PIP PLSC0013
Non-Destructive Examination of ASME B31.4 and B31.8 Metallic Pipelines
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

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1. **Scope**

This Practice provides requirements for nondestructive examination (NDE) of pressure containing welds on steel pipelines, compressor stations, meter stations, pump stations, and fabricated assemblies. This Practice does not apply to structural welds, ongoing examinations for mechanical integrity, or welds on boiler and pressure vessels.

2. **References**

Applicable parts of the following industry codes and standards shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate. Code section references below are specific to the code editions in effect at the issuance of this Practice.

2.1 **Industry Codes and Standards**

- American Petroleum Institute (API)
  - API Standard 1104 - *Welding of Pipelines and Related Facilities*
- American Society of Mechanical Engineers (ASME)
  - ASME B31.4 - *Pipeline Transportation Systems for Liquids and Slurries*
  - ASME B31.8 - *Gas Transmission and Distribution Piping Systems*
  - ASME BPVC-IX - *ASME Boiler and Pressure Vessel Code, Section IX: Welding and Brazing Qualifications*
- American Society for Nondestructive Testing (ASNT)
  - SNT-TC-1A - *Recommended Practice, Personnel Qualification and Certification in Nondestructive Testing*

3. **Definitions**

- **owner**: The party who owns the facility wherein the nondestructive examination services will be performed
- **purchaser**: The party who awards the contract to the supplier. The purchaser may be the owner or the owner’s authorized agent.
- **purchaser’s inspector**: The purchaser’s authorized representative with authority to act in the interest of, and on behalf of, the purchaser in quality assurance matters
- **supplier**: The party responsible for providing the nondestructive examination services

4. **Requirements**

4.1 **NDE Procedures and Personnel Qualifications**

4.1.1 Radiographic examination shall only be performed by personnel qualified in accordance with the minimum requirements of *ASNT SNT-TC-1A*, Level I.
4.1.2 Each radiographic crew shall work under the direct supervision of personnel qualified in accordance with *ASNT-TC-1A*, Level II or higher, and who is qualified in the radiographic testing method.

4.1.3 Personnel qualified in accordance with *SNT-TC-1A*, Level II or higher shall interpret the radiographs.

4.1.4 Before starting the inspection work, the certification records for all personnel performing and interpreting the results of radiographic examinations shall be provided to the purchaser’s inspector. This documentation shall be placed in the owner’s project file.

4.1.5 The purchaser’s inspector may request that a qualification radiograph be made before the production work begins. The identification of the specific location, weld, welders, and inspection crew shall be provided for the records stored in the owner’s project files.

4.1.6 An updated copy of supplier’s radiographic procedures shall be submitted annually for owner’s record.

4.2 Nondestructive Examination Methods

4.2.1 Girth Welds

4.2.1.1 NPS 2 and Greater

1. Girth welds of Nominal Pipe Size (NPS) 2 or greater shall be examined by a full volumetric examination technique.

2. The following full volumetric techniques shall be used as applicable:
   a. For radiographic examination method, conventional or digital
   b. For ultrasonic method, shear wave or phased array

4.2.1.2 Less than NPS 2

1. For radiographic examination, girth welds of less than NPS 2 shall be examined using a super imposed or elliptical technique.

2. Contact shots shall not be permitted.

3. If the use of radiographic methods is not practical, the magnetic particle method shall be used.

4. If the use of the magnetic particle method is not practical, the liquid penetrant method shall be used.

4.2.2 Other Weld Types

4.2.2.1 Fillet welds, branch connections, longitudinal (sleeve) and other configurations that cannot be radiographed shall be examined using the magnetic particle method.

4.2.2.2 If the use of the magnetic particle method is not practical for an application (e.g., stainless steels and non-ferromagnetic materials), the liquid penetrant or the ultrasonic shear wave method shall be used.
4.3 Minimum NDE Requirements

4.3.1 The minimum Nondestructive Examination (NDE) requirements for all piping shall be in accordance with Table 1.

4.3.2 The minimum requirements in Table 1 can be exceeded with the approval of the owner.

4.3.3 The purchaser’s inspector shall randomly select welds from each day’s work made by each welder who performs production welding in accordance with the frequencies defined in Table 1.

4.3.4 The selected welds shall be nondestructively examined over the entire weld circumference and shall be in accordance with the specified requirements.

