

Conduct of Engineering Request for Variance or Alternate Method

To display the *VAR Request Metadata* pane for this document, click **File > Info > Properties > Show Document Panel.**

1.0 General

1.1 Document Number: VAR-10547	1.2 Revision: 0				
1.3 Brief Descriptive Title: B31.5, Refrigeration Piping and Heat Transfer Components, Alternative Leak Testing					
1.4 Affected Program: Engineering Standards	1.5 Request Type: Alternate Method				
1.6a Affected Tech Area 99	1.6b Affected Buildings Sitewide				
1.7 Requestor: Swartz, Ari Ben Organization: ES-EPD					
1.8 Revision History <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Revision Number</th> <th style="text-align: left; border-bottom: 1px solid black;">Changes and Comments</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px;">0</td> <td style="padding: 2px 5px;">Initial issue.</td> </tr> </tbody> </table>		Revision Number	Changes and Comments	0	Initial issue.
Revision Number	Changes and Comments				
0	Initial issue.				

2.0 Affected Conduct of Engineering Program/Documents

2.1 Affected "P" Document: P342 Engineering Standards If against the P document itself, revision (or N/A): <p style="text-align: center;">N/A</p>	2.2 Subordinate or related document(s) [AP, master spec, LANL ESM chapter & section; or code, Order, standard, etc.]: Document Title/No.: LANL Engineering Standards Manual STD-342-100 Chapter 17, Pressure Safety, Section ASME - New ASME System Requirements, Attachment ASME - 1 – Code and Regulation Application Revision 0 Document Title/No.: 22 0813, Testing Piping Systems Revision 10 Document Title/No.: 23 2300, Refrigerant Piping Revision 4
2.3 Section/Paragraph: B31.5	
2.4 Specific Requirement(s) as Written in the Document(s): B31.5 Refrigeration Piping and Heat Transfer Components This Code prescribes requirements for the materials, design, fabrication, assembly, erection, test, and inspection of refrigerant, heat transfer components, and secondary coolant piping for temperatures as low as -320°F (-196°C), whether erected on the premises or factory assembled, except as specifically excluded in the following paragraphs. This Code shall not apply to any of the following: (a) any self-contained or unit systems subject to the requirements of Underwriters Laboratories or other nationally recognized testing laboratory (b) water piping,	

other than where water is used as a secondary coolant or refrigerant (c) piping designed for external or internal gage pressure not exceeding 15 psi (105 kPa) regardless of size (d) pressure vessels, compressors, or pumps, but does include all connecting refrigerant and secondary coolant piping starting at the first joint adjacent to such apparatus.

2.5 Contractual, preference, or other basis for requirement in 2.4:

LANL's historical approach to meeting 10 CFR 851 Attachment A, paragraph 4, Pressure Safety

2.6 Type of VAR from ESM Chap 1, Z10 [*Applies only to standards variances*)

Type 2

2.7 Discipline

Pressure Safety

3.0 Request Information & Comments

3.1 NCR required (work has occurred)? **No**

If Yes, NCR Number: *Enter text.*

3.2 System/Component Affected

OpSystem Acronym & Name **COOLW - Cooling Water Systems**

System Number or Name **CW**

3.3 Highest ML Level

ML-4

3.4 Proposal with Justification/Compensatory Measures:

Enter text...

Proposal

Apply ASHRAE 15-2019 Addendum e [Safety Standard for Refrigeration Systems](#) (or successor document) leak testing methods as an alternative to the B31.5-specified leak test.

ASHRAE 15-2019 Addendum e (1/27/2022) excerpts:

Pg. 12:

9.13.6 Leakage Test. The leak test *shall* be in accordance with ANSI/ASHRAE Standard 147, ASME B31.5, or this section.

9.13.6.1 Leak Testing Protocol. After the time to complete the strength test, continue to pressure test in accordance with Section 9.13.5 for a minimum period as *specified* in Table 9-7. The system *shall* show no loss in pressure on the pressure measuring device during the pressure test. Calculation of the pressure differential based on a change in ambient temperature *shall* be permitted. A vacuum of 0.0097 psi (67 Pa) absolute or lower *shall* be achieved (0.0197. in Hg [32°F]; 500 µm Hg [0°C]; 500 microns). After achieving a vacuum, the system *shall* be isolated from the vacuum pump. The system pressure *shall not* rise above 0.029 psi (200 Pa) absolute (0.059 in. Hg [32°F]; 1500 µm Hg [0°C]; 1500 microns) for a minimum period as *specified* in Table 9-7.

