Preparing Activity: NAVFAC Replacing without change
UFGS-15216N (September 1999)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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04/06

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SECTION 40 17 26.00 20

WELDING PRESSURE PIPING
04/06

NOTE: This guide specification covers the requirements for welding of piping and piping system components which will contain fluids under pressure including hydraulic systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

NOTE: Piping materials, components, and supports are specified in other sections of the project specifications.

NOTE: The following information shall be shown on the project drawings:

1. Tensile strength, elongation, shear strength, size, length, type, and location of the welds, as necessary.

2. The project drawings should be checked to ensure that any supplementary information required by the

paragraphs has been shown and that there is no conflict between the drawings and the specifications. See also Note in paragraph entitled "Definitions." The project drawings must indicate, or text of the project specifications must specify, the tensile strength, elongation, shear strength, size, length, type, and location of the welds, as necessary.

****

PART 1 GENERAL

1.1 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Std 1104	(2013; Errata 1-3 2014; Addendum 1 2014; Errata 4 2015; Addendum 2 2016) Welding of Pipeline and Related Facilities

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A	(2020) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(2022) Power Piping
ASME B31.3	(2022) Process Piping
ASME B31.4	(2022) Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquid

ASME B31.5	(2022) Refrigeration Piping and Heat Transfer Components
ASME B31.9	(2020) Building Services Piping
ASME BPVC SEC I	(2017) BPVC Section I-Rules for Construction of Power Boilers
ASME BPVC SEC II-C	(2017) BPVC Section II-Materials Part C-Specifications for Welding Rods Electrodes and Filler Metals
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC V	(2017) BPVC Section V-Nondestructive Examination

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(2012) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A3.0M/A3.0	(2020) Standard Welding Terms and Definitions
AWS B2.1/B2.1M	(2021) Specification for Welding Procedure and Performance Qualification
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
AWS Z49.1	(2021) Safety in Welding and Cutting and Allied Processes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction

1.2 RELATED REQUIREMENTS

****

NOTE: The project drawings should be checked to ensure that any supplementary information required by the paragraphs has been shown and that there is no conflict between the drawings and the specifications.

****

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

****
NOTE: Insert the applicable ANSI piping codes. ANSI B31.2, "Fuel Gas Piping," and ASME B31.8, "Gas Transmission and Distribution Piping Systems," not listed under paragraph entitled "References," may be used.
****

AWS A3.0M/A3.0 [and applicable ANSI piping documents].

1.4 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Welding pressure piping

SD-07 Certificates

Welding procedures qualification

Nondestructive examination (NDE) procedures

NDE personnel certification procedures

Inspector certification

Submit inspector certification and NDE personnel certification for record.

SD-11 Closeout Submittals

Weld identifications

1.5 QUALITY ASSURANCE

1.5.1 Welding Pressure Piping

Show location, length, and type of welds, and indicate postweld heat treatment and nondestructive testing as required.

1.5.2 Procedures

****

NOTE: Insert the applicable ANSI piping codes. ANSI B31.2, "Fuel Gas Piping," and ASME B31.8, "Gas Transmission and Distribution Piping Systems," not listed under paragraph entitled "References," may be used.

****

Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer in accordance with the qualified procedures. Notify the Contracting Officer at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welding operator/welder performance qualifications, and nondestructive examination (NDE) procedures. These records shall be readily available at the site for examination by the Contracting Officer. Qualify the procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses. [ANSI Piping] [_____] requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

1.5.2.1 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification provided that

the following conditions are fulfilled:

a. Copies of welding procedures, procedure qualification test records, and welder and welding operator performance qualification test records are submitted and approved in accordance with the paragraph entitled "Submittals."

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality control organization.

c. The welding procedures, welders, and welding operators were qualified in accordance with ASME BPVC SEC IX or AWS B2.1/B2.1M, AR-2 level; and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of this specification.

d. The requirements of paragraph entitled "Welder and Welding Operator Performance Qualification" for renewal of qualification were met, and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.5.2.2 Performance

****

NOTE: The paragraphs will be edited and inserted if necessary to ensure proper implementation of the "CONTRACTOR QUALITY CONTROL PROGRAM." The specification writer or design engineer must indicate how much quality control of welding is needed for each project and who is to be responsible, i.e., primarily the Contractor or the Government. If quality control is to be the responsibility of the Government, delete paragraphs entitled "Performance" and "Qualification of Inspection and Nondestructive Examination (NDE) Personnel" through "NDE Personnel Qualification" and renumber paragraphs as necessary. Rarely will a project require 100 percent testing of welds by NDE methods. The designer must determine the required methods and the extent of inspection and testing and must indicate the extent in this or other sections of the project specifications or on the project drawings by notes, nondestructive test symbols, or other means. The specifications or project drawings must clearly indicate which joints require 100 percent NDE inspection, which joints require random NDE inspection, and which NDE methods are to be employed for each joint. For random inspection, the project drawings must indicate the location, number of joints, and minimum increment length of weld that will be subject to NDE inspection without predisclosing the exact spots to be examined. Joints not indicated to be tested by NDE methods shall be subject to visual inspection only. In cases where the nature of the welding is such as to require visual inspection only, the requirements for nondestructive examinations should be deleted from these paragraphs and from paragraph entitled "Qualification of Inspection and Nondestructive

Examination (NDE) Personnel."
****

The Contractor shall be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.

1.5.3 Welding Procedures Qualification

****
NOTE: The project drawings must indicate, or text of the project specifications must specify, the tensile strength, elongation, shear strength, size, length, type, and location of the welds, as necessary.
****

****
NOTE: Insert the applicable ANSI piping codes. ANSI B31.2, "Fuel Gas Piping," and ASME B31.8, "Gas Transmission and Distribution Piping Systems," not listed under paragraph entitled "References," may be used.
****

Qualification of the welding procedures for each group of materials to be welded is required as indicated in ASME BPVC SEC IX. Record in detail and qualify the "Welding Procedure Specifications" for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of ANSI Standards and to this specification. The welding procedures shall specify end preparation for welds, including cleaning, alignments, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by ANSI Piping documents, unless otherwise indicated or specified. Describe the type of backing rings or consumable inserts, if used, and, if they are to be removed, the removal process. Welding procedure qualifications shall be identified individually and referenced on the shop drawings or suitably keyed to the contract drawings.

1.5.4 Welder and Welding Operator Performance Qualification

****
NOTE: Insert the applicable ANSI piping codes. ANSI B31.2, "Fuel Gas Piping," and ASME B31.8, "Gas Transmission and Distribution Piping Systems," not listed under paragraph entitled "References," may be used.
****

Qualify each welder and welding operator assigned to work covered by this specification by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with [ASME BPVC SEC IX, [ANSI Piping Standards]] [_____] and as

specified.

1.5.5 Renewal of Qualification

Requalification of a welder or welding operator shall be required under one or any combination of the following conditions:

a. When a welder or welding operator has not used the specific welding process for a period of 3 months. The period may be extended to 6 months if the welder has been employed on another welding process.

b. There is specific reason to question the welder's ability to make welds that will meet the requirements of the specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract and a qualification test has not been taken within the preceding 12 months. Renewal of qualification under this condition need be made on only a single test joint or pipe of any thickness, position, or material to reestablish qualification for any thickness, position, or material for which the welder or welding operator had qualified previously.

1.5.6 Qualification of Inspection and (NDE) Personnel

Qualification of Inspection and Nondestructive Examination (NDE) Personnel: Qualify inspection and nondestructive examination personnel in accordance with the following requirements:

1.5.6.1 Inspector Certification

Qualify welding inspectors in accordance with AWS QC1.

1.5.6.2 NDE Personnel Certification Procedures

****

NOTE: The paragraphs will be edited and inserted if necessary to ensure proper implementation of the "CONTRACTOR QUALITY CONTROL PROGRAM." The specification writer or design engineer must indicate how much quality control of welding is needed for each project and who is to be responsible, i.e., primarily the Contractor or the Government. If quality control is to be the responsibility of the Government, delete paragraphs entitled "Performance" and "Qualification of Inspection and Nondestructive Examination (NDE) Personnel" through "NDE Personnel Qualification" and renumber paragraphs as necessary. Rarely will a project require 100 percent testing of welds by NDE methods. The designer must determine the required methods and the extent of inspection and testing and must indicate the extent in this or other sections of the project specifications or on the project drawings by notes, nondestructive test symbols, or other means. The referenced applicable publications and Army Technical Manual, "Welding Design, Procedures and Inspection," TM-5-805-7, will be used for guidance in determining inspection and testing requirements. The specifications or project

drawings must clearly indicate which joints require 100 percent NDE inspection, which joints require random NDE inspection, and which NDE methods are to be employed for each joint. For random inspection, the project drawings must indicate the location, number of joints, and minimum increment length of weld that will be subject to NDE inspection without predisclosing the exact spots to be examined. Joints not indicated to be tested by NDE methods shall be subject to visual inspection only. In cases where the nature of the welding is such as to require visual inspection only, the requirements for nondestructive examinations should be deleted from these paragraphs and from paragraph entitled "Qualification of Inspection and Nondestructive Examination (NDE) Personnel."

****

Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification. Base procedures on appropriate specific and general guidelines of training and experience recommended by ASNT SNT-TC-1A, [Supplement A-Radiographic] [Supplement B-Magnetic particle] [Supplement C-Ultrasonic] [and] [Supplement D-Liquid Penetrant].

1.5.6.3 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. Do not start welding work prior to procedure qualification. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.5.7 Symbols

Conform to AWS A2.4.

1.5.7.1 Weld Identifications

Submit a list of the welders' names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

1.5.8 Safety

Conform to AWS Z49.1, 29 CFR 1910-SUBPART Q, "Welding, Cutting, and Brazing," 29 CFR 1926-SUBPART J, "Welding and Cutting."

1.6 ENVIRONMENTAL

Do not perform welding when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding.

1.7 DELIVERY AND STORAGE

Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturers' original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

PART 2 PRODUCTS

2.1 WELDING MATERIALS

****

NOTE: Normally, selection of the electrodes is done by the Contractor as part of his qualified welding procedure. In special cases, if the selection of the proper electrode is critical to the design, the designer may specify the electrodes to be used. In special cases it also may be necessary to specify the welding process.

****

Comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING

Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Contracting Officer. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at one meter 3 foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater.

3.2 WELDING OPERATORS

Perform welding in accordance with qualified procedures using qualified welders and welding operators.

3.3 SUPPORTS

Welding of hangers, supports, and plates to structural members shall

conform to AWS D1.1/D1.1M.

3.4 EXAMINATIONS AND TESTS

****

NOTE: The paragraphs will be edited and inserted if necessary to ensure proper implementation of the "CONTRACTOR QUALITY CONTROL PROGRAM." The specification writer or design engineer must indicate how much quality control of welding is needed for each project and who is to be responsible, i.e., primarily the Contractor or the Government. If quality control is to be the responsibility of the Government, delete paragraphs entitled "Performance" and "Qualification of Inspection and Nondestructive Examination (NDE) Personnel" through "NDE Personnel Qualification" and renumber paragraphs as necessary. Rarely will a project require 100 percent testing of welds by NDE methods. The designer must determine the required methods and the extent of inspection and testing and must indicate the extent in this or other sections of the project specifications or on the project drawings by notes, nondestructive test symbols, or other means. The referenced applicable publications and Army Technical Manual, "Welding Design, Procedures and Inspection," TM-5-805-7, will be used for guidance in determining inspection and testing requirements. The specifications or project drawings must clearly indicate which joints require 100 percent NDE inspection, which joints require random NDE inspection, and which NDE methods are to be employed for each joint. For random inspection, the project drawings must indicate the location, number of joints, and minimum increment length of weld that will be subject to NDE inspection without predisclosing the exact spots to be examined. Joints not indicated to be tested by NDE methods shall be subject to visual inspection only. In cases where the nature of the welding is such as to require visual inspection only, the requirements for nondestructive examinations should be deleted from these paragraphs and from paragraph entitled "Qualification of Inspection and Nondestructive Examination (NDE) Personnel."

****

****

NOTE: Information based on the two tables must be developed and included in each project specification. Tables must clearly define the systems to be inspected and the type of NDE required. Specify 100 percent NDE when required by UFC 3-460-01, "Design: Petroleum Fuel Facilities" and 49 CFR 195, as covered by paragraph entitled "Piping Subject to 100 percent NDE."

****

Visual and nondestructive examinations shall be performed [by the

Government] [by the Contractor] to detect surface and internal discontinuities in completed welds. [Employ the services of a qualified commercial inspection or testing laboratory or technical consultant approved by the Contracting Officer.] Visually examine welds [Radiographic,] [Liquid penetrant,] [Magnetic particle,] [or] [Ultrasonic] examination shall be required as indicated in Tables [IV] [and] [V] attached to this section [or in accordance with other sections where detailed requirements are specified]. Random NDE testing applies to ASME B31.3 and ASME B31.4 piping unless specified otherwise. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the paragraph entitled "Corrections and Repairs" of this section.

3.4.1 Random NDE Testing

****

NOTE: The paragraphs will be edited and inserted if necessary to ensure proper implementation of the "CONTRACTOR QUALITY CONTROL PROGRAM." The specification writer or design engineer must indicate how much quality control of welding is needed for each project and who is to be responsible, i.e., primarily the Contractor or the Government. If quality control is to be the responsibility of the Government, delete paragraphs entitled "Performance" and "Qualification of Inspection and Nondestructive Examination (NDE) Personnel" through "NDE Personnel Qualification" and renumber paragraphs as necessary. Rarely will a project require 100 percent testing of welds by NDE methods. The designer must determine the required methods and the extent of inspection and testing and must indicate the extent in this or other sections of the project specifications or on the project drawings by notes, nondestructive test symbols, or other means. The referenced applicable publications and Army Technical Manual, "Welding Design, Procedures and Inspection," TM-5-805-7, will be used for guidance in determining inspection and testing requirements. The specifications or project drawings must clearly indicate which joints require 100 percent NDE inspection, which joints require random NDE inspection, and which NDE methods are to be employed for each joint. For random inspection, the project drawings must indicate the location, number of joints, and minimum increment length of weld that will be subject to NDE inspection without predisclosing the exact spots to be examined. Joints not indicated to be tested by NDE methods shall be subject to visual inspection only. In cases where the nature of the welding is such as to require visual inspection only, the requirements for nondestructive examinations should be deleted from these paragraphs and from paragraph entitled "Qualification of Inspection and Nondestructive Examination (NDE) Personnel."

****

****

NOTE: This paragraph will be deleted when the Contractor is not required to perform random inspection. Edit to delete any listed nondestructive test method which is inapplicable. Insert a number from 1 to 99 for percent of welds to be randomly inspected; 10 percent is recommended for most projects.

When [radiographic,] [liquid penetrant,] [magnetic particle,] [or] [ultrasonic] examination is required, test a minimum of [10] [_____] percent of the total length or number of piping welds. Randomly select the welds examined, but include an examination of welds made by each welding operator or welder. If random testing reveals that a weld fails to meet minimum quality requirements, examine an additional [10] [_____] percent of the welds in that same group. If the additional welds examined meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds examined also fail to meet the quality requirements, that entire group of welds shall be rejected. Remove and reweld rejected welds or examine rejected welds 100 percent and remove and reweld defects.

3.4.2 Visual Examination

Visually examine welds as follows:

a. Before welding -- for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

b. During welding -- for conformance to the qualified welding procedure.

c. After welding -- for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.4.3 Nondestructive Examination

NOTE: Delete any nondestructive test method not required. If magnetic particle inspection is required, specify whether wet or dry particle method is appropriate.

NDE shall be in accordance with written procedures. Procedures for [radiographic,] [liquid penetrant,] [magnetic particle,] [or] [ultrasonic] tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer's QA personnel. In addition to the information required in ASME BPVC SEC V, the written procedures shall include:

a. Timing of the nondestructive examination in relation to the welding operations.

b. Safety precautions.

3.4.4 Examinations and Tests by the Government

Examinations and tests will conform to paragraphs "Visual Examination" and

"Nondestructive Examination" of this section, except that destructive tests may be required also. When destructive tests are made, qualified welders or welding operators shall make repairs using welding procedures which will develop the full strength of the members cut. Welding shall be subject to examination and tests in the mill, shop, and field.

3.4.5 Piping Subject to 100 Percent NDE

ASME B31.4 [and ASME B31.3] Piping Subject to 100 Percent NDE: 100 percent of each day's girth welds installed in the following locations shall be nondestructively examined 100 percent by radiographic, magnetic particle, or liquid penetrant examination unless impracticable, in which case at least 90 percent must be examined. Nondestructive examination must be impracticable for each girth weld not examined.

a. At onshore locations where a loss of hazardous liquid (petroleum, petroleum products, or anhydrous ammonia) could reasonably be expected to pollute stream, river, lake, reservoir, or other body of water, and any offshore area;

b. Within railroad or public road rights-of-way;

c. At overhead road crossings and within tunnels;

d. Within the limits of any incorporated subdivision of a State government; and

e. Within populated areas, including, but not limited to, residential subdivisions, shopping centers, schools, designated commercial areas, industrial facilities, public institutions, and places of public assembly.

3.5 ACCEPTANCE STANDARDS

****

NOTE: These acceptance standards are taken from ASME B31.1 and are suitable for most jobs. Evaluations of indications as given in ASME B31.1 are applicable to these standards. Visual acceptance standards are given for some other piping codes. It should be noted that specific project design requirements may necessitate revision or expansion to cover different items of work and varying standards of acceptance.

****

3.5.1 Visual

The following indications are unacceptable:

a. Cracks--external surface.

****

NOTE: In the text below, if only ASME B31.3 is applicable, delete all text in brackets. For ASME B31.3 under normal service conditions, use 25 percent with text in brackets and omit last sentence in brackets. For ASME B31.4 use 12.5 percent, and add the material in brackets pertaining to B31.4.

Consider use of ASME B31.1 acceptance standard for codes other than B31.3 and B31.4.
****

b. Undercut on surface which is greater than 1.00 mm 1/32 inchdeep [or [25 percent for ASME B31.3] [and] [12.5 percent for ASME B31.4 and ASME B31.9] of the wall thickness, whichever is less,] provided that the remaining wall thickness is not less than the minimum design thickness. [For ASME B31.4 and in accordance with API Std 1104, undercuts over 0.40 mm through 0.80 mm 1/64 inch through 1/32 inch or over 6 to 12.5 percent of the pipe wall thickness, whichever is smaller, shall not exceed 51 mm 2 inches in a continuous weld length of 305 mm 12 inches or 1/6 the length of the weld, whichever is smaller; and undercuts 0.40 mm 1/64 inch or 6 percent of the wall thickness, whichever is smaller, are acceptable regardless of length.]

****
NOTE: Include Tables I, II, or III below as applicable to project.
****

c. Weld reinforcement:

(1) ASME B31.1, conform to Table I.

TABLE I REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS			
	Maximum Thickness of Reinforcement for Design Temperature		
Thickness of Base Metal, millimeters (mm)	Greater than 400 degrees C	175 degrees C - 400 degrees C	Less than 175 degrees C
	mm	mm	mm
Up to 3.00, incl.	2.00	2.50	5.00
Over 3.00 to 5.00, incl.	2.00	3.00	5.00
Over 5.00 to 13.00, incl.	2.00	4.00	5.00
Over 13.00 to 25.00, incl.	2.50	5.00	5.00
Over 25.00 to 50.00, incl.	3.00	6.00	6.00
Over 50.00	4.00	The greater of 6 mm or 1/8 times the width of the weld in mm.	
NOTES:			

TABLE I REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS			
	Maximum Thickness of Reinforcement for Design Temperature		
Thickness of Base Metal, millimeters (mm)	Greater than 400 degrees C	175 degrees C - 400 degrees C	Less than 175 degrees C
	mm	mm	mm
1. For double welded butt joints, this limitation on reinforcement given above shall apply separately to both inside and outside surfaces of the joint.			
2. For single welded butt joints, the reinforcement limits given above shall apply to the outside surface of the joint only.			
3. The thickness of weld reinforcement shall be based on the thickness of the thinner of the materials being joined.			
4. The weld reinforcement thicknesses shall be determined from the higher of the abutting surfaces involved.			
5. Weld reinforcement may be removed if so desired.			

TABLE I REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS			
	Maximum Thickness of Reinforcement for Design Temperature		
Thickness of Base Metal, inches	Greater than 750 degrees F	350 degrees F - 750 degrees F	Less than 350 degrees C
	inch	inch	inch
Up to 1/8, incl.	1/16	3/32	3/16
Over 1/8 to 3/16, incl.	1/16	1/8	3/16
Over 3/16 to 1/2, incl.	1/16	5/32	3/16
Over 1/2 to 1, incl.	3/32	3/16	3/16
Over 1 to 2, incl.	1/8	1/4	1/4

TABLE I REINFORCEMENT OF GIRTH AND LONGITUDINAL BUTT WELDS			
	Maximum Thickness of Reinforcement for Design Temperature		
Thickness of Base Metal, inches	Greater than 750 degrees F	350 degrees F - 750 degrees F	Less than 350 degrees C
	inch	inch	inch
Over 2	5/32	The greater of 1/4 inch or 1/8 times the width of the weld in inches.	
NOTES:			
1. For double welded butt joints, this limitation on reinforcement given above shall apply separately to both inside and outside surfaces of the joint.			
2. For single welded butt joints, the reinforcement limits given above shall apply to the outside surface of the joint only.			
3. The thickness of weld reinforcement shall be based on the thickness of the thinner of the materials being joined.			
4. The weld reinforcement thicknesses shall be determined from the higher of the abutting surfaces involved.			
5. Weld reinforcement may be removed if so desired.			

(2) ASME B31.3, conform to Table II.

TABLE II	
Wall Thickness, mm	Height, mm
Less than or equal to 6.40	Less than or equal to 1.60
Greater than 6.40, is less than or equal to 12.70	Less than or equal to 3.20
Greater than 12.70, is less than or equal to 25.40	Less than or equal to 4.00
Greater than 25.40	Less than or equal to 4.80
NOTES:	

TABLE II	
Wall Thickness, mm	Height, mm
1. Wall thickness is the nominal wall thickness of the thinner of components joined by butt weld.	
2. Height: For "Normal Service" and "Severe Cyclic" conditions, use the listed value. For "Category D Fluid Service," use twice the listed value. Measure from surfaces of adjacent components. The lesser of the two measurements, in any plane through the weld, shall not exceed the applicable value at right. Weld metal shall merge smoothly into component surfaces.	

TABLE II	
Wall Thickness, inches	Height, inches
Less than or equal to 1/4	Less than or equal to 1/16
Greater than 1/4, is less than or equal to 1/2	Less than or equal to 1/8
Greater than 1/2, is less than or equal to 1	Less than or equal to 5/32
Greater than 1	Less than or equal to 3/16
NOTES:	
1. Wall thickness is the nominal wall thickness of the thinner of components joined by butt weld.	
2. Height: For "Normal Service" and "Severe Cyclic" conditions, use the listed value. For "Category D Fluid Service," use twice the listed value. Measure from surfaces of adjacent components. The lesser of the two measurements, in any plane through the weld, shall not exceed the applicable value at right. Weld metal shall merge smoothly into component surfaces.	

(3) ASME B31.4, conform to Table I for under 175 degrees C 350 degrees F.

(4) ASME B31.5, conform to Table III.

TABLE III	
Pipe Wall Thickness, mm	Reinforcement Thickness, mm
6.40 and under	1.60

TABLE III	
Pipe Wall Thickness, mm	Reinforcement Thickness, mm
Over 6.40 through 12.70	2.40
Over 12.70, through 25.40	3.20
Over 25.40	4.80

TABLE III	
Pipe Wall Thickness, inches	Reinforcement Thickness, inches
1/4 and under	1/16
Over 1/4 through 1/2	3/32
Over 1/2, through 1	1/8
Over 1	3/16

(5) ASME B31.9: Thickness of weld reinforcement shall not exceed 4.80 mm 3/16 inch.

d. Lack of fusion on surface.

e. Incomplete penetration (applies only when inside surface is readily accessible).

f. Convexity of fillet weld surface greater than 10 percent of longest leg plus 1.0 mm 0.03 inch.

g. Concavity in groove welds.

h. Concavity in fillet welds greater than 2.0 mm 1/16 inch.

i. Fillet weld size less than indicated or greater than 1 1/4 times the minimum specified fillet leg length.

3.5.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

a. Any cracks and linear indications.

b. Rounded indications with dimensions greater than 5.0 mm 3/16 inch.

c. Four or more rounded indications in a line separated by 2.0 mm 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 3870 square mm 6 square inches of surface, with the major dimension of this area not to exceed 150 mm 6 inches, with the area taken in the most unfavorable location

relative to the indications being evaluated.

3.5.3 Liquid Penetrant Examination

Indications whose major dimensions are greater than 2.0 mm 1/16 inch shall be considered relevant. The following relevant indications are unacceptable:

a. Any cracks or linear indications.

b. Rounded indications with dimensions greater than 5.0 mm 3/16 inch.

c. Four or more rounded indications in a line separated by 2.0 mm 1/16 inch or less edge-to-edge.

d. Ten or more rounded indications in any 3870 square mm 6 square inches of surface, with the major dimension of this area not to exceed 150 mm 6 inches, with the area taken in the most unfavorable location relative to the indications being evaluated.

3.5.4 Radiography

Welds that are shown by radiography to have any of the following discontinuities are unacceptable:

a. Any type of crack or zone of incomplete fusion or penetration.

b. Any other elongated indication which has a length greater than:

(1) 6.0 mm 1/4 inch for t up to 19.0 mm 3/4 inch, inclusive;

(2) 1/3 t for t from 19.0 mm 3/4 inch to 57.00 mm 2 1/4 inches, inclusive;

(3) 19.00 mm 3/4 inch for t over 57.00 mm 2 1/4 inches where t is the thickness of the thinner portion of the weld.

("t" pertains to the thickness of the weld being examined. If a weld joins two members having different thickness at the weld, "t" is the thinner of these two thicknesses.)

c. Any group of indications in line that have an aggregate length greater than t in a length of 12t, except where the distance between the successive indications exceeds 6L where L is the longest indication in the group.

d. Porosity in excess of that shown acceptable in Appendix A-250, Acceptance Standard for Radiographically Determined Rounded Indications in Welds, ASME BPVC SEC I.

3.5.5 Ultrasonic Examination

Permitted for ASME B31.3 and ASME B31.4 piping only. Linear type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

a. 6.0 mm 1/4 inch for t up to 19.0 mm 3/4 inch

b. 1/3 t for t from 19.0 mm 3/4 inch to 57.0 mm 2 1/4 inches

c. 19.0 mm 3/4 inch for t over 57.0 mm 2 1/4 inches

("t" is the thickness of the weld being examined. If the weld joins two members having different thickness at the weld, "t" is the thinner of these two thicknesses. Discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration are unacceptable regardless of length.)

3.6 CORRECTIONS AND REPAIRS

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NOTE: Insert the applicable ANSI piping codes. ANSI B31.2, "Fuel Gas Piping," and ASME B31.8, "Gas Transmission and Distribution Piping Systems," not listed under paragraph entitled "References," may be used.

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Remove defects and replace welds as specified in [ANSI Piping Standards] [_____], unless otherwise specified. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

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NOTE: Regarding Table IV, information based on the table must be developed and included in each project specification. Tables must clearly define the systems to be inspected and the type of NDE required. Specify 100 percent NDE when required by UFC 3-460-01, "Design: Petroleum Fuel Facilities" and 49 CFR 195, as covered by paragraph entitled "Piping Subject to 100 Percent NDE." Where appears, select 100 percent or random but not both.

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TABLE IV - EXAMINATIONS AND TESTS FOR VARIOUS MATERIALS AND SERVICES				
Examinations or Tests Required				
Material or Application	Visual	Radiographic	[Magnetic Particle] [or] [Liquid Penetrant]	Ultrasonic
High-alloy austenitic or nickel steels or nickel alloys for cryogenic service and vacuum service				
a. Tack welds	Yes	No	No No	
b. Root passes	Yes	No	Yes No	
c. Intermediate passes	Yes	No	No No	
d. Completed weld	Yes	100 percent for DN over 32 mm 60 percent for DN 32mm and less 100 percent for NPS over 1-1/4 inches 60 percent for NAPA PS 1-1/4 inches and less	Yes(PT only); 50 mm 1/2 inch and over	Yes for wall thickness
High-alloy austenitic or nickel steels or nickel alloys for other than cryogenic or vacuum service				
a. Tack welds	Yes	No	No No	
b. Root passes	Yes	No	[No][Yes]	No
c. Intermediate passes	Yes	No	No No	
d. Completed weld	Yes	[100 percent] [Random]	Yes (PT only)	[No] [Yes]
Stainless steel to carbon steel				
a. Completed weld	Yes	[No] [Yes] [Random]	Yes (PT only)	No
Carbon steel piping systems				
a. Tack welds	Yes	No	No	No

TABLE IV - EXAMINATIONS AND TESTS FOR VARIOUS MATERIALS AND SERVICES				
	Examinations or Tests Required			
Material or Application	Visual	Radiographic	[Magnetic Particle] [or] [Liquid Penetrant]	Ultrasonic
b. Root passes	Yes	No	[No] [Yes MT]	No
c. Intermediate passes	Yes	No	No	No
d. Completed weld	Yes	[100 percent] [Random]	[No] [Yes MT]	No

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NOTE: Regarding Table V, information based on the table must be developed and included in each project specification. Tables must clearly define the systems to be inspected and the type of NDE required. Specify 100 percent NDE when required by UFC 3-460-01, "Design: Petroleum Fuel Facilities" and 49 CFR 195, as covered by paragraph entitled "Piping Subject to 100 Percent NDE."

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TABLE V - MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING			
	Temperatures over 400 degrees C and at all pressures.	Temperatures between 175 degrees C and 400 degrees C inclusive and at all pressures over 7100 kPa gage	All others
Buttwelds (Girth and Longitudinal)	RT for DN over 50 mm MT or PT for DN 50 mm and less.	RT for over 50 mm DN with thickness over 19 mm. Visual for all sizes with thickness 19 mm or less.	Visual for all sizes and thicknesses.

TABLE V - MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING			
	Temperatures over 400 degrees C and at all pressures.	Temperatures between 175 degrees C and 400 degrees C inclusive and at all pressures over 7100 kPa gage	All others
Welded Branch Connections (Size indicated is Branch Size)	RT for DN over 50 mm MT or PT for DN 50 mm and less.	RT for branch over 100 mm DN and thickness of branch over 19 mm. Visual for all sizes with branch thickness 19 mm or less.	Visual for all sizes and thicknesses.
Fillet, Socket Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

NOTES:

1. Thickness refers to pressure boundary wall thickness (such as pipe wall, fitting wall, or nozzle wall thickness).

2. All welds must be given a visual examination in addition to type of specific nondestructive examination specified.

3. NPS-Nominal Pipe Size.

4. RT-Radiographic examination; MT-magnetic particle examination; PT-liquid penetrant examination.

5. RT of branch welds shall be performed before any nonintegral reinforcing material is applied.

6. The thickness of buttwelds is defined as the thicker of the two abutting ends after end preparation.

7. Temperatures and pressures shown are design.

8. In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 50 mm of weld thickness and all accessible final weld surfaces.

TABLE V - MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING			
	Temperatures over 400 degrees C and at all pressures.	Temperatures between 175 degrees C and 400 degrees C inclusive and at all pressures over 7100 kPa gage	All others
9. For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.			

TABLE V - MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING			
	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at all pressures over 1052 psig gage	All others
Buttwelds (Girth and Longitudinal)	RT for NPS over 2 inches MT or PT for NPS 2 inches and less.	RT for over 2 inch NPS with thickness over 3/4 inch. Visual for all sizes with thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Welded Branch Connections (Size indicated is Branch Size)	RT for NPS over 2 inch MT or PT for NPS 2 inch and less.	RT for branch over 4 inch NPS and thickness of branch over 3/4 inch. Visual for all sizes with branch thickness 3/4 inch or less.	Visual for all sizes and thicknesses.
Fillet, Socket Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

TABLE V - MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS FOR ASME B31.1 PIPING			
	Temperatures over 750 degrees F and at all pressures.	Temperatures between 350 degrees F and 750 degrees F inclusive and at all pressures over 1052 psig gage	All others
NOTES:			
1. Thickness refers to pressure boundary wall thickness (such as pipe wall, fitting wall, or nozzle wall thickness).			
2. All welds must be given a visual examination in addition to type of specific nondestructive examination specified.			
3. NPS-Nominal Pipe Size.			
4. RT-Radiographic examination; MT-magnetic particle examination; PT-liquid penetrant examination.			
5. RT of branch welds shall be performed before any nonintegral reinforcing material is applied.			
6. The thickness of buttwelds is defined as the thicker of the two abutting ends after end preparation.			
7. Temperatures and pressures shown are design.			
8. In lieu of radiography of welded branch connections when required above, liquid penetrant or magnetic particle examination is acceptable and, when used, shall be performed at the lesser of one-half of the weld thickness or each 1/2 inch of weld thickness and all accessible final weld surfaces.			
9. For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.			

-- End of Section --