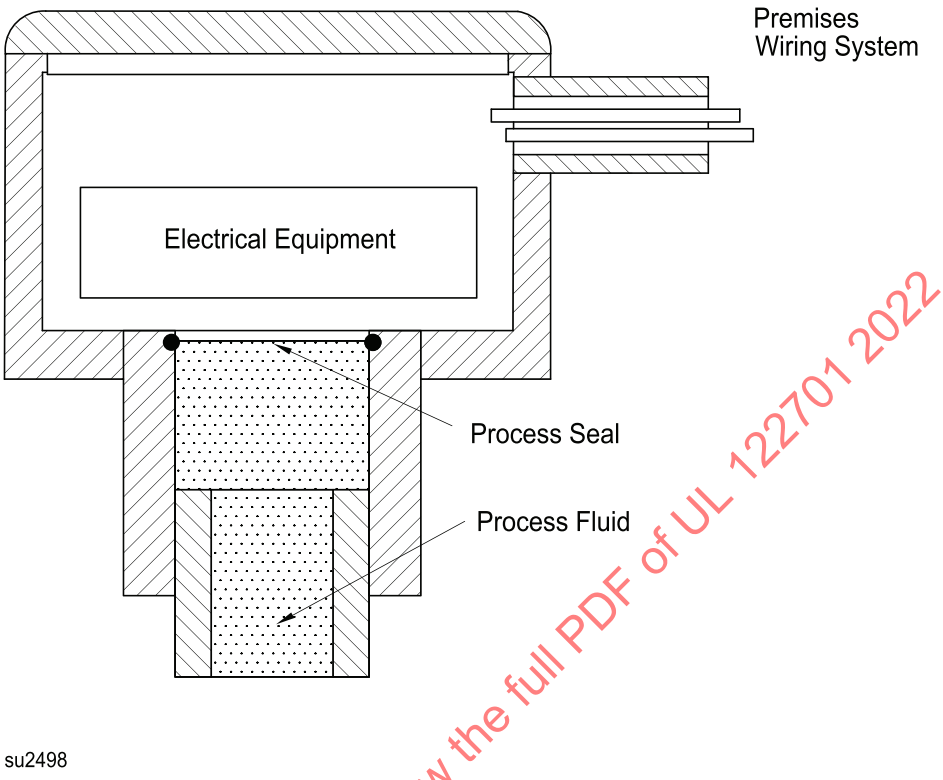
Figure 4.2

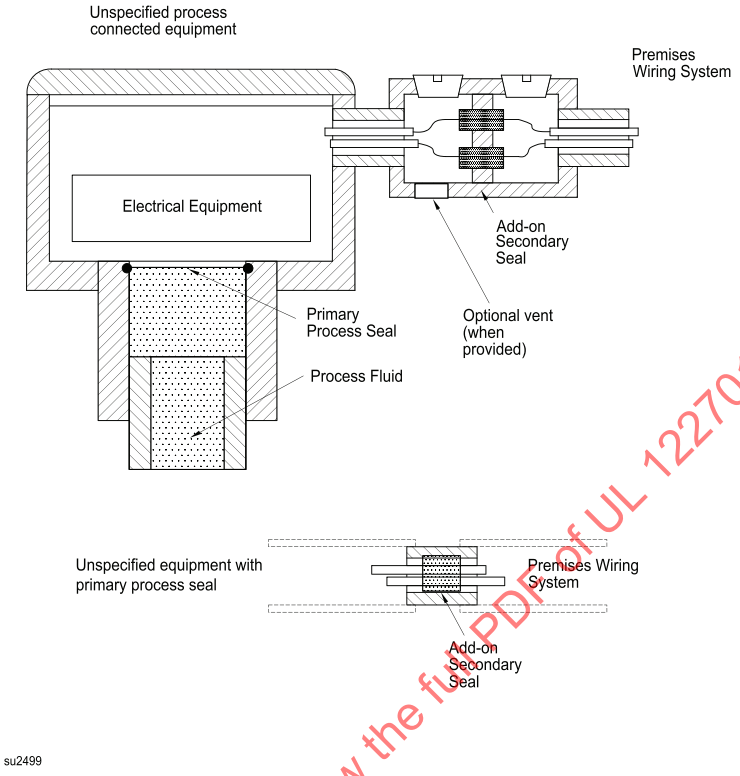
Equipment Process Sealing Components – Single Seal



4.2 ADD-ON SECONDARY SEAL – A secondary seal intended to be installed between unspecified process connected equipment and the premises wiring system (see Figure 4.3).

