

	Quality control-iraq	Revision: 01
	Work instruction	Effective:20.july.2020
	Visual inspection	QC VT/2015/01

Record of amendments

The following is a brief summary of the most recent revisions to this document.

Date	Revesion No	Amended By	Description of Changes
01 MAR 2015	00	QUALITY CONTROL	Initial issue
20 July 2020	01	QUALITY CONTROL	Update Edition SNT TC 1A 2001 TO SNT TC 1A 2016

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1 SCOPE

1.1. This procedure is to cover methods to be employed for the visual examination of welds and areas to detect discontinuities open to the surface, to determine surface conditions, alignment of mating surface, or evidence of leaking, in system components.

2 PURPOSE

2.1. This procedure is to specify the minimum requirements for visual examination that shall be performed, as necessary, during the fabrication and erection of components to provide verification that the design and WPS requirements are being met. In addition this procedure shall be performed to verify that all completed welds in components comply with the acceptance standards.

3 REFERENCES

3.1. ASME Boiler & Pressure Vessel Code Section V – Non Destructive Examination, Edition 2013.

3.2. ASME B31.1, Power Piping, Edition 2012, for acceptance criteria.

3.3. AWS-QC1, Standard for AWS Certification of Welding Inspectors.

3.4. AWS D1.1 American Welding Society

3.5. API American Petroleum Institute

3.6. Quality Control Written Practice (Training, Qualification & Certification for NDE Personnel).

4 DEFINITIONS

4.1. X2 or X5 Magnification power of lens.

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5 RESPONSIBILITIES

The NDE Examiner shall be responsible for conducting and reporting the results of examination.

6 PROCEDURE

6.1 PERSONNEL QUALIFICATIONS

6.1.1. All personnel involved in Visual Examinations shall be qualified and certified in accordance with the requirements of Quality control Written Practice (Training, Qualification & Certification for NDE Personnel). Interpretation, evaluation and reporting of examination results shall be done by a minimum certified level II VT inspector.

6.1.2. As alternative, visual examination personnel certified to AWS-QC1 as Certified Welding Inspectors (CWI's) with a valid certificate may be employed in visual examination according to this procedure.

6.1.3. Visual examination personnel may be qualified in accordance with the requirements of ASME Sec. V using the following procedure:

- A. Instruction in the fundamentals of visual examination methods (8 Hours).
- B. On-the job training (12 Hours) to familiarize the personnel with the appearance and interpretation of indications of weld defects.
- C. An eye test examination performed at least once each year to determine optical capability of reading a minimum of Jaeger number 1 letters at a distance of not less than 12 inches (30 cm) on a standard Jaeger test chart.
- D. Upon completion of the above requirements the personnel shall be given an oral or written examination and performance examination to determine if the personnel are qualified to perform the required examination and interpretation of results.
- E. Certified Visual examination personnel whose work has not included performance of specific examination method for period of one year or more shall be recertified by successfully completing the examination of (D) above and also passing the visual examination of (C) above.

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6.1.4. When the written practice is revised, the certification of NDE personnel remains valid to the requirements of the previous revision until the expiry date of the personnel qualification certificate; then, recertification to the requirements of the new revision is required.

6.1.5. The certification of personnel shall be checked by the Quality Assurance Manager prior to work commencement.

6.1.6. Personnel shall have an annual vision test to assure natural or corrected near distance acuity such that they are capable of reading standard J-1 letters on standard Jaeger test type charts for near vision. Equivalent near vision tests are acceptable.

6.2 EQUIPMENT

6.2.1. May include one or combinations of the following tools:

6.2.1.1. Steel Rule 150 mm and/or 300 mm.

6.2.1.2. Weld Gauges (different types as appropriate).

6.2.1.3. Magnifying lens (x 2 to x 5)

6.2.1.4. Inspection mirrors (different sizes)

6.2.1.5. Suitable lighting

6.2.1.6. Crayons and markers (temporary and permanent)

6.2.1.7. Light meter capable of measuring visible light intensity in lux / foot candles (f.c.). The light meter shall meet the calibration requirement of T-952 of ASME Code Section V.

