

1.0 SCOPE

This procedure establishes the minimum requirement for performing radiographic examination of hot pulled induction bends weld seam in accordance with the requirements of the referenced codes / standards.

2.0 APPLICABLE CODE & STANDARDS

- API 5L 45th Edition 2012 "Specification for Line Pipe"
- ISO 15590-1:2009 "Petroleum and natural gas industries —Induction bends, fittings and flanges for pipeline transportation systems —Part 1: Induction bends"
- MSS-SP-75-2008 "Specification for high test, wrought, butt welding fitting"
- ASME B 16.49:2007 "Factory-Made, Wrought Steel, Butt welding Induction Bends for Transportation and Distribution Systems"
- ISO 9712 "Qualification and certification of personnel"

3.0 RESPONSIBILITY

Personnel performing Radiographic Examination shall be level-II responsible for interpretation evaluation of indications during the examination & preparation of examination reports. An ASNT NDT LEVEL III shall be responsible for overall supervision.

4.0 PERSONNEL QUALIFICATION

NDT personnel shall be qualified as per WCL written practice & Vision examination shall be as per applicable SNT-TC-1A.

- 1) NDT L-III shall be responsible for overall supervision.
- 2) NDT L-II personnel set up the equipment, perform tests and report the results.

5.0 PRECAUTIONS FOR PERSONNEL SAFETY

Protective measures shall be taken by radiographic personnel to ensure that no individual is exposed to radiation in excess of the prescribed limits as per WCL Radiation safety and Emergency Procedure & revision No. 06.02.

6.0 SURFACE PREPARATION

6.1 Weld shall be visually examined prior to release for radiography.

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6.2 The weld ripples or weld surface irregularities on both the inside (where accessible) and outside shall be removed by any suitable process to such a degree that any such irregularities appearing on the resulting radiographic image do not mask nor are confused with the image of any discontinuity.

6.3 If the weld is ground flush, markers, such as arrows or v's pointing towards the centerline of the weld shall be placed on both side of weld approximately 6.00 mm (0.25 inch) away from the toe of the weld. At least two sets of arrows or v's shall appear on the film. One set near each end of the interpreted area of the film

6.4 BACK SCATTER RADIATION. A lead no. 'B' with minimum dimensions of 10mm in height and 1.5 mm in thickness shall be attached to the back of each film holder during each exposure to determine if back scatter radiation is exposing the film.

7.0 EQUIPMENT DETAILS

7.0 Instrument type

Type of source: ANDREX / DANG DONG / X-Ray machine/ Gamma- ray

Max. X-ray voltage/Gamma: 300 KV/ Iridium-192 Max Focal Size: 3.5 X3.5 mm

Min. FFD : 70 cm.

7.1 Lead Screen

Lead screen are used to improve radiography quality and reduced Exposure time

7.2 Film

- Radiography shall be conducted with industrial radiographic film. Film shall be as per ASTM E 1815 type II or ISO 11699 class C5; (Agfa-D7) film shall be selected to produce radiographs processing acceptable sensitivity, density and contrast.

- Radiographic film shall be processed manually; processing shall be done in accordance with requirements of ASTM E - 94.

- Unexposed film shall be stored on its side or end and protected from the effects of light, Pressure, Excessive humidity, damaging fumes, vapors or penetrating radiation. Expired films shall not be used.

7.3 Intensifying Screens

- Only lead intensifying screens shall be used.

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- For radiography using x-ray sources the minimum thickness of the lead screen shall be between 0.02 mm and 0.25 mm for front as well as back.

- Lead screens which are an integral part of 'ready pack' (i.e. Pb contact pack) film are acceptable.

7.4 Image Quality Indicators

- ISO/ASTM wire type IQI shall be used in accordance with ISO 19232-1, OR ASTM E 747-04 and the essential wire diameter shall be given in Table E3 & E4 (API 5L 45th edition) for the applicable weld thickness.
- Damaged IQI's shall not be used (e.g. bent wires)

7.5 Viewing Facilities

- The viewing facilities should provide subdued background lighting on an intensity that will not cause troublesome reflections, shadows or glare on the radiograph.
- Densitometers shall be used to measure the density of the film. The densitometer shall be calibrated annually in accordance with ASTM E 1079:2010. Performance shall be verified before each use with a density filmstrip traceable to a National standard.

8.0 EXAMINATION

8.1 A single wall exposure technique shall be used for x-ray radiography.

8.2 Single wall exposure – single wall viewing (SWE / SWV) technique – the radiation passes through only one wall.

8.3 The radiation will pass through double wall of the bend which is viewed on radiographic as DWSI for acceptances.

9.0 RADIOGRAPHIC EXPOSURE REQUIREMENTS

9.1 Selection of radiation energy - The voltage for examination with x-ray tubes shall be selected to ensure that the required wire is visible on the radiograph.

9.2 Geometric un-sharpness - The geometric un-sharpness: U_g'' ($U_g = F_t / D$) shall not be more than 0.5 mm (0.020") for steel thickness under 50.8 mm (2")

10.0 LOCATION MARKERS

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10.1 Each radiograph shall exhibit location markers, which appear as radiographic images on the film. The markers shall be placed on the part being examined & not on the exposure holder / cassettes. Location markers shall not intrude into the area of interest if any, such radiograph shall be rejected and reshoot shall be taken.