Figure 4.3

Add-On Secondary Seal



4.3 AEROSOL – Suspension in air or gas of solid or liquid particles.

4.4 ANNUNCIATION – Means by which a seal failure is indicated.

4.5 DUAL SEAL EQUIPMENT – Equipment which incorporates, along any single potential leakage path, a primary process seal and one or more secondary process seals such that the failure of two or more independent seals is required to allow migration of process fluids from their designed containment into the premises wiring system. Refer to Figure 4.1.

4.6 EQUIPMENT WITH LIMITED PRESSURE AT THE ELECTRICAL CONNECTIONS – Process connected equipment that is rated for a maximum process pressure of 1.5 kPa (6 inches of water) gauge or is provided with a drain, vent or other means sufficient to prevent pressurizing the premises wiring connection above 1.5 kPa (6 inches of water) in the event of a failure of the primary process seal.

4.7 PREMISES WIRING (SYSTEM) – Power, lighting, control, and signal circuit wiring together with all their associated hardware, fittings, and wiring devices, both permanently and temporarily installed including wiring from the service point or power source to the outlets or wiring from and including the power source to the outlets where there is no service point.

NOTE 1 Such wiring does not include wiring internal to appliances, luminaires, motors, controllers, motor control centers, and similar equipment.

4.8 PRIMARY PROCESS SEAL – A process seal that is directly in contact with process fluids under conditions of normal operation.

4.9 PROCESS CONNECTED EQUIPMENT – Electrical equipment that contains a process seal and is intended for connection to an external system that contains process fluids.

4.10 PROCESS FLUID – A flammable or combustible liquid, vapor or gas that is used in or is a by-product of an industrial process.

NOTE 1 For the purposes of this standard, use of the term process fluid refers to a flammable process fluid. For further information, refer to UL 60079-0 (CAN/CSA-C22.2 No. 60079-0), ANSI/ISA 60079-10-1 (IEC 60079-10-1), and NFPA 497.

4.11 PROCESS SEAL – A seal between electrical systems and flammable or combustible process fluids where a failure could allow the migration of process fluids into the premises wiring system.

NOTE 1 Although an entire containment system may constitute a potential source of release under unusual conditions, this standard recognizes the concept of infallible containment as defined in UL 60079-2 (CAN/CSA-C22.2 No. 60079-2).

4.12 SEAL WITH MOVING PARTS – A process seal containing structures that, under conditions of normal operation, are capable of motion relative to other parts of the seal.

NOTE 1 Examples include seals of shafts and rods that transmit rotary or linear motion into the sealed area. Seals incorporating the following are not considered to be seals with moving parts:

a) Thin diaphragms and other structures that may deflect when pressurized.

b) Vibrating structures such as tuning forks, Coriolis tubes, and vortex sensors.

4.13 SECONDARY PROCESS SEAL – A process seal that comes into contact with process fluids only in the case of a primary process seal failure.

4.14 SINGLE SEAL EQUIPMENT – Equipment that incorporates, along any single potential leakage path, a single sealing structure such that a failure of the seal would result in the migration of process fluids from their designed containment into the premises wiring system. Refer to Figure 4.2.

4.15 UNSPECIFIED PROCESS CONNECTED EQUIPMENT – equipment not assessed in accordance with this document but designed in accordance with applicable standards for the specific type of equipment such as the leakage and rupture from fluids under pressure.

NOTE 1 Examples of standards that include requirements for a primary seal in a dual seal system include UL 61010-1 (CAN/CSA-C22.2 No. 61010-1).

5 General Requirements

5.1 Basis for requirements

5.1.1 The process seal specifications shall include the following:

a) Process temperature range;

b) Working pressure range;

c) Process wetted materials of construction.

NOTE 1 It is assumed for the purposes of this document that installers will follow standard engineering practice and adhere to industry standards for the selection, installation, and operation of equipment that contain process seals. For example: the selection of a thermowell for use in a flowing process fluid should adhere to the requirements found in ASME/PTC 19.3.

5.2 Single seal equipment

5.2.1 Single seal equipment shall be subjected to the conditioning and acceptance tests specified in 6.2.

5.2.2 Single seal equipment shall be marked in accordance with 7.1.1(c)(1).

5.3 Dual seal equipment

5.3.1 Dual seal equipment with annunciation

5.3.1.1 Dual seal equipment with annunciation shall be tested in accordance with 6.3. Annunciation may be achieved either through the inclusion of a vent or drain between the primary and secondary process seals or by electronic sensing or other suitable means. See 5.7 for annunciator requirements.

Dual seal equipment incorporating a method of annunciation shall be marked in accordance with 7.1.1(c)(2).

NOTE 1 For dual seal equipment incorporating annunciation of a primary seal failure, it is not necessary to consider long term deleterious effects on the primary and secondary seals of dual seal equipment.

5.3.2 Dual seal equipment without annunciation

5.3.2.1 The primary seal of dual seal equipment without annunciation shall be subjected to the conditioning and acceptance tests specified in 6.2. The secondary seal shall be tested in accordance with 6.3.5.

5.3.2.2 The primary seal of dual seal equipment without annunciation shall not depend upon Bourdon tubes or seals with moving parts.

5.3.2.3 Dual seal equipment without annunciation shall be marked in accordance with 7.1.1(c)(3).

5.4 Equipment with limited pressure at the electrical connections

5.4.1 Equipment that is rated for a maximum process pressure of 1.5 kPa (6 inches of water) gauge need not be subjected to the conditioning and testing requirements of this standard and is considered to meet the requirements of this standard and shall be marked in accordance with 7.1.1(c)(4).

5.4.2 Equipment rated above 1.5 kPa (6 inches of water) and provided with a drain, vent or other means sufficient to prevent pressurizing the premises wiring connection above 1.5 kPa (6 inches of water) in the event of a failure of the primary process seal shall be evaluated in accordance with 6.4 and marked in accordance with 7.1.1(c)(4).

5.5 Purged and pressurized equipment

5.5.1 Process connected equipment using continuous-flow purged enclosures or pressurized equipment with infallible containment that meet the requirements of UL 60079-2 (CAN/CSA-C22.2 No. 60079-2) such that a leak of the process seal(s) cannot produce a flammable mixture in the enclosure need not be subject to the conditioning and testing of this standard, and is considered to meet the requirements of this standard. Continuous flow purged equipment shall be marked in accordance with 7.1.1(c)(1).

5.6 Add-on secondary seals

5.6.1 Add-on secondary seals shall:

a) Be subjected to the conditioning and acceptance tests specified in 6.2 and shall not depend upon seals with moving parts; or

b) Be subjected to the applicable secondary seal leakage test of 6.3.5, and shall incorporate a means of annunciation in accordance with 5.7.

c) Be marked in accordance with 7.1.1(c)(5).

5.7 Annunciators

5.7.1 Leakage annunciation may be achieved either through the inclusion of a vent or drain between the primary and secondary process seals or by electronic sensing or other suitable means. Annunciation methods include but are not limited to:

a) Audible “whistle”;

b) Visible rupture or leakage;

c) Electronic detection; and

d) Detectable failure of the equipment to operate as intended.

Annunciators shall be subjected to the verification tests found in 6.3.4.

6 Type verifications and tests

6.1 Test sample

6.1.1 Prior to conditioning and test, the sample shall be visually inspected to ensure that it is in compliance with design documents. A single representative test sample shall be subjected to the tests of either 6.2 or 6.3 depending on whether the sample is a single or dual seal equipment. In each test requiring the application of pressure to the seal or parts of the seal, a suitable fluid shall be used. Unless otherwise stated, all tests required by this document shall be conducted at a temperature of (20 ±5) °C and a nominal atmospheric pressure of 1 atmosphere.

