
USACE / NAVFAC / AFCEC UFGS-33 52 23.15 (May 2025)

Preparing Activity: NAVFAC

Superseding
UFGS-33 52 23.15 (November 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated October 2025

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 52 23.15

POL SERVICE PIPING WELDING

05/25

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Closure Weld
 - 1.2.2 Complete Joint Penetration (CJP)
 - 1.2.3 Designer of Record
 - 1.2.4 Examination
 - 1.2.5 Examiner
 - 1.2.6 Hazardous Area
 - 1.2.7 Heat-Affected Zone (HAZ)
 - 1.2.8 Independent
 - 1.2.9 In-Process Examination
 - 1.2.10 Inspection
 - 1.2.11 Inspector
 - 1.2.12 Hot Work
 - 1.2.13 Marine Chemist
 - 1.2.14 Owner's Inspector
 - 1.2.15 Piping Engineer
 - 1.2.16 POL Service Piping
 - 1.2.17 Weld Map
 - 1.2.18 Timely
 - 1.2.19 Weld Slag
- 1.3 SUBMITTALS
- 1.4 SAFETY
 - 1.4.1 Control of Hazardous Energy
 - 1.4.2 Preparation for Welding
 - 1.4.3 Gas-Free Condition
- 1.5 PERFORMANCE
- 1.6 GENERAL REQUIREMENTS
 - 1.6.1 Procedures
 - 1.6.2 Weld Inspection
 - 1.6.3 Nondestructive Examination
 - 1.6.4 Records Retention

- 1.6.5 Timely Reporting
- 1.6.6 Protect in Place
- 1.7 DESIGN REQUIREMENTS
 - 1.7.1 Code and Criteria Basis
 - 1.7.2 Closure Welds
 - 1.7.3 Structural Welds
 - 1.7.4 Piping or Pipeline Welds
 - 1.7.5 Weld Plan
- 1.8 QUALITY ASSURANCE
 - 1.8.1 Data Management
 - 1.8.2 Weld Log
 - 1.8.2.1 Progress Reporting
 - 1.8.3 Weld Symbolology
 - 1.8.4 Weld Marking
 - 1.8.5 Shop Drawings
 - 1.8.6 Inspection Procedures
 - 1.8.7 Examination Procedures
 - 1.8.8 Procedure Standards
 - 1.8.9 Inspection and Examination Reporting
- 1.9 QUALIFICATIONS AND CERTIFICATIONS
 - 1.9.1 Welding Procedure Specification
 - 1.9.2 Procedure Qualification Record
 - 1.9.3 Welding Personnel
 - 1.9.3.1 Welder Performance Qualification
 - 1.9.3.2 Renewal of Welder Qualification
 - 1.9.4 Previously Qualified Procedures and Personnel
 - 1.9.5 Independent Test Organization
 - 1.9.6 Inspection and Examination Personnel
 - 1.9.6.1 Prohibited Practices
 - 1.9.6.2 Weld Inspector
 - 1.9.6.3 In-Process Weld Inspector
 - 1.9.6.4 Nondestructive Examiner
 - 1.9.6.5 Examiner Certification Standards
 - 1.9.7 Piping Engineer of Record
- 1.10 DELIVERY, STORAGE, AND HANDLING
 - 1.10.1 Material Control
 - 1.10.2 Partial Issue
 - 1.10.3 Damaged Container
 - 1.10.4 Damaged Material

PART 2 PRODUCTS

2.1 WELDING MATERIALS

PART 3 EXECUTION

- 3.1 WELDING OPERATIONS
 - 3.1.1 Identification
 - 3.1.2 Base Metal Preparation
 - 3.1.3 Weld Joint Fit-up
 - 3.1.4 Butt Weld Joint Spacing
 - 3.1.5 Preheat and Interpass Temperatures
 - 3.1.6 Production Welding Instructions
 - 3.1.7 Postweld Heat Treatment
- 3.2 EXAMINATIONS, INSPECTIONS AND TESTS
 - 3.2.1 Quality Control of Welding
 - 3.2.2 Weld Inspection
 - 3.2.2.1 Weld Inspection Duties
 - 3.2.3 In-Process Weld Inspection

- 3.2.4 Nondestructive Examination
- 3.2.5 Special Requirements for PAUT
 - 3.2.5.1 Procedure Essential Variables
 - 3.2.5.2 Non-Essential Variables
- 3.2.6 Examination, Inspection, and Tests by the Government
 - 3.2.6.1 Supplemental NDE, Inspection, and Tests
 - 3.2.6.2 Destructive Tests
- 3.3 EXAMINATION AND INSPECTION FREQUENCY
 - 3.3.1 Examination And Inspection Schedule
- 3.4 ACCEPTANCE STANDARDS
 - 3.4.1 Acceptance Criteria
 - 3.4.2 Visual
 - 3.4.3 Magnetic Particle
 - 3.4.4 Liquid Penetrant
- 3.5 CORRECTION AND REWORK
 - 3.5.1 Defect Removal
 - 3.5.1.1 Methods of Defect Removal
 - 3.5.1.2 Grinding
 - 3.5.1.3 Rewelding
 - 3.5.1.4 Peening or Caulking
- 3.6 MAINTAINING CLEANLINESS OF PIPING
 - 3.6.1 Pigging Plan
- 3.7 QUALITY CONTROL DETERMINATION
- 3.8 COMMISSIONING

-- End of Section Table of Contents --

USACE / NAVFAC / AFCEC

UFGS-33 52 23.15 (May 2025)

Preparing Activity: NAVFAC

Superseding

UFGS-33 52 23.15 (November 2018)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 33 52 23.15

POL SERVICE PIPING WELDING 05/25

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 \(CCR\)](#).

PART 1 GENERAL

1.1 REFERENCES

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

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

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

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

AMERICAN PETROLEUM INSTITUTE (API)

- API 570 (2016; Addendum 1 2017; Addendum 2 2018; ERTA 1 2018) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems
- API RP 2009 (2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
- API Std 650 (2025) Welded Tanks for Oil Storage

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

- ANSI/ASNT CP-189 (2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
- ASNT SNT-TC-1A (2024; Addendum 2025) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- ASME B16.5 (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
- ASME B16.48 (2015) Line Blanks
- ASME B31.3 (2024) Process Piping
- 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	(2025) Standard Welding Terms and Definitions
AWS A5.1/A5.1M	(2025) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.3/A5.3M	(2023) 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	(2023) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS A5.18/A5.18M	(2023) Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.22/A5.22M	(2024) 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 Processes
AWS C5.5/C5.5M	(2003) Recommended Practices for Gas Tungsten Arc Welding
AWS D1.1/D1.1M	(2025) Structural Welding Code - Steel
AWS D1.2/D1.2M	(2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum
AWS D1.6/D1.6M	(2017) Structural Welding Code - Stainless 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, Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM E329	(2025a) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E1316	(2020a) Standard Terminology for Nondestructive Examinations
ASTM E2700	(2014) Standard Practice for Contact Ultrasonic Testing of Welds Using Phased Arrays

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 326	(2015) Standard for Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair
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U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2024) Safety -- Safety and Occupational Health (SOH) Requirements
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U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-460-01	(2019; with Change 3, 2023) Design: Petroleum Fuel Facilities
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1.2 DEFINITIONS

Except as provided in this Section, definition of welding terms is in accordance with AWS A3.0M/A3.0, and definition of inspection and examination terms is in accordance with ASTM E1316.

1.2.1 Closure Weld

The final weld connecting POL service piping systems, components, or sub-assemblies which have been successfully tested in accordance with ASME B31.3. For purposes of this Section, a closure weld can include connection of new work to existing piping and is considered within the

scope of ASME B31.3.

1.2.2 Complete Joint Penetration (CJP)

A weld condition in which fusion between base and filler has occurred across the entirety of surfaces intended for welding and between all weld passes.

1.2.3 Designer of Record

The professional engineer designated by the prime contractor to be in multidisciplinary responsible charge of all POL service piping design and repair.

1.2.4 Examination

As used in this Section, a process for determining weld properties, conditions, or characteristics using nondestructive techniques, technologies, and methods, and performed by qualified and certified examiner(s). Nondestructive examination (NDE) is a quality control function performed by the contractor as part of oversight organization duties.

1.2.5 Examiner

As used in this Section, specialist with responsibility to use various nondestructive techniques, technologies, and methods to inform the quality of welds. Examiner(s) is a QC Specialist pursuant to Section 01 45 00 QUALITY CONTROL and is part of the contractor quality control organization.

1.2.6 Hazardous Area

As used in this Section, any area within 30 meters 100 feet of active storage tanks, areas within 30 meters 100 feet of leaking section of fuel pipeline or other vapor sources, areas within 60 meters 200 feet of the downwind side of potential vapor emission sources (i.e., pressure-vacuum vents, sample ports, open vents on active tanks, weeping flanges or joints).

1.2.7 Heat-Affected Zone (HAZ)

The portion of base metal whose mechanical properties or microstructure have been altered by the heat of welding, brazing, soldering, or thermal cutting.

1.2.8 Independent

Impartial third party not a part or affiliated with Contractor or subcontractor principal or subsidiary businesses.

1.2.9 In-Process Examination

A series of steps prescribed in ASME B31.3 to inspect and examine a closure weld for which a hydrostatic leak test is not possible. Can also be used on other joints. As used in this Section, in-process examination requires visual means aided by liquid penetrant examination (PT) or magnetic particle examination (MT) methods in determination of the weld condition. In this Section, the terms in-process examination and in-process inspection are used synonymously.

1.2.10 Inspection

As used in this Section, contractor oversight activity to observe work performed on materials or components to determine acceptability and control the quality of welds. Inspection is performed by qualified and certified inspector(s). In this Section, the weld inspection function is separate and distinct from inspection activities performed by an Owner's Inspector (pursuant to ASME B31.3) and from inspection activity of the Quality Control Manager (pursuant to Section 01 45 00 QUALITY CONTROL).

1.2.11 Inspector

As used in this Section, specialist with oversight responsibility to control the quality of welds. Inspector(s) is a QC Specialist pursuant to Section 01 45 00 QUALITY CONTROL and is part of the contractor quality control organization. The contractor inspector role is separate and distinct from both an Owner's Inspector (pursuant to ASME B31.3), and separate and distinct from the Quality Control Manager role (pursuant to Section 01 45 00 QUALITY CONTROL).

1.2.12 Hot Work

For work covered by this Section, drilling, boring, flame heating, welding, torch cutting, brazing, carbon arc gouging, grinding, abrasive blasting, or any work which produces heat, by any means, of 200 degrees C 400 degrees F or more; or in the presence of flammable material or flammable atmosphere, other ignition sources such as spark or arc producing tools or equipment, static discharges, friction, impact, open flames or embers, nonexplosion-proof lights, fixtures, motors or equipment.

1.2.13 Marine Chemist

The holder of a valid Certificate issued by the National Fire Protection Association in accordance with the "Rules for Certification of Marine Chemists" establishing the individual as a Qualified Person pursuant to NFPA 326.

1.2.14 Owner's Inspector

Technical representative(s) of the Contracting Officer responsible for assuring that contractor performance meets requirements and contractor quality control organization is effective. In this Section, the Owner's Inspector role (pursuant to ASME B31.3) is separate and distinct from Inspector, Examiner, and Quality Control Manager roles.

1.2.15 Piping Engineer

One or more licensed professional engineers, or an engineering firm, acceptable to the Contracting Officer who are knowledgeable and experienced in the engineering disciplines associated with evaluating hydraulic, mechanical, and material characteristics which affect integrity and reliability of POL service piping systems. The piping engineer is the piping or pipeline subject matter expert. More than one individual can serve in the role as long as one is designated to be in responsible charge.

1.2.16 POL Service Piping

Pipe, piping, pipeline, fittings, components, assemblies, and

appurtenances used for petroleum, oil, or lubricant (POL) conveyance service under pressure or force of gravity, including modifications to existing systems.

1.2.17 Weld Map

Drawing(s) containing sketches and tables which correlate design, weld plan, shop drawings, welder identification, weld inspection, nondestructive examination, and physical locations.

1.2.18 Timely

As used in this Section, receipt of reporting records by the Contracting Officer no more than 10 days after installation of weld.

1.2.19 Weld Slag

Crystalline residue remaining on a weld surface.

1.3 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 and Air Force 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.

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. Submittals not having a "G" or "S" classification are 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 Specification; G, [_____]

Procedure Qualification Record; G

Welder Performance Qualification; G, [_____]

Weld Plan; G, [_____]

SD-02 Shop Drawings

Pigging Plan; G, [_____]

SD-06 Test Reports

Weld Log; G, [_____]

SD-07 Certificates

Weld Inspector Certificate; G, [_____]

Independent Test Organization; G, [_____]

In-Process Weld Inspector Certificates; G, [_____]

Weld Examiner Certificate; G, [_____]

1.4 SAFETY

Safety precautions must conform to Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, EM 385-1-1, API 570, API RP 2009, and AWS Z49.1.

1.4.1 Control of Hazardous Energy

Prior to welding, provide proper lockout and tagout (LOTO) of the piping or pipeline and appurtenances to completely isolate work from fuel, vapors, and sources of energy. Isolate using physical means such as blind flange compliant with ASME B16.5 or solid-plate line blank compliant with ASME B16.48 to prevent fuel or vapor transfer into the workspace. Use isolation means of sufficient strength to withstand pressure which might be exerted by liquid, gas, or vapor in an active pipeline, piping, or tank. Use gaskets on both sides if a line blank is inserted between two flanges. Do not use a valve as sole means of isolation. If LOTO isolates a segment of active fuel piping from thermal relief, install temporary relief capability.

Execute in accordance with accepted Accident Prevention Plan, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and EM 385-1-1. Coordinate LOTO installation, maintenance, inspection, and removal with facility fuel system operator.

1.4.2 Preparation for Welding

Develop written procedures in accordance with EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and AWS Z49.1. Test piping for

hydrocarbons and purge as necessary. Do not start grinding or welding until vapor-free certification is received from the Marine Chemist and requirements of EM 385-1-1 have been met.

1.4.3 Gas-Free Condition

Degass piping until requirements of Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, the accepted Accident Prevention Plan, and the certified Marine Chemist are met. Obtain gas-free certification from the Marine Chemist. Maintain the gas-free environment. Display the Marine Chemist certificate on-site and available for review at all times during welding work.

1.5 PERFORMANCE

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.

POL piping work always requires visual inspection of all welds. In some cases work may not require 100 percent examination of welds by nondestructive methods. The designer must determine required methods, extent of examination and testing, and whether an independent inspector is required. Those determinations must be communicated in this section, in the project program or SOW, and on project drawings. Use section text, drawing notes, NDE symbols, or other means. The referenced applicable publications must be used for guidance in determining inspection and testing requirements.

The specifications or drawings must clearly indicate which joints require 100 percent examination (all underground joints require 100 percent radiographic testing (RT) or phased array ultrasonic testing (PAUT)), which joints require random examination, and which methods are to be employed for each joint.

Phased array ultrasonic testing can only be used when radiography is not permitted or is infeasible, and requires prior Service Headquarters approval. See UFC 3-460-01 Design: Petroleum Fuel Facilities. Identify early when RT is not permitted or infeasible and contact the Service Headquarters representative IAW UFC 3-460-01.

Establish and maintain a system integral with the quality control program for inspection and examination of design and construction. Perform inspection and examination to ensure contract work conforms to requirements. Maintain complete records and make them available to the Government.

Contractor is responsible for the quality of all design, joint preparation, welding, inspection, examination, testing, records maintenance, and reporting. All materials used in welding operations must be clearly identified and recorded. Inspection, examination, and testing defined in this Section are minimum requirements. Provide additional inspection, examination, and testing when necessary to achieve the required quality of work.

1.6 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 must indicate, or text of project specifications must specify that factory applied internal and external coatings be stopped one inch from a girth weld leaving a 2 inch uncoated area for welding.

Drawings must identify which welds are closure welds and require in-process weld inspection and examination. Drawings must indicate the type of examination required at each weld joint.

In process examination is not required on every weld unless specifically stated in the Project Program or Statement of Work.

This section covers welding of POL service piping systems. Contractor must oversee the quality of design, joint preparation, welding, inspection, and examination. Deviation from applicable codes, approved procedures, and approved drawings is not permitted without prior written approval by the Contracting Officer. Materials or components with welds made offsite are not accepted if the welding does not conform to requirements of this Section, unless otherwise specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Unless otherwise specified, the choice of weld process is responsibility of the Contractor. See paragraph DESIGN REQUIREMENTS for limitations on use of closure welds.

The Contracting Officer or Owner's Inspector may conduct inspection, test, or oversight work. Government inspection or testing are for the sole benefit of the Government. They do not:

- a. Relieve Contractor of responsibility for providing adequate quality control measures
- b. Relieve Contractor of responsibility for damage to or loss of the material before acceptance

c. Constitute or imply acceptance

1.6.1 Procedures

Develop procedures for welding all metals included in the work. Procedures for making transition welds between different P-number materials or between plates or pipes of different thickness must be qualified.

1.6.2 Weld Inspection

This Section contains requirements to inspect all welds. Ensure full compliance with requests of the weld inspector(s) to correct deficiencies in materials and workmanship. It provides minimum requirements to qualify personnel, procedures, and equipment, and contains acceptance criteria. Correct all deficiencies in materials and workmanship in accordance with requirements of this Section.

1.6.3 Nondestructive Examination

This Section contains requirements to examine welds with nondestructive means to detect the presence of defects. It provides minimum requirements to qualify personnel, procedures, and equipment, and contains acceptance criteria. Correct all deficiencies in materials and workmanship in accordance with requirements of this Section.

1.6.4 Records Retention

Maintain current records of test results obtained in weld procedure qualification. Maintain current records of performance test results obtained to qualify welders and welding operators. Maintain welder continuity records. Maintain all records of weld inspection and NDE at the site and readily available for review by the Contracting Officer. Produce all records as part of Statement of Work (SOW) or Project Program completion report requirements.

1.6.5 Timely Reporting

Timely reporting of weld inspection and examination progress is required. A weld is not finished until its associated Weld Log record with affirmative inspection and examination results has been received and is found complete and accurate. Do not submit a request for progress payment for unfinished welding work.

1.6.6 Protect in Place

Protect in place tanks, piping, components, flanges, gaskets, motors, valves, pumps, impellers, risers, coating, finishes, gauges, alarms, conduit, and conductors. Employ measures to protect people, equipment, and surfaces from exposure to and damage from sparks, heat, radiant energy, and light emission. See paragraph MAINTAINING CLEANLINESS OF PIPING for more requirements.

1.7 DESIGN REQUIREMENTS

Consult with experts experienced in fuel piping or pipeline welding. Provide subject matter professional engineering expertise to design welding. Validate site conditions to fully inform procedures,

specifications, sketches and shop drawings. Produce work plans, procedures, specifications, sketches, and shop drawings which are complete and usable. Provide means to minimize heat distortion. Identify work which requires special methods such as preheat or postweld heat treatment, dissimilar metal joints or thickness, in-process weld examination, or closure welds. Establish fit-up and edge preparation tolerances.

Product[s] to be conveyed in the piping [is][are] [_____] [MIL-DTL-5624 Grade JP-4][and][MIL-DTL-5624 Grade JP-5][and][MIL-DTL-83133 JP-8][and][AFLP-3747 Jet A F-24][and][ASTM D4814 Mogas(F-46)][and][Diesel (F-76)]. Unless noted otherwise in SOW or Project Program, Fluid Service Category is Normal per [ASME B31.3](#).

1.7.1 Code and Criteria Basis

[UFC 3-460-01](#), [API 570](#), and [ASME B31.3](#) are relevant design codes and criteria. [ASME B31.3](#) incorporates by reference other requirements of [ASME BPVC SEC V](#), [ASME BPVC SEC IX](#), and American Welding Society (AWS). For applicable processes, provide design and plans consistent with standards and guides [AWS D10.4](#), [AWS D10.10/D10.10M](#), [AWS D10.11M/D10.11](#), [AWS D10.12M/D10.12](#), and [AWS C5.5/C5.5M](#).

1.7.2 Closure Welds

Restrict use of closure welds, as defined in this Section, to the minimum. Design work to maximize use of hydrostatic test(s) as means of compliance with leak test requirements of [ASME B31.3](#) paragraph 345. Refer to Section[[33 52 40 FUEL SYSTEMS PIPING \(NON-HYDRANT\)](#)][[33 52 43.13 AVIATION FUEL PIPING](#)][[33 52 10 FUEL SYSTEMS PIPING \(SERVICE STATION\)](#)] for hydrostatic test requirements. Designate on drawings or sketches the location of each closure weld and provide notes which state in-process examination requirements in accordance with this Section, [API 570](#), and [ASME B31.3](#). Ad-hoc, field-determined, or unnecessary closure weld designations are not allowed.

Closure welds in the work are only acceptable under the following circumstances.

- a. A closure weld is the only means by which the pipe or assembly can be installed into the system due to a physical constraint
- b. The closure weld cannot be leak-tested in accordance with [ASME B31.3](#), either in-situ or offsite

1.7.3 Structural Welds

In accordance with [AWS D1.1/D1.1M](#) Structural Welding Code, [AWS D1.2/D1.2M](#) Structural Welding Code (aluminum), and [AWS D1.6/D1.6M](#) Structural Welding Code (stainless steel). Welding of hangers, supports, and plates to structural members must conform to Section [05 05 23.16 STRUCTURAL WELDING](#). Do not weld attachment studs to any surface of the pressure-containing boundary. A weld which connects a support to the pressure-containing boundary is considered a piping or pipeline weld.

1.7.4 Piping or Pipeline Welds

In accordance with [API 570](#), [ASME B31.3](#) Process Piping Code, and this Section. Restrict process for root pass to gas tungsten arc. Butt joint or groove welds must have CJP. Branch connection welds must be no closer

than two times the run piping thickness from an adjacent weld.

1.7.5 Weld Plan

Provide a weld plan which addresses all aspects of welding operations, inspection, and examination to meet requirements of this Section. Include specification and qualifying record for each procedure along with a summary table which lists all qualified welding personnel and the Welding Procedure Specification (WPS) under which they are qualified. For each welding operation, identify a sequence to minimize heat distortion both in-situ and offsite. Provide a process for machine welding if used. Describe how the quality of welding operations will be controlled. Submit [Weld Plan](#) in accordance with paragraph SUBMITTALS.

