

1. Scope

1.1 This procedure describes the visual examination that may be performed on any number of items or components such as structural welds, tools, threaded connections, castings, forgings or other machined parts

1.2 This procedure may be applied to the standard practices set forth in TH Hill's DS-1 Volume 3 latest edition

1.3 This procedure may also be applied to the requirements set forth in AWS D1.1 structural weld inspection for both tubular and non-tubular inspection as well as API 6A requirements

2. Referenced Documents

2.1 TH Hill DS-1 Volume 3 – Drill Stem Inspection, latest edition

2.2 AWS D1.1 – Structural Welding Code-Steel, latest edition

2.3 ASME Section V, Article 9 – Visual Inspection, latest edition

2.4 API 6A/ ISO 10423 – Specification for Wellhead and Christmas Tree Equipment, latest edition

2.5 ASNT SNT-TC-1A – Recommended Practice for the Qualification and Certification of NDT Personnel

2.6 If contract requirements specify reference documents other than the latest edition Frontline Testing and Inspection's Management will ensure that all details of this procedure still comply. If noncompliance is found this procedure shall be revised or a project specific procedure shall be written

3. Personnel Qualification

3.1 Personnel performing inspections to this procedure shall be qualified and certified in accordance with ASNT SNT-TC-1A latest edition and Frontline Testing and Inspection's procedure for the qualification and certification of personnel

3.2 Only those personnel, certified Level II or higher in the method being employed, can perform inspections in accordance with this procedure

3.3 For weld inspection, current AWS CWI certification meets the personnel qualification requirements of this procedure

4. Techniques

4.1 Direct inspection

When direct inspection is employed it shall be performed when access is sufficient to place the eye within 24" of the surface to be examined and at an angle not less than 30° to the surface to be examined. Mirrors shall be used, when deemed necessary to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations

4.2 Remote inspection

When conducting remote inspection, the use of visual aids such as telescopes, bore scopes, fiber scopes, cameras, or other suitable instruments shall be used. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual observation

5. Equipment Requirements

5.1 The following is a list of standard required equipment for direct visual inspection

5.1.1 6" long, 1/64" graduated, rule

5.1.2 Flash light or another adequate light source

5.1.3 Rags, scrapper or other suitable cleaning apparatus as applicable

5.1.4 Mirror

5.1.5 Dial calipers (if applicable)

5.1.6 Pit gauge (if applicable)

5.1.7 Thread gauge (if applicable)

5.1.8 Fillet weld gauges or other suitable and applicable weld gauge

5.1.9 Light meter (only if not in obviously acceptable light, i.e. sunlight)

5.2 The following is a list of standard required equipment for remote visual inspection. The owner's manual shall be followed for proper use of any scopes, if employed

5.2.1 Telescope (if applicable)

5.2.2 Bore scope (if applicable)

5.2.3 Fiber scope (if applicable)

5.2.4 Camera (if applicable)

5.2.5 Flashlight or another adequate light source

5.2.6 Light meter (only if not in obviously acceptable light, i.e. sunlight)

5.3 Minimum light level

At the inspection surface, the minimum light level shall be at least 1000 Lux (100 foot-candles). A light meter shall be used that is within its re-calibration interval

5.3.1 In the event inspection is to be performed in under obviously acceptable lighting then the employment of the light meter may not be necessary. Sunlight and/or most typical 60watt incandescent light bulbs will put out enough illumination to exceed 1000lux (100 foot-candles)

5.3.2 Artificial light may be used anytime it is deemed necessary by the NDT Level II. Flashlights, drop lights or any other similar form of light may be used

5.4 Cleaning equipment, as deemed necessary, shall be used. This may be rags, solvents, buffers, wire brushes or scrapper

5.5 Calibration requirements for testing and inspection equipment shall be as deemed in Frontline Testing and Inspection's Quality Management System. Of the equipment listed in this procedure, the following shall be calibrated or have calibration verification performed every 6 months

5.5.1 Light meter

5.5.2 Scopes

5.5.3 Thread gauges

5.5.4 Pit gauge

5.5.5 Dial calipers

5.6 The following gauges shall be certified and have supporting documentation of such certification by the manufacturer

5.6.1 Fillet weld/ weld gauges

6. Preparation

6.1 It shall be determined that the light source is adequate to produce the desired luminance across the entire area or weld surface to be inspected

6.2 Parts, areas, welds or threads shall be cleaned to the degree that all dirt, paint, scale, weld spatter, grease, oil, slag or any other foreign debris is removed to allow for a complete visual inspection. Surfaces being prepared for inspection shall include all areas of interest as well as 1" of the adjacent area of the part or weld

6.3 If sand blasting or other more extreme means of cleaning is required the client will be notified and arrangements made

7. Process

7.1 Direct Visual Inspection

7.1.1 Surfaces to be inspected shall include 1" of the adjacent surface

7.1.1.1 For weld inspection this is to include 1" of the adjacent parent material measured from either toe of the weld to include the HAZ

7.1.1.2 For threaded connections, unless otherwise specified, the entire connection shall be inspected including 1" of the adjacent material measured from the shoulder or final thread, depending on thread type

7.1.2 Mirrors may be used as needed

7.1.3 The entire area of interest shall be visually inspected including the 1" of the adjacent areas. The governing code shall be referenced for specific details of what to look for

7.1.4 The applicable gauges shall be used to determine dimensions of anomalies if any

7.1.5 Articulation of the light, mirror or any other device being employed to assist in the inspection shall be made to avoid shadows

7.2 Remote Visual Inspection

7.2.1 If employing any type of bore scope or fiber scope you must determine the level of magnification, if any, prior to starting the inspection

7.2.2 The inspector shall be thoroughly familiar with the standard operation of the scope as specified in the owner's manual

7.2.3 Surfaces to be inspected shall include 1" of the adjacent surface

7.2.3.1 For weld inspection this is to include 1" of the adjacent parent material measured from either toe of the weld to include the HAZ

7.2.3.2 For threaded connections unless otherwise specified the entire connection shall be inspected including 1" of the adjacent material measured from the shoulder or final thread depending on thread type

7.2.4 The entire area of interest shall be visually inspected including 1" of the adjacent areas. The governing code shall be referenced for specific details of what to look for

7.2.5 The applicable gauges shall be used to determine dimensions of anomalies if any. 7.2.6 Articulation of the light, mirror or any other device being employed to assist in the inspection shall be made to avoid shadows

8. Evaluation & Acceptance Criteria

8.1 All discontinuities found shall be evaluated in accordance with the applicable code or specification as dictated by the client. In most all instances, cracks are prohibited and shall be brought to the attention of the client or client representative immediately

8.2 Definitions applicable to weld inspection

8.2.1 Lack of Penetration – Failure of the filler metal and base metal or the base metal alone if no filler metal is used, to fuse integrally at the root of the weld to the depth required in the WPS

8.2.2 Lack of Fusion – Failure to fuse together adjacent layers of weld metal or weld metal and base metal

8.2.3 Undercut – Melting away of the side wall of a welding groove at the edge of a layer or bead or a reduction in the base metal thickness at the fusion line

8.2.4 Visible Porosity – Gas pockets or voids free of any solid material; pores may be individual, clustered and/ or aligned/ linear

8.2.5 Overlap – Condition in which the weld metal protrudes beyond the boundary dictated by the WPS; normally seen at the weld toe

8.2.6 Linear discontinuities – May be cracks or non-fusion; may be found anywhere in interest

8.2.7 Under-fill – Depression on the face of the weld surface extending below the surface of the adjacent base metal

8.2.8 Improper weld size – Excessive or insufficient width of weld surface

8.2.9 Concave weld and Convex weld

8.2.10 Arc strike – Discontinuity left on surface of base metal where the arc-welding electrode has momentarily touched the base metal

8.3 Weld Appearance

8.3.1 Uniformity of weld ripple, variation in width of surface layer, depressions, reinforcement height

8.3.2 Spatter – Metal particles expelled during welding which are attached to but do not form a part of either the weld or parent metal

8.3.3 Crater – Depression at the termination of a bead or in the weld pool beneath the electrode

8.3.4 Profile – Contour of a fillet weld face

8.3.5 Misalignment – Failure to properly align abutting parts to be joined by butt welds

8.3.6 Excessive reinforcement – Weld metal more than the quantity required to fill a joint

8.4 The client is ultimately responsible for dictating the applicable acceptance criteria

9. Reporting

9.1 All rejected findings shall be reported to the client or client representative immediately

9.2 Frontline Testing and Inspection personnel will produce a report at the end of each job with the following minimum information

9.2.1 Name of inspector (printed and signed)

9.2.2 Certification level and method of inspector

9.2.3 Date of inspection

9.2.4 Location of inspection

9.2.5 Description and traceability of test specimens

9.2.6 Results of inspection (acceptable or rejected) including applicable tolerances

9.2.7 Inspection procedure number including revision level

9.2.8 Acceptance criteria including revision level

9.2.9 Test equipment serial number and calibration due date (if applicable)

9.2.10 Light intensity

9.2.11 Customer name

9.2.12 Customer project name, if applicable

9.2.13 Customer PO or job number, if applicable

9.2.14 Drawing number and revision, if applicable

9.2.15 Inspection report number

9.2.16 Client representative name and date (if applicable)
