****
USACE / NAVFAC / AFCEC / NASA **UFGS-40 05 13.96 (May 2010)**

Preparing Activity: USACE **Superseding**
UFGS-43 02 00 (April 2006)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021
****

SECTION TABLE OF CONTENTS

DIVISION 40 - PROCESS INTERCONNECTIONS

SECTION 40 05 13.96

WELDING PROCESS PIPING

05/10

PART 1 GENERAL

1.1 REFERENCES
1.2 DEFINITIONS AND SYMBOLS
1.3 PERFORMANCE REQUIREMENTS
1.4 SUBMITTALS
1.5 QUALIFICATIONS
1.5.1 Welding Procedures Qualification
1.5.2 Welder and Welding Operator Performance
1.5.2.1 Certification
1.5.2.2 Identification
1.5.2.3 Renewal of Qualification
1.5.3 Inspection and NDE Personnel
1.5.3.1 Inspector Certification
1.5.3.2 NDE Personnel
1.6 REGULATORY REQUIREMENTS
1.7 DELIVERY, STORAGE, AND HANDLING
1.7.1 Material Control
1.7.1.1 Damaged Containers
1.7.1.2 Partial Issues
1.7.2 Damaged Materials

PART 2 PRODUCTS

2.1 MATERIALS

PART 3 EXECUTION

3.1 WELDING OPERATIONS
3.1.1 Base Metal Preparation
3.1.2 Weld Joint Fit-Up
3.1.3 Preheat and Interpass Temperatures
3.1.4 Production Welding Instructions
3.1.5 Postweld Heat Treatment
3.2 EXAMINATIONS, INSPECTIONS, AND TESTS
3.2.1 Random NDE Testing

3.2.2 Visual Inspection
3.2.2.1 Before Welding
3.2.2.2 During Welding
3.2.2.3 After Welding
3.2.3 NDE Testing
3.2.4 Inspection and Tests by the Government
3.3 ACCEPTANCE STANDARDS
3.3.1 Visual
3.3.2 Magnetic Particle Examination
3.3.3 Liquid Penetrant Examination
3.3.4 Radiography
3.3.5 Ultrasonic Examination
3.4 CORRECTIONS AND REPAIRS

-- End of Section Table of Contents --

****

USACE / NAVFAC / AFCEC / NASA | **UFGS-40 05 13.96 (May 2010)**

Preparing Activity: USACE | **Superseding UFGS-43 02 00 (April 2006)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2021

****

SECTION 40 05 13.96

WELDING PROCESS PIPING
05/10

****

NOTE: This guide specification covers the requirements for welding of piping and piping system components used for fluids and gases 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).

****

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 SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A	(2020) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing
ASNT SNT-TC-1A Q&A Bk A	(2010) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Radiographic Testing Method
ASNT SNT-TC-1A Q&A Bk B	(2007) Supplement to Recommended Practice SNT-TC-1A (Q&A Book): Magnetic Particle Method
ASNT SNT-TC-1A Q&A Bk C	(2011; Text Correction 2011) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Ultrasonic Testing Method
ASNT SNT-TC-1A Q&A Bk D	(2011; Text Correction 2011) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Liquid Penetrant Testing Method

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(2020) Power Piping
ASME B31.3	(2016) Process Piping
ASME B31.4	(2019) Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquid
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B31.8	(2018; Supplement 2018) Gas Transmission and Distribution Piping Systems
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	(2014; Errata 2015) Specification for Welding Procedure and Performance Qualification
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

1.2 DEFINITIONS AND SYMBOLS

Definitions shall be in accordance with AWS A3.0M/A3.0. Symbols shall be in accordance with AWS A2.4.

1.3 PERFORMANCE REQUIREMENTS

****

NOTE: If quality control is to be the responsibility of the Government, delete this paragraph.

The paragraphs will be edited and bracketed portions 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.

In many cases a project may not 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, NDE symbols, or other means. The referenced applicable publications will be used for guidance in determining inspection and testing requirements.

The specifications or 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 drawings must indicate the location, number of joints, and minimum

increment length of weld that will be 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 NDE should be deleted from these paragraphs and from paragraph Inspection and NDE Personnel.
****

Quality of all joint preparation, welding, and examination is the Contractor's responsibility for. Clearly identify and record all materials used in the welding operations. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when it is deemed necessary to achieve the quality required.

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

Pressure Piping; G[, [_____]]

SD-03 Product Data

Welding Operations

SD-07 Certificates

Qualifications

1.5 QUALIFICATIONS

Welding procedures, welders, and welding operators previously qualified by test may be accepted for the work without requalification, provided that all of the following conditions are fulfilled:

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

b. Testing was performed by an approved testing laboratory or technical consultant or by the Contractor's approved quality assurance 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 "Renewal of Qualification" below are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.5.1 Welding Procedures Qualification

Record in detail and qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure shall conform to the requirements of [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8,] and to this specification. The welding procedures shall specify end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds shall be as required by approved welding procedures, unless otherwise indicated or specified. The type of backing rings or consumable inserts, if used, shall be described and if they are to be removed, the removal process shall be described. Copies of the welding procedure specifications and procedure qualification test results for each type of welding required shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be

referenced on the detail drawings or keyed to the contract drawings.

1.5.2 Welder and Welding Operator Performance

Each welder and welding operator assigned to work shall be qualified in accordance with [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8].

1.5.2.1 Certification

Before assigning welders or welding operators to the work, provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. 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.

1.5.2.2 Identification

Identify each particular weld with the personal number, letter, or symbol assigned to each welder or welding operator. To identify welds, written records indicating the location of welds made by each welder or welding operator shall be submitted, and each welder or welding operator shall apply the personal mark adjacent to the welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. For seam welds, identification marks shall be placed adjacent to the welds at 1 m 3 foot intervals. Identification by die stamps or electric etchers will not be allowed.

1.5.2.3 Renewal of Qualification

Requalification of a welder or welding operator is required under any 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 or welding operator has been employed on some other welding process.

b. When a welder or welding operator has not welded with any process during a period of 3 months, all the personal qualifications shall be considered expired, including any extended by virtue of a., above.

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

d. 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.

e. Renewal of qualification for a specific welding process under conditions a., b., and d., above, needs to be made on only a single test joint or pipe of any thickness, position, or material to reestablish the welder's or welding operator's qualification for any thickness, position, or material covered under previous qualification.

1.5.3 Inspection and NDE Personnel

****

NOTE: If quality control is to be the responsibility of the Government, delete these paragraphs.

Coordinate with paragraph Performance.

****

All inspection and NDE personnel shall be qualified in accordance with the following requirements.

1.5.3.1 Inspector Certification

Welding inspectors shall be qualified in accordance with AWS QC1.

1.5.3.2 NDE Personnel

NDE personnel shall be certified, and a written procedure for the control and administration of NDE personnel training, examination, and certification shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT SNT-TC-1A, [ASNT SNT-TC-1A Q&A Bk A] [ASNT SNT-TC-1A Q&A Bk B] [ASNT SNT-TC-1A Q&A Bk C] [and] [ASNT SNT-TC-1A Q&A Bk D].

1.6 REGULATORY REQUIREMENTS

****

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

Project drawings must indicate, or text of project specifications must specify, the welding procedures, and size, length, type, and location of the welds, as necessary.

****

This section covers the welding of pressure piping systems. Submit detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made offsite will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Develop procedures for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. 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 worksite. Maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between

different materials or between plates or pipes of different wall thicknesses shall be qualified. [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8] 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. Safety precautions shall conform to AWS Z49.1.

1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

1.7.1 Material Control

****

NOTE: If additional requirements are necessary regarding limits on out-of-oven exposure time, refer to AWS D1.1/D1.1M.

****

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within 1/2 hour, be placed in a storage oven.

1.7.2 Damaged Materials

Materials which are damaged shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

PART 2 PRODUCTS

2.1 MATERIALS

****

NOTE: Normally, selection of the electrodes is done by the Contractor. 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.
****

Provide welding materials which 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 OPERATIONS

Perform welding in accordance with qualified procedures using qualified welders and welding operators. Submit detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

Welding shall not be done 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. Welding of hangers, supports, and plates to structural members shall conform to Section 05 05 23.16 STRUCTURAL WELDING.

3.1.1 Base Metal Preparation

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 6 mm 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

Preheat temperatures shall meet the requirements specified by [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8]. However, in no case shall the preheat be below 10 degrees C 50 degrees F for ferritic steel or austenitic stainless steel, or 0 degrees C 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 149 degrees C 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 260 degrees C 500 degrees F for carbon steels. Preheat techniques shall be such as to ensure that the full thickness of the weld joint preparation and/or adjacent base material, at least 75 mm 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating

shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 66 degrees C 150 degrees F. Interpass temperatures shall be checked on the surface of the component within 25 mm 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 150 mm 6 inches ahead of the weld, but not on the area to be welded.

3.1.4 Production Welding Instructions

a. Welding shall not be done when the ambient temperature is lower than minus 18 degrees C 0 degree F.

b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.

c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees C minus 40 degrees F or lower.

d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.

e. The purge on groove welds shall be maintained for at least three layers or 5 mm 3/16 inch.

f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.

g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 8 km/hour 5 mph (440 fpm).

h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 10 mm 3/8 inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.

i. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable

high-alloy steels, the area shall be magnetic particle examination inspected.

j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:

(1) The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements: ASME BPVC SEC II-C, SFA 5.14, Classification ERNiCr-3; or ASME BPVC SEC II-C, SFA 5.11, Classification ENiCrFe-2.

(2) The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8] and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 6 mm 1/4 inch thick.

(3) Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.

k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 93 degrees C 200 degrees F or less, stainless filler metal 309 ASME BPVC SEC II-C, SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.

l. Grinding of completed welds is to be performed only to the extent required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8]. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external surfaces.

3.1.5 Postweld Heat Treatment

a. Postweld heat treatment shall be performed in accordance with [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8]. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.

b. Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 149 degrees C 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per 25 mm inch of weld thickness.

c. For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

****

NOTE: Coordinate with paragraph Performance.

Information based on the table must be developed and included in each project specification. The table must clearly define the systems to be inspected and the type of NDE required. The information presented in TABLE I is based on ASME B31.1. Specific project requirements may necessitate revision or expansion. In no case shall the degree of testing and type of NDE be less than that required by the standard applicable to the work.

****

Visual and NDE shall be performed [by the Government] [by the Contractor] to detect surface and internal discontinuities in completed welds. [The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor.] All tack welds, weld passes, and completed welds shall be visually inspected. In addition, [magnetic particle] [liquid penetrant] examination shall be performed on root passes. [Radiographic] [Liquid penetrant] [Magnetic particle] [or] [Ultrasonic] examination shall be required as indicated in TABLE I. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS			
Type Weld	Piping Service Conditions and Nondestructive Test		
	Temperatures over 400 degrees C 750 degrees F and at all pressures	Temperatures between 177 degrees C 350 degrees F and 400 degrees C 750 degrees F inclusive and at pressures above 7100 kPa 1025 psig	All others
Butt Welds (Girth and Longitudinal)	RT for NPS over 50 mm 2 inches MT or PT for NPS 50 mm 2 inches and less	RT for over 50 mm 2 inches NPS with thickness over 20 mm 3/4 inch. Visual for all sizes with thickness 20 mm 3/4 inch or less.	Visual for all sizes and thicknesses

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS			
Type Weld	Piping Service Conditions and Nondestructive Test		
Welded Branch Conncetions (Size indicated is branch size) (See Note 7)	RT for NPS over 100 mm 4 inches MT or PT for NPS 100 mm 4 inches and less	RT for over 100 mm 4 inches NPS with thickness over 20 mm 3/4 inch. Visual for all sizes with thickness 20 mm 3/4 inch or less.	Visual for all sizes and thicknesses
Fillet, Socket Attachment and Seal Welds	PT or MT for all sizes and thicknesses	Visual for all sizes and thicknesses	Visual for all sizes and thicknesses
NOTES TO TABLE I			
(1) All welds must be given a visual examination in addition to type of specific nondestructive examination specified.			
(2) NPS - nominal pipe size.			
(3) RT - Radiographic examination; MT - magnetic particle examination; PT - liquid penetrant examination.			
(4) RT of branch welds shall be performed before any nonintegral reinforcing material is applied.			
(5) The thickness of butt welds is defined as the thicker of the two abutting ends after end preparation.			
(6) Temperatures and pressures shown are design.			
(7) 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 13 mm 1/2 inch of weld thickness and all accessible final weld surfaces.			
(8) For nondestructive examination of the pressure retaining component, refer to the standards listed in applicable code or the manufacturing specifications.			
(9) Fillet welds not exceeding 6 mm 1/4 inch throat thickness which are used for the permanent attachment of nonpressure retaining parts are exempt from the PT or MT requirements of the above table.			

3.2.1 Random NDE Testing

****

NOTE: Coordinate with paragraph Performance.

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

****

When random [radiographic] [liquid penetrant] [magnetic particle] [or] [ultrasonic] examination is required, test a minimum of [_____] percent of

the total length or number of piping welds. The welds inspected shall be selected randomly, but the selection shall include an examination of welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional [_____] percent of the welds in that same group shall be inspected. If all of the additional welds inspected 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 inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

3.2.2.1 Before Welding

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

3.2.2.2 During Welding

For cracks and conformance to the qualified welding procedure.

3.2.2.3 After Welding

For cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.2.3 NDE Testing

****

NOTE: Delete any NDE 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. In addition to the information required in ASME BPVC SEC V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor, and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the

tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

****

NOTE: These acceptance standards were 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. Specific project design requirements may necessitate revision or expansion to cover different items of work and varying standards of acceptance. In no case shall the acceptance criteria be less conservative than the criteria specified by the standard applicable to the work. The 5 mm 3/16 inch dimension specified in sub item c is based on TABLE 127.4.2 of ASME B31.1 for temperatures less than 177 degrees C 350 degrees F and thicknesses less than 25 mm 1 inch. If actual conditions exceed these limits, this requirement shall be expanded or revised as required.

****

3.3.1 Visual

The following indications are unacceptable:

a. Cracks.

b. Undercut on surface which is greater than 1 mm 1/32 inch deep.

c. Weld reinforcement greater than 5 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 0.76 mm 0.03 inch.

g. Concavity in groove welds.

h. Concavity in fillet welds greater than 2 mm 1/16 inch.

i. Fillet weld size less than indicated or greater than 1.25 times the minimum indicated fillet leg length.

3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

a. Any cracks and linear indications.

b. Rounded indications with dimensions greater than 5 mm 3/16 inch.

c. Four or more rounded indications in a line separated by 2 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.

3.3.3 Liquid Penetrant Examination

Indications with major dimensions greater than 2 mm 1/16 of an 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 mm 3/16 inch.

c. Four or more rounded indications in a line separated by 2 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.

3.3.4 Radiography

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

a. Porosity in excess of that shown as acceptable in ASME BPVC SEC I, Appendix A-250.

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

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

(1) 6 mm 1/4 inch for "t" up to 19 mm 3/4 inch inclusive. Where "t", here and below, 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.

(2) 1/3 "t" for "t" from 19 mm 3/4 inch to 57 mm 2-1/4 inch, inclusive.

(3) 19 mm 3/4 inch for "t" over 57 mm 2-1/4 inch.

d. 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.

3.3.5 Ultrasonic Examination

Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of length. Linear-type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

a. 6 mm 1/4 inch for "t" up to 19 mm 3/4 inch. Where "t", here and below, is the thickness of the weld being examined; if the weld joins two members having different thicknesses at the weld, "t" is the thinner of these two thicknesses.

b. 8 mm 1/3 inch for "t" from 19 to 57 mm 3/4 to 2-1/4 inch.

c. 19 mm 3/4 inch for "t" over 57 mm 2-1/4 inch.

3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in [ASME B31.1,] [ASME B31.3,] [ASME B31.4,] [ASME B31.5,] [ASME B31.8] unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired 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, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --