STANDARD SPECIFICATIONS FOR

PIPING – FLUSHING, TESTING AND INSPECTION

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1.0 PURPOSE

The purpose of this specification is to define the construction requirements of flushing, testing and inspection of pipelines.

2.0 SCOPE

2.1 This specification supplements the applicable code requirements/specifications/standards for fabrication, erection, inspection, testing of pipelines.

2.2 Engineering drawings/codes/standards shall take precedence over this specification if there are any conflicting clauses.

3.0 FLUSHING

3.1 Flushing of all lines shall be done before pressure testing.

3.2 Flushing of all lines including IBR lines etc. shall be done in the presence and as per the approval of the Owner/Consultant.

3.3 Flushing of pipe lines will be done by fresh potable water or dry compressed air wherever water flushing is not desirable to clean the pipe of all dirt, debris or loose foreign materials.

3.4 The supply of compressed air for flushing will be Contractor's responsibility and it will be done at his cost.

3.5 It will be Contractor's responsibility to provide pumping equipment, compressors, water/air hoses with accessories etc., Wherever required, instruments such as pumps, pressure gauges, safety valves etc. spool pieces, temporary gaskets, tools and tackles and all other arrangements, equipment, materials and consumables etc. required as aids for completing the flushing as per the directions of the Owner/Consultant.

3.6 During flushing, care shall be taken for on line instruments as per clause of this specification.

3.7 The Contractor shall carry out all the activities required before, during and after the flushing operation arising from the flushing requirement such as but not limited to the following:

3.7.1 Removing of valves, specials, distance pieces, on line instruments and any piping part before flushing. The flanges to be broken for this purpose should be envisaged by the Contractor, approved by the Owner/Consultant and should be provided with temporary gaskets at the time of initial erection.

3.7.2 After flushing is completed and approved, the valves, distance pieces, piping specials etc. shall be re-installed by the Contractor with permanent gaskets. However, flanges at equipment nozzles and other places where isolation is required during testing, only temporary gaskets will be provided.

3.7.3 Flushing will be continued till the inside of the pipe is fully cleaned to the satisfaction of the Owner/Consultant.

3.7.4 For air flushing the line/system will be pressurised by the compressed air at the required pressure. Then pressure will be released by quick opening of a valve already in line or installed temporarily for this purpose.

This procedure will be repeated as many times as required till inside of the pipe is fully cleaned. The arrangement for raising and releasing the air pressure will be made by the Contractor as per the approval of the Owner/Consultant.
3.7.5 During the flushing, discharged water / air shall be drained to the place directed by the Owner/ Consultant. Care shall be taken during flushing so as not to damage / spoil other agencies work. As desired by the Owner / Consultant, proper temporary drainage for flushing of water shall be provided by the Contractor. Precautions shall also be taken to prevent entry of water / foreign particles in to equipment, electrics, motors, instruments, electrical installations etc. in the vicinity of lines being flushed.

3.7.6 In case where fluid inlet in to the pipe lines through connected equipment such as columns, vessels, exchangers etc. is unavoidable this shall be done after having approval of the Owner / Consultant. However, equipment thus included in the circuit for the flushing shall be completely drained and dried with compressed air after flushing is completed.

3.7.7 Wherever required as per specification lines will be dried with air after flushing.

4.0 GENERAL REQUIREMENTS OF TESTING

The intent of this specification is to provide a basis and guide for carrying out field testing of piping to ensure leak tightness.

This covers the general requirements for testing of piping after erection as specified by the code of Petroleum Refinery Piping ANSI B.31.3. Chapter VI Inspection and Test - Latest Edition.

Upon completion of installation the piping system shall be inspected to ascertain that each of the following points have been adhered to:

i) Proper use of material.
ii) Correct erection of line (in accordance with drawings).
iii) Correct installation of (temporary) blind discs to be employed during testing.
iv) The correct application of pre-established pressure.
v) Sectioning of the line in correspondence with these materials and / or equipment, which are not a part of the test.

With the exclusion of instrumentation, piping systems fabricated or assembled in the field shall be test in the field, irrespective of whether or not that have been pressure tested prior to site welding or fabrication (Process and Utility piping system).

For the steam piping falling under Indian Boiler Regulation, testing shall be done as per latest Indian Boiler Regulation. The test shall be performed in accordance with the requirements of local Boiler Inspector, prior to testing all lines shall be flushed as per procedure in clause thereof. All tests shall be completed to the satisfaction of the Owner / Consultant. On completion of the test the system shall be dried with compressed air at the pressure decided by the Owner / Consultant and made ready for operation. From all permanent strainers the screens mesh shall be removed before flushing is done.

After completion of flushing and testing, draining and drying of lines, the permanent strainers screens shall be cleaned and re-installed. During flushing temporary strainers shall be retained. After flushing temporary strainers shall be removed, cleaned and re-installed before testing. All joints remaining untested during hydro-testing such as nozzles in columns, vessels, heat exchangers etc. shall be tested pneumatically after the hydrogenating is over. Pneumatic test pressure will be indicated by the Owner / Consultant and Contractor shall ensure that this test pressure is not exceeded any time during this test.
All tests shall be conducted as per the procedure outlined in this specification. Lines repaired by welding subsequent to the pressure test shall be retested after the repair at the same test pressure originally applied. However, the Owner / Consultant may waive such retest in case of minor addition or alteration by taking some precautionary measure to assure sound construction.

