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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue as GEN-1. Formerly Subsection 5.0 of Section I of chapter.	Ari Ben Swartz, <i>ES-EPD</i>	Larry Goen, <i>ES-DO</i>
1	3/15/2016	Removed reference to ML-1/2 for NCRs.	Ari Ben Swartz, <i>ES-EPD</i>	Larry Goen, <i>ES-DO</i>
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Contact the Standards point of contact (POC) for upkeep, interpretation, and variance issues.

Chapter 17	<u>Pressure Safety POC</u>
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DEFINITIONS

Alteration – The change of a pressure boundary that changes the original design structure. Does not include the removal and replacement of components, but modification of the component itself (e.g., welding an additional port to a U-stamped vessel).

ASME B31 – American Society of Mechanical Engineers Piping Codes.

ASME BPVC – American Society of Mechanical Engineers Boiler and Pressure Vessel Code.

Authorized Inspector (AI) – An inspector regularly employed by an ASME accredited Authorized Inspection Agency in accordance with the requirements in the latest edition of ASME QAI-1, *Qualifications for Authorized Inspection*.

Boiler – A closed vessel in which water or other liquid is heated, steam or vapor is generated, steam or vapor is superheated, or any combination thereof, under pressure or vacuum for use external to itself, by the direct application of heat from the combustion of fuels or from electricity.

Check Valve – A poppet or swing disk (may or may not be spring loaded) valve that has one-way flow direction to keep system contents from back flowing.

Chief Pressure Safety Officer (CPSO) – Point of contact (POC) for this chapter. Is a subject matter expert (SME) in pressure systems design, will assist Designers with applicable codes for pressure system design. Reviews and approves variances and alternate methods related to ESM Chapter 17. May delegate certain functions to deputy chief pressure safety officers or pressure safety officers (PSOs).

Code Equivalent – A pressure vessel or other component that, through documentation, proves that the design meets all the design, fabrication, test, and inspection requirements established by the applicable code, but does not have a code stamp and does not require a code certified Inspector.

Code of Record (COR) – The codes and standards (by year) used to perform the design and construction are considered the code of record. (See Engineering Standards Manual (ESM) Chapter 1 Section Z10 - General Requirements for all Disciplines/Chapters.)

Components – The set of items within a piping system that are joined together to make up a functioning process. Piping components are a sub-set of all components in a piping system. See definition of piping components below for those components which are within the scope of the B31 pressure piping codes.

Cryogenic – A liquid with a normal (i.e., at standard temperature and pressure) boiling point below approximately 120 K (–238°F, –150°C) that can be used as a working fluid in mechanical refrigerators or as a cooling bath in cryostats. Other fluids (e.g., CO₂, refrigerants, etc.) also known as pseudo-cryogenic liquids that are not cryogenic must be taken into consideration as having similar pressure hazards as that of cryogenics.

Deputy Chief Pressure Safety Officer (DCPSO) – qualified in accordance with ESD-QS-001 (or successor). Delegated duties of the CPSO for specific locations by the CPSO.

Design – The total documentation package created to satisfy the Design Criteria and meet the Design Basis.

Design Basis – The codes, standards and/or equivalent safety evaluations that ensure that new or modified pressure systems are designed, fabricated, tested, and inspected by trained and qualified personnel in accordance with applicable and sound engineering principles that will protect workers.

Design Criteria – The set of minimum requirements that bound the design of systems, structures, and components. Design Criteria is most often identified in a Scope of Work, Requirements and Criteria Document, or similar.

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Design Review – Verification by a qualified or trained reviewer (i.e., pressure safety subject matter expert) that the design meets the Design Basis and Design Criteria associated with pressure safety scope.

Pressure System Designer (aka Designer) – The personnel or organization in responsible charge of the engineering design.

ASME Pressure System Designer – The personnel or organization qualified as required by the ASME Code of Record (COR) that is in responsible charge of the engineering design. This is sometimes referred to as the Engineer in the ASME piping codes or the User or Designated Agent in ASME BPVC Section VIII Division 1 (see Nonmandatory Appendix NN, Guidance to The Responsibilities of the User and Designated Agent).

