



SOUTHWEST GAS CORPORATION

ENGINEERING STAFF

MATERIAL SPECIFICATION

Prepared By: M.R. Haught
Approved By: J.F. Wunderlin *JFW*

Section No.:	MS P-6
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Issue Date:	12/09/96
Superseded Date:	Original

COMPRESSED NATURAL GAS (CNG) EQUIPMENT

High Pressure Natural Gas Ground Storage Vessels

1. SCOPE

These requirements apply to compressed natural gas (CNG) storage vessels which are only to be used for high pressure natural gas storage at natural gas vehicle fuel supply stations.

2. APPLICABLE DOCUMENTS

- 2.1 American Society of Mechanical Engineers (ASME), Boiler and Pressure Vessel Code, Section VIII, Division 1, "Rules for Construction of Pressure Vessels."
- 2.2 American Society for Testing Materials (ASTM) A-372, "Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels."
- 2.3 American Society for Testing Materials (ASTM) A-509, "Standard Definition of a Steel Forging."

3. TERMINOLOGY

3.1 General

- 3.1.1 "Southwest Gas," "Southwest" or "SWG" wherever used in this specification and other related documents will refer exclusively to Southwest Gas Corporation.
- 3.1.2 The terms "approved," "as approved," "satisfactory," "as directed," "or equal" or other similar terms wherever used in this specification and other related documents will mean "as determined by Southwest Gas," unless specifically stated otherwise.
- 3.1.3 "Product Information Package" or "PIP" wherever used in this specification and other related documents will mean the required information that a manufacturer must submit to SWG to determine if the product is suitable for use by SWG, unless specifically stated otherwise.



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4. MATERIALS AND MANUFACTURE

- 4.1 Steel forgings shall be made in accordance with the definition of steel forgings in ASTM A-509.
- 4.2 The completed vessel, after all forging operations, shall be heat treated by the applicable methods outlined in ASTM A-372.
- 4.3 After heat treatment, the outside surface of each vessel shall be subjected to the magnetic particle test or the liquid penetrant test as outlined in ASME Section VIII, Division 1, Subsection B, Part UF, "Requirements for Pressure Vessels Fabricated by Forging."
- 4.4 Each vessel shall be furnished with a 1/2-inch (12.75 mm) full port stainless steel ball valve on the front and a spring-loaded safety relief valve on the rear, with a full port 3/4-inch (19.05 mm) stainless steel ball valve between the vessel and the relief valve. All valves associated with the high pressure natural gas storage vessels shall have a burst safety factor of four times the working pressure.
- 4.5 Each high pressure natural gas vessel shall have a suitable condensate drain valve located at the lowest point practicable in the vessel. On three-pack assemblies, the vessels shall be mounted in the frame at a slight incline to allow the majority of condensation to accumulate at the drain valve.
- 4.6 All high pressure natural gas ground storage vessels shall be manufactured in accordance with the guidelines described in the ASME Boiler and Pressure Code, Section VIII, Division 1 standards.
- 4.7 The exterior surface of the high pressure vessels shall be painted with epoxy primer and a white urethane final coat.

5. PERFORMANCE REQUIREMENTS

- 5.1 The ground storage vessels shall have a design burst safety factor of three times the designed working pressure.
- 5.2 Each 4,000 psi (27.58 Mpa) vessel shall have a maximum allowable design working pressure vessel that shall be capable of storing 13,750 standard cubic feet of natural gas @ 3,600 psi @ 70°F (389.36 m³ @ 24.82 MPa @ 21°C).



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5. PERFORMANCE REQUIREMENTS (Continued)

- 5.3 Each 5,500 psi (37.92 MPa) vessel shall have a maximum allowable design working pressure vessel that shall be capable of storing 12,206 standard cubic feet of natural gas @ 5,000 psi @ 70°F (345.64 m³ @ 34.47 MPa @ 21°C).
- 5.4 Three-pack ASME CNG storage vessels must be designed to meet Seismic Zone 4 regions.

6. DIMENSIONS AND TOLERANCES

- 6.1 For 4,000 psi (27.58 MPa) vessels with a maximum allowable operating pressure of 3,600 psi (24.82 MPa), the vessel OD shall not exceed 24 inches (610 mm) in diameter, 20 feet (6.10 m) in length, a minimum vessel wall thickness of 1.154 inches (29.31 mm) and a nominal wall thickness of 1.318 inches (33.48 mm).
- 6.2 For 5,500 psi (37.92 MPa) design pressure vessels with a maximum allowable operating pressure of 5,000 psi (34.47 MPa), the vessel OD shall not exceed 20 inches (508 mm) in diameter, 23 feet (7.01 m) in length, a minimum vessel wall thickness of 1.303 inches (33.10 mm) and a nominal wall thickness of 1.489 inches (37.82 mm).
- 6.3 For 4,000 psi or 5,500 psi (27.58 MPa or 37.92 MPa) three-pack assembly, the mounting frame assembly shall not exceed 26 inches wide by 8 feet high (0.66 m × 2.44 m).
- 6.4 All vessel dimensions and tolerances shall conform to the guidelines in the ASME, Section VIII, Division 1 standards.

7. INSPECTION

- 7.1 Successful review of the Product Information Package (PIP), as well as any future reference by SWG to the Seller's part number or internal code number in any future contract or purchase, will mean only that no conflict with the specification was found, and will not relieve the Seller from meeting all the requirements of this specification.
- 7.2 SWG retains the option to inspect the manufacture and testing of high pressure natural gas storage vessels sold to SWG.



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7. INSPECTION (Continued)

- 7.3 SWG will make appropriate inspections and tests of any and all materials, products or systems supplied to this specification. SWG will have the right, at their option, to reject any material which fails to conform to this specification. Any such rejection may take place at the manufacturer's facility, the vendor's warehouse or any subsequent delivery location, before or after SWG assumes possession. Notice of the rejection will be made promptly to the supplier by SWG's Corporate Purchasing Department. The defective product will be replaced or returned for credit at the manufacturer's expense.
- 7.4 Any changes in the manufacturing of previously approved high pressure natural gas ground storage vessels covered under this document for sale to SWG must be approved by SWG's Engineering Staff. Failure to obtain SWG's approval may be cause for rejection and disqualification as an approved supplier.

8. CERTIFICATION

The manufacturer's or supplier's certification will be furnished to SWG. This certification will state that samples representing each lot have been manufactured, tested and inspected in accordance with this specification and that all requirements have been met.

9. MATERIAL SAFETY DATA SHEETS

In accordance with law, the Seller will supply Material Safety Data Sheets for all applicable items supplied under this specification to the following:

- 1) The Receiving location
- 2) Engineering Staff
- 3) Southwest Gas Corporation
Staff Safety
Mail Station LVA-581
P.O. Box 98510
Las Vegas, NV 89193-8510



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10. PRODUCT MARKING

Each ground storage vessel shall be stamped on the thickened head portion with both the maximum allowable working pressure based on a stress equal to one-fourth the specified minimum tensile strength and also the maximum allowable working pressure based on a stress equal to one-third the specified minimum tensile strength. The words "Appendix 22" shall be stamped following the maximum allowable working pressure.

11. PACKAGING AND PACKAGE MARKING

The ASME supplier shall ship the vessels in a manner that shall prevent damage to the vessels and vessel coatings.

12. STOCK CLASSIFICATION DESCRIPTION

- ASME CNG Storage Vessel, 4,000 psi.
- ASME CNG Storage Vessel, 5,500 psi.
- ASME (3-pack) CNG Storage Vessel, 4,000 psi.
- ASME (3-pack) CNG Storage Vessel, 5,500 psi.