Informative Note: The vacuum pump should gradually create a vacuum to avoid freezing of any moisture in the *piping* system.

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Table 9-7 Duration of Leak Test

<u>Leak Test</u>	<u>Pipe Length, <i>L</i></u>		<u>Maximum Nominal Pipe Size</u>		<u>Minimum Period of Test</u>
	<u>(ft)</u>	<u>(m)</u>	<u>NPS (in.)</u>	<u>DN (mm)</u>	<u>hours</u>
Pressure Test	<u>$L < 100$</u>	<u>$L < 30$</u>	<u>$NPS \leq 3/4$</u>	<u>$DN \leq 20$</u>	<u>0.25</u>
			<u>$3/4 < NPS \leq 3$</u>	<u>$20 < DN \leq 75$</u>	<u>1.0</u>
			<u>$3 < NPS$</u>	<u>$75 < DN$</u>	<u>24</u>
	<u>$100 < L < 200$</u>	<u>$30 < L < 61$</u>	<u>$NPS \leq 3$</u>	<u>$DN \leq 75$</u>	<u>1.0</u>
			<u>$3 < NPS$</u>	<u>$75 < DN$</u>	<u>24</u>
	<u>$200 < L$</u>	<u>$61 < L$</u>	<u>Any</u>	<u>Any</u>	<u>24</u>
Vacuum Test	<u>$L \leq 100$</u>	<u>$L \leq 30$</u>	<u>$NPS \leq 3/4$</u>	<u>$DN \leq 20$</u>	<u>1.0</u>
			<u>$3/4 < NPS \leq 3$</u>	<u>$20 < DN < 75$</u>	<u>8.0</u>
			<u>$3 < NPS$</u>	<u>$75 < DN$</u>	<u>24</u>
	<u>$100 < L < 200$</u>	<u>$30 < L < 61$</u>	<u>$NPS \leq 3$</u>	<u>$DN \leq 75$</u>	<u>8.0</u>
			<u>$3 < NPS$</u>	<u>$75 < DN$</u>	<u>24</u>
	<u>$200 < L$</u>	<u>$61 < L$</u>	<u>Any</u>	<u>Any</u>	<u>24</u>

Informative Note: The maximum nominal pipe size is the largest interconnecting field piping installed.

Background/Justification

ASME B31.5-2019 allows application of methods of equal sensitivity.

538.4.3 Leak Test. After the pressure test in para. 538.4.2 is completed, a leak test shall be performed.

(a) Examination for leaks shall be by the gas and bubble formation testing as detailed in ASME BPVC, Section V, Article 10, or by other methods of equal sensitivity.

EXCEPTION: Refrigerant vapor detection methods shall be used when refrigerant is used in the test medium. Comply with environmental regulations when venting refrigerants.

(b) Examination shall be made of all joints and connections. The piping system shall show no evidence of leaking.

(c) The pressure used for leak tests shall be either the design pressure or a pressure specified in the engineering design.

The state of New Mexico uses UMC 2021; it requires compliance to ASHRAE 15-2016 as a minimum. ASHRAE 15-2019 Addendum e is more rigorous than the 2016 and has a method for leak testing protocol to test using pressure or vacuum based on pipe size and length.

ASTM E432 – 91 (R2017) *Standard Guide for Selection of a Leak Testing Method* states that bubble testing has the lowest sensitivity in Multiple-Seal Units, but also allows for evacuated testing. E432 excerpts:

1. Scope

1.1 This guide is intended to assist in the selection of a leak testing method. Fig. 1 is supplied as a simplified guide.

1.2 The type of item to be tested or the test system and the method considered for either leak measurement or location are related in the order of increasing sensitivity...

5.3.2 Multiple-Sealed Units—In the testing of sealed units, applicable testing methods are, in the order of increasing sensitivity: bubble testing, flow measurement, pressure measurement, infrared analyzer, alkaline-ion diode halogen detector, helium mass spectrometer, and radioactive tracer. The last four methods are applicable to a back pressurizing testing procedure.