6.1.2 A flowchart of the conditioning and test process can be found in Annex A.

6.2 Tests for single seal equipment, dual seal equipment without annunciation, and add-on secondary seals without annunciation

6.2.1 Sequence of conditioning and tests

6.2.1.1 The test sample shall be subjected to the required conditioning tests in the following order:

a) Temperature cycling.

b) Fatigue cycling.

6.2.1.2 After the prescribed conditioning is completed, the test sample shall be subjected to the leakage and burst pressure tests of 6.2.4 and 6.2.5.

6.2.2 Temperature cycling

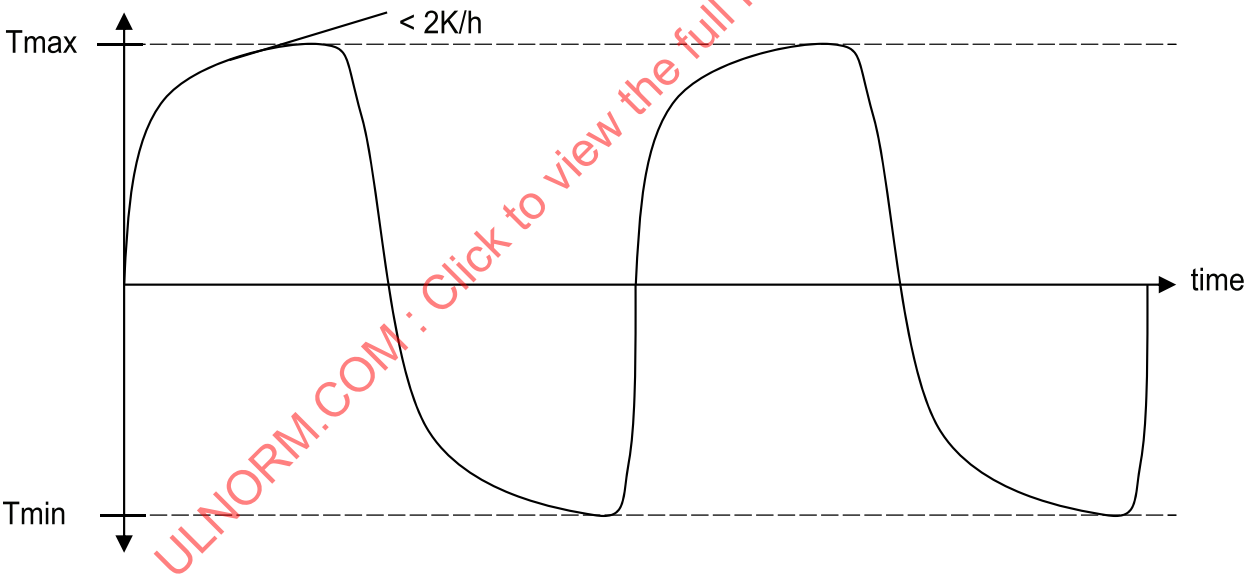
6.2.2.1 For equipment incorporating seals with non-metallic parts excluding glass and ceramic, a representative sample of the seal shall be subjected to temperature cycling conditioning as follows:

Duration:	Two (2) weeks or 150 cycles (whichever occurs first)
Maximum Temperature (T_{max}):	Manufacturer's maximum rated process seal temperature increased by 10 to 15 K
Minimum Temperature (T_{min}):	Manufacturer's minimum rated process seal temperature reduced by 5 to 10 K
Stabilization:	The test temperature is considered to have stabilized when the rate of change of temperature does not exceed 2 K/h

If the seal is incorporated into equipment that assures the temperature of the seal is maintained such that the maximum fluctuation is limited to 10 K, the temperature cycling test may be waived.

6.2.2.2 See the profile below for a graphical representation of the temperature cycling conditioning.

Temperature cycle conditioning profile



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6.2.3 Fatigue cycling

6.2.3.1 Seals shall be fatigue cycled. A representative sample of the seal shall be cyclically pressurized and depressurized as follows: