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RECORD OF REVISIONS

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0	11/21/2013	Initial issue. Supersedes blue-sheeted KSL 16-30-008 on similar topic.	David Bingham, <i>ES-EPD</i>	Larry Goen, <i>ES-DO</i>

Contact the Welding Standards POC for upkeep, interpretation, and variance issues.

ITM-1306-NDE-VT-101	Welding POC and Committee
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This document is online at <http://engstandards.lanl.gov>

1.0 Purpose

This procedure establishes the minimum requirements for LANL (and Subcontractor personnel working on behalf of LANL) performing visual and dimensional examinations when specified by a referencing code section.

It specifically meets the requirements of ASME Section V Article 9 and ASNT *Recommended Practice No. SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing*. This procedure also meets the intent for visual and dimensional examinations identified by other codes and standards, e.g., AWS D1.1, etc.¹

2.0 Scope

This procedure establishes the technique, tools, equipment, calibration requirements, and personnel qualification requirements necessary to perform visual and dimensional examinations. Examinations shall be performed by direct, remote, translucent method, or any combination of them. Examinations shall be performed by personnel who are certified by LANL in accordance with WIGN 6-02, *NDE Inspector Qualification*, which will ensure compliance with ASME Section V Article 9.

This procedure does not apply to other personnel approved by LANL to perform visual and dimensional inspections (e.g., approved fabricator personnel, Subcontractor personnel, or Subcontractor-hired third party inspection agency) approved by LANL but representing the Subcontractor and work to their own quality assurance plan and procedures.

Note: Examinations using the translucent method or other methods not specifically covered in this procedure shall be performed in accordance with addenda to this procedure approved per WIGN 6-02 and specifying the technique, tools, equipment, calibration requirements, and personnel qualification requirements necessary to perform the examinations.

3.0 References

ASNT *Recommended Practice No. SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing (2006)*

ASNT-CP-105, *Topical Outlines for Qualification of Nondestructive Testing Personnel*

ANSI/ASQ Z1.4, *Sampling Procedures and Tables for Inspection by Attributes*

ASME B31 series codes, (B31.1, *Power Piping*; ASME B31.3, *Process Piping*; ASME B31.5, *Refrigeration Piping and Heat Transfer Components*; ASME B31.8, *Gas Transmission & Distribution Piping Systems*; ASME B31.9, *Building Services Piping*; etc.)

ASME B&PVC Section V, *Nondestructive Examination*

ASME B&PVC Section VIII, *Rules for Construction of Pressure Vessels*

ASTM E 1316, *Standard Terminology for Nondestructive Examinations*

AWS Structural Welding Codes (AWS D1.1 *Structural Welding Code-Steel*; AWS D1.3, *Structural Welding Code-Sheet Steel*; AWS D1.4, *Structural Welding Code-Reinforcing Steel*; AWS D1.6, *Structural Welding Code-Stainless Steel*; etc.)

LANL MOF-CM WI-400-282, *Inspection and Test for Acceptance*

LANL Engineering Standards Manual (ESM) and Master Specifications

¹ Evidence of this procedure meeting the essential and non-essential variables of these codes is contained in a separate record filed with this document on the Standards Program server.

LANL Procedure P330-2, *Control and Calibration of Measuring and Test Equipment*

LANL Procedure P330-6, *Nonconformance Reporting*

LANL Procedure P1020-1, *Laboratory Records Management*

4.0 Acronyms and Definitions

Acronym / Term	Description
Certification	Written testimony of qualification
Certifying Authority	The person or persons properly designated in WIGN 6-02, <i>NDE Inspector Qualification</i> to sign certifications on behalf of LANL; specifically, the LANL Engineering Services –Engineering Project Delivery (ES-EPD) Welding Program Administrator (WPA) or other Level III designated by the WPA
Certifying agency	LANL ES-EPD is the organization certifying NDE personnel for this procedure, as specifically authorized by the LANL WPA or other Level III designated by the WPA
Comparable	Being at an equivalent or similar level of NDE responsibility and difficulty as determined by the LANL WPA
Documented	The condition of being in written form
ES-EPD	Engineering Services Division, Engineering Project Delivery Group
Qualification	Demonstrated skill and knowledge, along with documented training and experience required for personnel to properly perform the duties of a specific job.
Recommended practice	A set of guidelines to assist the employer in developing uniform procedures for the qualification and certification of NDE personnel to satisfy the employer’s specific requirements
Training	An organized program developed to impart the knowledge and skills necessary for qualification
VT	Visual examination
WPA	Welding Program Administrator (LANL)

5.0 Certification

A. Personnel employed at LANL who perform visual and dimensional examinations and are certified by the LANL Welding Program Administrator (WPA) to WIGN 6-02, *NDE Inspector Qualification*.

- Personnel certified as an American Welding Society (AWS) Senior Certified Welding Inspector (SCWI), or Certified Welding Inspector (CWI) are qualified to perform visual and dimensional examinations per ASME and AWS code requirements.

- Construction Engineers or Quality Control Inspectors deemed qualified to perform visual and dimensional examinations in their respective fields of expertise, provided they meet the physical requirements listed under visual examinations, shall be certified by the LANL WPA.

B. Education, Training, and Experience Requirements

1. Thoroughly familiar with the visual or dimensional attributes needed to be verified and able to perform examinations based on the attributes. This shall be verified and documented via interview with the LANL WPA.
2. Trained in the use of necessary equipment and ensure that the equipment is calibrated if required in accordance with P330-2. If required, on-the-job training shall be provided by the LANL WPA or his designee.
3. Able to interpret and evaluate results with respect to applicable codes, standards and specifications.
4. Able to organize and report the results of the examination and handle in accordance with P1020-1.
5. Level II personnel shall exercise assigned responsibility for on-the-job training and guidance of Level I and trainee personnel, if applicable.

C. Vision Requirements

Personnel performing visual or dimensional examination shall be given an annual vision examination in accordance with WIGN 6-02.

Where differentiation of colors is critical to job performance, the capability to distinguish and differentiate contrast among colors or shades of gray used in the method shall also be demonstrated annually.

Records of visual examinations shall be maintained by the LANL WPA.

6.0 Equipment

A. Equipment for dimensional inspection may include, but is not limited to the following:

GROUP 1	GROUP 2	GROUP 3
machinist’s rule	protractor	optical comparator
tape measure	Pi Tape	optical measuring machine
straight edge	micrometer	coordinate measuring machine (cmm)
angle gauge	calipers	FaroArm
radius gauge	height gauge	
surface block	profilometer	

1. Group 1 Equipment: no temperature stabilization is required.

2. Group 2 Equipment: No temperature stabilization is required for measurements taken within normal ambient temperature range of 35°-110° F. For measurements taken outside the normal ambient temperature range of 35°-110° F and requiring an accuracy of more than three decimal places (x.xxx inches); a minimum stabilization time of 1 hour shall be provided.
 3. Group 3 Equipment: Equipment manufacturer recommendations shall be reviewed and followed regarding environmental conditions for use.
- B. Measuring equipment shall be clean, undamaged, and in good working condition. Ensure that instrument calibration is current, as applicable. Discard and replace damaged or deteriorated inspection equipment. Ensure that equipment that has been lost, damaged, or returned from calibration with the “as-found” condition out-of-tolerance is documented and evaluated by NCR per P330-6.
- C. The surface under inspection shall have sufficient lighting (natural or artificial white light). Sufficient lighting is defined by the ability to detect a 1/32 inch (0.8 mm) black line on an 18 percent neutral gray card or a 1/32 inch increment on a machinist’s scale or equivalent under the conditions of inspection.
- D. Any cleaning solutions for austenitic stainless steel, nickel-based alloys, and titanium shall contain less than 1% halogens (chlorine and fluorine) and less than 1% sulfur. Grinding wheels and wire brushes used for surface cleaning shall be in accordance with engineering specifications. At a minimum; when using mechanical means such as wire wheels or brushes, use only like materials (e.g., stainless steel with stainless steel).

NOTE: Personal protective equipment appropriate to the work area shall be worn at all times while using cleaning solvents and/or mechanical cleaning methods in preparation for dimensional inspections. All safety, environmental, and radiological requirements of the area where the examination is to be performed shall be complied with. The Material Safety Data Sheet for any chemical to be used for cleaning shall be immediately available for employee examination.