10.2 The starting point & the direction of numbering shall be identified adjacent to the weld. Location markers shall be identified on the surface of the specimen being radiographed. Regardless of the technique used the area of interest of the radiograph shall be accurately traceable to its location on the part until acceptance.

10.3 Film identification - Each radiograph shall be permanently identified using lead numbers and / or letters. The radiographic identification shall include the following information

1. P.O. No.
2. Client name
3. Bend size x thickness
4. Bend angle
5. Bend no
6. Bend radius
7. Seam or weld identification.
8. R/S for reshoot.
9. Date of radiography

11.0 PENETRAMETER SELECTION

11.1 Penetrometer shall be used wire type penetrometers and shall be selected to ensure that the designated wire required shall be included in the penetrometer pack used. When possible the penetrometer shall be selected to ensure that there exist wires both above and below the designated wire.

11.2 Selection of the penetrometer shall be based on the nominal thickness of the base material plus weld reinforcement.

11.3 Penetrometer (IQI) placement - Source side penetrometer (s) shall be used at all times. The IQI shall only be placed on the film side when the surface facing the radiation source is inaccessible. In these circumstances, a letter "F" shall be placed near the IQI and this procedural change recorded in the test report.

11.4 Number of penetrometers - Two penetrometers shall be used and both shall be within 25.4 mm (1 inch) of the both end of the single film length, both penetrometer shall be source side.

12.0 RADIOGRAPHIC FILM INTERPRETATION

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12.1 All radiographs shall be free from mechanical, chemical or other blemishes to the extent that they do not mask and are not confused with the image of any discontinuity in the area of interest. Such blemishes include, but are not limited to; fogging, processing defects such as streaks, watermarks or chemical stains, scratches, finger marks, crimps, dirt, static marks, smudges or false indications due to defective screens.

12.2 A film of 3"X12" shall be used for each exposure. If an area of interest contains an artifact a second exposure shall be made.

12.3 The density of the radiograph shall be not less than 2.0 (except weld reinforcement), and shall be chosen such that

- (a) The density through the thickest portion of weld seam is not less than 1.5.
- (b) The maximum contrast for the type of film used is achieved.

13.0 DENSITY VARIATION

Density Variation - Radiographic density anywhere through the area of interest shall not vary more than – 15% and + 30% from the measured density next to the designation wire of the penetrometer. If density variation exceeds the permissible -15% and +30% range additional penetrometers shall be used for each exceptional area of areas and the area of interest re – radiographed.

Backscatter radiation – radiographed film displaying a light image of the letter "B" on a darker background shall be cause for rejection of the radiograph. A dark image of the letter "B" on a lighter background shall be considered acceptable.

14.0 FILM VIEWING

- Film shall be viewed in an area with subdued lighting as required by paragraph 7.6
- Personnel interpreting radiographs shall allow 3 minutes in any darkened area for their eyes to adjust if coming in to the darkened area from normal room light and at least 5 minutes if coming in from full sunlight.
- Radiograph shall be interpreted only in those areas in which the penetrometer (s) has established that a suitable radiographic technique has been used.
- Composite viewing of double film exposure is not permitted.
- Each exposed film shall be properly stored to prevent damage to the film.

15.0 FINAL INTERPRETATION OF RADIOGRAPHS

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The film interpreter shall record on a radiography examination report format accompanying the radiographs, the type of defects present on each radiograph and the area (s) rejected.

16.0 ACCEPTANCE CRITERIA

Acceptance criteria shall be applicable as per API 5L 45th edition annexure-E table E.5 & 6/ Cust. Specification.

17.0 DISPOSITION OF BEND CONTAINING DEFECTS

Pipes containing defects shall be given one or more of the following dispositions:

- The defects shall be removed by grinding in accordance with the repair procedure.
- The sections of pipe containing defects shall be cut off within the applicable limits for length.
- If the pipe is rejected, the same pipe is documented in NCR format no. - WCL/QA/F/04 Rev. 01.

18.0 DOCUMENTATION

Radiography examination shall be recorded. Including:

- a) Report number, date, w.o. No. and the governing acceptance criteria.
- b) Weld identification number.
- c) Radiation source type,
- d) The radiographic interpreters full name.
- e) Film brand, type and processing method.
- f) IQI and designated wire.

Test results (Before Bending) shall be recorded on Bendco Form:

Test results (After Bending) shall be recorded on Bendco Form:

19.0 RETENTION OF RADIOGRAPH

Radiograph retained minimum five years after the date of purchase from the manufacturer.

20.0 SAFETY PRECAUTION

DO'S

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- Only authorized personnel is authorized to operate the machine.
- Before performing any inspection or maintenance, machine should be switched OFF.
- Movement of pipes to be carried out with keeping safe distance of co-workers.
- Ensure the interlock function while operating the X-ray machine.
- The siren & blinking light must be automatically activated as soon as the machine is switched ON.
- Use recommended PPE's.

DON'TS

- Do not enter the unit room, unless the machine is switched OFF
- Do not by-pass the inter-locking system deployed in the door.
- Do not allow unauthorized person near x-ray panel room.
- Do not cross pipe conveyor when red light is ON.

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