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HYDROSTATIC PRESSURE TESTING OF PIPING

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Standard and Specification specifies pressure and leak test procedure and acceptance criteria of piping works to perform minimum quality level.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. ASME B31.3 Process Piping
2. ASME SECTION.IX "Welding and Brazing Qualifications"

DEFINITIONS AND TERMINOLOGY

Calculated Test Pressure - The test pressure determined in this Project Standard and Specification below.

Category D Fluid Service - A fluid service in which all the following apply (per ASME B31.3):

- The fluid handled is nonflammable, nontoxic, and not damaging to human tissues
- The design gauge pressure does not exceed 10.35 bar
- The design temperature is between -29 C and 186 C

Category M Fluid Service - A toxic fluid service in which exposure to very small quantities of the fluid in the environment can produce serious irreversible harm to persons on breathing or bodily contact, even when prompt restorative measures are taken (per ASME B31.3).

Damaging to Human Tissues - A fluid which, under expected operating conditions, can harm skin, eyes, or exposed mucous membranes so that irreversible damage may be done unless prompt restorative measures are taken. Restorative measures may include flushing with water, administration of antidotes, medication, etc (per ASME B31.3).

Minimum Test Pressure - The lowest allowable test pressure gauge reading (the calculated test pressure plus the additional pressure resulting from the static head of the test fluid).

Maximum Test Pressure - The highest allowable test pressure gauge reading (the pressure test rating of the "weakest" component in the test system).

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified. However, nominal sizes of piping component shall be in accordance with inch system

PRESSURE TEST SYSTEM

1. As large a piping system as practicable including its associated equipment shall be hydro tested together as a unit, unless the difference among their design pressures exceeds 15 percent of the lowest design pressure of the system components.

   The test pressure in the system shall be equal to the test pressure applied to the system component of which the design pressure is the lowest among the system as mentioned in the following paragraph.

   Where piping systems of different design pressures are fully welded together, then "cascade" pressure testing will be required, (i.e. complete the pressure test on the higher pressure system prior to system closure welding and then repeat full Pressure Test Procedure for the test of the combined systems at the lowest pressure).
2. Heat exchangers, pressure vessels and fired heaters may be included in a test system, providing the system test pressure does not exceed the shop test pressure of any of the included items
3. The following equipment and components shall not be included in the system. The equipment shall be isolated from the system.
   a. Rotary equipment such as pumps, compressors and turbines.
   b. Safety valves rupture discs, flame arrest's, and steam traps.
   c. Pressure vessels with sophisticated internals.
   d. Equipment and piping lined with refractoriness.
   e. Storage tanks.
   f. Filters, if filter element(s) is not dismantled.

g. Heat exchangers of which tube sheets and internals have been designed for differential pressure between tube side and shell side.
h. Instruments such as control valves, pressure gages, level gages, and flowmeter (excluding thermocouples).

4. Exclusions

   The followings are excluded from the requirements of this specification:

   a. Any package unit previously tested by the manufacturer in accordance with the applicable codes.
   b. Plumbing systems, which are tested in accordance with the applicable plumbing codes.
   c. Lines and systems which are open to the atmosphere such as drain, vents, open discharge of relief valve, and atmospheric sewers.
   d. Instrument impulse lines between the block valve at the process or utility line and the connected instrument.

5. Although instruments shall normally be excluded from the system, process lead lines shall be tested to the first block valve together with the piping system.

   Any vents or bypasses downstream of the instrument's first block valves shall be opened or the instrument shall be disconnected during the test to insure full protection of that instrument.

6. The test shall be hydrostatic using water, except if there is a possibility of damage due to freezing, or if the operating fluid or piping material would be adversely affected by water.

   Any other suitable liquid shall be used with contractor's approval.

   a. Testing on site with Kerosene or other inflammable fluids or compressed air shall be avoided as far as possible (except where specifically called for) and shall be carried out only with the approval of contractor.
   b. If a flammable liquid is used, its flash point shall be not less than 50C° and consideration shall be given to the test environment.

7. Pneumatic testing shall be considered for the following:

   a. Gas, steam, or vapor lines when the weight of the hydro test liquid would overstress supporting structures or pipe wall.
   b. Piping with linings subject to damage by the hydro test liquid.
   c. The instrument air headers shall be tested with dry-oil free air. The commodity test may be used if the systems are completed and the instrument air compressor is operational.

TEST WATER CRITERIA

Care shall be taken to insure the use of clean water for hydrostatic tests. And the sea water is prohibited to be used.

A suitable filter should be provided in the filling line to the systems in order to remove foreign matter such as sand, rust or other particles in the proposed test water.

Hydrostatic testing shall be performed using clam potable water with a chloride content of max 50 ppm for austenitic steels. In case this requirement can't be fulfilled the pipeline shall be reamed completely and flushed with water fulfilling the above requirement of 50 ppm max of chlorides.

TESTING

1. Hydrostatic testing of piping designed for internal pressure

   The minimum hydrostatic test pressure at any point in the system shall be as follows.
   - Not less than 1-1/2 times of the design pressure.
   - For a design temperature above the test temperature, the minimum test pressure shall be as calculated by the following equation.
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$$Pt = \frac{1.5 \cdot P \cdot St}{S}$$

   Where:

   Pt = minimum calculated hydrostatic test pressure (kg/cm^2)
   P = internal design pressure (kg/cm^2)
   St = allowable stress at test temperature (kg/cm^2)
   S = allowable stress at design temperature (kg/cm^2)
   See Table I, Appendix A, IASME 831.3 1
   When St and S are equal, test pressure is 1.5 x P.

   Where the test pressure as defined above would produce a stress in excess of the specified minimum yield strength at test temperature, the test pressure shall be reduced to a pressure at which the stress will not exceed the specified minimum yield strength at the test temperature.

The maximum test pressure at which the stress produced will not exceed the specified minimum yield strength may be calculated by the following equation:

$$Pm = \frac{2S.E.t}{D}$$

Where:

Pm = maximum test pressure (kg/ cm^2)
S = specified minimum yield strength at test temperature (kg/cm^2)
t = specified pipe wall thickness minus mill tolerance (cm)
D = outside diameter (cm)
E = quality factor (see ASME B31.3 table A-1 B)

2. Hydrostatic testing of Piping Designed for External Pressure. (Jacked limes)
   a. Lines in external pressure service shall be subjected to an internal test pressure of 1-1/2 times the external differential design pressure but not less than a gauge pressure of 1.055kg/m^2 (15 psi).
   b. Jacketed lines, the internal line shall be pressure tested on the basis of the internal or external design pressure, whichever is critical. This test shall be preformed prior to completion of the jacket.
   c. The jacket shall be pressure tested of the basis to the jacket design conditions.
   d. Where systems require hydrostatic testing through static equipment, the test pressure shall be selected so as not to exceed vessel test pressure.

BLINDS FOR PRESSURE TEST

Plain test blanks shall be used with 1/16 inch flat asbestos gaskets for blanking flat face, and raised face. Provide full face blanks and gaskets for CL 125 connections. However, where permanent operational blinds are installed, they may be used for pressure testing.

Plate material, extra length bolts and gaskets, which are made at the Job Site could be used for testing. Maximum allowable hydrostatic testing pressure for test blinds refer to Appendix A.

Temporary spades and blanks installed for testing purposes shall be designed to withstand the test pressure without distortion. Temporary test spades and blanks shall be readily identifiable by painting a red color on the handle.
For ring joint flanges, spare ring joints shall be required as they are to be used only once.

TEST PACK PREPARATION

General

Contractor will prepare a marked up of p & id indicating the test limits.

From the marked up PID, Subcontractor will divide the piping into suitable Test Packs. The size of the packs may be revised by Subcontractor provided that the specification for limits below is complied with. Contractor shall be notified of such revisions and will authorize Subcontractor to proceed if said revisions meet the specification.

Test Pack Limits

Subcontractor shall not test through equipment without contractor's written approval.

Test Pack Format

- Pressure test report for Piping
- Marked-up PID
- Blind check list
- Welding History Report and Welding Joint Marked ISO Drawing
- NDE Report
- PWHT and Hardness test Report
- Post – Test Punch List (contractor + Client)
- Copies of reinforcing pad pressure test certificates (If necessary).

Test packs will include the latest available revision of each isometric covering the scope of the test.

a. Test limits, and highlight line to be tested.
b. Size (thickness') and location of all test blinds and including those required at instrument connections e.g. orifice flanges.
c. Identify location for the connection of the fill and drainage points for the system.
d. Vent points
e. Drain points
f. Location and range of pressure gauges to be used. Minimum (2) Calibrate gauges enquired, one located at an accessible low point of the test and one gauge located at the highest points on the test manifold.
g. Any other special requirements such as chloride content if applicable.