Preparing Activity: NAVFAC Superseding
UFGS-33 52 90.00 20 (February 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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USACE / NAVFAC / AFCEC / NASA **UFGS-33 52 23.15 (November 2018)**

Preparing Activity: NAVFAC **Superseding**
UFGS-33 52 90.00 20 (February 2010)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023

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SECTION 33 52 23.15

POL SERVICE PIPING WELDING
11/18

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NOTE: This guide specification covers the requirements for welding of piping and piping system components used for petroleum, oil and lubricants (POL) under pressure, including modification to existing hydrant fueling systems.

The following guidance is offered the designer. ASME B31.3 - Process Piping.

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).

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PART 1 GENERAL

1.1 REFERENCES

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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.

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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 650	(2013; Errata 1 2013; Addendum 1 2014; Errata 2 2014; Addendum 2 2016; Addendum 3 2018) Welded Tanks for Oil Storage

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 B31.3	(2022) Process Piping
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 A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.3/A5.3M	(1999; R 2007) Specification for Aluminum and Aluminum-Alloy Electrodes for Shielded Metal Arc Welding
AWS A5.4/A5.4M	(2012; R 2022) Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS A5.9/A5.9M	(2022) Welding Consumables-Wire Electrodes, Strip Electrodes, Wires, and Rods for Arc Welding of Stainless and Heat

	Resisting Steels- Classification
AWS A5.10/A5.10M	(2021) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS A5.18/A5.18M	(2021) Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.22/A5.22M	(2012) Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods
AWS A5.32/A5.32M	(2021) Welding Consumables-Gases and Gas Mixtures for Fusion Welding and Allied Processess
AWS C5.5/C5.5M	(2003) Recommended Practices for Gas Tungsten Arc Welding
AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel
AWS D10.4	(1986; R 2000) Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
AWS D10.7/D10.7M	(2008) Guide for the Gas Shielded Arc Welding of Aluminum and Aluminum Alloy Pipe
AWS D10.10/D10.10M	(2021) Recommended Practices for Local Heating of Welds in Piping and Tubing
AWS D10.11M/D10.11	(2007) Guide for Root Pass Welding of Pipe Without Backing
AWS D10.12M/D10.12	(2000) Guideline for Welding Mild Steel Pipe
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors
AWS WHB-4.9	(2010) Welding Handbook, Volume 4 - Materials and Applications Part 1
AWS Z49.1	(2021) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E2700	(2014) Standard Practice for Contact Ultrasonic Testing of Welds Using Phased Arrays

1.2 DEFINITIONS

Definitions must be in accordance with AWS A3.0M/A3.0 except as follows:

a. Weld slag is defined as the crystalline residue remaining on the weld surface following a weld procedure which uses flux as a shielding method.

b. POL service piping consists of piping and components used for petroleum, oil and lubricants (POL) under pressure or gravity force including modifications to existing hydrant fueling systems.

1.3 SUBMITTALS

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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-01 Preconstruction Submittals

Welding Procedure Specifications (WPS); G[, [_____]]

Welder Performance Qualification (WPQ); G[, [_____]]

Procedure Qualification Record (PQR); G[, [_____]]

Welding Operations; G[, [_____]]

SD-02 Shop Drawings

POL Service Piping; G[, [_____]]

Pigging Plan; G[, [_____]]

SD-06 Test Reports

Welding Reports

Examinations, Inspections and Tests

SD-07 Certificates

Qualifications; G[, [_____]]

1.4 GENERAL 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. Project drawings and/or specifications must indicate that factory applied internal and external coatings be stopped one inch from a girth weld leaving a 2 inch uncoated area for welding.

****

This section covers the welding of Petroleum, Oil and Lubricant (POL) Service systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval by the Contracting Officer. 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. Procedures must be developed by the Contractor for welding all metals included in the work. Welding must not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing must be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing must be borne by the Contractor. The Contracting Officer must be notified at least one week in advance of the time and place of the tests. If the Contracting Officer elects to witness the tests, the qualification tests must be performed at or near the worksite. The Contractor must 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 must be qualified. Unless otherwise specified, the choice of welding process must be the responsibility of the Contractor. It should be noted that ASME B31.3 incorporates by reference, other requirements of ASME Section V, Section IX and specific AWS requirements.

1.5 PERFORMANCE

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NOTE: 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 (all underground joints require 100 percent radiographic testing (RT) or phased array ultrasonic testing (PAUT)), which joints require random NDE inspection, and which NDE methods are to be employed for each joint.

Phased array ultrasonic testing must be used when radiography is not permitted and with Service Headquarters approval only.

****

The Contractor will be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations must be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing must be the responsibility of the Contractor when he deems it necessary to achieve the quality required.

1.6 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 procedure specifications (WPS), the procedure qualification record (PQR) record, and the welder performance qualification (WPQ) are submitted and approved in accordance with paragraph SUBMITTALS.

b. Testing was performed by an approved testing laboratory or approved 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 B31.3 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.

1.6.1 Welding Operations

The Contractor must provide a description of how the critical welding operations will be accomplished. Provide the welding procedures to be used for each operation, the sequence of welding to minimize heat distortion, sequence of welding piping sections both in the trench and outside, machine welding if used, and multiple welders on same pipe weld. Submit detailed procedures which define methods of compliance to contract drawings and specifications.

1.6.2 Welding Procedure Specification and Procedure Qualification Records

The Contractor must record in detail and must qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure must conform to the requirements of ASME B31.3 and to this specification. The welding procedures must specify back purge gas requirements, end preparation for butt welds including cleaning, alignment, and root openings. Preheat, interpass temperature control, and postheat treatment of welds must be as required by approved welding procedures, unless otherwise indicated or specified. Copies of the welding procedure specifications and weld procedure qualification record results for each type of welding required must 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 must be identified individually and must be referenced on the POL service piping shop drawings. Submit detail drawings showing location, length, and type of welds; and indicating preweld and postweld heat treatment and NDE as required. The drawings must show the welding procedure specification (WPS) to be used at each weld location.

1.6.3 Welder and Welding Operator Performance

Each welder and welding operator assigned to work must be qualified in accordance with ASME B31.3.

1.6.3.1 Certification

Before assigning welders or welding operators to the work, the Contractor must provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification must state the type of welding and positions for which each is qualified, the code and welding procedure specification under which each is qualified, date qualified, and the firm and individual

certifying the qualification tests. The Contractor must provide a summary table showing all welders and the WPS with which they are qualified to weld.

1.6.3.2 Identification

Each particular weld must be identified 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 must be submitted, and each welder or welding operator must 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. Identification by die stamps or electric etchers will not be allowed.

1.6.3.3 Renewal of Qualification

Requalification of a welder or welding operator must be required under any of the following conditions:

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

b. When a welder or welding operator has not welded with any procedure during a period of 3 months, all the personal qualifications must be considered expired, including any extension 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 procedure under conditions a., b., and d., above, needs to be made on only a single test joint or pipe of a thickness, position, or material required by the welding procedure specifications to reestablish the welder's or welding operator's qualification for the previous qualification.

1.6.4 Test Reports

Test reports must consist of the following.

a. Records made by the AWS certified inspector for all duties performed per paragraph 4.2 of AWS QC1.

b. All NDE (radiograph, [PAUT]) reports with unique weld ID for each weld tested.

c. "Weld Maps". These maps/drawings correlate the shop drawings submitted to the NDE reports. The NDE report that shows a weld number as acceptable is correlated with weld number on the drawings.

d. Provide the location of each weld, what procedure was used, which welder did the weld, the results of the visual test, and the results of the NDE.

1.6.5 Inspection and NDE Personnel

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NOTE: Coordinate with paragraph PERFORMANCE.
****

Contractor must provide a commercially independent organization for all weld examinations. All inspection and NDE personnel must be qualified in accordance with the following requirements. The contractor must submit the qualifications of all the testing personnel that will perform all field tests for review by the Contracting Officer. The qualifications of all personnel on the job site that will perform welding inspections and NDE must be submitted for approval. All inspectors and NDE personnel must have a minimum of one year experience inspecting the piping material being used and five years in military or commercial aircraft hydrant fueling systems or truck fueling systems, petroleum refineries, power generating plants, or chemical process plants.[In addition, all PAUT personnel must meet ASNT Level III requirements.]

1.6.5.1 Inspector Certification

Visual welding inspectors must be qualified in accordance with AWS QC1.

1.6.5.2 NDE Personnel

NDE personnel must be certified Level II in accordance with ASME Section V, ASME B31.3 and ASNT SNT-TC-1A for each NDE procedure he is required to use, and a written procedure for the control and administration of NDE personnel training, examination, and certification must be established. The procedures must be based on appropriate specific and general guidelines of training and experience recommended by ASNT SNT-TC-1A. Should the NDE examiner also be a welder, that individual is disqualified from examining their own work.[Examiners performing PAUT must be qualified in accordance with ASME Section 5, Article 4, Mandatory Appendix VII.]

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.7.1 Material Control

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

Materials must 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 must not be in contact with the floor and must be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes must 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 must be rebaked in accordance with the manufacturer's instructions prior to issuance or must be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container must be immediately placed in a storage oven. The storage oven temperature must 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 must, [within 1/2-hour]; [within the limits established by AWS D1.1/D1.1M] be placed in a storage oven.

1.7.2 Damaged Materials

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

1.8 SYMBOLS

Symbols must be in accordance with AWS A2.4.

1.9 SAFETY

Safety precautions must conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING 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.

The selection of electrodes should be limited to non covered for all root passes. Covered electrodes may be allowed for fill passes after the root pass is completed. This will eliminate formation of weld slag on the interior of the pipe. Weld process for root passes is restricted to Gas Tungsten to provide for a clean weld on the initial pass.

In tight or confined spaces where oxygen supply may be a concern, use of a back purge gas may be re-evaluated and a covered electrode may be allowed. This condition should be addressed by the Designer and the Contracting Officer on a case by case basis.

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Welding materials for carbon steel, stainless steel and aluminum must comply with AWS WHB-4.9. Welding equipment, electrodes, welding wire, shielding and backing gas, and fluxes must be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures. All field girth root pass welds must be made with non-covered electrodes or welding wire. All root passes must be made with shielding and backing gas. External welds on the pipe such as attaching pipe supports may be made with covered electrodes or welding wire. Electrodes, welding wire [and][or] fluxes must be in accordance with Table 1. Welding materials for aluminum and aluminum alloy must comply with AWS D10.7/D10.7M.

TABLE I				
AWS	Process	Alloy	Consumable	Use
			(Examples) (1)	
AWS A5.1/A5.1M	SMAW	Low Carbon	E7018	Fill
AWS A5.4/A5.4M	SMAW	Stainless	E308L, E309L	Fill
AWS A5.3/A5.3M	SMAW	Aluminum		Fill
AWS A5.9/A5.9M	GTAW	Stainless	ER308L,ER309L	Root and Fill
AWS A5.10/A5.10M	GTAW	Aluminum		Root and Fill
AWS A5.18/A5.18M	GTAW	Low Carbon	E70S-3,E70S-6	Root and Fill
AWS A5.22/A5.22M	GTAW	Stainless	E308LT1-1	Root (Backing and Shielding Gas Required)
AWS A5.32/A5.32M	GTAW	All		Shielding Gas
Note(1): The consumable material designations shown are examples only and are not intended to limit the Contractor's selection of consumable materials.				

PART 3 EXECUTION

3.1 WELDING OPERATIONS

Welding must be performed in accordance with qualified procedures using qualified welders and welding operators. Welding must not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer must determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members must conform to Section 05 05 23.16 STRUCTURAL WELDING.

Welding must be performed in accordance with ASME B31.3 and the applicable portions of AWS D10.4, AWS D10.7/D10.7M, AWS D10.10/D10.10M, AWS D10.11M/D10.11, AWS D10.12M/D10.12, and AWS C5.5/C5.5M.

All joints unless indicated otherwise, in carbon steel, aluminum and

stainless steel piping systems must be welded. Unless otherwise approved, all girth welds must be complete penetration groove welds made in accordance with qualified welding procedures. The root pass on stainless steel, aluminum, and carbon steel pipe must be by the GTAW process.

a. Weld Preparation must comply with the requirements of ASME B31.3 and the qualified Welding Procedure Specification. The use of "rice paper" as purge blocks is not permitted. Contractor must submit alternate method for approval.

b. Backing Rings. The use of backing rings for making or repairing welds will not be permitted.

3.1.1 Base Metal Preparation

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

Mechanical grinding of thermal cut ends must be used to remove the heat affected area but should be limited to maximum 1/8 inch.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding must be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. End welds must be properly aligned prior to welding in accordance with Chapter V of ASME B31.3. All socket-welded joints must be properly fitted with gaps between the pipe and the bottom of the socket in accordance with ASME B31.3. Contractor must implement a program to ensure gaps are properly measured and documented. Welded temporary attachments must not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they must be the same material as the base metal, and must be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment must 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 must be visually examined.

3.1.3 Butt Weld Joint Spacing

Butt weld joints must be spaced a minimum of 150 mm 6 inches apart. Measurement must be taken from the toe of the first weld to the toe of the second weld. The measurement must be taken at the closest point between the welds when visually inspected. If spacing is not possible due to existing conditions, a reduction in spacing to not less than 50 mm 2 inches may be made.

3.1.4 Preheat and Interpass Temperatures

Preheat temperatures must meet the requirements specified by ASME B31.3. However, in no case will 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 must 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 must 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 must be employed. Oxy-fuel heating must not be used on austenitic stainless steel; however, air-fuel heating is acceptable if controlled to ensure that the surface temperature does not exceed 66 degrees C 150 degrees F. Interpass temperatures must be checked on the surface of the component within 25 mm one 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.

3.1.5 Production Welding Instructions

a. Welding must not be done when the ambient temperature is lower than minus 18 degrees C 0 degrees 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 must be welding grade and must 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 must 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 must be less than 2 percent prior to welding. The flow rate must be that required by the approved weld procedure specification.

e. The purge on groove welds must be maintained for at least two passes or 5 mm 3/16 inch whichever is greater.

f. Removable purge dam materials must be made of expandable or flexible plugs, such as Plexiglas, plywood (which must be dry when used). Wood dams must be kiln-dried quality. Purge dams must not be made of polyvinyl alcohol.

g. Any welding process which requires the use of external gas shielding must not be done in a draft or wind unless the weld area is protected by a shelter. This shelter must 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. Tack welds to be incorporated in the final welds must have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective must be removed and the groove must be retacked prior to welding. Temporary tack welds must be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area must be magnetic particle examination inspected.

i. 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 B31.3. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness must be avoided. Minimum weld external reinforcement must be flush between external

surfaces.

j. Each qualified welder must be assigned an identification symbol. All welds must be permanently marked with the symbol of the individual who made the weld.

****

NOTE: Designer to include Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT) and Section 33 52 10 FUEL SYSTEMS PIPING (SERVICE STATION) if carbon steel and stainless steel are to be connected.

****

k. Direct welded connection of carbon steel and stainless steel must not be made.[See Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT) and Section 33 52 10 FUEL SYSTEMS PIPING (SERVICE STATION) for method of connection.]

3.1.6 Postweld Heat Treatment

a. When required postweld heat treatment must be performed in accordance with ASME B31.3. Temperatures for local postweld heat treatment must be measured continuously by thermocouples in contact with the weldment.

b. Postweld heat treatment of low-alloy steels, when required, must 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 one inch of weld thickness.

3.2 EXAMINATIONS, INSPECTIONS AND TESTS

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NOTE: PAUT is only permitted at locations that prohibit the use of radiography and locations where it is impractical due to physical location or other constraints. PAUT is only permitted with approval of the Service Headquarters. In all cases where PAUT is used, all welds must be recorded and the results reviewed by an ASNT Level III certified inspector and the requirements in this section.

Coordinate with paragraph PERFORMANCE.

****

Weld inspection and NDE must be performed 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 meeting the requirements of paragraph INSPECTION AND NDE PERSONNEL, approved by the Contracting Officer, must be employed by the Contractor. All completed welds must be visually inspected in accordance with the visual inspection requirements of ASME B31.3 and AWS D1.1/D1.1M. [Radiographic] [Liquid penetrant] [Magnetic particle] [or] [PAUT] examination must be required as indicated below. When in-process weld quality control is required for tie-in welds, it must be performed in accordance with ASME B31.3. When inspection and testing indicates

disqualifying defects in a weld joint, the weld must be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS. The Contractor must submit weld inspection and NDE field testing reports to the Contracting Officer.[In all cases where PAUT is used, all welds must be recorded and the results reviewed by an ASNT Level III certified inspector and the requirements in this section.]

The person performing the weld inspection must perform the following:

a. Verify that the base materials and consumable welding materials conform to the specifications and that welding filler metals used are as specified for each base material.

b. Verify that the welding equipment to be used for the work is appropriate for use with the welding procedure specification and has the capability to meet the applicable requirements of the welding procedure.

c. Verify that only approved or qualified welding procedures are used for the work.

d. Verify that the edge preparation or joint geometry meet the requirements of the welding procedure and drawings.

e. Verify that the specified filler metals are used and that filler metals are maintained in proper condition, per requirements, or as recommended by the manufacturer.

f. Verify that the technique and performance of each welder, welding operator, and tack welder are as specified.

g. Verify that the work conforms to requirements of the applicable standards, drawings, or other documents.

h. Verify that the work inspected is identified and documented in accordance with specified requirements.

i. Prepare clear and concise reports and verify that records of the results of examinations are maintained.

j. Verify the approved WPS pre-heat and post heat procedures are being used.

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NOTE: For modifications to existing stainless steel hydrant systems insert the following paragraph:

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[Welders found making defective welds must be removed from the work or must be required to be requalified in accordance with ASME B31.3.
]

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NOTE: Coordinate with paragraph PERFORMANCE.

This paragraph is to be edited based on the piping code used for design. Both ASME B31.3 and ASME B31.4 allow for different percentages of additional testing with ASME B31.3 generally being more stringent. The selection of ASME B31.3 or ASME

B31.4 should be consistent with the application. See UFC 3-460-01, "Design: Petroleum Fuel Facilities". For modification to existing hydrant systems at paragraph NDE TESTTING FREQUENCY insert the following first paragraph.
****

3.2.1 Visual Inspection

Weld joints must be inspected visually as follows:

a. Before welding - for compliance with requirements for joint preparation, alignment and fit-up, and cleanliness in accordance with ASME B31.3.

b. During welding - for cracks and conformance to the approved welding procedure only when in-process weld quality control is required by ASME ASME B31.3.

c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, weld slag on the interior of the pipe and size of welds in accordance with ASME B31.3 and AWS D1.1/D1.1M. Visual examination of the interior of the pipe may be performed by any of the remote means allowed by ASME BPVC SEC V, visual inspection. Visual examination of the weld must be performed prior to any other NDE examinations as required by this specification.

3.2.2 NDE Testing Frequency

All pipe field welds, including high point vent pipe tees, insert butt welded weld-o-lets, and low point drain pipe, must be examined by [radiographic] methods to determine conformance to the paragraph ACCEPTANCE STANDARDS. All socket welds and sock-o-lets or weld-o-lets to pipe welds must be examined with either magnetic particle or liquid penetrant methods, in addition to the visual examinations. The services of a qualified commercial or testing laboratory approved by the Contracting Officer must be employed by the Contractor for testing of piping welds. Costs of testing, including retesting of repaired welds, must be borne by the Contractor.

a. Provide 100 percent [radiographic testing] [PAUT] for all underground piping and hydrant pump discharge piping.

b. Provide select [radiographic testing] [PAUT] in accordance with [ASME B31.3] for all aboveground piping. The inspection must include an examination of welds made by each welding operator or welder.[Not less than [_____] percent of total welds shall be examined.] If the testing reveals that any welds fail to meet minimum quality requirements, an additional percent of the welds in that same group must be inspected in accordance with ASME B31.3. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented must be accepted and the defective welds must be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds must be rejected. The rejected welds must be removed and rewelded, or the rejected welds must be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.3 NDE Testing

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

For modifications to existing Hydrant Systems choose only radiographic or PAUT from the first paragraph and include the 2nd paragraph.

Phased array ultrasonic testing must be used when radiography is not permitted and with Service Headquarters approval only.

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NDE must be as required by ASME B31.3 and in accordance with written procedures. Procedures for [radiographic] [liquid penetrant] [magnetic particle] [ultrasonic] [or] [PAUT] tests and methods must conform to ASME BPVC SEC V. Only Radiography [or PAUT] are acceptable test methods for butt welded joints.[Refer to ASTM E2700 for PAUT.] The approved procedure must be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPVC SEC V, the written procedures must include the timing of the NDE in relation to the welding operations and safety precautions.

[The services of a commercially independent qualified testing agency approved by the Contracting Officer must be employed by the Contractor for testing of piping welds. Costs of testing, including retesting of repaired welds, must be borne by the Contractor. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectionable defect must be removed by grinding [and], [or] other suitable mechanical means. The weld surface must be merged smoothly with the base metal surface.

][3.2.4 Special Requirements for PAUT Testing

Phased array inspection must meet the review requirements of API Std 650 Twelfth Edition, Annex U, Section U5 and the Inspection requirements of ASME Section V 2017.

Calibration standards must meet the requirements of ASME Section V 2017 figure T-434.3-1, T-434.3-2.

The final data package shall be reviewed by a UT Level-III individual qualified in accordance with their employer's written practice. ASNT SNT-TC-1A or CP-189 shall be used as a guideline. Only Level-II or Level-III personnel shall perform UT examinations, analyze the data, or interpret the result. Alternatively, the review may be achieved by arranging for a data acquisition and initial interpretation by a Level-II individual, and a final interpretation and evaluation shall be performed by a Level-III individual qualified. The review shall include the following:

3.2.4.1 Essential Variables

Essential variables are listed below. Changes in any one of them beyond that allowed in the specification must require procedure requalification.

a. Weld configurations to be examined, including thickness dimensions and base material product form (pipe, plate)

b. The surfaces from which the examination shall be performed Technique(s) Angle(s) and mode(s) of wave propagation in the material

c. Search unit type(s), frequency(ies), and element size(s)/shape(s) element size and number, and pitch and gap dimensions

d. Focal range (identify plane, depth, or sound path)

e. Virtual aperture size (i.e., number of elements, effective height, and element width)

f. Angular range used (i.e., 40 deg. to 50 deg., 50 deg. to 70 deg.)

g. Angle incremental change (i.e., 12 deg , 1 deg.)

h. Element incremental change (i.e., 1,2)

i. Additional S-scan, E-scan requirements Range of element numbers used (i.e., 1-126, 10-50)

j. Scan plan

k. Weld axis reference point marking

l. Rastering angle(s)

m. Aperture start and stop element numbers

n. Aperture incremental change(s) (number of elements stepped)

o. Additional S-scan requirements: Sweep angular range(s)

p. Angular sweep increment (incremental angle change, deg)

q. Aperture element numbers (first and last)

r. Calibration [calibration block(s) and technique(s)]

s. Scanning technique (automated vs. semi-automated)

t. Scanner adhering and guiding mechanism

u. Method for discriminating geometric from flaw indications

v. Method for sizing indications

w. Computer enhanced data acquisition, when used Scan overlap

x. Computer software revision

y. Personnel performance requirements, Personnel qualification requirements

z. Surface condition (examination surface, calibration block)

3.2.4.2 Non-Essential Variables

a. Couplant: brand name or type

b. Post-examination cleaning technique

c. Automatic alarm [and][or] recording equipment, when applicable Records, including minimum calibration data to be recorded (e.g., instrument settings)

]3.2.5 Inspection and Tests by the Government

The Government may 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 must 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 must 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 must be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding must 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

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NOTE: These acceptance standards were taken from ASME B31.3 and ASME B31.4 and are suitable for most jobs. Evaluations of indications, as given in ASME B31.3 and ASME B31.4, 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 must the acceptance criteria be less conservative than the criteria specified by the standard applicable to the work. If actual conditions exceed these limits of ASME B31.3 or ASME B31.4, this requirement must be expanded or revised as required. For modifications to existing hydrant systems and stainless steel systems select the 2nd paragraph below and delete the first paragraph.

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[Acceptance standards must be in accordance with ASME B31.3 paragraph 341.3.2, Chapter VI in addition to the following specified items.

][Interpretation of test results and limitations on imperfections in welds must comply with the requirements of 100 percent radiography, per

ASME B31.3, paragraph 341.3.2, Chapter VI. For hydrant systems and stainless steel systems the evaluation must be based on severe cyclic conditions in addition to the following-specified items.

]3.3.1 Visual

The following indications are unacceptable:

Weld Slag on the interior of the pipe.

3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

a. Any 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 must 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.

3.4 CORRECTIONS AND REPAIRS

Disqualifying defects must be removed and repaired as specified in ASME B31.3 unless otherwise specified. Disqualifying defects discovered between weld passes must be repaired before additional weld material is deposited. After defect removal is complete and before rewelding, the area must 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 must be reexamined by the same test method originally used for that area. Any indication of a defect must be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present.

3.4.1 Defect Removal

Defective or unsound weld joints must be corrected by removing and replacing the entire weld joint, or for the following defects corrections must be made as follows:

a. Excessive Convexity and Overlap: Reduce by removal of excess metal.

b. Excessive Concavity of Weld, Undersized Welds, Undercutting: Clean and deposit additional weld metal.

c. Excessive Weld Porosity, Inclusions, Lack of Fusion, Incomplete Penetration: Remove defective portions and reweld.

d. Cracks or liner indications in Weld or Base Metal: Remove crack throughout its length, including sound weld metal for a distance of twice the thickness of the base metal or two inches, whichever is less, beyond each end of the crack, followed by the required rewelding. Complete removal must be confirmed by magnetic particle inspection for carbon steel or liquid penetrant inspection for stainless steel. Inspection procedures must comply with the requirements of ASME B31.3.

e. Poor Fit-Up: Cut apart improperly fitted parts, and reweld.

3.4.1.1 Methods of Defect Removal

The removal of weld metal or portions of the base metal must be done preferably by chipping, grinding, sawing, machining, or other mechanical means. Defects also may be removed by thermal cutting techniques. If thermal cutting techniques are used, the cut surfaces must be cleaned and smoothed by mechanical means to remove the heat affected zone. In addition, a maximum of 1/8-inch of metal must be removed by mechanical means from the cut surfaces of stainless steel.

Wherever a defect is removed, and repair by welding is not required, the affected area must be blended into the surrounding surface eliminating sharp notches, crevices, or corners.

3.4.1.2 Rewelding

Repair welds must be made using an electrode or filler wire smaller than that used in making the original weld. Rewelding must be done using qualified welding procedures. The surface must be cleaned before rewelding. Repair welds must meet the requirements of this specification.

3.4.1.3 Peening or Caulking

The use of force (peening) or foreign materials to mask, fill in, seal, or disguise any welding defects must not be permitted.

3.5 MAINTAINING CLEANLINESS OF PIPING

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NOTE: The intent of the following paragraph is to require cleaning of the piping system as it is being installed. The designer must include Section 33 08 53 AVIATION FUEL DISTRIBUTION SYSTEM START-UP for modifications to hydrant systems and Section

33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT) for other POL service piping systems.
****

The Contractor must keep the interior and ends of all new piping affected by the Contractor's operations thoroughly cleaned of foreign matter and water before and after being installed. Piping systems must be kept clean during installation by means of plugs or other approved methods. When work is not in progress, open ends of piping and fittings must be closed so that no water or other foreign substance will enter the pipes or fittings. Piping must be inspected before placing into position. The interior of each length of pipe must be cleaned after welding; A swab, with a leather or canvas belt disc to fit the inside diameter of pipe, must be pulled through each length of pipe after welding in place. It must be the Contractor's responsibility for insuring that the interior of the piping is free of foreign matter including weld slag when it is connected into the system.

[3.5.1 Pigging Plan

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NOTE: Select the following paragraph if a high degree of cleanliness is required such as modifications to an existing hydrant fueling system. For existing systems review piping details and devices to determine if the system can be pigged or modified so it can be pigged.
****

The pigging plan must be submitted for approval by the Contracting Officer. The pigging plan must provide a minimum of two runs through the system with each set of pigs. There must be a minimum of two types of pigs, polyurethane and foam. More types of pigs (brushes, scrapers) or runs may be required depending on the type of debris found in the system. The pigging plan must be submitted to the Contracting Officer for approval.

]3.6 COMMISSIONING

For commissioning of POL service piping systems see Section 33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT). For repairs or modifications to hydrant systems see Section 33 08 53 AVIATION FUEL DISTRIBUTION SYSTEM START-UP.

-- End of Section --