Design Pressure – The pressure at the most severe condition of coincident internal or external pressure and temperature (minimum or maximum) expected during service (see Design temperature).

Design Temperature – The temperature at which, under the coincident pressure, the greatest thickness or highest component rating is required during the expected service (see Design pressure).

Dewar – A double-walled flask of metal or silvered glass with a vacuum between the walls, used to hold liquids at well below ambient temperature (cryogenic).

The simplest Dewars are open-mouthed, non-pressurized, vacuum-jacketed or otherwise insulated vessel designed to hold cryogenic liquids that allow the gas to escape either through an open top or past a loose-fitting stopper to prevent the risk of explosion.

More sophisticated Dewars trap the gas above the liquid and hold it at high pressure. This increases the boiling point of the liquid, allowing it to be stored for extended periods. Excessive vapor pressure is released automatically through safety valves.

Double Block and Bleed (DBB) – The practice of shutting in a section of pipe on both sides of the valve rather than just one. Occupational Safety and Health Administration (OSHA) describes DBB as "the closure of a line, duct, or pipe by closing and locking or tagging two inline valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves."

Emergency Isolation Valve (EIV) – A valve located outside a building for a flammable gas distribution system.

Examiner – An individual with the training and experience commensurate with the needs of the specified examinations. It is the person who performs the quality control examinations and is performed by the manufacturer, fabricator, or erector.

Existing Pressure System – A pressure system with at least one year of operating history on the effective date of Rev. 10 of [P101-34](#), *Pressure Safety*.

Facility Pressure System – Any pressure system that is owned by the facility operations directorate, or where the cost of maintenance or repair is paid for by the facility or institution, not directly by the program it supports. Normally either a utility proper or found in utility/mechanical rooms that provide building services (e.g., building heating boilers, instrument air system, etc.).

Failure Modes and Effects Analysis (FMEA) – A step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service. For more information see [FSD-300-3-001](#), *Hazard Analysis Manual*. This Functional Series Document (FSD) is related to P300, *Integrated Work Management*.

Fault Condition – Any failure caused by component failure, human error, chemical reaction, or environmental conditions that may cause an increase in pressure above the maximum allowable working pressure (MAWP) of code-stamped items or the pressure rating of a component or system. Los Alamos National Laboratory (LANL) uses a single fault condition design evaluation approach unless there is a potential for Latent Failure.

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Flammable Gas — A gas having a flammable range with air at 20°C (68°F) and a standard pressure of 101.3 kPa (14.7 psi). See 29CFR1910, *Occupational Safety and Health Administration*, [Appendix B to 1910.1200 B.2](#) for additional classification criteria of flammable gases.

Flexible – Flexible refers to an element of a pressure or vacuum system, used in place of a pipe or rigid metal tubing. May also referred to as expansion joints, flexible tubing, or flex hoses.

Fluid – A substance which can be pressurized or be the pressure source in a pressure system. Pressure system fluids are most commonly gas or liquid but could also be a solid used to generate pressure via chemical reactions.

Fluid Service (FS) Categories – LANL-specific fluid service category which allows a graded approach for design review. See [P101-34](#) Section 9.1 for detailed definitions and examples of FS1 High Hazard, FS2 Moderate Hazard, FS3 Low Hazard, and FS3-ULH Ultra-Low Hazard.

Hydrostatic Test – A test performed on a pressure system or component where a liquid (usually water) is introduced, without void space, pressurized to a designated level in a manner prescribed in the applicable code.

Hydro-Pneumatic Test – A test performed on a near liquid full pressure system where the pressure is provided by pressurized gas.

In-Service Leak Test – An ESM Chapter 17 defined test performed on a new joint (from modification or maintenance) to an existing pressure system performed after initial construction. This term is not an ASME term but is only under the jurisdiction of ESM Chapter 17.

Initial Service Test – A test at the normal operating conditions of the system.

