



NATIONAL PETROCHEMICAL COMPANY
STANDARDS

MATERIAL STANDARD
FOR
TALL TOWERS

NPCS-MS-PV-02

REVISION : 0

DECEMBER 1992



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1 SCOPE

- 1.1 This standard covers the requirements for fabrication workmanship, inspection, marking, testing and packing of fusion welded towers, and intended to supplement the applicable Code.
- 1.2 For purchaser purpose this standard along with the NPCS-ES-PV-02 shall be compiled with.
- 1.3 The compliance with this standard does not relieve the fabricator from his own responsibilities and guarantees for the soundness of tower to be delivered

2 STANDARDS AND CODES (LATEST EDITION AND ADDENDA)

- ASME
 - Boiler and Pressure vessel Code Sec.VIII, Div.1 and/or 2
 - Boiler and Pressure Vessel Code Sec.11
 - Boiler and Pressure Vessel Code Sec.V
 - Boiler and Pressure Vessel Code Sec.IX
- 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
 - Engineering Standard for Pressure Vessels.
- NPCS-SD-PV-17
 - Tolerance for Vertical Pressure Vessels.
- NPCS-SD-PV-18
 - Tolerance for Horizontal Pressure Vessels.



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 tower shall be installed **cocentric** with the holes **in** the tower wall, within 3 mm. The holes shall be made in the tower 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 towers shall be furnished complete as what will be shown on tower drawings or as required herein and shall include all necessary bolts, nuts, gaskets, internals and externals as what will be shown.

3.2 **WELDING**

3.2.1 **Joint Preparation**

3.2.1.1 Edge preparation shall be in accordance with **ASME Code section VIII, Parts UW-31 (For Fitting and Alignment) & UW-32 (For Cleaning of Surfaces to be Welded)**.

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Edges to be welded shall be prepared by machining or 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 a 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.
- 3.2.1.6 When thermal cutting is used on austenitic stainless steels or other high alloys, the bevel surfaces 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 towers 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 Penning is only permitted to the extent necessary to clean the welds.



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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 tower fabricator for approval by purchaser before commencement of work.

3.2.2.3 Welding on towers 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 conform to ASME Code requirements regardless of whether or not the tower carries a code stamp.

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 specifications and procedure qualification records shall be submitted by the fabricator for purchaser's review and approval prior to the start of fabrication.

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 Section 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.

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- 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-Cr-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, Inco-82, Into-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 tower 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 tower wall.
- 3.2.3.7 The welding technique used in tower fabrication shall be the same as that used during procedure qualification tests.
- 3.2.3.8 Special attention shall be paid to avoid local off-set or "peaking" during welding.
- 3.2.3.9 Bare electrodes shall be in accordance with the following:

WELDING PROCESS

ELECTRODE

Submerged Arc Welding	AWS A 5.17, ASME SFA-5.1:
Inert Gas Welding	AWS A 5.18, ASME SFA-5.11
Flux-Cored Arc Welding	AWS A 5.20, ASME SFA-5.20

- 3.2.3.10 Deposited weld metal mechanical properties shall conform to the base metal. Low-alloy, high strength weld material shall not be used unless the tower is required to be postweld heat treated (PWHT) at a temperature of 620°C minimum.

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