4.3.5 Partial nondestructive examination of welds that does not include the entire circumference of the pipe shall not be included in the required percentage of weld examinations.

4.3.6 In addition to testing all welds by an approved NDE method as defined in Section 4.4, welds shall be visually examined.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Weld Type</th>
<th>NDE Requirements</th>
</tr>
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<tbody>
<tr>
<td>Pipelines and Components Constructed in Accordance with ASME B31.8/B31.4</td>
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<tr>
<td>• Hoop stress(^{(1)(2)}) less than 20% of Specified Minimum Yield Strength (SMYS)</td>
<td>• Butt weld</td>
<td>• Visual examination</td>
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<td></td>
<td>• Fillet weld</td>
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<td>• Branch weld</td>
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<tr>
<td>• Hoop stress equal to or greater than 20% SMYS</td>
<td>• Butt weld (girth, branch, longitudinal)</td>
<td>• Visual examination and</td>
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<td>• Fillet weld</td>
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<td></td>
<td>• Branch weld</td>
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<td></td>
<td>• Nondestructive examination(^{(3)}) of:</td>
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<td></td>
<td>o B31.4 – 10% of welds</td>
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<td></td>
<td>o B31.8:</td>
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<td></td>
<td>▪ 10% of welds in Class 1 area</td>
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<td></td>
<td>▪ 15% of welds in Class 2 area</td>
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<td></td>
<td>▪ 100% of welds in Class 3 and 4 areas and welds that meet additional B31.8 criteria(^{(4)})</td>
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<td>▪ 100% for pipeline tie-ins, including tie-ins of replacement sections and all above-ground piping fabrications</td>
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<tr>
<td>• Repair welds or welds for tapping operations</td>
<td>• Butt weld (girth, longitudinal)</td>
<td>• Visual examination</td>
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<tr>
<td></td>
<td>• Fillet weld</td>
<td></td>
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<tr>
<td></td>
<td>• Branch weld</td>
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</tr>
</tbody>
</table>

1 Hoop stress: \(P = \frac{(2S)(t)}{D}F \times Ex T\) where \(S\) = Yield strength in PSI, \(D\) = Nominal outside pipe diameter in inches, \(t\) = Nominal pipe wall thickness in inches, \(F\) = Design Factor, \(E\) = Longitudinal Joint Factor, \(T\) = Temperature Derating Factor, and \(P\) = Pressure (psig) that produces a hoop stress of 100% of the pipe SMYS. The % of SMYS is calculated using the system Maximum Allowable Operating Pressure (MAOP) for gas or the system Maximum Operating Pressure (MOP) for hazardous liquids.

2 For branch welds, use the hoop stress in the carrier pipe for evaluation of hoop stress. For fillet welds, use the hoop stress of the pressure member to which the fillet weld is attached for evaluation of hoops stress. For a sleeve longitudinal weld, use the hoop stress of the underlying carrier pipe for evaluation of hoop stress.

3 Nondestructive examination using an approved method.

4 Additional B31.8 Criteria – Welds at crossing of rivers and within railroad/public rights-of-way.
4.4 Acceptance Standards for Nondestructive Examination

Acceptance Criteria for Pipelines and Components Constructed in Accordance with ASME B31.8 or ASME B31.4

NDE results shall be graded in accordance with API Standard 1104 to determine weld acceptance or rejection. The sub-section that matches the inspection technique applied shall be used.

4.5 Documentation

NDE documentation shall be provided each day to the purchaser’s inspector. This record shall be kept in the owner’s project file.

Minimum NDE documentation requirements shall include the following:

a. Date
b. Location
c. Project ID
d. Number of welds nondestructively examined and accepted
e. Number of welds rejected
f. Code used to grade and record the final disposition of acceptance or rejection of each weld reviewed
g. Technician’s level of qualifications
h. Technician’s names and signature of film interpreter
i. For each weld examined, the following information shall be provided:
   (1) Description of item (e.g., 12.75 inch butt weld)
   (2) Type and grade of material
   (3) Thickness of material
   (4) Thickness of reinforcement (if applicable)
   (5) Radiographic technique used
   (6) Rejectable relevant indications
   (7) Location of rejection
   (8) Weld identification
   (9) Welders identification
   (10) NDE inspection crew identification