Inspector – A qualified person who verifies all required examinations and testing have been completed and inspects to the extent necessary to be satisfied that the design of the system conforms to all applicable examination requirements of the code and of the engineering design.

Latent Failure – Less apparent failures in the design of organizational systems, the environment, or equipment that are often hidden until they contribute to the occurrence of errors or allow errors to go unrecognized until failure occurs. An example of a latent failure is a dual stage regulator. The first stage failure is not detectable, and the regulator itself must be evaluated as a single failure.

Leak Test – A pressure test which proves the integrity of a pressure boundary. Specific types of leak tests include hydrostatic leak test, hydro-pneumatic leak test, pneumatic leak test, initial service leak test, and sensitive leak test.

Lockout/Tagout (LO/TO) – (defined by [P101-3](#)) The placement of a lock and/or tag on an energy isolating device or lockout device by an authorized worker in accordance with the requirements of this procedure to ensure that the machinery, systems, and equipment being controlled cannot be operated until the lock is removed.

Lower Explosive Limit (LEL) – The lowest concentration (percentage by volume) of a gas or vapor in air capable of producing combustion in the presence of an ignition source (flame, heat, etc.). It can also be referred to as the Lower Flammability Limit (LFL).

Manufacturer's Pressure Rating – The pressure rating of a piping component published by the manufacturer. Usually includes coincident temperature ratings.

Maximum Allowable Working Pressure (MAWP) – (Defined by ASME BPVC Section VIII Division 1 Mandatory Appendix 3) The maximum gauge pressure permissible at the top of a completed vessel in its normal operating position at the designated coincident temperature for that pressure.

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Maximum Operating Pressure (MOP) – The maximum intended operating pressure. MOP may equal design pressure unless there is a relief device then MOP is usually 10% to 20% below the design pressure to prevent a relief device from opening during normal operation.

Modification – (Defined by [P101-34](#)) A change in the form, fit, or function of a pressure system, and typically involves one related to design parameters (e.g., requirements, criteria, characteristics), physical configuration, and/or operational conditions.

Nondestructive Examination (NDE) – Examinations including (but not limited to) visual examination (VT), radiographic examination (RT), ultrasonic examination (UT), and dye-penetrant testing (PT) used to qualify the condition of a pressure vessel or component. Also known as nondestructive testing (NDT).

Non-Hazardous Fluids – Any fluid or mixture that is nonflammable, nontoxic, and is not corrosive.

Non-Reclosing Pressure Relief Device - A pressure relief device designed to actuate and remain open after operation. A manual resetting means may be provided.

Rupture Disk Device – Also known as burst disk. A non-reclosing pressure relief device actuated by inlet pressure and designed to remain open after operation. The device performs its function by bursting a pressure-containing disk. An ASME rupture disk includes the disk and the disk holder.

Damage Ratio – A damaged rupture disk will burst at some pressure other than predicted. This disparity can be reported by a value called the “damage ratio.” The damage ratio is equal to the actual burst pressure of a damaged disk divided by the stamped burst pressure. A damage ratio of one or less provides assurance that the disk, even damaged, will burst at or below the stamped burst pressure, while a value higher than one would indicate the actual burst pressure could exceed the stamped burst pressure. As an example, a damaged disk with a 100-psig stamped burst pressure and a damage ratio of 1.5 could have an actual burst pressure of 150 psig. This information can be provided by the burst disk manufacturer.

Reversal Ratio – Is equal to the actual burst pressure of a rupture disk installed in reverse divided by stamped burst pressure. If the value is one or less, the disk will relieve at or below its stamped burst pressure even when installed in reverse. If the value is greater than one, the actual burst pressure will be greater than the stamped burst pressure. This information can be provided by the rupture disk manufacturer.

Operating Ratio – A manufacturer specified de-rating of rupture disk to provide a good service life from the bursting disk, and to prevent premature failures or nuisance bursts under continuous usage.

Guidance: Rupture disk life is generally tied to the stress history (pressure and temperature) applied to the disk. Relatively low pressures and static conditions will generally result in very long disk life, while cyclic conditions approaching the burst pressure will result in shorter disk life.