6.2.1.8. Temperature indicating devices (thermocouples, thermometers, crayons, etc.)

6.2.1.9. Callipers or Micrometres.

6.2.1.10. Straight edge and / or Protractor

6.2.1.11. Depth gauges

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6.3 SURFACE CONDITION:

6.3.1. Generally satisfactory results may be obtained when the surface of the part is in the as-welded, or as-rolled condition. Surface preparation by grinding, machining, or other methods may be necessary where surface irregularities could mask the interpretation. The surface shall be dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil, or other extraneous matter that could interfere with the examination.

6.4 PREPARATION:

6.4.1. Preparation may include degreasing, removal of scale, weld ripples, spatter, grinding or chipping marks, etc. that may interfere with the interpretation.

6.4.2. Cleaning may be accomplished using detergents, organic solvents, descaling solutions, paint removers, sand or grit blasting methods.

6.5 EXTENT OF EXAMINATION

6.5.1. In accordance with the applicable inspection and test plan of the component.

6.6 GENERAL EXAMINATION METHOD:

6.5.1. Direct visual examination shall usually be made when access is sufficient to place the eye within 24 in. (600 mm) of the surface to be examined and at angle not less than 30 deg. to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examination. Illumination (natural or supplemental white light) for the specific part, component, vessel, or section being examined is required.

6.5.2. The minimum light level shall be 100 foot-candles (1000 lux). The light source, technique used, and light level verification is required to be demonstrated one time, documented, and maintained on file.

6.5.3. In some cases, remote visual examination may have to be substituted for direct examination. Remote visual examination may use visual aids such as mirrors, telescopes, horoscopes, fiberoptics, cameras, or other suitable instruments. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual observation.

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6.7 WELD EXAMINATION METHOD

6.7.1. All welds shall be subject to 100 % visual examination.

6.7.2. Visual examination of weld shall include general condition of surface being examined including excessive grinding, arc strikes, spatters, cracks, melt through, scratches, weld reinforcement (thickness, undercutting), weld appearance, high low, alignment of jointed parts and shape of weld capping.

6.7.3. The surface condition of weld shall be suitable for proper interpretation of other required non-destructive test of the welds.

6.7.4. The weld surface shall be regular and shall blend smoothly into adjacent base material.

Incomplete or insufficient size of weld shall be repaired.

6.7.5. Any crack on the surface requires an additional surface examination with liquid penetrant along the entire weld. Each crack shall be repaired and the weld examined again.

6.7.6. Butt welds shall have complete penetration.

6.7.7. The surface of the weld may be left "as welded" provided they are sufficiently free from coarse ripples, grooves, overlaps, abrupt ridges, and valley to avoid stress raisers.

6.7.8. Indications such as group of pores, porosity, or worm holes require grinding / welding repair, as appropriate.

6.7.9. Fillet welds shall be regularly blend with adjacent surfaces and the legs shall be in accordance with specified tolerated dimensions.

6.7.10. Fillet weld surface shall be free from coarse ripples or grooves, and shall merge smoothly with the surfaces joined.

6.8 EVALUATION:

6.8.1. All examinations shall be evaluated in terms of the acceptance standards (Paragraph 6.9)

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6.8.2. An examination checklist shall be used to plan visual examinations and to verify that the required visual observations were performed.

6.9 ACCEPTANCE CRITERIA:

6.9.1. Acceptance standards specified in (A) below or with the limitations on imperfections specified in the material specification under which the pipe or component was furnished

A. Acceptance Standards. The following indications are unacceptable:

- a) Cracks — external surface.
- b) Undercut on surface this is greater than $\frac{1}{32}$ in. (1.0 mm) deep.
- c) Weld reinforcement greater than specified in Table 1-1(for Pressure vessel ASME Sec. VIII Div.1) and Table 1-2 (for Power piping ASME Sec.B31.1).
- d) Lack of fusion on surface.
- e) Incomplete penetration (applies only when inside surface is readily accessible).
- f) Any other linear indications greater than $\frac{3}{16}$ in. (5.0 mm) long.
- g) Surface porosity with rounded indications having dimensions greater than $\frac{3}{16}$ in. (5.0 mm) or four or more rounded indications separated by $\frac{1}{16}$ in. (2.0 mm) or less edge to edge in any direction. Rounded indications are indications which are circular or elliptical with their length less than three times their width.
- i) The internal misalignment of piping ends to be joined shall not exceed 2 mm.
- j) Lack of penetration (examined of the root from inside) is not acceptable when joint design require a full penetration.
- k) Weld profiles shall have a smooth and regular transition to the parent metal.



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SI Units

Material Nominal Thickness, mm	Maximum Reinforcement, mm.	
	Category B & C Butt Welds	Other Welds
Less than 2.4	2.4	0.8
2.4 to 4.8, incl.	3.2	1.6
Over 4.8 to 13, incl.	4.0	2.4
Over 13 to 25, incl.	4.8	2.4
Over 25 to 51, incl.	5	3.2
Over 51 to 76, incl.	6	4
Over 76 to 102, incl.	6	6
Over 102 to 127, incl.	6	6
Over 127	8	8

Table 1-1

Table 127.4.2 Reinforcement of Girth and Longitudinal Butt Welds

Thickness of Base Metal, in. (mm)	Maximum Thickness of Reinforcement for Design Temperature					
	> 750°F (400°C)		350°F–750°F (175°C–400°C)		< 350°F (175°C)	
	in.	mm	in.	mm	in.	mm
Up to $\frac{1}{4}$ (3.0), incl.	$\frac{3}{16}$	2.0	$\frac{3}{32}$	2.5	$\frac{1}{16}$	5.0
Over $\frac{1}{8}$ to $\frac{3}{16}$ (3.0 to 5.0), incl.	$\frac{1}{16}$	2.0	$\frac{1}{8}$	3.0	$\frac{3}{16}$	5.0
Over $\frac{3}{16}$ to $\frac{1}{2}$ (5.0 to 13.0), incl.	$\frac{1}{8}$	2.0	$\frac{5}{32}$	4.0	$\frac{1}{4}$	5.0
Over $\frac{1}{2}$ to 1 (13.0 to 25.0), incl.	$\frac{3}{32}$	2.5	$\frac{3}{16}$	5.0	$\frac{1}{4}$	5.0
Over 1 to 2 (25.0 to 50.0), incl.	$\frac{1}{4}$	3.0	$\frac{1}{4}$	6.0	$\frac{1}{4}$	6.0
Over 2 (50.0)	$\frac{5}{32}$	4.0	The greater of $\frac{1}{4}$ in. (6 mm) or $\frac{1}{8}$ times the width of the weld in inches (millimeters).			

Table 1-2

GENERAL NOTES:

- For double welded butt joints, this limitation on reinforcement given above shall apply separately to both inside and outside surfaces of the joint.
- For single welded butt joints, the reinforcement limits given above shall apply to the outside surface of the joint only.
- The thickness of weld reinforcement shall be based on the thickness of the thinner of the materials being joined.
- The weld reinforcement thicknesses shall be determined from the higher of the abutting surfaces involved.
- Weld reinforcement may be removed if so desired.

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6.10 DOCUMENTATION

6.10.1. Each examination shall be reported together with evaluation and where necessary diagrammatic sketches shall be made to show the location of defects.

6.10.2. As a minimum, the report shall give the following information:

- A. Job No.
- B. Product Serial No.
- C. Drawing / line number.
- D. Item or weld reference.
- E. Evaluation
- F. Date of examination.
- G. Welders' mark, number or identity.
- H. Equipment and technique.
- I. Operator's name and qualification level.
- J. Other information as required such as observations, dimensional checks ... etc.

