



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

MATERIAL STANDARD
FOR
HORIZONTAL & VERTICAL PRESSURE VESSELS
NPCS-MS-PV-01
REVISION : 0

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1 SCOPE

- 1.1 This standard covers the requirements for fabrication, workmanship, inspection, marking, testing and packing of fusion welded horizontal and vertical vessels (hereafter referred to as "vessels" for brevity) and is intended to supplement the applicable codes.
- 1.2 For purchase purposes, this standard alongwith the NPCS-ES-PV-01, shall be complied with.
- 1.3 The compliance with this standard does not relieve fabricator from his own responsibilities and guarantees for the soundness of vessel to be delivered.

2 STANDARDS AND CODES (LATEST EDITION AND ADDENDA)

- ASME Boiler and Pressure Vessel Code, Section. VIII. Division 1 and/or 2.

Boiler and Pressure Vessel Code, Section II.

Boiler and Pressure Vessel Code, Section IX.

Boiler and Pressure Vessel Code, Section V.
- All codes referred to, in the above mentioned codes such as ANSI-B 16.5, API-605, ANSI B 16.25, etc.
- AWS/ASME Specification for Welding Electrodes.
- NPCS-ES-PV-01 Pressure Vessels.
- NPCS-SD-PV-17 Tolerances for vertical vessels.
- NPCS-SD-PV-18 Tolerances for Horizontal Vessels.

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3 FABRICATION

3.1 GENERAL

3.1.1 When shop working, such as rolling, forming, pressing, etc., can alter the Steel properties and bring them beyond the limits specified by the applicable code, such working shall be followed by a suitable heat treatment, in order to bring such properties back to the prescribed limits.

3.1.2 No hot working is allowed for austenitic Steels with the exception of Stainless Steel forgings.

3.1.3 When low-alloy Steel heads are fabricated with many welded sections, the forming operation shall be carried out in hot condition with particular care as to the finishing temperature or before postweld heat treatment. This applies also for the re-rolling of welded plate courses.

3.1.4 All repairs to defective materials (such plates, forgings, etc.) are subject to prior approval of purchaser.

3.1.5 Couplings set-on to the outside surface of a vessel shall be installed cocentric with the holes in the vessel wall, within 3 mm. The holes shall be made in the vessel wall by drilling or by flame cutting and reaming. If flame cutting and reaming is used instead of drilling, the resulting holes shall be as smooth as a drilled hole and free from all slag and torch undercutting.

3.1.6 Coupling threads must be clean and free from defects, including weld spatter, after installation. Deformed couplings, and those with damaged threads, must be replaced before acceptance.

3.1.7 All vessels shall be furnished complete as what will be shown on vessel drawings or as required herein and shall include all necessary bolts, nuts, gaskets, internals and externals as what will be shown.

3.1.8 Supports for horizontal vessels shall be welded to the vessel, except when specifically ordered to be shipped loose.

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- 3.1.9 All horizontal vessels shall be supported by saddle supports fabricated to fit the outside surface of the vessel within the tolerances required by the design to prevent excessive localized stresses in the shell. Saddles shall not be placed over vessel girth welds and are to be continuously seal welded to the shell.
- 3.1.10 Vertical vessels shall normally be supported on skirts or lugs. Small, slightly loaded vessels may be supported on structural Steel or Steel pipe legs.
- 3.2 WELDING
- 3.2.1 Joint Preparation
- 3.2.1.1 Edge preparation shall be in accordance with ASME Code, Section VIII.
- UW-31 For fitting and alignment.
 - UW-32 For cleaning of surfaces to be welded.
- Edges to be welded shall be prepared by machining or by automatic oxy-acetylene cutting, followed by grinding. Shear cutting is allowed only for Carbon Steel sheets thinner than 12 mm. Manual oxy-acetylene cutting is allowed only where nozzles or manholes are to be inserted, provided grinding is subsequently carried out.
- 3.2.1.2 Oxy-acetylene cutting is normally not permitted on Cr-MO Steel with Chrome content 2% or higher. If it has to be carried out, then a finishing by machining or grinding shall subsequently be made, to remove all hardened areas within the heat affected zone back to the nominal hardness of the parent metal.
- 3.2.1.3 Grinding of austenitic Steel shall be made using wheels of suitable type, and used exclusively for austenitic Steel.
- 3.2.1.4 Before welding, edges shall be checked in order to ascertain the absence of flaking, irregularities or serious defects.
- 3.2.1.5 For low-alloy Steels and for high-strength Steel with thickness above 30 mm, the edges shall be inspected by magnetic-particle or liquid penetrant method.