Example: If the disk being used has an operating ratio of 90% and has a rated burst pressure of 5 Barg @ 22°C, with a total performance burst tolerance of +/- 10%. This would mean the min/max burst pressure for this disk would be: Min 4.5, to max 5.5 Barg @ 22°C. With the operating ratio of the disk being 90% of the minimum rated burst pressure, this means the disk should not be subjected to a system operating pressure of more than 4.05 Barg.

Pressure Ratio – The long-term pressure rating of a rupture disk divided by its stamped rating.

Operating Pressure – The normal operating pressure of a pressure system. This may be a range of values.

Operating Temperature – The normal operating temperature of a pressure system. This may be a range of values.

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Owner – Department of Energy (DOE) National Nuclear Security Administration (NNSA) owns the LANL pressure systems. NNSA delegates the Owner of ESM Chapter 17 pressure systems to the LANL Building Code Official [see ESM Chapter 1 Section Z10, Table Z10-2, LANL Authorities (e.g., from Delegation by NNSA)].

Owner's Inspector or ASME Owner's Inspector – The Owner's Inspector is responsible to the Owner for ensuring that the requirements of the applicable Code for inspection, examination, and testing are met. If a Quality System is specified by the Owner to be employed, the Owner's Inspector is responsible for verifying that it is implemented. This role is also known as the Owner's Representative or Owner's Agent, etc. Not to be confused with an Authorized Inspector.

Owner's Inspector Delegate or ASME Owner's Inspector's Delegate: The delegate of the Owner's Inspector that is qualified and responsible to perform inspection(s).

Oxygen Hazards Analysis – The documented evaluation of an oxygen system design including materials, testing, cleaning, and assembly to reduce the likelihood of a fire. Typically follows a Failure Mode and Effect Analysis (FMEA) to evaluate all oxygen system failure modes.

Permanent Pressure System – A pressure system that does not meet the definition/criteria of a temporary pressure system.

Pilot-Operated Pressure Relief Valve – A pressure relief valve in which the disk is held closed by system pressure, and the holding pressure is controlled by a pilot valve actuated by system pressure (BPVC Section XIII).

Piping Components – (Defined by ASME B31.3) Mechanical elements suitable for joining or assembly into pressure-tight fluid-containing piping systems. Components include pipe, tubing, fittings, flanges, gaskets, bolting, valves, and devices such as expansion joints, flexible joints, pressure hoses, traps, strainers, inline portions of instruments, and separators.

Pneumatic Test – A test performed on a pressure system or component where a gas is introduced and pressurized to a designated level in a manner prescribed in the applicable code.

Pressure Relief Device (PRD) – (Defined by ASME BPVC Section XIII) a device designed to prevent pressure or vacuum from exceeding a predetermined value in a pressure vessel by the transfer of fluid during emergency or abnormal conditions.

Pressure Relief Valve (PRV) – (Defined by ASME BPVC Section XIII) a pressure relief device designed to actuate on inlet static pressure and reclose after normal conditions have been restored.

Pressure Source – The pressure supply source that provides pressure to a system. Examples include gas cylinder, compressor, pump, heated vessel (boiler), cryogen Dewar, trapped cryogen expansion, chemical reaction, etc. is not a regulated pressure.

Pressure System – All pressure vessels and pressure sources including cryogenics, pneumatic, hydraulic, and vacuum. Vacuum systems should be considered pressure systems due to their potential for catastrophic failure from backfill pressurization. Associated hardware (e.g., gauges and regulators), fittings, piping, pumps, and pressure relief devices are also integral parts of the pressure system (10CFR851).

Pressure Vessel – Containers for the containment of pressure, either internal or external.

Pressure System Database (PSD) – The LANL Conduct of Engineering Office (CENG) managed database for pressure systems.

Peer Reviewer – An employee who has completed training curriculum 13046 (or successor) and is authorized to review designs associated with programmatic (non-safety basis) FS3 and FS3-ULH category pressure systems.