Following basis for preparation of process / utility loops shall be followed by the Contractor.

The selection of piping systems for individual test will be based on the following:

1) Test Pressure required.
2) Maximum allowable pressure for the MOC of piping.

Depending on the above requirement and based on Construction completed / on construction progress, maximum length of piping shall be included for each test. Piping checks incorporating various lines to be tested at the same process shall be marked on the P&I diagram.

4.1 Systems / lines may be tested in sections to facilitate completion of work in that area or areas, however, such sections so tested shall be capped out, tagged suitably and subsequently tested as a complete system prior to final acceptance. Such weld joints (untested) may be exempted from hydraulic testing by the Owner / Consultant subject to radiography approval of these joints.

4.2 Lines, which are directly, open to atmosphere such as vents, drains, safety valves, discharge shall not be tested but all joints shall be visually inspected. Wherever necessary, as decided by the Owner / Consultant, such lines shall be tested by continuous flow of fluid to eliminate the possibility of blockage.

4.3 Instrumentation pressure impulse piping shall start beyond the first block valve located in the process line. During the pressure test this isolation valve must be kept closed to prevent dirt or any foreign matter entering in to the instrument piping. Temperature impulse connections shall be blocked off by a blind flange or threaded plug to be provided by the Contractor.

4.4 Locally mounted indicating pressure gauge may be tested with the piping if the test pressure does not exceed the scale range. However, the gauge shall be blocked off from the piping during cleaning and flushing. Where lines to which they are connected will receive a higher test pressure the gauge shall be isolated by closing the gauge isolation valve.

The Owner / Consultant shall be notified in advance by the Contractor of the testing sequence / programme to enable him to be present for witnessing the test. The Contractor shall be fully responsible for making all necessary arrangements with the local Boiler Inspector to witness the necessary tests applicable to steam lines falling under purview of Indian Boiler Regulations.

Required number of copies of test certificates in this respect shall be obtained in the relevant forms of IBR and shall be furnished to the Owner / Consultant.

5.0 **TEST FLUID**

Fresh potable water shall be used as the testing medium for the hydrostatic testing of piping unless specified otherwise. Air shall be used as alternate medium wherever specified in the line list / specification and for drying the lines. In testing of stainless steel equipment and piping water containing more than 50 ppm of chloride shall not be used.

In case chloride content of water is less than 50 ppm. water used for hydrostatic testing of S.S. equipment and / or piping should be drained completely as soon as test is approved.
Salty water shall never be used for hydrostatic testing under any circumstances. Pressure testing for certain specific lines will have to be carried out as per piping specifications.

6.0 TEST PREPARATION

All equipment, materials, consumables, and services mentioned below but not limited to them, required for carrying out pressure testing of piping shall be provided by the Contractor at his cost.

- Pump sets for pressurisation, air compressor etc.
- Hoses for water and other test fluid if any, with accessories and adaptor flanges.
- Supply, fabrication and erection of temporary carbon steel piping valves, fittings specials etc.
- Pressure gauges, safety valves and all such instruments with necessary connections.
- Temporary gaskets wherever required as per specifications and instructions of the Owner.
- Soap solution, grease, graphite, white lead, paints etc. all consumables.
- Tools, Tackles, pipe wrenches, spanners etc.
- All aids not specified here but required for carrying out pressure test of piping.

6.1 Before testing all piping shall be cleaned by fresh potable water or blown with compressed air where water flushing is not desirable to make it free from dirt, loose scale, debris and other loose foreign material as per the details given in clause thereof. This should be completed wherever required prior to completion of final weld in order that visual inspection of interior is possible.

6.2 INSTRUMENTATION

6.2.1 Any restrictions which interfere with filling of draining such as orifice plates etc., shall not be installed until flushing is completed. Till such time that orifice plate is installed orifice flanges shall be provided with temporary gaskets.

6.2.2 Control valves shall be first installed with temporary gaskets. Before flushing is started control valves shall be removed and reinstalled after completion of flushing and testing with permanent gaskets. If for any reason control valve is retained in the line during tests, it shall be isolated by blinking off.

6.2.3 All safety valves and rotameters shall be installed only after flushing and testing is completed successfully.

6.3 Wherever in the line any void is existing, due to any reasons, for absence of control valves, safety valves, check valves etc., it will be filled with temporary spools.

6.4 All joints welded, screwed or flanged shall be left exposed for the examination during the test. Before pressurising the lines each weld joint shall be cleaned by wire brush to make it free from rust and any other foreign matter.

6.5 The test will be carried out with permanent gaskets installed unless otherwise specified herein or instructed by the Owner.
6.6 Vents and drains at the highest and the lowest points in the piping systems shall be provided.

6.7 Pumps, blowers, compressors, in line instruments other equipment and piping specialties shall be isolated during flushing and pressure testing by metallic blinds, blanks caps or plugs.

6.8 No pressure test shall be carried out against closed valve unless approved by the Owner / Consultant.

6.9 Piping which is spring or counter weight supported shall be temporarily supported where the weight of the test fluid would overload the supports.

Retaining pins or spring supports shall be removed only after testing is completed and test fluid is fully drained.

6.10 Piping systems subject to extended hydrostatic test period shall be provided with protective device to relieve excess pressure due to the thermal expansion of the test fluid.

6.11 TEST PRESSURE GAUGES

6.11.1 All gauges used for field testing should be of the Bourdon type having a suitable range and dial scale not less than 4 ½ diameter. Test pressure indication should fall between 40% to 80% of gauge scale range. Gauge shall be of good quality and shall be in first class working condition.

6.11.2 Prior to the start of test and periodically during the field test programme all test gauges shall be calibrated using a standard Dead Weight gauge tester or other suitable approved testing apparatus. Any gauge showing incorrect zero reading, or error of more than + 2% of full scale range shall be discarded. The Owner / Consultant shall check the accuracy of water pressure gauge used for calibration. The Contractor shall furnish documentary proof of having calibrated each gauge / instrument to the satisfaction of the Owner / Consultant and shall maintain such records until completion of the project.

6.11.3 The pressure gauge shall be installed as close as possible to the lowest point of piping system to be rested to avoid over stressing of any of the lower portion of the system. For longer lines and vertical lines two or more pressure gauges shall be installed at the locations decided by the Owner / Consultant. Over and above the pressure gauges installed in the system being tested, a pressure gauge will be installed on discharge of pumps or other pressurising source.

For lines containing check valves any of the following alternatives will be adopted for pressure testing:

i) Wherever possible pressurise up stream of valve.

ii) Replace the valve by a temporary spool and reinstall the valve after testing.

iii) Provide blind on valve flanges and test the up streams and down streams of the line separately and remove the blind after testing, (in all the above mentioned cases wherever valves, flanges are required to make and break for testing, the Contractor shall provide temporary gaskets at the time of initial installation of check valves. Final gaskets will be provided only after completion of testing.)

7.0 PROCEDURE FOR PRESSURE TESTING

7.1 All pipe lines to be tested are shown in the piping specifications. The medium to be used and test pressure to be applied is also indicated in the piping specifications provided to the Contractor for the performance of work.
7.2 TEST PRESSURE

7.2.1 The minimum hydrostatic / pneumatic test pressure shall be indicated in the piping specifications or as per instructions of the Owner / Consultant.

7.2.2 The selection of the piping system for one individual test will be based on the following:

- Test pressure required as per line list.
- Maximum allowable pressure for the material of Construction of piping.

Depending upon the above requirements and based on construction progress maximum length of piping shall be included in each test.

7.3 PRESSURISING, INSPECTION APPROVAL

7.3.1 All vents and other connections used as vents shall be left open while filling the line with test fluid for complete removal of air, in the lines for pressurising and depressurising the system temporary isolating valves shall be provided in valve vents, drains do not exist in the systems.

7.3.2 Pressure shall be applied only after the system / line is ready and approved by the Owner / Consultant.

7.3.3 Pressure shall be applied by means of a suitable test pump of other pressure source which shall be isolated from the system as soon as test pressure is reached and established the system.

7.3.4 The test pressure shall be retained long enough to facilitate inspection of the complete system. Duration of the test in each case shall be fixed up by the Owner / Consultant but in no case it will be less than 2 hours. No leakage of any kind will be permissible. The glands of the valves in the system being tested shall be tightened by the Contractor, so as to stop / minimise the leakage, if any. In case leakage is not stopped after adequate tightening of the glands, the handwheel of such valves shall be painted red only on the rim to identify these valves for subsequent repair. The gland packing for replacement shall be supplied by the Owner.

The Contractor shall replace the gland packing on the valve and tighten it to make it leak proof. Valve gland tightening and handwheel painting shall be done by the Contractor.

7.3.5 Care shall be taken to avoid increase in pressure due to temperature variation during the test.

7.3.6 After completion of hydrotest, the pressure shall be released gradually. All vents and drains shall be kept open till the lines are fully drained. After draining, lines / systems shall be dried by air.

7.3.7 Pressure test shall be considered, complete only after approval by the Owner / Consultant. Defects, if any noticed during testing shall be rectified immediately and retesting immediately and retesting of the system / line shall be done by the Contractor at his cost.
8.0 TEST RECORDS

Records in triplicate shall be prepared and submitted by the Contractor for each system (linewise) for the flushing and the pressure test done giving following details in the proforma approved by the Owner / Consultant.

- Date of flushing.
- Date of test.
- Identification of piping tested, i.e. line no., line diagram no., plant area etc.
- Flushing medium used.
- Test fluid used.
- Minimum test pressure required and actual test pressure obtained.
- Signature of the Contractor’s representative.
- Approval signature of the Consultant.
- Approval signature of the Owner.