



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

CONSTRUCTION STANDARD
FOR
WELDING & HEAT TREATMENT

NPCS-CS-PI-01

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16 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR

17 TECHNICAL NOTES

EXHIBIT A ELECTRODE QUALIFICATION TEST RECORD

EXHIBIT B STRESS RELIEF HEAT TREATMENT PROCEDURE
SPECIFICATION

EXHIBIT C FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

EXHIBIT D FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)

EXHIBIT E FORMAT FOR MANUFACTURER'S RECORD OF WELDER OR
WELDING OPERATOR QUALIFICATION TESTS

EXHIBIT F RADIOGRAPHIC PROCEDURE FOR PIPE WELDING

EXHIBIT G WELDER'S IDENTIFICATION CARD

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1 GENERAL

1.1 SCOPE

This standard shall be followed for the fabrication of all types of welded joints and their heat treatment requirement, of Carbon Steel and alloy Steel piping system within the battery limits of the plant.
The welded pipe joints shall include the following:

- a) All pipe joints of the longitudinal and circumferential butt-welded and socket-welded types.
- b) Attachments of forgings, flanges and other supports to pipes.
- c) Welded manifold headers and other sub-assemblies.
- d) Welded branch connections with or without reinforcing pads.
- e) Joints in welded/fabricated piping components.
- f) The attachments of smaller connections for vents, drain, drips and other instrument tapings.

1.2 This standard gives additional requirements to the applicable codes, standard and specification in paragraph 2 of this standard.

1.3 In case any contradiction between applicable codes and standard occur, contractor shall contact client for advice.

1.3 No deviation shall be made from this standard without the written approval of client.

1.5 Any approval granted by client shall not relieve contractor of his responsibilities and guarantee.

1.6 LIMITATION

This standard shall not be applicable for welding of pipelines for transportation of liquid petroleum, gases and other similar products.

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STANDARDS AND CODES

All welding work, equipment for welding, heat treatment, other auxiliary functions and welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures unless otherwise specified in the welding standard chart and the technical notes attached. In the case of conflicting requirements, the requirements mentioned in welding specification chart/Technical Notes shall be governing.

- ANSI B31.3 Chemical Plant and Petroleum Refinery Piping.
- ANSI B16.25 Buttwelding Ends.
- AWS 3.0 Terms and Definitions.
- AWS 5.1 Specification for Welding
Through 5.29 Filler Materials.
- ANSI Z 49.1 Safety in Welding and Cutting.
- ASME Sec.IX Welding and Brazing Qualifications.
- ASME Sec.V Non Destructive Examination
- ASME Sec.11 Material Standards :
Part C Welding Rods, Electrodes and Filler Metals.
- NPCS-ES-PI-02 Engineering Standard for Piping Material Specification.

In the event of any differences due to the additional requirements mentioned in this standard, over and above those obligatory as per codes, this standard shall be binding.

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3 USED ABBREVIATION

3.1 For terms and definitions, reference is made to AWS 3.0.

- WPS : Welding Procedure Specification.
- PQR : Procedure Qualification Record.
- WPQ : Welder's Performance Qualification.
- PWHT : Post Weld Heat Treatment.

3.2 Welding process abbreviations:

- OFW : Oxygen Fuel Welding.
- SMAW : Shielded Metal Arc Welding.
- SAW : Submerged Arc Welding.
- GMAW : Gas Metal Arc Welding.
- FCAWe : Flux Cored Arc Welding.
- GTAW : Gas Tungsten Arc Welding.



4 WELDING CONSUMABLES

4.1 CONSUMABLE APPROVAL

4.1.1 Contractor shall provide, at his own expense, all the welding consumables necessary for the execution of the job such as electrodes, filler wires, oxygen, Acetylene, Argon, etc., and these should bear the approval of client.

4.1.2 The welding electrodes and filler wires supplied by contractor shall conform to the class specified in the welding specification chart. The materials shall be of the make approved by client.

4.1.3 Electrode qualification test records should be submitted as per the Exhibit-A (attached1 in respect of the electrodes tested by contractor, for obtaining the approval of client.

4.1.4 Contractor shall submit batch test certificates, from the electrode manufacturers, giving details of physical and chemical tests carried out by them, for each batch of electrodes to be used.

4.1.5 When joining similar metals, the deposited weld metal shall have the same nominal composition and mechanical properties of the base except as specified in clause 4.1.6 . The use of Carbon - 0.5% Mo filler metal for welding of Carbon Steel is not permitted without the approval of client.

4.1.6 For field fabrication, type 309 filler metal may be used for socket and seal welds on 1.25%Cr-0.5%Mo piping where the service temperature does not exceed 467 °C (800 °F). Use ENiCr Fe-2 or NiCr Fe-3 filler metal where service temperature exceed 467 °C; in this case no PWHT is required unless otherwise required by process. But preheat is required.

4.1.7 For GTAW process, the use of AWS A5.2.69 filler wire is not permitted.

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4.2 CONSUMABLE STORAGE

4.2.1 All electrodes shall be purchased in **sealed** containers and stored properly to prevent deterioration. The electrodes removed from the containers shall be kept in holding ovens at the temperature recommended by the **electrode** manufacturer. "Out of the oven time" of electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer. The electrodes shall be handled with care to avoid any damage to the flus covering.

4.2.2 All low Hydrogen type of electrodes shall be rebaked at 350°C for 1 hr minimum and stored in ovens kept at 80-100°C before use. Recommendations of the electrode manufacturer shall be followed, if available.

4.2.3 The electrodes, filler wires and flus used shall be free from rust, oil, grease, earth and other foreign matter which affect the quality of welding.

4.2.4 Tungsten electrodes used shall conform to ASME, SFA 5.12 specification.

4.2.5 No electrodes shall be lying about the site or in workshops. Such electrodes shall be scraped.

4.3 CONSUMABLE APPLICATION

Refer welding specification chart for piping classes.



5 SHIELDING & PURGING GAS

- 5.1 Argon gas used in GTA welding for shielding' purposes shall be 99.995% pure. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests. Normally this rate may be 12-20 CFH.
- 5.2 Argon gas with a purity level of 99.995% shall be used for purging.
- 5.3 When GTAW process alone or a combination of GTAW and SMAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in welding specification chart.
- 5.4 Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.
- 5.5 After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails. For systems which have a small volume (upto 1/2 cubic foot) to be purged, a gas flow rate of 6 CFH is usually adequate. Systems of larger volume may require higher flow rates and these should be established during procedure qualification tests.
- 5.6 Gas backing (purging) is not required for socket type of welded joints.
- 5.7 Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding! use of water soluble dams should be made.

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6 EQUIPMENT & ACCESSORIES

- 6.1 Contractor should have the arrangement of sufficient number of welding and cutting equipment, auxiliaries, and accessories of sufficient capacities so as to meet the target/schedule.
- 6.2 All the equipment for performing the heat treatment, including transformers, thermo-couples, pyre-meters, automatic temperature recorder with suitable calibration arrangements, etc., shall be provided by contractor at his own expense and these should bear the approval of client.
- 6.3 Contractor shall make necessary arrangements at his own expenses, for providing the radiographic equipment, radiographic films, and all the equipment/materials required for carrying out the dye-penetrant/magnetic particle test for satisfactory and timely completion of the job.
- 6.4 Redoing of any work necessitated by faulty equipment or operation used by the contractor, will be done at his own expense.

7 WELDING PROCESSES

- 1.1 Welding of various materials under this standard shall be carried out using one or more of the following processes, with the approval of client.
- Shielded Metal Arc Welding process (SMAW).
 - Gas Tungsten Arc Welding process (GTAW).
 - Submerged Arc Welding (SAW); (Manual SAW shall not be used for pressure containing parts.)
- 1.2 The welding processes to be employed will be given in the welding specification chart. Any deviation desired by contractor shall be with the written approval of client.

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7.3 Automatic and semi-automatic welding processes shall be employed only with the express approval of client. The welding procedure adopted and consumables used shall be specifically approved.

7.4 A combination of different welding processes could be employed for a particular joint only after duly qualifying the welding procedure to be adopted and obtaining the approval of client.

7.5 Compressor piping requiring special cleaning (As will be indicated on isometrics), shall have a GTAW root pass, using inert backing gas.

8 EDGE PREPARATION

8.1 The edges to be welded shall be prepared to meet the joint design requirements by any of the following methods recommended:

a) Carbon Steel

Gas cutting, machining or grinding methods shall be used. After gas cutting, oxides shall be removed by chipping or grinding.

b) Low Alloy Steels (containing upto 2-1/4% Chromium):

Gas cutting, machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

c) High alloy steels, cupro-nickel, nickel alloys, and aluminum alloys:

Plasma cutting, machining or grinding methods shall be used. After plasma cutting, cut surfaces shall be machined or ground smooth.

8.2 Double-welded buttjoints are preferred and shall be used whenever possible and for all pipe of 30" OD and larger, where accessible.



- 8.3 Materials that require preheating for welding shall be preheated in the same way for thermal cutting or gouging.
- 8.4 End profiles of pipes and fitting to be butt welded shall be in accordance with ANSI B16.25.
- 8.5 Pipes for socket weld joints shall be cut square; the clearance between pipe end and socket bottom shall be 1 mm to 3 mm. For other socket weld requirements see ANSI B31.3.
- 8.6 Branch connection cut-outs shall be carefully bevelled and accurately matched to form a suitable welding groove, as per ANSI B31.3, permitting complete penetration at all the points.
- 8.7 Flanges, e.g. slip on flanges, shall be assembled in accordance with the relevant section of ANSI B31.3 "Fillet Welds".
- 8.8 CLEANING
- 8.8.1 The ends to be welded shall be properly cleaned to free of paint, oil, grease, rust, oxides, sand, earth and other foreign matter, over a width of 20 mm minimum besides the weld edges. The ends shall be completely dry before the welding commences.
- 8.8.2 On completion of each run, craters, welding irregularities, slag, etc., shall be removed by grinding and chiselling. Wire brushes used for cleaning Stainless Steel joints shall have Stainless Steel wires and the grinding wheels used for grinding Stainless Steel shall be of a suitable type. Separate grinding wheels and wire brushes should be used for Carbon steels and Stainless Steels.
- 8.8.3 Where openings or branches are cut in run of pipe, all material which may drop inside the pipe, shall be completely removed before the branch is welded into the place.
- 8.8.4 The most care shall be taken to avoid sand, dirt or other debris from entering piping which is designated for Air or Nitrogen pressure testing as these system will not be flushed with water.