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**Record of Revisions**

REVISION	DATE	DESCRIPTION	POC	RM
0	03/11/2019	Initial issue.	David Bingham, <i>ES-EPD</i>	Larry Goen, <i>ES-DO</i>

## 1.0 Introduction

- A. This procedure describes the process used to perform pressure change testing using the positive pressure change method.
- B. The process consists of preparation work necessary to initiate testing and pressurize the test item to a pre-determined setting, allow the system to stabilize before starting the test, then observing the pressure decay over a prescribed period of time which will be calculated based on sensitivity required and system volume.
- C. This procedure was developed to meet the requirements of ASME Boiler and Pressure Vessel Code Section V-2017, Article 10 (ASME BPVC Section V) Mandatory Appendix VI – *Pressure Change Test*.
- D. Addenda may be added to address specific needs identified for specific requirements identified in engineering output documents (e.g., Specifications and Drawings) if within the allowable changes of ASME BPVC Section V.
- E. This procedure supports the implementation of SD330, *LANL Quality Assurance Program* and P330-8, *Inspection and Test for Acceptance*.

## 2.0 Purpose and Scope

- A. The purpose of this document is to provide instructions to perform pressure change testing using the positive pressure change method on systems requiring this testing method in order to determine acceptance of the system based on an engineering-based, pre-determined acceptable leak rate, typically between  $10^{-3}$  and  $10^{-6}$ , to satisfy the referenced code requirement (e.g., for B31.3 see ASME B&PVC Section V, Article 10, T-1022).
- B. This testing is performed to ensure that the system being tested conforms to design specifications and applicable acceptance criteria.
- C. The scope of this document includes all stages of the testing from preparation requirements, pre- and post-cleaning requirements, pressure boundary identification, acceptable test sensitivity and leakage rate, temperature limits, pressurization system requirements, personnel qualification, procedure qualification, procedure requirements, calibration requirements, and test report requirements.

## 3.0 References

- [SD330, LANL Quality Assurance Program](#)
- [P330-2, Control and Calibration of Measuring and Test Equipment \(M&TE\)](#)
- [P330-8, Inspection and Test](#)
- AP-350-235, *Project Document Control and Records Management*
- LANL Engineering Standards Manual, Chapter 13, [Volume 6-02](#), Attachment 3, *Written Practice for NDE Personnel Qualification & Certification*
- ASNT-SNT-TC-1A, *Recommended Practice for Qualification & Certification of NDE personnel*.
- ASME Boiler and Pressure Vessel Code, Section V, *Nondestructive Examination*

#### **4.0 Definitions and Acronyms**

See ASME BPVC Section V Mandatory Article 1, Mandatory Appendix I VII, *Glossary of Terms for Nondestructive Examination* and Article 30, *Terminology for Nondestructive Examinations Standard, Section E*.

#### **5.0 Hazards**

Caution: Testing using the positive pressure change method could cause system rupture or other system damage. Ensure that the system to be tested is robust enough for the test pressures.

Implementation of this procedure does not introduce any other hazards other than those associated with normal construction field work environment. Follow the requirements of individual integrated work control documents (IWDs) and procedures.

#### **6.0 Equipment**

##### **6.1 Gages**

- A. Dial or recording gage ranges shall be no less than one and a half—and no greater than four times—the test pressure (1-1/2 to 4x). The dial(s) should be graduated over a range approximately double the test pressure. Note: These ranges do not apply to digital gages (load cells). Digital gage(s) shall have the accuracy, resolution, and range necessary for a successful test.
- B. The gage(s) shall be connected to the test system.
- C. Gages shall be visible to the operator performing the pressure test at all times including during pressurization, testing, and depressurization or venting.
- D. When other types of gages are required Code they may be used in conjunction with or in place of dial or recording gages.

#### **7.0 Implementation**

##### **7.1 Test Planning Requirements**

- A. Before any testing is performed, a specific test plan shall be written, reviewed, and approved for each anticipated system test. At a minimum, the written test plan shall include:
  1. Identification of the Test System to be tested. Marked up drawings, pictures, or sketches should be considered.
  2. Specific boundaries of the Test System to be tested. Include method of boundary establishment—e.g., capped, blind flange, valve settings, etc. Include location of test equipment.
  3. The Test Procedure shall establish a single value or range of values for each of the following items.
    - Test Pressure
    - Soak Time
    - Test Duration
    - Recording Interval
    - Acceptance Criteria

4. Specific equipment to be used during the testing.
    - Pressurization equipment, manufacturer, and model.
    - Relief device (if equipped must have calculation showing the relief is sized correctly).
    - Pressure gauge manufacturer, model, and current calibration data record.
    - Temperature measuring instrument manufacturer, model, and current calibration data record. If temperature gauge is not required, state as N/A.
    - Dry bulb or dew point measuring instruments and current calibration data record. If such equipment is not required, state as N/A.
  5. Surface preparation technique for system to be tested—e.g., clean and air-dried, roughing pump used to remove moisture, etc.
  6. Test temperature range. The minimum metal temperature during test shall not be below that specified in the referencing Code Section for the hydro, hydro-pneumatic, or pneumatic test. The minimum or maximum temperature during test shall also be compatible with the testing method (surface shall not be below 40 ° F or above 140 ° F throughout examination).
  7. Identification of qualified test personnel. Include approved qualification records and evidence of performing pressure change testing using the positive pressure change method.
  8. Information regarding test start time, soak time if applicable, test duration time, expected pressure reading at start time, acceptable pressure reading at end of test, intervals and method of recording pressure change. The test duration shall be sufficient to establish the leakage rate of the item(s) being tested as required by the referenced code. Provide rationale supporting selected time duration.
  9. Calculations provided by engineering determining the allowable leakage rate for the system size and associated test duration period (see Attachment 1 of this procedure for formulas and examples).
  10. Post-testing cleaning technique. If none is required, state as such.
  11. Statement that the system has been visually inspected, acceptable, and ready for testing. Note any exceptions for owner review and acceptance prior to testing.
- B. Test gauge shall be connected to the system and be readily visible to the operator controlling the test for the entire duration of the evaluation and test period.
- NOTE:** Multiple gauges may be used.
- C. The test instrument shall be calibrated at least yearly, when in use; the instrument shall provide results accurate to within the manufacturer's listed

accuracy. If there is a reason to believe there is an instrument error, the instrument shall be recalibrated.

- D. If the leakage rate exceeds the specified limit, the test shall be repeated after the cause of the excessive pressure change or leakage rate has been determined and repaired in accordance with the referenced Code Section.

**7.2 Procedure Qualification**

Note: Procedure qualification may be performed following issuance of Rev. 0 of this procedure in March 2019; verify with Chapter 13 or 17 POC that this was performed to avoid unnecessarily repeating this section.

**When procedure qualification is required by the referenced code<sup>1</sup>**, then ASME B&PVC Section V, Article 1, T-150 (d) shall be met as follows:

- A. A performance demonstration examination is required under the control and supervision of a Level III Examiner who is qualified and certified for pressure change testing.
- B. The performance demonstration test shall be witnessed by the LANL Inspector and the responsible Level II Examiner.
- C. The performance demonstration test shall be conducted on a minimum of one test specimen having flaws whose size, location, orientation, quantity and characterization have been determined prior to the demonstration and are known only by the Level III Examiner.
- D. The procedure shall be considered qualified when the supervising Level III and the Inspector are satisfied that indications produced by the demonstration procedure effectively reveal the size, location, orientation, quantity, and characterization of the flaws known to be present in the examined test specimen.
- E. Changes to the essential variables require requalification of the written procedure (see ASME B&PVC Section V, Article 10 T-1021.3 and Mandatory Appendix VI, Table VI-1021).

**7.3 Test Procedure**

- A. The Essential and Nonessential Variables shall be stated, including:

Requirement	Essential Variable
Pressure or vacuum gage manufacture and model	X
Temperature measuring instrument manufacture and model, when applicable	X
Surface preparation technique	X
Material temperature	X
Personnel performance qualification requirements when required	X
Vacuum pumping system, when applicable	-
Post testing cleaning technique	-
Personnel qualification requirements	-
Procedure qualification <b>when required by call code</b>	-

<sup>1</sup> Not required by B31.3 at time of writing.

#### 7.4 Testing

- A. Testing shall be performed in accordance with the approved test plan. Any deviations shall be noted. NOTE: deviations may make the test invalid.
- B. It is recommended that a preliminary leak test be performed to eliminate gross leaks.
- C. Unless specified in the referencing Code Section, components that are to be pressure-leak tested shall not be tested at a pressure exceeding 25% of the Design Pressure.
- D. For this method of testing, the pressure source shall be capable pressurizing the test system to the test pressure.
- E. The test pressure shall be held for the duration specified by the referencing Code Section or, if not specified, it shall be sufficient to establish the leakage rate of the test system within the accuracy or confidence limits required by the referencing Code Section.
- F. Temperature Stabilization
  - 1. For small test systems the where only the system metal temperature can be measured, a wait time of at least 15 minutes is required before starting the test.
  - 2. For larger test systems, before starting the test, the gas temperature shall be stable by direct measurement of the gas after pressurization to test pressure. Note: It may be necessary to allow the gas temperature to equilibrate with the metal temperature of the test system and the surroundings.
- G. At the start of the test the initial temperature (metal or gas), pressure, and other generally required data like dew point or humidity and barometer reading shall be taken, and at regular intervals (not to exceed 1 hour) after until the end of the specified test duration. Note: Data intervals should be specified to given meaningful trend data.
- H. An absolute pressure gage or a regular pressure gage (gage pressure) and a barometer shall be used when it is necessary to compensate for barometric pressure variations.
- I. When water vapor pressure variation can significantly affect the test pressure or required by the referencing Code, a relative humidity or an internal dew point temperature shall be measured.
- J. Evaluation – Unless otherwise specified by referenced code or specification, the area under test is acceptable when the leak rate exhibited is less than or equal to allowable leakage rate as specified by engineering or the referencing Code.
- K. Repair/Retest – If leakage exceeds the allowable rate then the test shall be considered a failure and system shall then be depressurized. Effort shall then be taken to locate and repair the leak(s) as required by the referenced code or specification. After repairs have been made, the areas shall be retested.

## 7.5 Reporting

- A. Reporting shall include but is not limited to information in the approved test plan. A sample template is provided as Form FM01, attached.
1. Project/Location
  2. Specification or procedure
  3. Date of test
  4. Certified level and name of Examiner
  5. Description of Test System
  6. Pressure instrument, manufacturer, model, range, and identification number, calibration data
  7. Temperature measurement device, manufacturer, model number, calibration data
  8. Verification of pretest surface preparation
  9. Equipment used
  10. Positive test pressure
  11. Soak time
  12. Test duration (start and stop time)
  13. Recording interval
  14. Data to be recorded at each interval
  15. Initial pressure, final pressure, pressure change
  16. Dew point or relative humidity recorded if necessary for test
  17. Surface Temperature
  18. Acceptance Criteria
  19. Test Results
  20. Verification of posttest cleaning performed
  21. Nondestructive Examiner(s)/Operator(s) Z-Number(s) and signature(s), level of certification (Level I, Level II, Level III)
  22. Inspector acceptance

## 8.0 Required Qualification and Training

Personnel responsible for performing this test shall be certified in accordance with the recommendations of ASNT-TC-1A.

**Note:** Assistants need not be certified.

All Testing Personnel are required to self-study (read) and acknowledge understanding of the requirements of this procedure.

Table 1: Required Training

Type of Training Required:	Level of Training:	Instructions:
<input checked="" type="checkbox"/> Informal Qualification	<input checked="" type="checkbox"/> Self-Study (Read)	<input checked="" type="checkbox"/> Notification of changes
<input checked="" type="checkbox"/> Formal Qualification	<input checked="" type="checkbox"/> Attendance	<input checked="" type="checkbox"/> Retrain on changes
<input checked="" type="checkbox"/> Continuing Qualification	<input type="checkbox"/> Checklist	<input checked="" type="checkbox"/> Retrain on entire revision
<input type="checkbox"/> No Training Required	<input type="checkbox"/> Other _____	<input type="checkbox"/> Retraining not required

**9.0 Exceptions and Variances**

Follow ESM Chapter 1 Section Z10.

**10.0 Records**

**10.1 Individual Test Report Records**

For projects executed under Project Management (SD350), documents and records associated with this procedure shall be identified, managed, and retained in accordance with the PMSS Records Management Plan (AP-PMSS-020) and the approved PRFP per AP-350-235, *Project Document Control and Records Management*.

All other projects/tasks shall follow applicable (e.g., Division) SI-DC requirements.

**10.2 Qualified Procedure Records**

The qualification document shall be annotated to indicate qualification of the written procedure and identify the examined test specimen. The name and/or identity and signature of the supervising Level III and the witnessing Inspector shall be added to indicate their acceptance of the procedure qualification.

The written procedure shall include the requirements from the referenced code for the following (see ASME B&PVC Section V, Article 10, T-1022):

- A. personnel qualification/certification
- B. technique(s)/calibration standards
- C. extent of examination
- D. acceptable test sensitivity or leakage rate
- E. report requirements
- F. retention of records

**11.0 Attachments**

Attachment 1: Formulas for Calculation of Test Time and Acceptable Leakage based on System

FM01: Test Report Form

**12.0 References**

The following may be available upon request to the Chapter 13 or 17 POCs or Standards Manager:

1. Test plan example (glovebox)
2. Essential variables checklist approved by LANL Level III.
3. Qualification record report for this procedure.