1.8 QUALITY ASSURANCE

NOTE: In this section, three essential oversight roles are required for contractor to control the quality of welds. The inspector and examiner are QC specialists who report results directly to the QC Manager as part of the QC program.

The inspector (certified by AWS and per ASNT Level II in visual) primarily performs the visual method, which can be aided by PT or MT. Through agreement between the organizations, an AWS CWI or SCWI certificate holder is eligible to become certified as an ACCP (ASNT) Level II in visual testing.

The examiner (certified per ASNT) is independent and performs a technical method.

The quality control manager performs inspection, ensures inspection and examination are complete and accurate, rejects noncompliant work, directs rework, and provides QC reports to the Government.

ASME B31.3 identifies an Owner's Inspector role. This is a Government oversight function and is distinct and separate from the inspector role in this section, despite use of the same word "inspector."

Provide welding procedure specifications, procedure qualification records, and welder performance qualification records for each procedure and welder. Provide means and methods to control the quality of welding operations. If used, provide a method to track and control the quality of multiple welders on the same weld.

1.8.1 Data Management

Organize repair data in a non-proprietary management system such as a database or spreadsheet. Establish a piping location identification scheme which uniquely identifies each piping weld, its location, its orientation, and its relative position to other piping features. Provide secure, auditable, and organized data. Ensure the system has the capability to track the provenance of each weld. Cloud-based systems are

not acceptable. Limit access to the management system to ensure data integrity.

1.8.2 Weld Log

Produce, populate, and maintain a [Weld Log](#) capable of uniquely tracking the specific location of every weld in the work. Follow the established location identification scheme. Weld identification on shop drawings must match weld tracking log and weld marking. The log must include the following minimum contents.

- a. Weld map depicting physical location, location on the piping, clock position, and orientation
- b. Type of weld including temporary and tack welds
- c. Applicable WPS
- d. Name or identification number of welding personnel
- e. Date and time of completion of welding or tacking
- f. Date and type of weld inspection, inspector name, acceptance criteria; acceptance determination
- g. Date and type of nondestructive examination, examiner name, acceptance criteria, acceptance determination
- h. Date, name, description of defects found, reason for noncompliance
- i. Corrective action planned or taken, including all steps above leading to an acceptance determination
- j. Date and time of the QCM inspection for each determination that a specific weld (welding, inspection, and examination) is complete, meets requirements, and is acceptable

1.8.2.1 Progress Reporting

Update and populate the log as work progresses. Submit to the Contracting Officer on a regular basis as part of progress documentation. Provide a progress submittal weld log (including records for in-process inspection and examination) for oversight in a timely manner and indicating the QCM determination that a weld is complete, meets requirements, and is acceptable. Notify the Contracting Officer if weld log submittal lags by more than 10 work days.

1.8.3 Weld Symbolology

Provide weld symbolology in accordance with [AWS A2.4](#).

1.8.4 Weld Marking

Neatly mark on the work with a marker or paint pen sufficient information for Government QA of the work. Use block letters approximately [5 cm 2 inches](#) in height and in legible color contrasting with the work surface. The QCM is responsible to manage and oversee all marking, timeliness, and content. In the event marking cannot be made on the piping itself, use an all weather placard attached to the work at the location of each weld.

Minimum information is listed below. Should weld rework be required, neatly place a single line through obsolete marking and provide new marking.

- a. Unique weld identifier (correlated to the design)
- b. Welder identification
- c. Inspector identification, date, and result
- d. Examiner identification, date, and result
- e. QCM determination, date, and result

1.8.5 Shop Drawings

Prepare and submit detail CAD drawings showing location, length, clock position, and type of welds. Indicate preweld and postweld heat treatment, inspection, and NDE. The drawings must identify the WPS to be used at each weld location. Indicate locations of closure welds and in-process examination per the design.

1.8.6 Inspection Procedures

Provide weld inspection procedures compliant with [API 570](#), [ASME B31.3](#), and paragraph PROCEDURE STANDARDS. The weld inspector(s) is considered a QC Specialist and must report results directly to the QC Manager, as specified in Section [01 45 00](#) QUALITY CONTROL.

1.8.7 Examination Procedures

Provide examination procedures compliant with [API 570](#), [ASME B31.3](#), and paragraph PROCEDURE STANDARDS. The weld examiner(s) is considered a QC Specialist and must report results directly to the QC Manager, as specified in Section [01 45 00](#) QUALITY CONTROL. Identify a procedure standard for any method planned to be used which is not listed. Apply standard practice [ASTM E2700](#) when developing procedure for examining welds using phased array ultrasonic method (PAUT). Paragraph SPECIAL REQUIREMENTS FOR PAUT contains additional procedure requirements.

1.8.8 Procedure Standards

Method	Procedure Standard
Ultrasonic Examination (UT)	ASME BPVC SEC V Article 4
PAUT in lieu of RT	API Std 650 Annex U ASME BPVC SEC V Article 4 and Mandatory Appendix VII
PT	ASME BPVC SEC V Article 6
MT	ASME BPVC SEC V Article 7
Radiographic Examination (RT)	ASME BPVC SEC V Article 2

Method	Procedure Standard
Visual Examination (VT)	ASME BPVC SEC V Article 9

1.8.9 Inspection and Examination Reporting

Provide timely reports in accordance with paragraphs SUBMITTALS and weld log PROGRESS REPORTING. At minimum, 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 using the unique identifier for each weld inspected.
- b. All NDE examiner reports using the unique identifier for each weld examined.
- c. Weld map location of each weld, weld procedure, welder identification, results of visual inspection, results of NDE.
- d. Up-to-date Weld Log.
- e. Records made by the AWS certified inspector for in-process weld inspection, including visual method report as required in ASME B31.3.

1.9 QUALIFICATIONS AND CERTIFICATIONS

Before assigning welders or welding operators to the work, provide the Contracting Officer with names and 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 who certified the qualification tests. Provide a summary table showing all welders and the WPS for which they are qualified to weld.

Do not start welding until qualified weld procedures, welders, and welding operators have been provided. Qualify procedures for making transition welds between different materials or between metal of different wall thickness. Qualification testing must be performed by an approved independent test laboratory, or by the Contractor if approved by the Contracting Officer. Cost of such testing must be borne by the Contractor. Notify the Contracting Officer at least one week in advance of the time and place of tests. If the Contracting Officer elects to witness the tests, the qualification tests must be performed at or near the worksite and at the notified time and place.

1.9.1 Welding Procedure Specification

Qualify the WPS for every proposed welding procedure. Qualification must conform to the requirements of ASME B31.3 and this Section. Specify back purge gas requirements and end preparation for joints to include cleaning, alignment, and root opening tolerances. Include procedures for weld repairs. Specify interpass temperature control and any weld special treatment requirements as required by the design. Identify weld procedures uniquely and reference on the Weld Tracking Log and shop drawings.

Submit copies of the WPS for each type of welding required in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility to produce acceptable welds.

1.9.2 Procedure Qualification Record

Perform tests, qualify all procedures including weld repair, and document the results in detail on procedure qualification records. Qualify each proposed welding procedure. Qualify procedures in compliance with ASME B31.3, ASME BPVC SEC IX, and this Section. Use the PQR format QW-483 in ASME BPVC SEC IX. Submit each PQR together with its associated WPS, and in accordance with paragraph SUBMITTALS.

1.9.3 Welding Personnel

Conduct tests using qualified procedures to determine welding personnel are capable of producing the minimum requirements of an acceptable weldment. Test all welding personnel for each welding process to be used. Tests conducted by a different employer are not acceptable. Test in accordance with ASME B31.3 and ASME BPVC SEC IX.

1.9.3.1 Welder Performance Qualification

A welder or welding operator may be qualified by volumetric NDE or by bend tests on a test coupon. Qualification by initial production welding is not allowed. Before assigning welding personnel to the work, provide WPQ records which certify the individual is performance-qualified for the procedure in accordance with ASME B31.3. 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. Use the WPQ format in ASME BPVC SEC IX QW-484A for welders and QW-484B for welding operators. All welder qualification records must be signed and stamped by a certified welding inspector (CWI) as defined in AWS QC1. Submit each WPQ in accordance with paragraph SUBMITTALS.

1.9.3.2 Renewal of Welder 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 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 are 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 requirements of the specifications.
- d. The welder or welding operator was qualified by an employer, other than 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 or welding operator qualification for the previous qualification.

1.9.4 Previously Qualified Procedures and Personnel

Welding procedure specifications, 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 each WPS, procedure qualification record (PQR), and welder performance qualification (WPQ) are submitted and approved in accordance with paragraph SUBMITTALS.
- b. Testing was performed by an approved test laboratory, approved technical consultant, or by the Contractor's approved quality control organization.
- c. The welding procedures, welders, and welding operators were qualified in accordance with API 570 and ASME B31.3, and base materials, filler materials, electrodes, equipment, and processes conformed to the applicable requirements of the design and this Section.
- d. The requirements of paragraph RENEWAL OF WELDER QUALIFICATION are met and records showing name of employer and period of employment using the process for which qualified are submitted as evidence of conformance.

1.9.5 Independent Test Organization

The independent test organization can be a testing laboratory, technical consultant, or NDE testing firm, and must meet principles of ASTM E329. The principal business of the testing organization, testing laboratory, technical consultant, or firm must be NDE, inspection, and testing, and must have no involvement in project procurement, fabrication, construction or installation. The test organization, testing laboratory, technical consultant or NDE testing firm must be a first tier subcontractor. Submit current Independent Test Organization certification which demonstrates compliance with this Section in accordance with paragraph SUBMITTALS.

1.9.6 Inspection and Examination Personnel

**NOTE: Coordinate with paragraph PERFORMANCE. See
NOTE in paragraph QUALITY ASSURANCE regarding
required oversight roles.**

Provide a commercially independent organization for all weld examinations. Submit qualifications of all inspection and examination personnel for approval by the Contracting Officer. All inspection and NDE personnel must be qualified in accordance with the following requirements.

1.9.6.1 Prohibited Practices

- a. The contractor quality control manager cannot be the weld inspector or the weld examiner.

- b. Should a weld inspector also be a welder, that individual is disqualified from inspecting or examining a weld or any portion thereof of the inspector's own work.
- c. Should a weld examiner also be a welder, that individual is disqualified from inspecting or examining a weld or any portion thereof of the examiner's own work.

1.9.6.2 Weld Inspector

- a. Qualification: Weld inspector must be qualified in accordance with [ASME B31.3](#) and [API 570](#), and have minimum [5][7] years of experience inspecting process pipe or pipeline welding on military or commercial fuel systems. The weld inspector(s) is considered a QC Specialist.[All inspectors must be independent and must not represent nor be an employee of the prime construction contractor, welding subcontractor, fabricator, erector, or manufacturer.]
- b. Certification: Welding inspectors must be certified as CWI or senior certified welding inspector (SCWI) as defined in [AWS QC1](#) with a [ASME BPVC SEC IX](#) endorsement. Provide [AWS Weld Inspector Certificate](#) in accordance with paragraph SUBMITTALS.[Provide one SCWI in responsible charge of weld inspection duties to oversee CWI inspection and review all weld inspection reports.]

1.9.6.3 In-Process Weld Inspector

- a. Qualification: In-process weld inspector must be qualified in accordance with [ASME B31.3](#) and [API 570](#), and have minimum [5][7] years of experience inspecting process pipe or pipeline welding on military or commercial fuel systems. The in-process weld inspector(s) is considered a QC Specialist.[All inspectors must be independent and must not represent nor be an employee of the prime construction contractor, welding subcontractor, fabricator, erector, or manufacturer.]
- b. Certification: In-process weld inspector must be certified as CWI or senior certified welding inspector (SCWI) as defined in [AWS QC1](#) with a [ASME BPVC SEC IX](#) endorsement, and must be certified as a Level II in visual method compliant with [ASNT SNT-TC-1A](#). Provide both [AWS](#) and [ASNT In-Process Weld Inspector Certificates](#) in accordance with paragraph SUBMITTALS.

1.9.6.4 Nondestructive Examiner

- a. Qualification: Examiners must be qualified to perform NDE in accordance with [ASME B31.3](#) and [API 570](#). Examiners must meet minimum requirements for qualification in [ANSI/ASNT CP-189](#). Qualified examiners must have minimum [3][5] years verifiable experience performing nondestructive examination of fuel pipeline or piping. Experience is defined as work activity performing a specific NDE method under the direction of qualified supervision but does not include time spent in training programs. Examiners performing PAUT must be qualified in accordance with [ASME BPVC SEC V](#) Mandatory Appendix VII, and [API Std 650](#) Annex U Personnel Qualifications and Training, with Level III Review. Personnel performing nondestructive examination must not represent nor be an employee of the prime construction contractor, welding subcontractor, fabricator, erector, or manufacturer, and must be employed by an independent test

organization.

- b. Certification: Provide examiners certified compliant with [ANSI/ASNT CP-189](#) pursuant to the table EXAMINER CERTIFICATION STANDARDS for the applicable method. Level II Limited certification does not meet the Level II requirement. Provide [Weld Examiner Certificate](#) in accordance with paragraph SUBMITTALS.

1.9.6.5 Examiner Certification Standards

Method	Standard
UT	Level II or III
PAUT in lieu of RT	API Std 650 Annex U with Level III review
PT	Level II or III
MT	Level II or III
RT	Level III
VT	Level II

1.9.7 Piping Engineer of Record

Professional engineer in responsible charge of the POL service piping design.

- a. Qualification: [5][7] years of experience in POL facilities engineering, including design, inspection, and construction of pipelines or process piping systems.
- b. Certification: Bachelor of Science degree in Civil or Mechanical Engineering; Licensed as a professional civil or mechanical engineer.

1.10 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, and other welding materials must be delivered to the site in manufacturer original package and stored in a dry space until used. Packages must be properly labeled and designed to give maximum protection from moisture, prevent contamination, and to ensure safe handling.

1.10.1 Material Control

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

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

1.10.2 Partial Issue

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 and kept in a storage oven until use.

1.10.3 Damaged Container

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 they 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.

1.10.4 Damaged Material

Materials which are damaged must be discarded. Do not use covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire.

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.

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

Perform welding in accordance with the Weld Plan and qualified procedures using qualified personnel. Do not weld when the quality of the completed weld could be impaired by prevailing working or weather conditions. The Contracting Officer must determine when weather or working conditions are unsuitable for welding.

For applicable processes, provide operations consistent with standards and guides AWS D10.4, AWS D10.10/D10.10M, AWS D10.11M/D10.11, AWS D10.12M/D10.12, and AWS C5.5/C5.5M.

- The root pass on stainless steel, aluminum, and carbon steel pipe must be by the GTAW process.
- 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 CJP groove welds made in accordance with qualified welding procedures.

