

Preparing Activity: NAVFAC

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

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DIVISION 33 - UTILITIES

SECTION 33 52 90.00 20

WELDING FOR POL SERVICE PIPING

04/07

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USACE / NAVFAC / AFCEA / NASA UFGS-33 52 90.00 20 (April 2007)

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UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 33 52 90.00 20

WELDING FOR POL SERVICE PIPING 04/07

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. New hydrant fueling systems are not covered by this specification.

The following guidance is offered the designer. ANSI/ASME B31.3 - Chemical Plant and Petroleum Refinery Piping is applied to on-installation POL farm and fuel distribution systems. ANSI/ASME B31.4 - Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids applies to off-installation transport pipelines or pipelines delivering fuel to the installation.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

PART 1 GENERAL

1.1 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of

**SpecsIntact automated reference checking is
recommended for projects based on older guide
specifications.**

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

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (2001) Recommended Practice

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1998) Standard Symbols for Welding,
Brazing and Nondestructive Examination

AWS A3.0 (2001) Standard Welding Terms and
Definitions Including Terms for Adhesive
Bonding, Brazing, Soldering, Thermal
Cutting and Thermal Spraying

AWS A5.1/A5.1M (2004; Errata 2004) Carbon Steel
Electrodes for Shielded Metal Arc Welding

AWS A5.10/A5.10M (1999) Bare Aluminum and Aluminum Alloy
Welding Electrodes and Rods

AWS A5.18/A5.18M (2005) Carbon Steel Filler Metals for Gas
Shielded Arc Welding

AWS A5.20 Carbon Steel Electrodes for Flux Cored Arc
Welding

AWS A5.22 Stainless Steel Electrodes for Flux Cored
Arc Welding and Stainless Steel Flux Cored
Rods for Tungsten Arc Welding

AWS A5.3/A5.3M (1999) Aluminum and Aluminum-Alloy
Electrodes for Shielded Metal Arc Welding

AWS A5.32 Welding Shielding Gases

AWS A5.4 (1992; R 2000) Stainless Steel Electrodes
for Shielded Metal Arc Welding

AWS A5.9 (1992) Specification for Bare Stainless
Steel Welding Electrodes and Rods

AWS C5.5 (2003) Recommended Practices for Gas
Tungsten Arc Welding

AWS D1.1/D1.1M (2006; Errata 2006) Structural Welding
Code - Steel

AWS D10.10 (1999) Local Heat Treatment of Welds in
Piping and Tubing

AWS D10.11 (1992) Recommended Practices for root Pass

Welding of Pipe Without Backing

AWS D10.12	(2000) Recommended Practices and Procedures for Welding Plain Carbon Steel Pipe
AWS D10.4	(2000) Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
AWS D10.7	(2000) Guide for Shielded Arc Welding of Aluminum and Aluminum Alloy Pipe
AWS QC1	(2006) AWS Certification of Welding Inspectors
AWS WHB-4.8	(1998) Welding Handbook, vol II, Materials and Applications
AWS Z49.1	(2005) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B31.3	(2004) Process Piping
ASME B31.4	(2006) Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquid
ASME BPVC SEC V	(2004; 2005 Addenda; 2006 Addenda) Boiler and Pressure Vessel Code; Section V, Nondestructive Examination

ASTM INTERNATIONAL (ASTM)

ASTM E 329	(2005b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 94	(2004) Radiographic Examination

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-271	(Rev F) Requirements for nondestructive Testing Methods
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1.2 DEFINITIONS

Definitions shall be in accordance with AWS 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

*****NOTE: Submittals must be limited to those necessary *****
for adequate quality control. The importance of an
item in the project should be one of the primary
factors in determining if a submittal for the item
should be required.

A "G" following a submittal item indicates that the
submittal requires Government approval. Some
submittals are already marked with a "G". Only
delete an existing "G" if the submittal item is not
complex and can be reviewed through the Contractor's
Quality Control system. Only add a "G" if the
submittal is sufficiently important or complex in
context of the project.

For submittals requiring Government approval on Army
projects, a code of up to three characters within
the submittal tags may be used following the "G"
designation 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
projects.

Submittal items not designated with a "G" are
considered as being for information only for Army
projects and for Contractor Quality Control approval
for Navy projects.

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are [for Contractor Quality Control
approval.] [for information only. When used, a designation following the
"G" designation identifies the office that will review the submittal for
the Government.] The following shall be submitted in accordance with
Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Welding procedure qualification; [G] [; G, [____]]

Welding Operations; [G] [; G, [____]]

Detailed procedures which define methods of compliance to
contract drawings and specifications.

SD-02 Shop Drawings

POL Service Piping; [G] [; G, [____]]

Detail drawings showing location, length, and type of welds; and
indicating preweld and postweld heat treatment and NDE as
required. The drawings shall show the welding procedure

specification (WPS) to be used at each weld location.

Pigging Plan; [G] []; G, [____]]

SD-06 Test Reports

Welding Reports

Written records and drawings indicating location of welds made by each welder or welding operator.

Examinations, Inspections and Tests

SD-07 Certificates

Qualifications; [G] []; G, [____]]

Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

Pipe Fitting Inspector-Owners (factory); [G] []; G, [____]]

Inspection and material procurement records. System and material testing and certification records.

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 (1) inch from a girth weld leaving a 2" 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 shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 1 week in advance of the time and place of the tests. If the Contracting Officer elects to witness the tests, the qualification tests shall be

performed at or near the worksite. The Contractor shall maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor.

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.

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% Radiographic Testing (RT) which joints require random NDE inspection, and which NDE methods are to be employed for each joint.

The Contractor shall be responsible for the quality of all joint preparation, welding, and examination. All materials used in the welding operations shall be clearly identified and recorded. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall 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, the welding procedure qualification record, and the welder and welding operator certifications 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], [ASME B31.4], 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 shall 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.

1.6.2 Welding Procedure Specification and Qualification Records

The Contractor shall record in detail and shall qualify the Welding Procedure Specifications for every proposed welding procedure. Qualification for each welding procedure shall conform to the requirements of [ASME B31.3,] [ASME B31.4,] and to this specification. The welding procedures shall 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 shall 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 shall be submitted in accordance with paragraph SUBMITTALS. Approval of any procedure does not relieve the Contractor of the sole responsibility for producing acceptable welds. Welding procedures shall be identified individually and shall be referenced on the [POL service piping](#) shop drawings.

1.6.2 Welder and Welding Operator Performance

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

1.6.2.1 Certification

Before assigning welders or welding operators to the work, the Contractor shall provide the Contracting Officer with their names together with certification that each individual is performance-qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code and welding procedure specification under which each is qualified, date qualified, and the firm and individual certifying the qualification tests. The Contractor shall provide a summary table showing all welders and the WPS with which they are qualified to weld.

1.6.2.2 Identification

Each particular weld shall 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 shall be submitted, and each welder or welding operator shall apply the personal mark adjacent to the welds using a rubber stamp or felt-tipped marker with permanent, weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. Identification by die stamps or electric etchers will not be allowed.

1.6.2.3 Renewal of Qualification

Requalification of a welder or welding operator shall 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 shall 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 shall 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, ultrasound, etc.) 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

NOTE:

Coordinate with paragraph Performance.

All inspection and NDE personnel shall be qualified in accordance with the following requirements. The contractor shall 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 shall be submitted for approval. All inspectors and NDE personnel shall have a minimum of one (1) year experience inspecting the piping material being used and five (5) years in military or commercial aircraft hydrant fueling systems or truck fueling systems, petroleum refineries, power generating plants, or chemical process plants.

1.6.5.1 Inspector Certification

Welding inspectors shall be qualified in accordance with [AWS QC1], [ASME B31.3, Chapter VI].

1.6.5.2 NDE Personnel

NDE personnel shall be certified in accordance with Chapter VI, ASME B31.3 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 shall be established. The procedures shall be based on appropriate specific and general guidelines of training and experience recommended by ASNT RP SNT-TC-1A.

1.6.5.3 Testing Agency

The testing agency, testing laboratory, technical consultant or contractor's approved quality assurance organization shall meet the requirements of ASTM E 329.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.7.1 Material Control

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

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

1.7.1.1 Damaged Containers

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

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, [within 1/2 hour]; [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 shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4.

1.9 SAFETY

Safety precautions shall 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 or Gas Metal Arc Welding 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 shall comply with AWS WHB-4.8. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures. All field girth root pass welds shall be made with non-covered electrodes or welding wire. 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 shall be in accordance with Table 1. Welding materials for aluminum and aluminum alloy shall comply with AWS D10.7.

TABLE I.

AWS	Process	Alloy	Consumable Example (1)	Use
AWS A5.1/A5.1M	SMAW	Low Carbon	E7018, E6010	Fill
AWS A5.4	SMAW	Stainless	E308L, E309L	Fill
AWS A5.3/A5.3M	SMAW	Aluminum		Fill
AWS A5.9	GTAW/GMAW	Stainless	ER308L, ER309L	Root and Fill
AWS A5.10/A5.10M	GTAW/GMAW	Aluminum		Root and Fill
AWS A5.18/A5.18M	GTAW/GMAW	Low Carbon	E70S-3, E70S-6	Root and Fill
AWS A5.20	FCAW	Low Carbon	E71T1-1	Fill
AWS A5.22	GTAW/FCAW	Stainless	E308LT1-1	FCAW Fill
AWS A5.32	GTAW/GMAW	All		GTAW-Root 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 shall be performed in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer shall determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall conform to Section 05 05 23.00 10 WELDING, STRUCTURAL.

Welding shall be performed in accordance with [ASME B31.3]; [ASME B31.4] and the applicable portions of [AWS D10.4]; [AWS D10.7]; [AWS D10.10]; [AWS D10.11]; [AWS D10.12]; [AWS C5.5]

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

- a. Weld Preparation shall 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 shall 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 shall not be used on austenitic stainless steel or nonferrous materials.

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

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. End welds shall be properly aligned prior to welding in accordance with Chapter V of ASME B31.3. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 6 mm 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

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

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

3.1.4 Production Welding Instructions

- a. Welding shall not be done when the ambient temperature is lower than minus 18 degrees C 0 degree F.
- b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.
- c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees C minus 40 degrees F or lower.

- d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding. The flow rate shall be that required by the approved weld procedure specification.
- e. The purge on groove welds shall be maintained for at least two passes or 5 mm 3/16 inch whichever is greater.
- f. Removable purge dam materials shall be made of expandable or flexible plugs, such as Plexiglas, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.
- g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 8 km/hour 5 mph (440 fpm).
- h. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.
- 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,] [ASME B31.4,]. If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external surfaces.
- j. Each qualified welder shall be assigned an identification symbol. All welds shall be permanently marked with the symbol of the individual who made the weld.

NOTE: Designer to include Specification Section
33 52 43.00 20 and 23 11 16.00 20 if carbon steel
and stainless steel are to be connected

- k. Direct welded connection of carbon steel and stainless steel shall not be made. [See Section 33 52 43.00 20, AVIATION FUEL DISTRIBUTION AND DISPENSING and Section 23 11 16.00 20, FIBERGLASS REINFORCED PLASTIC (FRP) PIPING (FOR PETROLEUM) for method of connection.]

3.1.5 Postweld Heat Treatment

- a. Postweld heat treatment shall be performed in accordance with [

ASME B31.3,] [ASME B31.4,]. Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.

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

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

NOTE: Coordinate with paragraph Performance.

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

Weld inspection and NDE shall 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, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, [magnetic particle] [liquid penetrant] examination shall be performed on root passes. [Radiographic] [Liquid penetrant] [Magnetic particle] [or] [Ultrasonic] examination shall be required as indicated below. When inspection and testing indicates disqualifying defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS. The Contractor shall submit weld inspection and NDE field testing reports to the Contracting Officer.

The person performing the weld inspection shall 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.

TABLE I. MANDATORY MINIMUM NONDESTRUCTIVE EXAMINATIONS

Type Weld	Piping Service Conditions and Nondestructive Test		
	Temperatures over 400 degrees C and at all pressures.	Temperatures between 177 degrees C and 400 degrees C inclusive and at pressures above 7100 kPa.	All others.
Butt Welds (Girth and Longitudinal)	RT for NPS over 50 mm MT or PT for NPS 50 mm and less.	RT for over 50 mm NPS with thickness over 20 mm. Visual for all sizes with thickness 20 mm or less.	Visual for all sizes and thicknesses.
Welded Branch Connections (Size indicated is branch size) (See Note 7)	RT for NPS over 100 mm MT or PT for NPS 100 mm and less.	RT for branch over 100 mm NPS and thickness of branch over 20 mm inch. Visual for all sizes with branch thickness 20 mm or less.	Visual for all sizes and thicknesses.
Fillet, Socket Attachment and Seal Welds	PT or MT for all sizes and thicknesses.	Visual for all sizes and thicknesses.	Visual for all sizes and thicknesses.

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

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

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

NOTE: Coordinate with Paragraph Performance

This paragraph is to be edited based on the piping code used for design. Both B31.3 and B31.4 allow for different percentages of additional testing with B31.3 generally being more stringent. The selection of B31.3 or 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 3.2.2 insert the following 1st paragraph.

3.2.1 Visual Inspection

Weld joints shall be inspected visually as follows:

- a. Before welding - for compliance with requirements for joint preparation, alignment and fit-up, and cleanliness.
- b. During welding - for cracks and conformance to the approved welding procedure.
- c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, weld slag on the interior of the pipe and size of welds. 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.

3.2.2 NDE Testing Frequency

[All pipe field welds, including high point vent pipe tees, weld-o-lets, sock-o-lets and low point drain pipe, shall be examined by radiographic methods to determine conformance to the paragraph "Acceptance Standards." The services of a qualified commercial or testing laboratory approved by the Contracting Officer shall be employed by the Contractor for testing of piping welds. Costs of testing, including retesting of repaired welds, shall be borne by the Contractor.]

Provide 100% radiographic testing for all underground piping. Provide random radiographic testing in accordance with [ASME B31.3]; [ASME B31.4] for all aboveground piping. The inspection shall include an examination of welds made by each welding operator or welder. If the testing reveals that any welds fail to meet minimum quality requirements, an additional percent of the welds in that same group shall be inspected in accordance with [ASME B31.3]; [ASME B31.4]. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.3 NDE Testing

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

For modifications to existing Hydrant Systems choose
only radiographic from the 1st paragraph and include
the 2nd paragraph.

NDE shall be as required by [ASME B31.3], [ASME B31.4] and in accordance with written procedures. Procedures for [radiographic] [liquid penetrant] [magnetic particle] [or] [ultrasonic] tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPVC SEC V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

[The services of a qualified testing agency approved by the Contracting Officer shall be employed by the Contractor for testing of piping welds. Costs of testing, including retesting of repaired welds, shall be borne by the Contractor. Procedures for radiographic inspection shall be in accordance with MIL-STD-271 or ASTM E 94. Weld ripples or surface irregularities that might mask or be confused with the radiographic image of any objectionable defect shall be removed by grinding [and], [or] other suitable mechanical means. The weld surface shall be merged smoothly with the base metal surface.]

3.2.4 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 shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

NOTE: These acceptance standards were taken from
ASME B31.3 and B31.4 and are suitable for most jobs.

Evaluations of indications, as given in ASME B31.3 and 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 shall 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 B31.4, this requirement shall 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.

[Acceptance standards shall 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 shall comply with the requirements of 100% radiography, per ASME B31.3. Chapter IX, Table K341.3.2A. For hydrant systems and stainless steel systems the evaluation shall be based on severe cyclic conditions in addition to the following-specified items.]

3.3.1 Visual

The following indications are unacceptable:

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

3.3.2 Magnetic Particle Examination

The following relevant indications are unacceptable:

- a. Any cracks and linear indications.
- b. Rounded indications with dimensions greater than 5 mm 3/16 inch.
- c. Four or more rounded indications in a line separated by 2 mm 1/16 inch or less edge-to-edge.
- d. Ten or more rounded indications in any 3870 square mm 6 square inches of surface with the major dimension of this area not to exceed 150 mm 6 inches with the area taken in the most unfavorable location relative to the indications being evaluated.

3.3.3 Liquid Penetrant Examination

Indications with major dimensions greater than 2 mm 1/16 of an inch shall be considered relevant. The following relevant indications are unacceptable:

- a. Any cracks or linear indications.
- b. Rounded indications with dimensions greater than 5 mm 3/16 inch.
- c. Four or more rounded indications in a line separated by 2 mm 1/16 inch or less edge-to-edge.

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

3.4 CORRECTIONS AND REPAIRS

Disqualifying defects shall be removed and repaired as specified in [ASME B31.3,] [ASME B31.4,] unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present.

3.4.1 Defect Removal

Defective or unsound weld joints shall be corrected by removing and replacing the entire weld joint, or for the following defects corrections shall 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. Crack 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 shall be confirmed by magnetic particle inspection for carbon steel or liquid penetrant inspection for stainless steel. Inspection procedures shall comply with the requirements of ASME B31.3.
- e. Poor Fit-Up: Cut apart improperly fitted parts, and reweld.

3.1.5.2 Methods of Defect Removal

The removal of weld metal or portions of the base metal shall 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 shall be cleaned and smoothed by mechanical means to remove the heat affected zone. In addition, a maximum of 1/8-inch of metal shall 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 shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners.

3.1.5.3 Rewelding

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

3.1.5.4 Peening or Caulking

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

NOTE: The intent of the following paragraph is to require cleaning of the piping system as it is being installed. The designer shall include Section 15899 for modifications to hydrant systems and Section 13004 for other POL service piping systems.

3.5 MAINTAINING CLEANLINESS OF PIPING

The Contractor shall 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 shall 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 shall be closed so that no water or other foreign substance will enter the pipes or fittings. Piping shall be inspected before placing into position. The interior of each length of pipe shall be cleaned after welding; A swab, with a leather or canvas belt disc to fit the inside diameter of pipe, shall be pulled through each length of pipe after welding in place. It shall 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.

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.

3.5.1 [Pigging Plan

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

3.6 COMMISSIONING

For commissioning of POL service piping systems see section [23 14 00](#) COMMISSIONING OF FUEL FACILITY SYSTEMS. For repairs or modifications to

hydrant systems see Section 15899 "Commissioning of Hydrant Fuel Systems."

-- End of Section --