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- 3.2.1.6 When thermal cutting is used on austenitic stainless Steel or other high alloys, the bevel surface shall be ground to bright metal. Before welding, the surfaces shall be reasonably smooth and true. Grinding wheels and Stainless Steel wire brushes used on high alloy material shall not have been used on ferrous materials.
- 3.2.1.7 Shell and head joints shall be full penetration, double welded butt joints. For joints inaccessible from the inside, the fabricator shall submit for approval an alternative method where a full penetration and full fusion weld can be achieved from one side.
- 3.2.1.8 In vessels which are to be 100% radiographed, nozzle to shell welds (Root & Fail run) shall be crack detected by magnetic particle/dye penetrant examination.
- 3.2.1.9 Peening is only permitted to the extent necessary to clean the welds.
- 3.2.2 Welding Procedure & Performance Qualifications
- 3.2.2.1 Welders qualifications shall be in accordance with ASME Code, Section IX. Separate qualifications are required for Carbon Steel, and the different types of low and high alloy Steels.
- 3.2.2.2 Detailed welding procedures as required by the Code for Carbon Steel, low alloy Steel and alloy Steels, including weld preparation and selection of electrodes, shall be submitted by vessel fabricator for approval of purchaser before commencement of work.
- 3.2.2.3 Welding on pressure vessels shall be carried out by Welders or Welding Operators previously qualified for the procedure and filler material used by them.
- 3.2.2.4 All welding shall be done by a metal ARC process.
- 3.2.2.5 For double-welded butt joints (joints welded on both sides), the welding procedure shall specify fabricator's standard inspection procedure used to assure metal soundness after gouging and cleaning the backside of weld.
- 3.2.2.6 Welding procedure specification and procedure qualification records shall be submitted by the fabricator for purchaser's review and approval prior to the start of fabrication.

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- 3.2.2.7 Welding procedures submitted to purchaser shall be clearly identified with the specific applicable items.
- 3.2.3 Filler Metal Requirements
- 3.2.3.1 Filler rod shall be selected so that the principal elements in the deposited weld metal, joining base metal to base metal, shall be of the same nominal composition as the base metal, except as specified in Clauses 3.2.3.2 and 3.2.3.3 of this standard.
- 3.2.3.2 For dissimilar joints in base metals consisting of ferritic materials, Carbon Steel (P-1) through 12% Chrome (P-7), the filler metal shall be of the low Hydrogen type and comparable to the composition of either base metal. The higher base metal is generally preferred.
- 3.2.3.3 For dissimilar joints in base metals consisting of ferritic materials on one side and austenitic Stainless Steels, higher Chrome-Nickel and Nickel-Chrome, including Monel on the other side, the filler metal shall meet the requirements of ASME/AWS Classifications Ni-CT-Fe-3 except the type 309, type 309 L, type 309 cb or type 310 filler metal may be used upon specific approval by purchaser.
- 3.2.3.4 When Carbon Steel is welded to austenitic Stainless Steel, the dissimilar joint shall be made with electrodes of Into-182, Into-82, Inco-Weld A, type 310 (25-20) or type 309 (25-12) in order of preference.
- 3.2.3.5 Low-Hydrogen electrodes shall also be used for Carbon Steels with C% > 0.23 (in ladle analysis for high-strength Steels, for low-alloy Steels, and wall thickness exceeds 20 mm (3/4")). Covered welding electrodes for non-alloy welding shall be in accordance with Specification AWS A5.1. Weld metal tensile properties and composition shall be essentially the same as the plate being welded. Low-alloy, high strength weld materials shall not be used unless the vessel is required to be post weld heat treated.
- 3 2.3 6 In welding with electrodes or with a semiautomatic process, arc striking shall always be made within the bevel, or on a special plate put beside the joint; in no case shall be the arc be struck on vessel wall.
- 3 2.3 7 The welding technique used in vessel fabrication shall be the same as that used during procedure qualification tests.