

Additional Requirements for Pressure Storage Spheres

(This practice is appropriate for attachment to Inquiry or Purchase Document)

IP 9-2-1

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Rev. 1

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Changes shown by ↗

SCOPE

- I 1.1 This practice covers the modifications and additions to [IP 5-1-1](#) for the design, fabrication, and inspection of **non-refrigerated** carbon steel pressure storage spheres.
- I 1.2 **An asterisk (*)** indicates that a decision by the Purchaser is required or that additional information is furnished by the Purchaser.

SUMMARY OF ADDITIONAL REQUIREMENTS

- R 2.1 (Modification) This practice covers the design, fabrication, inspection, and testing of spheres under the provisions of **ASME Code Section VIII, Division 1 or Division 2, API-620**, or recognized codes of other nations.
Spheres may be designed, fabricated, inspected and tested under the provisions of a code which is accepted by the authorities where the sphere is to be located and by the Owner's Engineer plus the additional requirements of this practice; such codes are referred to as recognized codes in this practice.
The requirements of the recognized code (of other nations or **ASME Section VIII, Division 2**) may be used in lieu of any specific ASME requirements referenced herein for non-ASME Division 1 spheres.
- I 2.2 (Addition) **Table 1** lists the practice and standards which shall be used with this practice to supplement [IP 5-1-1, Table 1](#).
- I * 2.3 (Addition) **Table 2** lists the practices and standard which shall be used with this practice to supplement [IP 5-1-1, Table 2](#) as specified by the Purchaser.

TABLE 1

PRACTICE	
IP 3-2-3	Fire Water Systems
IP 5-1-1	Pressure Vessels
STANDARDS	
ANSI Standard	
A12.1	Safety Requirements for Floor and Wall Openings, Railings and Toeboards
ASME Standard	
B16.11	Forged Steel Fittings, Socket-Welding and Threaded

TABLE 2

PRACTICES	
IP 3-15-1	Pressure Relief Valves
IP 5-1-2	Additional requirements for Heavy Wall Pressure Vessels, Thickness Over 2 Inches
STANDARD	
API Standard	
620	Recommended Rules for Design and Construction of Large Welded, Low-Pressure Storage Tanks

- I 2.4 For User convenience, the beginning of each paragraph in this practice is noted as follows:
 - a. (Addition) The paragraph specifies additions to [IP 5-1-1](#).
 - b. (Modification) The paragraph specifies modifications to [IP 5-1-1](#).

DOCUMENTATION

- I 3.1 (Modification) **An outline drawing** shall be furnished for each sphere, and shall contain the data shown in [Table 3](#). Location of the sphere marking or name-plate shall be indicated on this drawing.

- I * 3.2 (Modification) **A manufacturer's data report** shall be furnished and shall contain the same information as required in Form U-1 of **ASME Code Section VIII**. If the sphere is constructed for use at a location where the ASME Code is not mandatory, it shall be noted on the form if the sphere does not carry an ASME Code symbol. Material strength properties, specified or guaranteed, shall be included and shall represent the properties in the as-fabricated condition. The data report shall be signed by the Manufacturer, by an Authorized Inspector as defined in Par. UG-91 of the ASME Code, and as otherwise required by the applicable code. Other documentation (code papers, etc.) covering the construction of spheres built to the code of another nation shall be signed by the manufacturer and, where applicable, by others having authority to sign such documentation.

Six signed copies of data reports and other required documentation shall be submitted to the Inspector prior to shipment of the sphere.

- I * 3.3 (Addition) **Six copies of a gage table** showing calculated capacity shall be furnished. Unless otherwise specified, capacity shall be shown in 42 U.S. gallon barrels for 1/8 in. increments of liquid level [m³ for 10 mm increments plus auxiliary table showing m³ for 1 mm increments].

MATERIALS

- S * 4.1 (Modification) **Materials having a specified minimum tensile strength** at room temperature greater than 70,000 psi (482 MPa) shall not be used without approval of the Owner's Engineer.
- S 4.2 (Addition) **Castings** shall not be used as pressure components welded to the shell of spheres.
- S 4.3 (Addition) **Sphere Supports**. The code allowable tensile and compressive stress basis for spheres shall also apply to sphere supports.
- R,S 4.4 (Addition) **Materials for permanent attachments, welded to the sphere**, shall be of the same nominal chemical composition and physical properties as the sphere.
- S 4.5 (Addition) The **Critical Exposure Temperature (CET)** for pressure storage spheres is defined as the lower of the following:
- Lowest one day mean temperature.
 - The temperature equivalent to 25% of the design pressure on the vapor pressure curve for the material stored.