5.3.2.1 Evacuated Unit Testing—With evacuated units, the choice of a testing procedure is relatively simple. If the system includes a gage, this gage may be used to show the presence of gas contamination.

Summary

A pressure test for system integrity is required prior to leak testing. The application of the ASHRAE 15-2019 Addendum e paragraph 9.13.6.1 Leak Testing Protocol provides the same or greater level of leak detection as ASME B31.5-2019 paragraph 538.4.3 Leak Test. As such, any of the three methods of leak testing may be used to satisfy the leak testing requirement.

- 1) Bubble leak testing per B31.5 538.4.3
- 2) Pressure testing per ASHRAE 15 Addendum e 9.13.6.1
- 3) Vacuum testing per ASHRAE 15 Addendum e 9.13.6.1

Notes:

- 1) Examiner qualification for the three leak test methods is required to meet B31.5 paragraph 536.3 Examination Personnel Qualification and Certification.
- 2) LANL can provide a method and a test to qualify personnel to perform bubble leak testing. For information contact the COE office.

3.5 Attachments

Document Title or Description **None**

3.6a Project ID
N/A

3.6b: Project Name
N/A

3.6c: Code of Record Date
N/A

3.7 Duration:
Lifetime

3.8a If Finite Period, Start Date:
[Click to enter a date.](#)

3.8b End Date:
[Click to enter a date](#)

3.8c Provide the PFITS number for tracking removal/correction: **[PFITSNum]**

3.9 USQD/USID required (Nuclear, High/Mod Hazard)? **No**
If Yes, USQD/USID Number [Click here to enter text.](#)

3.10 QA Review for process change matters potentially affecting LANL's NQA-1 implementation
Is a QPA Determination required?: **No** If **Yes**, then: [Choose an item.](#)
QPA Comments: [Enter text..](#)

3.11 POC Determination: **Accept**
POC Comments: [Enter text..](#)

3.12 Management Program Owner's (SMPO) Approval for P341 and APs; P342, ESM, ML-1 and -2, and Contract Matters; and P343

SMPO Determination: **Accept**
Comments: [Enter text..](#)

4.0 Participant Signatures **NOTE:** DO NOT ADD NAMES FROM WITHIN WORD! *Save and close the form first, then do 1-4 below:*

1. From the SharePoint library, select the document, then click the **ellipsis (...)** in the second column; a small dialog appears
2. In the small dialog click the **ellipsis** again
3. Click **Edit Properties** and check out the document if prompted to Enter names using the controls provided, then **Save**

<p>4.1 POC (Management Program Owner's Representative):</p> <p>Swartz, Ari Ben</p>	<p>Organization ES-EPD</p>	<p>Signature</p>
<p>4.2 Facility Design Authority Representative</p> <p>Apperson, Jason Wesley</p> <p>FDAR signature not required <input type="checkbox"/></p>	<p>Organization ES-DO</p>	<p>Signature</p>
<p>4.3 LANL Owing Manager (FOD or R&D/Program)</p> <p>[FODorPrgmMgrName]</p> <p>FOD or Program Manager signature not required <input checked="" type="checkbox"/></p>	<p>Organization Enter text..</p>	<p>Signature</p>
<p>4.4 Quality Reviewer's Name:</p> <p>[QPAName]</p> <p>QPA review/signature not required <input checked="" type="checkbox"/></p>	<p>Organization Enter text.</p>	<p>Signature</p>
<p>4.5 Safety or Security Management Program Owner's Approval for P341 and APs; P342, ESM and Contract Matters; and P343</p> <p>Apperson, Jason Wesley</p> <p>SMPO signature not required (Type 1 variance) <input type="checkbox"/></p>	<p>Organization ES-DO</p>	<p>Signature</p>
<p>4.6 Additional Signer 1</p> <p>[AdditionalSigner1]</p> <p>Role: Enter text.</p>	<p>Organization Enter text.</p>	<p>Signature</p>
<p>4.7 Additional Signer 2</p> <p>[AdditionalSigner2]</p> <p>Role: Enter text.</p>	<p>Organization Enter text.</p>	<p>Signature</p>
<p>4.8 CoE Administrator Signature</p> <p>Salazar-Barnes, Christina L</p> <p>NOTE: The CoE Admin is always the last signature placed on this document. The date of that signing is the date of this document.</p>	<p>Signature</p>	