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

3.1.1 Identification

Assign each welder or welding operator weld a unique identification mark (number, letter, or symbol). Place identification mark on the work and the weld map. Ensure each identification is neat and legible, traceable to a welder, and associated with a performance qualification record. Apply the unique identification mark adjacent to each weld with permanent weatherproof means using a rubber stamp, felt-tipped marker, paint pen, or other method approved by the Contracting Officer. Do not use fluorescent paint or any method which deforms the metal. Identification by die stamps or electric etcher is not allowed.

3.1.2 Base Metal Preparation

Use mechanical grinding of thermal cut ends to remove the HAZ, or to dress metal for proper fit-up. This practice is limited to the HAZ or a maximum 3 mm 1/8 inch length of removal. Do not use oxy-fuel cutting on austenitic stainless steel or nonferrous materials. Do not reduce pipe thickness outside of a weld. See paragraph GRINDING for requirements in the event pipe thickness is reduced from nominal.

3.1.3 Weld Joint Fit-up

Provide fabrication, assembly, erection, preparation, and fit-up in accordance with API 570 and ASME B31.3. Use bars, jacks, clamps, or other mechanical fixtures to fit, align, and retain joints in position during the welding operation. Align and prepare end joints prior to welding in accordance with Chapter V of ASME B31.3. For socket-welded joints, implement a program to ensure gaps are properly measured and documented to be in conformance with ASME B31.3. Branch connection welds must be no closer than 2 times the run piping thickness from an adjacent weld.

Do not use welded temporary attachments 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 careful cutting or grinding after the weld operation is completed. Cut the attachment no closer than 6 mm 1/4 inch from the member and remove remaining material by careful grinding. Do not grind into base metal. After the temporary attachment has been removed, inspect the area using VT. For any area with grinding that could reduce metal or pipe wall thickness below nominal, refer to and follow requirements in paragraph GRINDING.

3.1.4 Butt Weld Joint Spacing

Butt weld joints must be spaced a minimum of 150 mm 6 inches apart with measurement taken from the toe of the first weld to the toe of the second weld. Measure 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.

3.1.5 Preheat and Interpass Temperatures

Meet the requirements specified by ASME B31.3 for preheat temperatures. However, in no case can 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. 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 the full thickness of weld joint preparation and 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, only use a neutral flame. Do not use oxy-fuel heating 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 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of 150 mm 6 inches ahead of the weld, but not on the area to be welded.

3.1.6 Production Welding Instructions

- a. Welding must not be done when 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. During periods of high winds welding is not permitted 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 plexiglass or dry and clean plywood. Wood dams must be kiln-dried quality. Do not use purge dams made of polyvinyl alcohol.
- g. Any welding process which requires the use of external gas shielding cannot 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. Remove tack welds that are cracked or defective and retack the groove 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 examined by MT.

- i. Grinding of completed welds is to be performed only to the extent required for inspection or NDE, including in-process 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 is not allowed. See paragraph CORRECTION AND REWORK. Minimum weld external reinforcement must be flush between external surfaces.
- j. Each qualified welder must be assigned unique identification. All welds must be permanently annotated with the mark or 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) for method of connection.

3.1.7 Postweld Heat Treatment

- a. When required, perform postweld heat treatment 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 1 inch of weld thickness.

3.2 EXAMINATIONS, INSPECTIONS AND TESTS

NOTE: PAUT is only permitted at locations that
prohibit the use of radiography and locations where
it is infeasible due to physical location or other
constraints. PAUT must be approved by the Service
Headquarters, See UFC 3-460-01. In cases where PAUT
is used, all welds must be recorded and the results
reviewed by an ASNT Level III in PAUT certified
individual and the requirements in this section.

Coordinate with paragraph PERFORMANCE.

Provide the services of a qualified inspection, testing, or examination organization meeting requirements of paragraph QUALIFICATIONS AND CERTIFICATIONS and approved by the Contracting Officer. [Radiographic][Liquid penetrant][Magnetic particle][and][PAUT]examination is

required pursuant to this Section. Perform inspection, examination, and testing as required by the SOW or Project Program, this Section, the piping engineer, [API 570](#), [ASME B31.3](#), and in accordance with written procedures.

- a. When in-process weld examination is required, perform in accordance with paragraph IN-PROCESS WELD INSPECTION.
- b. Hydrostatic test requirements are found in the SOW or Project Program and Section [[33 52 40 FUEL SYSTEMS PIPING \(NON-HYDRANT\)](#)][[33 52 43.13 AVIATION FUEL PIPING](#)][[33 52 10 FUEL SYSTEMS PIPING \(SERVICE STATION\)](#)].
- c. In all cases where PAUT is used in lieu of RT, permanently record the weld examinations. Have the results reviewed and receive concurrence by an examiner certified to [ANSI/ASNT CP-189](#) Level III and requirements of this Section.
- d. When examination, inspection, and testing indicate a defect in a weld joint, the weld must be repaired by a qualified welder in accordance with paragraph CORRECTION AND REWORK.
- e. When inspection, examination, and tests substantiate defects in a weld, rework the weld with a qualified welder in accordance with paragraph CORRECTION AND REWORK. Perform all inspection, examination, and tests on rework until acceptable results are achieved.
- f. Submit all weld inspection, examination, and test reports to the Contracting Officer.

3.2.1 Quality Control of Welding

- a. Verify 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 welding equipment to be used for the work is appropriate for use with the welding procedure specification and has the capability to meet requirements of the welding procedure.
- c. Verify only approved or qualified welding procedures are used for the work.
- d. Verify that edge preparation and joint geometry meet requirements of the welding procedure and drawings.
- e. Verify specified filler metals are used and that filler metals are maintained in proper condition, per requirements and as recommended by the manufacturer.
- f. Verify work conforms to requirements of the applicable code, standards, drawings, design, or other documents.
- g. Verify the approved WPS pre-heat and post heat procedures are being used.
- h. Prepare clear and concise reports and verify that records of the results of weld inspection and examinations are maintained.

3.2.2 Weld Inspection

Perform weld inspection to detect surface and subsurface discontinuities in completed welds. Visually inspect all welds in accordance with requirements of ASME B31.3, ASME BPVC SEC V, and AWS D1.1/D1.1M. Aid the VT by using PT or MT as-needed to determine the condition of a weld.

- a. Provide inspector personnel qualified and certified in accordance with paragraph INSPECTION AND EXAMINATION PERSONNEL.
- b. Visually inspect all tack welds and completed welds.
- c. Submit weld inspection reports to the Contracting Officer within 10 work days of performance.
- d. Provide inspection in accordance with paragraph EXAMINATION AND INSPECTION FREQUENCY.
- e. Weld personnel found making defective welds must be removed from the work or must be required to be requalified in accordance with ASME B31.3 by the Quality Control Manager.
- f. For each method used, provide a qualified procedure in accordance with paragraph INSPECTION PROCEDURES.

3.2.2.1 Weld Inspection Duties

- a. Verify the technique and performance of each welder, welding operator, and tack welder are as specified.
- b. Verify the work inspected is identified and documented in accordance with SOW or Project Program requirements and this Section.
- c. Prepare clear and concise reports and verify that records of the results of weld inspection and examinations are maintained.
- d. Review requirements in paragraph QUALITY CONTROL OF WELDING and determine whether the quality control program is effective.
- e. Perform VT inspection of all welds.

3.2.3 In-Process Weld Inspection

NOTE: 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 closure welds or welds designated for in-process inspection or examination, inspect in accordance with requirements of ASME B31.3, ASME BPVC SEC V, API 570, and AWS D1.1/D1.1M. Aid visual inspection with PT or MT in accordance with API 570 if needed to determine the condition of a weld. Perform in-process inspection in accordance with paragraph

WELD INSPECTION and the following.

- a. Provide in-process inspection in accordance with paragraph EXAMINATION AND INSPECTION FREQUENCY.
- b. Before welding: Inspect for compliance with requirements for joint preparation, cleanliness, preheating, fit-up, joint clearance, and internal alignment in accordance with ASME B31.3. Assess compliance with variables specified in the WPS including filler material, position, and electrode.
- c. During welding: After cleaning, inspect root pass for cracks, slag, and conformance to approved welding procedure. Assess weld condition between passes. When it is accessible, perform visual inspection of the interior side of the root pass by remote means allowed in ASME BPVC SEC V Article 9.
- d. After welding: Inspect for defects, contour and finish, bead reinforcement, undercutting, overlap, weld slag on the interior of the pipe, appearance, and weld size in accordance with ASME B31.3 and AWS D1.1/D1.1M. Perform visual inspection of the interior by remote means allowed in ASME BPVC SEC V Article 9 when it is accessible.
- e. Prepare and provide inspection record of in-process weld inspection including visual method report. Submit in-process weld inspection records and reports to the Contracting Officer within 10 work days of performance.

3.2.4 Nondestructive Examination

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 methods.

Phased array ultrasonic testing can be used when radiography is not permitted or infeasible but only with Service Headquarters approval. See UFC 3-460-01.

Perform NDE as required by API 570, ASME B31.3, SOW or Project Program, this Section, the design, and in accordance with written procedures. Procedures must conform to paragraph EXAMINATION PROCEDURES. Each approved procedure must be demonstrated to the satisfaction of the Contracting Officer. In addition to essential variables required in paragraph EXAMINATION PROCEDURES, the written procedures must include proper timing of NDE in relation to welding operations, weld inspection, and safety precautions.

Provide non-destructive examination in accordance with paragraph EXAMINATION AND INSPECTION FREQUENCY. Service organization must meet requirements of paragraph INDEPENDENT TEST ORGANIZATION and must be approved by the Contracting Officer.

Provide services of a commercially independent qualified testing agency

approved by the Contracting Officer for examination and testing of piping welds. The cost of examination and testing, including re-examination and re-test 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 or other suitable mechanical means. The weld surface must be merged smoothly with the base metal surface.

3.2.5 Special Requirements for PAUT

In addition to requirements below, see paragraph EXAMINATION PROCEDURES.

- a. Phased array ultrasonic examination must meet review requirements of [API Std 650 Annex U Personnel Qualifications and Training and Level III Review](#), and Inspection Requirements of [ASME BPVC SEC V](#).
- b. Calibration standards must meet the requirements of [ASME BPVC SEC V](#) Figures T-434.3-1 and T-434.3-2.
- c. Only [ASNT SNT-TC-1A](#) (or [ANSI/ASNT CP-189](#)) Level II or Level III certified personnel can perform PAUT examination, analyze the data, or interpret result.
- d. Final data package must be reviewed by an [ASNT SNT-TC-1A](#) (or [ANSI/ASNT CP-189](#)) Level III individual qualified in PAUT, and in accordance with the employer's written practice. The review may be achieved by arranging for a data acquisition and initial interpretation by a Level II individual with final interpretation and evaluation performed by a Level III individual. The review must include the following.

3.2.5.1 Procedure Essential Variables

Essential variables are listed below. Changes in any of the essential variables beyond that allowed in this Section triggers 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 will be performed
- c. Technique(s), angle(s), and mode(s) of wave propagation in the material
- d. Search unit type(s), frequency(ies), and element size(s), shape(s), number, pitch and gap dimensions
- e. Focal range: Identify plane, depth, or sound path
- f. Virtual aperture size (i.e., number of elements, effective height, and element width)
- g. Angular range used (i.e., 40 deg to 50 deg, 50 deg to 70 deg)
- h. Angle incremental change (i.e., 12 deg, 1 deg)
- i. Element incremental change (i.e., 1,2)
- j. Additional S-scan, E-scan requirement range of element numbers used

(i.e., 1-126, 10-50)

- k. Scan plan
- l. Weld axis reference point marking
- m. Rastering angle(s)
- n. Aperture start and stop element numbers
- o. Aperture incremental change(s), number of elements stepped
- p. Angular sweep increment (incremental angle change, deg)
- q. Aperture element numbers (first and last)
- r. Calibration technique(s) and block(s)
- s. Scanning technique (automated or 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 identification
- y. Personnel performance requirements, personnel qualification requirements
- z. Surface condition (examination surface, calibration block)
- aa. Recording equipment

3.2.5.2 Non-Essential Variables

- a. Couplant: brand name or type
- b. Post-examination cleaning technique
- c. Automatic alarm when applicable
- d. Records, including minimum calibration data to be recorded (e.g., instrument settings)

3.2.6 Examination, Inspection, and Tests by the Government

Welding is subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to SOW or Project Program, or requirements of this Section, the work may be rejected at any time before final acceptance of the system containing the weldment. If defective work is identified, provide a corrective action plan and initiate rework procedures. Perform rework, repair, inspection, examination, and testing compliant with SOW or Project Program requirements and this Section. The rework, repair, inspection, examination, and testing, except as noted below, is at no additional cost to the Government.

3.2.6.1 Supplemental NDE, Inspection, and Tests

In addition to requirements of the SOW or Project Program and this Section, the Government Owner's Inspector may perform supplemental nondestructive examination, inspection, or tests as deemed necessary. The cost of supplemental NDE, inspection, or tests will be borne by the Government. Coordinate safe access to the work for the NDE, inspection, and test personnel and equipment. If defective work is identified, provide a corrective action plan and initiate rework procedures.

3.2.6.2 Destructive Tests

In addition to requirements of the SOW or Project Program and this Section, the Contracting Officer or Owner's Inspector may order destructive tests to be performed by the Contractor. If destructive test results indicate that materials or workmanship do not conform to contract requirements, the cost of destructive tests, corrective action, and repair must be borne by the Contractor. When destructive tests are made, repairs must be made by qualified welders or welding operators using qualified welding procedures which will develop the full strength of the member.

3.3 EXAMINATION AND INSPECTION FREQUENCY

**NOTE: The examination and inspection frequency
stated is intended for normal temperature fluid
service or severe cyclic conditions as noted. For
other service conditions edit accordingly.**

Conduct NDE and inspection of all welding, including high point vent and low point drain piping. Determine and report conformance to the paragraph ACCEPTANCE STANDARDS. Provide frequency of NDE and inspection in accordance with the below requirements and paragraph EXAMINATION AND INSPECTION SCHEDULE.

- a. Provide 100 percent RT for welds on underground or inaccessible piping.
- b. Provide 100 percent RT for welds on severe cyclic piping to include aviation hydrant systems and truck fillstands.
- c. Examine each socket weld or socket welded branch connection with either magnetic particle or liquid penetrant methods.
- d. For aboveground welds examined by radiography at frequency less than 100 percent, provide random RT in accordance with ASME B31.3 on no less than 20 percent of welds. Random testing must include representation of welds made by each welding operator or welder and must include representation of each weld type present in the work. The progressive sampling requirements of ASME B31.3 apply.
- e. Where RT is infeasible, notify and provide justification to the Contracting Officer. Justification must be substantive and not be based on convenience. Upon approval by the Contracting Officer, perform UT in lieu of RT in accordance with this Section and API Std 650 Annex U and ASME BPVC SEC V.
- [f. Provide select [RT][PAUT] in accordance with ASME B31.3 for all

aboveground piping welds. The inspection must include an examination of welds made by each welding operator or welder.[Not less than [_____] percent of total welds must be examined.] If the testing reveals that a weld fails 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 quality requirements, the entire group of welds represented is accepted and the defective welds must be repaired. If any of the additional welds inspected fail to meet quality requirements, the entire group of welds represented is rejected. Rejected welds must be removed and rewelded.