7.0 VT and Dimensional Examination

- A. Review work documents for the purpose of identifying the basis for examination and acceptance and performance criteria. This includes, but is not limited to:
1. Specifications, drawings, work instructions, procedures, Lockout/Tagout requirements, referenced codes and standards, and procurement documents.
 2. When, during the work process, inspections/tests are to be performed. Consider post-installation inspections/tests and retesting, if applicable.
 3. Dimensional, physical, configuration, identification, cleanliness, or other characteristics to be examined.
 4. Examination method or combination of methods to be used: direct, remote, or translucent.
 5. Sampling requirements based on ANSI/ASQ Z1.4 or statistical analysis.
 6. Measuring and test equipment needed to perform the inspection/test, including calibration per P330-2; type, range, accuracy, and tolerance requirements.
 7. Provisions for ensuring that prerequisites for the given test have been met.

8. Hold and/or witness points.
 9. Provision for recording inspection/test results and creating project records per P1020-1.
- B. Item to be inspected shall be dry and free of contaminants that could interfere with measuring equipment or the inspection. If surface contamination is present, clean the area of interest or the entire part, as needed, with the most appropriate approved solution or method as allowed by the material. The clean area shall be at least 1 inch either side of the area of interest or the entire part as applicable. Allow both the part to be measured and the measuring equipment to be used to stabilize at ambient temperature if required.
- C. Verify that the acceptance criteria provided is appropriate to perform the visual or dimensional inspection.
- D. Ensure that measuring equipment is zeroed, as applicable, prior to starting measurement.
- E. Perform visual weld inspections after surface preparation. Use appropriate inspection equipment (such as fillet gages, high/low gages, scales, magnifiers, etc.). When access is sufficient to place the eye within 24 inches of the surface being inspected, and, at an angle of not less than 30 degrees to the surface being inspected, direct VT is preferred. When necessary, use mirrors to improve the angle of vision, and use aids such as a magnifying lens (maximum 10x magnification) to assist in inspections.
- F. When necessary, telescopes, borescopes, fiber optics cameras or other suitable equipment for remote visual inspections may be substituted for direct VT. Ensure that remote VT equipment has a resolution capability at least equivalent to that obtainable by direct VT.
- G. Examinations using the translucent method shall be performed in accordance with an appendix to this procedure specifying the process, tools, and requirements associated with the examination.
- H. Weld Inspection
1. Inspections shall be performed and documented as required by applicable code or design and CM-CE procedures.
 2. Material may be inspected in the as-welded, as-rolled, as-cast, or as-forged condition if the surface condition will not mask the indication of an unacceptable discontinuity. *When the surface to be inspected requires grinding, care should be taken to avoid reducing the thickness of the weld or base material below the required minimum dimensions.*

NOTE Visual inspection may be performed immediately after cooling except:

A514, A517, and A709 Grades 100 and 100W steels require not less than 48 hours to pass after completion of all welding prior to visual inspection. Final VT shall be performed in the final surface and heat-treated condition.

- I. Inspect and/or verify the following as applicable:
1. Prior to welding and/or during fit-up inspection:
 - a. The weld procedure specification (WPS) used in production is approved.
 - b. The welder(s) performing the work are currently qualified to the specified WPS.

- c. The base material is in accordance with the engineering drawing and WPS requirements.
 - d. The weld filler material used is in accordance with specified WPS requirements.
 - e. Unacceptable base metal discontinuities have been removed and/or repaired in accordance with approved procedures.
NOTE When pre-heat measurements are taken with temperature indicating crayons, the crayon measurement marks shall be no less than 1/2 inch from the weld preparation area.
 - f. Pre-heat requirements are in accordance with specified WPS requirements.
 - g. Weld joint geometry, alignment, and root opening are in accordance specified WPS requirements.
 - h. Weld preparation cleanliness is in accordance with specified WPS requirements.
 - i. Purging gas and dams are in accordance with specified WPS requirements.
 - j. Tack welds meet specified acceptance criteria.
 - k. Fixtures or temporary restraints are allowed by engineering and are adequate to reduce or prevent weld shrinkage/distortion/movement within fabrication tolerances.
2. In-process inspection:
- a. Root pass or first layer is in accordance with specified acceptance criteria.
 - b. Interpass temperatures are in accordance with specified WPS requirements.
 - c. Interpass cleanliness is in accordance with specified WPS requirements.
3. Final weld inspection:
- a. Completed welds are in accordance with the acceptance criteria.
 - b. Ensure that as-welded surfaces are in accordance with applicable specified acceptance criteria. This includes removing coarse ripples, grooves and/or valleys that interfere with inspection and interpretation of the weld