DESIGN

- S 5.1 (Addition) **Design, fabrication and inspection of spheres** shall be per the applicable code and standard used for the design pressure. If designed per the ASME Codes or API Standards, the following applies:

DESIGN PRESSURE	CODE AND STANDARD
Full vacuum to atmospheric	ASME Code Section VIII and API-620
Atmospheric to 15 psig (103 kPa)	API-620
Over 15 psig and less than or equal to 2 in. (50 mm) thickness	ASME Code Section VIII, with maximum compressive stress allowed per API-620 if more conservative
Over 15 psig and over 2 in. thickness	IP 5-1-2 , with maximum compressive stresses allowed per API-620 if more conservative

DESIGN LOADS

- S * 5.2 (Addition) **Spheres** with a design pressure greater than 15 psig (103 kPa) shall be designed to be filled with water. A combination hydrostatic-pneumatic test shall not be used without approval of the Owner's Engineer.
- M,O * 5.3 (Addition) The **elevation** of the bottom of the sphere **above finished grade** shall be specified, but in no case shall the bottom be less than 3 ft (900 mm) above finished grade.

NOZZLES AND CONNECTIONS

- O 5.4 (Addition) **The hydrocarbon pump suction internal extension** shall be 6 in. (150 mm) above the bottom tangent of the sphere or 6 in. (150 mm) above the water drawoff inlet, whichever is higher.

MANHOLES

- S 5.5 (Modification) **A 20 in. (500 mm) manhole** shall be provided in the top and bottom of each sphere. Manhole covers shall be hinged or provided with handling davits.

AUXILIARY STRUCTURES
STAIRWAYS AND PLATFORMS

- O * 6.1 (Addition) **Stairways and platforms** shall be provided to allow **access to operating valves and instruments**. Auxiliary structures to service instruments, connections, and access openings at the bottom of the sphere will be specified.
- O,S 6.2 (Addition) **A stairway with handrail** shall be provided from grade to the top of the sphere.
- S 6.3 (Addition) **Stairways** shall have the following provisions:
- Maximum angle with a horizontal line shall be 45 degrees.
 - Minimum effective tread width shall be 8 in. (200 mm).
 - Minimum effective width of stairways shall be 2 ft 6 in. (750 mm).
 - Stair landings shall not be less than 2 ft 6 in. in the direction of the stairway.
- M,O 6.4 (Addition) **Platform flooring** shall be steel floor plate, raised pattern, 1/4 in. (6 mm) nominal thickness. Drainage shall be provided by one 1/2 in. (13 mm) diameter hole for approximately every 15 sq. ft (1.5 m²) of floor plate area. Holes shall be located and drilled after installation.
- * **If a platform extension of the top stairway landing is specified** (for access to attachments on the top of the sphere), this platform shall be **grating**.
- M,O 6.5 (Addition) **Guard railings and toe plates** shall enclose all nozzle, pressure relief device and instrument attachments located on the top of the sphere.
- S 6.6 (Addition) **Railing and toe plates** shall be **carbon steel** and be per **ANSI A12.1**.

FABRICATION

- R 7.1 (Modification) **All reinforcing plates and sphere legs** shall be provided with 1/4 in. (6 mm) vent holes. These holes shall be plugged with plastic sealant after the sphere has been hydrostatically tested.
- S 7.2 (Modification) **All joints between shell plates** shall be of the double butt welded type with complete penetration and complete fusion.
- S * 7.3 (Addition) Spheres constructed of materials having minimum specified tensile strength greater than 70,000 psi (482 MPa) shall be postweld heat treated.
- R 7.4 (Addition) Detailed procedures for postweld heat treatment (PWHT) of spheres including thermocouple locations shall be submitted to the Purchaser for review prior to PWHT.

INSPECTION AND TESTING

- I 8.1 (Addition) **Mill test data**. If inspection is not made at the fabricators' plant or mill, the mill test data (including chemical and physical properties) shall be forwarded to the Purchaser no later than the time of plate shipment to the field. All chemical and physical reports shall indicate the specification to which the steel was manufactured and the heat treatment condition. All plates and data reports shall be readily identifiable with matching heat numbers.
- R 8.2 (Addition) **Field erected spheres shall be inspected**. Inspection includes witnessing of field test.