

**SPECIFICATION FOR PRESSURE TESTING OF
DI, PVC AND HDPE PIPE LINES**

Revised on 22-10-2020

Inspection

If stipulated by the purchaser, all materials are subject to inspection and approval at the manufacturer's plant.

Inspection on delivery

All pipe and appurtenances are subject to inspection on delivery. Neither inspection nor failure to provide inspection shall relieve the manufacturer of the responsibility to provide materials meeting the requirements of the Contract Documents. Materials not conforming to the requirements of this specification shall be made satisfactory or replaced. Pipe or appurtenances that fail to comply with specified tests shall be made satisfactory or replaced.

Workmanship

All pipe and appurtenances shall be tested under pressure for defects and leaks in accordance with this Specification.

Hydrostatic Testing

The Contractor shall submit for the Engineer's approval, the details of his proposed methods and program for testing (including details of test equipment) and shall arrange for all tests to be witness by the Engineer or his Representative. The Contractor shall provide all plant, equipment, material and labour necessary for carrying out testing including water, pumps, compressors, gauges, pipe connections, stop ends, and all other temporary works such as thrust blocks or bulkheads etc. No testing will be permitted until ten days after thrust blocks and other holding down works have been completed. The water used for hydrostatic pressure test is potable water.

The Contractor shall note that neither the satisfactory testing of pipeline, section of a pipeline or any other pipe work, nor the acceptance of the testing by the Engineer or his representative shall in any way relieve the Contractor of any of his responsibilities and obligations under the Contract. The Contractor shall notify the Engineer at least 24 hours before hand of his intention to test a section of pipeline being satisfied himself in the first instance, that the section of pipeline to be tested is satisfactory in all aspects.

The testing methods described in this Specification are specific for water-pressure testing only. These procedures shall not be applied for air-pressure testing because of the serious safety hazards involved with compressed air. Also, pipelines intended for buried service shall generally be tested with the backfill in place.

Contractor shall submit a complete method statement for all pressure testing sections not more than 1km pipe length including design of thrust blocks or temporary anchorages, method of supply of water, method of detecting leaks and repair leaks, etc and shall be obtained an approval from the Engineer before performing the hydrostatic test.

Hydrostatic pressure test

Test restrictions

Before the gauges used for pressure testing of pipelines, the Contractor shall arrange for it to be calibrated independently by a reputed laboratory approved by the Engineer and a certificate of its accuracy shall be provided to the Engineer for approval. One additional gauge as above shall be handed over to the Engineer for purposes of verification during testing. Subsequent calibration of pressure gauges shall be carried out by the Contractor, at regular time intervals or as required by the Engineer from an approved laboratory. Engineer may decide the number of pressure gauges needed to be calibrated depending on continuous pressure testing programme.

The test pressure shall not be less than 1.25 times the stated working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section or surge pressure, whichever is greater. The hydrostatic test shall be carried out at least a 2-hr duration for test pressure and at least a 24-hr duration for working pressure in minimum distance of 500m section or as specified by the Engineer.

The test pressure shall not exceed the thrust restraint design pressure or 1.5 times the pressure rating of the pipe or joint, whichever is less (as specified by the manufacturer).

Valves shall not be operated in either direction at a differential pressure exceeding the rated valve working pressure. The Contractor shall note that since valves cannot be guaranteed to be perfectly drop-tight, testing against closed valves shall not be permitted unless with the written approval of the Engineer. The open ends of the pipeline (or sections thereof) shall normally be stopped off by blank flanges, or end-caps, additionally secured where necessary by temporary struts and wedges.

The Contractor shall remain responsible for the care of the works during testing of the pipework. For purpose of interim testing, the pipeline shall be divided into sections. Each section shall be separately tested to the Engineer's satisfaction for hydrostatic pressure when each section is completed. Procedures for performing hydrostatic pressure tests for each section of pipeline shall include;

- Location and capacity of the test pump
- Test pressure at the pump and at the high and low points in the pipeline
- Procedures for venting the air from pipeline
- Source of supply water for testing
- Disposing the water after satisfactory testing

The length of pipeline to be tested shall not exceed 1000 m. A simple stop end consists of a section of steel pipe about 0.5-1.0m long onto which a closing plate has been welded, containing

the necessary opening for accommodating ongoing water and out-coming air. Stop ends may also include an opening through which the test water may be pumped from the line, if necessary, and shall be jointed to the pipe to be tested by means of a standard coupling or other method approved by the Engineer. Thrust blocks or temporary anchorages shall be provided to hold the stop end in place against the test pressure. The Contractor may also use proprietary restrained joints in lieu of thrust block.

If permanent air vents are not located at all high points, the Contractor shall install suitable cocks at such points so that the air can be expelled as the line is filled with water.

Field Hydrostatic Pressure Testing Procedure for uPVC/DI Pipe Lines

Hydrostatic pressure testing shall be carried out in accordance with AWWA C605-05 for uPVC pipelines and AWWA C600-05 for DI pipelines as per the following procedure.

1. Test setup and pressurization

Following the installation of any new pipeline, all newly laid pipe section thereof shall be subjected to a hydrostatic pressure test. Each test section of pipeline shall be slowly filled with water and allowed air to be released from the highest points of the pipeline. When venting air from pipelines, it is important to control the pipeline fill rate to avoid excessive surge pressures when the water reached the air venting opening (s). To allow air to escape from test section, flow velocities during filling shall not exceed the capacities of air release devices or other openings used to release entrapped air avoid or limit transient pressure surges, the filling flow velocity shall not exceed the design velocity of the piping system.

The specified test pressure shall be applied using a suitable pump connected to the pipeline. (Note: The specified test pressure shall be based on the elevation of the lowest point of the pipeline or section under test and corrected to the elevation of the test gauge-see test restrictions). Before applying the specified test pressure, air shall be expelled completely from the pipeline section under test. If permanent air vents are not located at all high points, corporation cocks (cocks which are used to give service connections from the main pipeline) shall be installed at these points to expel any air as the line is filled with water. Use of corporation cocks above rated pressure must be at the risk of the user and authorized specifically by the manufacturer.

The Contractor shall gradually increase the pressure in the pipeline to the test pressure and the pipeline shall be allowed to stabilize at the test pressure for at least 15 minutes before conducting the hydrostatic test. This may require several cycle of pressurizing and bleeding trapped air prior to beginning the test. The hydrostatic test shall be of at least a 2-hr duration. The test pressure shall not vary by more than $\pm 34.5\text{kPa}$ for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the

pipeline. The amount of makeup water added shall be accurately measured (liters per hour) by suitable methods and shall not exceed the applicable testing allowance as specified below.

2. Examination

Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the pressure test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered during or following the pressure test shall be repaired or replaced with reliable material, and the test shall be repeated until satisfactory results are obtained.

3. Testing allowance

Testing allowance shall be defined as the maximum quantity of makeup water that is added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, in order to maintain the specified test pressure (after the pipeline has been filled with water and the air has been expelled). Pipe installation shall not be accepted if the quantity of makeup water is greater than that determined by the following formula.

In metric units,

$$L_m = \frac{SD\sqrt{P}}{794,797}$$

Where

L_m = testing allowance (quantity of makeup water), in liters per hour

S = length of pipe section being tested, in meters

D = nominal diameter of the pipe, in millimeters

P = average test pressure during the hydrostatic test, in kilopascals

When air valves and hydrants are in the test section, the test shall be carried out after removing those components and blank flanged at the branch off. After completing the testing air valves and hydrants shall be fixed with the sluice valve.

4. Acceptance of installation

The final acceptance test shall be carried out for the lengths passed the above tests and joined together on completion of construction for all the sections. Final pipeline acceptance test pressure shall be 4 bars and procedures shall be as described above.

Acceptance shall be determined on the basis of testing allowance only. If any test of a new pipeline discloses a testing allowance greater than that specified above, repairs or replacements

shall be accomplished. All visible leaks are to be repaired regardless of the allowance used for testing.

Field Hydrostatic Pressure Testing Procedure for HDPE Pipe Lines

Hydrostatic pressure testing shall be carried out in accordance with “BS EN 805:2000 water supply- requirements for system and components outside buildings” for HDPE pipes as per the following procedure.

The maximum hydrostatic test pressure shall be compensated for temperatures other than 73⁰F (23⁰C) as Polyethylene pipe materials are typically pressure rated at 73⁰F (23⁰C).

1. Test procedure

The whole test procedure comprises of necessarily a preliminary phase including a relaxation period, integrated pressure drop test and main test phase.

- **Preliminary Test Phase**

- a) **Relaxation period**

After having arranged the test section for preliminary phase (same procedure could be used as described in above under for uPVC mains) i.e. after flushing, filling and venting the pipeline test section, an relaxation period of at least 60min shall be provided during which a pipeline will be exposed only to normal, atmospheric pressure, such condition is to be held for 60 minutes in order to release any pressure related stress. The pipe temperature shall not exceed 25⁰C during testing process.

- b) **Pressure build-up**

After this relaxation period raise the pressure continuously and quickly (in less than 10 min) to the test pressure. Use of motor pump is recommendable at longer pipeline sections.

- c) **Pressure maintenance phase**

The test pressure shall be maintained for a period of 30 minutes by pumping continuously or at short Intervals. Any obvious leaks (pipe joints, connection points) shall not be detected during this time.

d) Expansion phase

After 30 min of the test pressure maintenance, one hour relaxation period is required (without pumping) during which the pipeline may stretch (expand) due to visco-elastic creep. The remaining pressure shall be measured at the end of this period. The test procedure shall be continued in the event of a successful preliminary phase. If the pressure has decreased by more than 30% of the test pressure, interrupt the preliminary phase and depressurize the test section.

If pressure drop is more than 30%, it indicates a leakage, or a prohibited tube wall temperature ($>25^{\circ}\text{C}$). In such case the test shall be repeated.

- Integrated pressure drop test (vent control)

The results of the main test phase shall only be judged if the remaining volume of air in the test section is adequately low. The following steps are necessary.

- ❖ The remaining actual pressure measured at the end of the preliminary phase shall be reduced rapidly by discharging water from the system to produce Δp of 10% to 15% of the test pressure.
- ❖ The removed volume ΔV shall be Measured precisely
- ❖ The allowable water loss ΔV_{max} shall be calculated using the following formula and check that removed volume V does not exceed ΔV_{max} .

$$\Delta V_{\text{max}} = 1.2 \times V \times \Delta p \times [1/E_w + D/(e \times E_r)]$$

Where;

ΔV_{max} = the allowable water loss, in liters

V = volume of the tested pipeline section, in liters

Δp = measured pressure loss, in kilopascals

E_w = the bulk modulus of water, in kilopascals

D = internal pipe diameter, in meters

e = wall thickness of the pipe, in meters

E_r = modulus of elasticity of the pipe wall in the circumferential direction, in kilopascals

1.2 = an allowance factor (e.g. for air content) during the main test phase

For the interpretation of the result it is important to use the exact value of E_r considering the temperature and the duration of the test. Especially it shall be for smaller diameters and shorter test sections. Δp and ΔV shall be measured as accurately as possible.

If ΔV is more than ΔV_{max} the test procedure shall be interrupted and vent aging after the pipeline shall have been depressurized.

- Main test phase

The visco-elastic creep due to the stress caused by test pressure is interrupted by the integrated pressure.

The rapid decrease of the pressure in drop test leads to a contraction of the pipeline. The increase of pressure resulting from the concentration (main test phase) shall be observed and recorded for a period of 30 min. the main test phase is considered to be successful, if the pressure curve shows an increasing tendency and does not decrease at any time of this 30 min period, which is normally long enough to get a good indication.

If during that period the pressure curve shows a falling tendency, it indicates as leak within the system. In case of doubt the main test phase shall be extended to 90 min. In that case the pressure loss shall be limited to 25kPa (0.25 bar) from the maximum value occurring within the contraction phase.

All mechanical fittings shall be checked before visually inspecting the welded joints.

2. Acceptance of installation

If the pressure drops by more than 25kPa (0.25 bar) the test fail. If the test fail, the Contractor shall rectify any defect in the installation revealed by the test and shall repeat the test. The repetition of the main test phase shall be done by carrying out the whole test procedure including the relaxation period of 60 min in the preliminary phase.