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Pressure Safety Officer (PSO) – Pressure safety officer qualified in accordance with ESD-QS-001 (or successor). Person familiar with ASME code and who performs design reviews (per this document) of pressure systems. Not required to perform design calculations, but aids Designers in compliance with this chapter and the use of the ASME code. A PSO can request an alternate or designee to help perform the functions defined in this document upon approval of the CPSO.

Pyrophoric – A chemical with an autoignition temperature in air at or below 130°F.

Reputable Manufacturers List (RML) – Approved listing of components for use in NASME applications.

Sensitive Test – A test where leakage may be measured to at least 1×10^{-3} std mL/s under test conditions.

Set Pressure – The value of increasing (or decreasing) inlet static pressure at which a pressure relief device displays one of the operational characteristics as defined by *opening pressure*, *popping pressure*, *start-to-leak pressure*, *burst pressure*, or *breaking pressure*. Measured at the pressure relief valve inlet, at which there is a measurable lift, or at which discharge of a fluid becomes continuous. The terms open pressure, relief pressure, cracking pressure, and set points are equivalent when testing valves. (ASME BPVC Section XIII)

Stop Valve – A valve that is installed between the piping or component being protected and its PRD, or between the PRD and the point of discharge. Although allowed by some ASME B31 codes, this design scenario is discouraged.

Supporting Piping Systems – Any and or all the piping necessary for the function of the boiler, pressure vessels, or air receivers. Piping that is attached, exceeding that required for the function of the boiler, pressure vessel, or air receiver, is not "supporting piping." This is analogous to the application of Boiler External Piping under ASME B31.1 and B31.9.

System – For this chapter, a combination of multiple components (and possibly subcomponents) which together make a pressure system.

System Interaction – Interactions among pressure systems that may cause a system to be over pressurized or cause unwanted mixture of separate fluids, which necessitates the evaluation of all system interfaces (e.g., determination of check valve installation and placement). In extreme cases could warrant the use of dual check valves placed in series.

Tank – A container whose contents are always maintained at between atmospheric pressure and 15 psig, and cannot be pressurized above 15 psig, even during fault conditions.

Temporary Pressure System – A pressure system that meets one the following Fluid Service (FS) Hazard Category and operational life span criteria:

- Categorized as FS1 and has a maximum operational life span of one year.
- Categorized as FS2 and has a maximum operational life span of two years.
- Categorized as FS3 and has a maximum operational life span of three years.
- Categorized as FS3-ULH and has a maximum operational life span of five years.

Test Article – A component or system of components provided by a vendor or is part of a research and design deliverable. It is temporarily installed in LANL facilities exclusively for the purpose of being tested for data purposes, or destructive purposes. Included in this definition are those test articles that are being designed by LANL personnel, which are considered product, and must undergo numerous design changes, modifications, and alterations. Test articles are not subject to the design requirements of this chapter.

Examples of excluded test article systems include flight hardware such as: weapons research pressure components and systems (e.g., vehicle-specific flight-weight tritium reservoirs and associated flight-

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weight plumbing/components), or space vehicle pressure components and systems (e.g., vehicle flight-weight propulsion or hydraulic systems/components). However, pressure systems that support the design, testing and/or evaluation of such hardware are not excluded.

Tubing – Thin-walled pipe.

Upper Explosive Limit (UEL) – The maximum concentration (percentage by volume) of gas or vapor that will burn in air in the presence of an ignition source (flame, heat, etc.). It can also be referred to as the Upper Flammability Limit (UFL).

Vacuum System – An assembly of components which may include vessels, piping, valves, relief devices, flex hoses, gages, etc., operated with the internal pressure reduced to a level less than that of the surrounding atmosphere. See PS-REQUIREMENTS, *Specific Requirements by System Type* paragraphs for further information on what is and is not considered a vacuum system in the scope of this chapter.

Vacuum Vessel – A vessel operated with the internal pressure reduced to a level less than that of the surrounding atmosphere.

ACRONYMS

Acronym	Definition
ACFM	Actual Cubic Feet Per Minute
AFU	Acceptance for Use
AI	Authorized Inspector
ALD	Associate Lab Director (or Directorate)
ALDFO LOG-PT	Facilities & Operations (Associate Lab Directorate) Readiness, Packaging, and Transportation Division Office
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS CWI	American Welding Society Certified Welding Inspector
BPVC	Boiler and Pressure Vessel Code
BRmp	Melting Point Burn Ratio
CAD	Computer Aided Drafting
CENG	Conduct of Engineering
CGA	Compressed Gas Association
CGD	Commercial Grade Dedication

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CFR	Code of Federal Regulations
COR	Code of Record
COTS	Commercially Available Off-The-Shelf
CPSO	Chief Pressure Safety Officer
CRN	Canadian Registry Number
CSA	Canadian Standards Association
CSCC	Chloride Stress Corrosion Cracking
DBB	Double Block and Bleed
DOE/NNSA	Department of Energy/National Nuclear Security Administration
DCPSO	Deputy Chief Pressure Safety Officer
DOT	Department of Transportation
EIGA/IGC	European Industrial Gases Association / Industrial Gases Council
EIV	Emergency Isolation Valve
ESM	Engineering Standards Manual (LANL)
ES-UI	Engineering Services, Utilities and Infrastructure (LANL Group)
EU	European Union
FAD	Free Air Delivery
FEA	Engineering Finite Analysis
FMEA	Failure Modes and Effects Analysis
FOD	Facility Operations Directorate (or Director)
FS	LANL Fluid Service Categories
FSD	Functional Series Document
GPM	Gallons Per Minute
HDB	Hydrostatic Design Basis
HDD	Horizontal Directional Drilling

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IESL	Institutional Evaluation Suppliers List
IRT	Integrated Review Tool
IWD/WCD	Integrated Work Document / Work Control Document
LANL	Los Alamos National Laboratory
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
LO/TO	Lockout/Tagout
LOX	Liquid Oxygen
MAWP	Maximum Allowable Working Pressure
MOP	Maximum Operating Pressure
MSS	Maintenance and Site Services
MSS	Manufacturers Standardization Society
M&TE	Measuring and Test Equipment
NACE	National Association of Corrosion Engineers
NASME	Non-ASME Code Equivalency
NB	National Board
NBBI	National Board of Boiler Inspectors
NBIC	National Board Inspection Code
NDE	Nondestructive Examination
NDT	Nondestructive Testing
NEC	National Electric Code
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NPS	Nominal Pipe Size
OSH	Occupational Safety and Health (LANL Division)

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OSH-ISH	Occupational Safety and Health, Industrial Safety and Hygiene (LANL Group)
PA	Polyamide
PCTFE	Polychlorotrifluoroethylene
PED	Pressure Equipment Directive (European Union)
PIP	Process Industry Practices
PMT	Post Modification Testing / Post Maintenance Testing
POC	Point of Contact
PRD	Pressure Relief Device
PRID	Permits and Requirements Identification
PRV	Pressure Relief Valve
PSC	Pressure Safety Committee
PSD	Pressure Safety Database
PSID	Pressure System ID
PSIP	Pressure Safety Implementation Plan
PSO	Pressure Safety Officer
PSR	Pressure System Representative
PT	Dye-Penetrant Testing
PTFE	Polytetrafluoroethylene
QCSM	Quality Control Systems Manual
QR	Qualitative Risk
RFO	Restricted Flow Orifice
RML	Reputable Manufacturers List
RT	Radiographic Examination
SCC	Stress Corrosion Cracking
SCFM	Standard Cubic Feet Per Minute

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SDS / MSDS	Safety Data Sheet / Material Safety Data Sheet
SME	Subject Matter Expert
SMYS	Specified Minimum Yield Strength
SPOF	Single Point-Of-Failure
SSCs	Structures, Systems, and Components
T&P	Temperature and Pressure
UEL	Upper Explosive Limit
UFL	Upper Flammability Limit
UL	Underwriters Laboratories
ULH	Ultra-Low Hazard
UT	Ultrasonic Examination
VFD	Variable Frequency Drive
VT	Visual Examination