13.3.1 Examination And Inspection Schedule

Weld Type	Joint Type or Configuration	Frequency	Method
CJP groove	Butt	Each pass	VT
CJP groove	Butt	Final pass	VT, RT
Closure	Root pass	Each	VT, PT or MT; Note 1
Closure	Cover pass	Final	VT, RT; Note 1
Fillet		Final	VT, MT
Structural attachment	Installation or removal	Final pass or after removal	VT, PT or MT
	Cutline	Each	VT; Note 2
Repair		Note 3	Note 3
	Pipe interior	Root or final pass, when accessible	VT
Insert	Branch connection	Final pass	VT, RT
Non radiographicable	Branch Connection	Final pass	VT, PT or MT
CJP groove	Butt; inaccessible	Final pass	VT, RT
Socket		Final pass	VT, PT or MT

Note 1. In-process weld examination IAW API 570, ASME B31.3 and this Section.

Note 2. Examine the cutline for laminations, scale, burrs before welding.

Note 3. Examination and inspection requirement for a weld repair is pursuant to that of the original weld and must be repeated until no defect exists.

3.4 ACCEPTANCE STANDARDS

NOTE: These acceptance standards were taken from ASME B31.3 and ASME B31.4 and are suitable for most work. Evaluations of indications, as given in ASME B31.3 and ASME B31.4, are applicable to these criteria. 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 second paragraph below and delete the first paragraph.

[Inspection and examination acceptance standards must be in accordance with ASME B31.3. Acceptance criteria are in paragraph ACCEPTANCE CRITERIA and notes.

] [Inspection and examination acceptance standards must be in accordance with ASME B31.3. Acceptance criteria are in paragraph ACCEPTANCE CRITERIA and notes. For hydrant systems and stainless steel systems, use severe cyclic conditions. Interpretation of results and limitations on imperfections in welds must comply with the requirements of 100 percent radiography as defined in ASME B31.3.

] 3.4.1 Acceptance Criteria

Method	Criterion	Note
VT	ASME B31.3 Table 341.3.2	1
RT	ASME B31.3 Table 341.3.2	-
MT	ASME B31.3 344.3	2
PT	ASME B31.3 344.4	3
UT	ASME B31.3 344.6	-
PAUT in lieu of RT	ASME B31.3 Table 341.3.2	4

Note 1. In addition to paragraph ACCEPTANCE CRITERIA, requirements of paragraph VISUAL also apply.

Note 2. In addition to paragraph ACCEPTANCE CRITERIA, requirements of paragraph MAGNETIC PARTICLE also apply.

Note 3. In addition to paragraph ACCEPTANCE CRITERIA, requirements of paragraph LIQUID PENETRANT also apply.

Note 4. Use acceptance criteria for RT.

3.4.2 Visual

The following indications are unacceptable.

- a. Weld slag on the interior of the pipe.

3.4.3 Magnetic Particle

The following relevant indications are unacceptable.

- a. Any linear indication.
- b. Rounded indication with any dimension 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 (linear dimension), and with the area calculated in the most unfavorable location relative to the indications being evaluated.

3.4.4 Liquid Penetrant

Indications with a major dimension greater than 2 mm 1/16 of an inch must be considered relevant. The following relevant indications are unacceptable.

- a. Any crack or linear indication.
- b. Rounded indication with any dimension 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 (linear dimension), and with the area calculated in the most unfavorable location relative to the indications being evaluated.

3.5 CORRECTION AND REWORK

Disqualifying or rejectable inspection findings or examination indications must be completely removed and repaired as specified in ASME B31.3, unless specified otherwise in this Section. Defects discovered between weld passes must be completely removed and repaired before additional weld passes are made. After defect removal is complete and before rewelding, the area must be inspected and examined by the same method(s) which first revealed the defect to ensure the defect has been eliminated. After rewelding, the repaired area must again be inspected and examined by the same method(s) 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 defects are present.

3.5.1 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 careful 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 including sound weld metal for a distance of twice the thickness of the base metal or 5 cm 2 inches, whichever is less, and reweld.
- d. Cracks or linear indications in weld or base metal: Remove crack or linear indication throughout its length, extending removal into sound weld metal for a distance of twice the thickness of the base metal or 5 cm 2 in, whichever is less, beyond each end of a crack or linear indication. Confirm complete removal by MT for carbon steel or PT for stainless steel. Once removal is inspected and examined, then rework can commence.
- e. Poor Fit-Up: Cut apart improperly fitted parts, re-fit, and reweld.

3.5.1.1 Methods of Defect Removal

Remove weld metal or portions of base metal by chipping, grinding, sawing, machining, or other mechanical means. It is less preferable but defects also can be removed by thermal cutting techniques. If thermal cutting techniques are used, clean and smooth the cut surfaces by mechanical means to remove the HAZ. In addition, a maximum of 3 mm 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.

3.5.1.2 Grinding

For surfaces which require grinding, exercise caution to avoid reducing wall thickness. After all grinding operations are complete, measure with UT and record remaining metal thickness on areas which were ground. Perform thickness measurements, compare to nominal, and analyze results in accordance with API 570. Report results to the Contracting Officer.

3.5.1.3 Rewelding

Make repair welds 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 all requirements of this Section.

3.5.1.4 Peening or Caulking

The use of force (peening) or foreign materials to mask, fill, seal, or disguise any welding defect is prohibited.

3.6 MAINTAINING CLEANLINESS OF PIPING

NOTE: The intent of the following paragraph is to require cleaning of the piping system as it is being installed. Depending on the extent of the work, the designer could 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.

Keep the interior and ends of all new pipe and piping affected by work thoroughly cleaned of foreign matter and water before, during, and after installation. Keep piping systems clean during installation by means of plugs, covers, or other effective methods. When work is not in progress, secure ends of piping, components, and fittings so no water, debris, or foreign substance can enter. Inspect piping before placing into position. Clean the interior of each length of pipe after welding. Use a swab with a leather or canvas belt disc to fit the inside diameter of pipe and pull through each length of pipe after welding in place. It is the Contractor's responsibility to ensure the interior of piping is free of dirt, debris, water, and foreign matter, including weld slag, when it is connected into the system.

[3.6.1 Pigging Plan

NOTE: Use 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. Coordinate with Section 33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT).

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. See Section[33 52 40 FUEL SYSTEMS PIPING (NON-HYDRANT)][33 52 43.13 AVIATION FUEL PIPING].

]3.7 QUALITY CONTROL DETERMINATION

Perform quality control oversight of the welding, inspection, testing, and NDE work. Provide a determination by the QCM that each weld is complete, has been inspected by the inspector, has been examined by the examiner(s), and meets contract requirements. Mandatory elements of the determination are below. See paragraphs WELD MARKING and WELD LOG.

- a. Review of the weld
- b. Welder, inspector, and NDE examiner markings are complete, accurate,

and up to date

- c. Weld inspection and results
- d. Weld examination and results
- e. Weld Log is complete, accurate, and up to date
- f. Reporting to the Contracting Officer is complete, accurate, and up to date

[3.8 COMMISSIONING

For commissioning of POL service piping systems see Section[33 08 55 FUEL DISTRIBUTION SYSTEM START-UP (NON-HYDRANT)][33 08 53 AVIATION FUEL DISTRIBUTION SYSTEM START-UP].

] -- End of Section --