Hydrostatic Testing Procedure for HDPE Line Pipe

(FOR PROJECT SPECIFIC TESTING INFORMATION, SEE THE PROJECT SCOPE OF WORK DOCUMENT)

TESTING

Specifications

This document describes the procedures for hydrostatic testing of polyethylene piping, fittings, and components. In addition to the standards and procedures listed below, testing will be in accordance with *B31.8, ASME F2164, API 15LE, DOT 49 CFR 195, and DOT 49 CFR 192*. If there is a discrepancy between these documents, the most stringent shall apply.

General

The section of the piping system to be tested is isolated from other parts of the system and restrained against movement to prevent catastrophic failure. Components that are not to be subjected to test pressure or could be damaged by test pressure are isolated or removed as necessary. Isolated components are vented to atmosphere. The test section is filled with the testing liquid, raised to the test pressure, and allowed to stabilize. The system is inspected or monitored for leakage, and then test pressure is relieved. If repairs or corrections are necessary, they are performed only when the test section is depressurized. If necessary, a retest is performed after a relaxation period. At the conclusion of an acceptable test, the test section may be placed in service. Purging and disposal of the test liquid from the test section may be necessary.

All installed valves in the test section shall be tested in the open position. Vent valves shall be tested in the fully open position and blinded at the atmosphere end. Instruments and sensing lines shall be disconnected and the root valve shall be in open position and plugged.

The Contractor shall prepare a check list of all preparatory work undertaken and ensure that all safety measures are in place. The check list shall be signed by the Contractor and approved by the Company. All in-line instruments and instrument probes shall be removed, blocked and bled or otherwise isolated from the test.

Each test section shall be filled with water from approved source as indicated in the permit or by Company. Pre-tested test headers shall be installed prior to filling. During pressurization, a pressure/volume plot shall be made by taking regular readings from the pump stroke counter and pressure gauge.

Apparatus and Equipment for Hydrostatic Procedures

General **-** Components such as caps, valves, blind flanges, manual or automatic air release devices, vents, and other devices that are used to isolate the test section from other parts of the system, to purge air from the system, and to isolate components that are not to be subjected to test pressure are generally needed.

Isolation **-** Test section isolation and closure components are to be rated for pressures equal to or greater than the test pressure applied to the test section.

Although section isolation and closure components may only be connected to the test section for the duration of the test, the joint between the test section and a closure or isolation component should be at least as strong as joints in the test section. Additional restraint may be required.

Air release devices should be located at all high points along the test section. Excessively worn or deteriorated equipment is unsuitable and is not to be used.

Where an existing water supply is used to supply test water, protect the existing water supply from backflow contamination in accordance with local codes or as required by the authority having jurisdiction. Remove backflow protection and isolate the test section from the existing water supply before testing.

Filling and Pressurizing Equipment **-** Liquid filling and pressurizing equipment such as pumps, and pressure regulating devices will usually be necessary. Filling equipment should be capable of filling the test section in a reasonable time against any elevation head pressure that may be present. Pressurizing equipment should be able to maintain the necessary test pressure in the test section and provide sufficient quantities of make-up test liquid for the duration of the test. Pressure regulating equipment should be capable of maintaining pressures for the duration of the test.

Pressure Monitoring **-** Contractor shall furnish all labor and materials, including a pressure/temperature recorder, an ambient thermometer, dead weight tester, and pressure gauge to hydrostatically test the pipeline and facilities. The pressure and temperature recorder(s), and dead weight tester must be calibrated annually.

Use at least one calibrated pressure gauge or sensor accurate to within two percent (2 %) of full scale. It is preferred that the gauge or sensor full scale value not be more than twice the test pressure, and that scale graduations be no greater than two percent (2 %) of the full scale value. Using a valved tee, a gauge cock for bleeding, a pressure snubber, and a duplicate, back-up pressure gauge are recommended.

Deadweight or calibrated pressure gauge readings shall be recorded every fifteen minutes and temperature readings shall be recorded every 30 minutes for the duration of the test. The pipeline pressure and temperature shall be continuously recorded.

The pressure recording shall serve only as information data and shall not be used to determine pressure drop for pipeline leakage. No pipeline shall be judged acceptable

until a continuous test for the minimum time period have been recorded without pressure loss due or gain unless correlated to temperature change. All data and charts shall be clearly marked with the time and date, description of test section and type of test and shall be signed by Company representative and Contractor.

The hydrostatic test must have one inline relief valve (Contractor provided) that is set to relieve upon overpressure. This relief valve shall be tested and verified prior to beginning the hydrostatic test.

Locate the test pressure gauge or sensor to monitor test pressure at the lowest point in the test section. Pressure may also be monitored at other points as well.

Other equipment for connection of pump(s) to the test section and the liquid supply, controlling the flow of test liquid, power to the pump(s), connection of pressure gauge(s) or sensor(s) to the test section, monitoring pressure, and draining/purging the test liquid from the test section may also be necessary.

Specific Safety Precautions

This safety information is in addition to the safety information in other sections of this document.

Always take precautions to eliminate hazards to persons near lines being tested. For the entire duration of the procedure, including filling, initial pressurization, time at test pressure, and depressurization, only persons conducting the test or inspecting the system should be allowed near the section under test. These persons should be fully informed of the hazards of field pressure testing. All other persons should be kept a safe distance away. The test section must be supervised at all times.

Failure may result in sudden, violent, uncontrolled, and dangerous movement of system piping, or components, or parts of components.

Restraint Against Movement **-** Take measures to ensure that all parts of the section under test are restrained against movement if failure occurs. Such measures may include backfilling, anchoring, or other appropriate means.

Partial Backfilling During Testing **-** When underground connections, joints, and seals are to be exposed for observation during the test, use sufficient backfill material placed between the joints, and over the pipe to prevent movement, giving due consideration to restraining thrust forces. In particular, pipes connected to restrained joints that derive their stability from the interaction of the pipe and soil are to be backfilled prior to testing. Leakage usually occurs at a connection, joint, or seal in the system. Depending upon the type of connection, joint, or seal, leakage may be seepage, spray, or a stream of internal test liquid.

When properly made, heat fusion joints in polyethylene pipe are as strong as the pipe and do not leak. Leakage at a fusion joint indicates a faulty joint that may

rupture completely at any time. If leakage is observed at a fusion joint, move away immediately, and depressurize the test section.

Pre-Test Preparation and Set-Up

Before testing, heat fusion joints are to be completely cooled. Mechanical joints are to be completely assembled with all necessary seals and all fasteners installed and tightened.

Flushing, pigging, or other means of cleaning the system to remove dirt and debris that may damage valves and regulators is required before testing. Reference the Construction Specification for further details. Cleaning by Pigging involves forcing a resilient plastic plug (soft pig) through the pipeline. Usually, hydrostatic or pneumatic pressure is applied behind the pig to move it down the pipeline. Pigging should employ a launcher and receiver. Soft pigs must be used with polyethylene pipe. **Scraping finger type or bucket type pigs will severely damage the pipeline, and must not be used**.

Allow concrete supports and anchors in the test section to cure until they have developed at least 75% strength to withstand test pressure thrust forces. Restrain the test section against movement in the event of failure. Temporarily remove, restrain, or isolate expansion joints and expansion compensators before starting.

Test Section **-** Testing may be conducted on the entire system, or on segments of the system. Test section size is determined by the capacity of the filling and pressurizing equipment. It is necessary to fill, pressurize, and test the section within the allotted overall time for the test. Equipment that has inadequate capacity may not be able to complete the test within allowable testing time limits. If so, use higher capacity test equipment, or test a smaller (shorter) section of the system.

Test Temperature **-** Polyethylene piping materials are typically pressure rated at 73°F (23°C). At higher temperatures, reduced pressure ratings and test pressures may be required. If the equalized temperature exceeds 73ºF prior to beginning the test, the Company shall be consulted for elevated temperature pressure ratings.

All thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced when the section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun. Multiply the test pressure by the below table multiplier to determine the allowable elevated temperature test pressure.

Test Section Temperature *°F (°C)*	≤ 80 (≤ 27)†	≤ 90 (≤ 32)	≤100 (≤ 38)	≤110 (≤ 43)	≤ 120 (≤ 49)	≤ 130 (≤ 54)	≤ 140 (≤ 60)‡
Multiplier	1.00	0.90	0.80	0.75	0.65	0.60	0.50
† Use the 80°F (27°C) multiplier for 80°F (27°C) and lower temperatures. ‡ The maximum service temperature for Performance Pipe PE pressure piping is 140°F (60°C).							

aximum Test Pressure **-** Maximum Test Pressure is designated by the Company and is not included in this document.

Maximum Test Pressure is limited by the SDR rating of the polyethylene pipe, fittings, and components. For example, SDR 7 polyethylene piping has a maximum working pressure rating of 336 psi (at 73ºF) and SDR 11 polyethylene piping has a maximum working pressure rating of 202 psi (at 73ºF).

Therefore, for SDR 7 polyethylene piping, the **maximum test pressure** would be 336 psi X 1.5 equals 504 psi but will be designated by the Company in the Project Specific Scope of Work Document**.** This assumes a piping temperature of 73ºF or less. For temperatures greater than 73ºF, the test pressure must be de-rated according to the table above.

For SDR 11 polyethylene piping, the **maximum test pressure** would be 202 psi X 1.5 equals 303 psi but will be designated by the Company in the Project Specific Scope of Work Document. This assumes a piping temperature of 73ºF or less. For temperatures greater than 73ºF, the test pressure must be de-rated according to the table above.

The maximum test pressure is not to exceed 1.5 times the maximum working pressure rating of the polyethylene pipe (also taking into account appropriate temperature de-rating factors) where lower pressure-rated components or devices are not present, or have been removed or isolated from the test section.

Do not use higher test pressure even though some components in the test section may have a higher pressure rating.

Total testing time including the time required to pressurize, stabilize, hold test pressure, and depressurize should not exceed 8 hours. Look up information about leaving overnight if test pressure not acquired.

If retesting is necessary, the test section shall be depressurized (completely if a repair is required. Or down to the MAOP including the expected temperature de rate if temperatures are projected to be above 73 degrees F) for 8 hours prior to retesting if the following apply:

The line has previously been tested above the SDR rating (maximum working pressure rating) of the polyethylene piping for more than one hour.

A leak is discovered along the test section of pipe and requires repair.
If the test was not able to be conducted and the elevated pressure was not applied to the pipe for more than 1 hour, bring pressure down in the pipe to the MAOP including the expected temperature factors.
If the test section

Before pressure is applied, examine test equipment and all connections in the test section to ensure that all are in proper operating condition and tightly connected. Isolated components or devices are to be vented to atmosphere. All low pressure filling lines and other low pressure items should be vented, disconnected or isolated.

Hydrostatic Test Procedure

1. Filling **-** Fill the test section slowly. Purge all air. Take appropriate precautions to ensure that no air is trapped in the test section. (**Entrapped air can result in an explosive, violent, and dangerous catastrophic failure because both the pressure stress on piping and the energy used to compress the entrapped air are released.**)

To allow air to escape from the test section, flow velocities during filling should not exceed the capacities of air release devices or other openings used to release entrapped air. To avoid or limit transient pressure surges, the filling flow velocity should not exceed the design velocity of the piping system.

2. Temperature Equalization **-** Allow the test section and the test liquid to equalize to a common temperature.

3. Pressurizing (Initial Expansion Phase) **-** When the section is completely filled and purged of air, gradually increase pressure in the section to the minimum required test pressure (designated by Company).

If the minimum required test pressure cannot be attained, or if it takes an unreasonably long time to reach the minimum required test pressure, there may be excessive leakage, entrapped air, or open valving, or the pressurizing equipment may be inadequate for the size of the test section. If such faults exist, discontinue pressurizing, and correct them before continuing. Add make-up water as necessary to maintain the minimum required test pressure for 4 hours.

4. Test Phase **-** Reduce minimum required test pressure by 10 psi and monitor pressure for 1 hour. Do not increase pressure or add make-up water.

Example: Considering a minimum required test pressure of 200 psi, the 1 hour test phase would reduce the minimum required test pressure to 190 psi.

5. Pass/Fail Criteria **-** If no visual leakage is observed, and pressure during the test phase remains steady (within 5 % of the minimum required test phase pressure) for the 1 hour test phase period, a passing test is indicated.

Example: Using 200 psi minimum required test pressure and considering the 10 psi reduction to 190 psi during the test phase. The 5% window allows the pressure to drop by 9.5 psi.

6. Retesting - If retesting is necessary, depressurize the test section per item 8 below and correct any faults or leaks in the test section. Do not attempt to correct faults or fix leaks while the test section is under pressure.

7. Relaxation Period - Allow the test section to "relax" for at least 8 hours before re-pressurizing. After the relaxation period, repeat the initial expansion and test phases per step 3 and 4 above.

8. *Depressurization* - Depressurize the test section by reducing pressure or releasing test liquid at a controlled rate. Sudden depressurization can cause water hammer.

9. *After the Test (Dewatering/Drying)* - Remove temporary closure and isolation devices from the test section. Contractor shall dewater the line using foam pigs. Line shall be dried to a minimum of ¼" saturation as measured on foam pig or as deemed by the Company Representative. Regulations and codes may restrict or require specific procedures for some post-test procedures such as test liquid draining and disposal.

All thermocouples installed on the line shall be removed and the coating repaired to the satisfaction of the Company. All fill pressure and instrument connections on completion of the hydrostatic test shall be blanked off by the Contractor using blind flanges where possible or shall be otherwise plugged or capped by means approved by Company.

Test Records

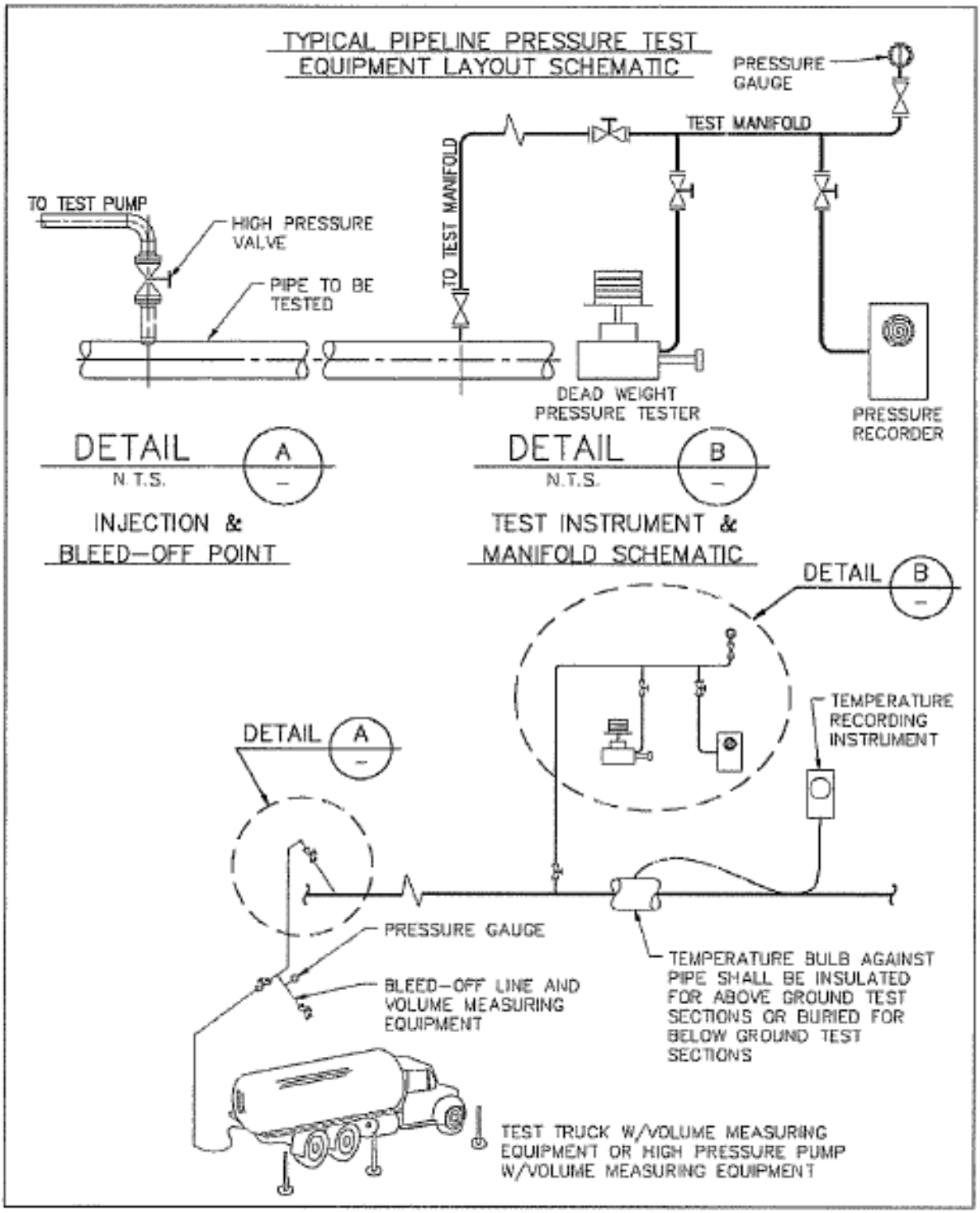
The procedure will be terminated after the Company has given his written approval of the successful test. The Contractor shall furnish to the Company, all necessary records for each test section. These shall include recording charts, deadweight and temperature half hourly reading logs, recording charts, and complete reports on any leaks or breaks all properly witnessed by the Contractor's, Company's and the Company's third party Inspection representatives.

Within Seven (7) days of successful completion of the hydrostatic test, the Contractor shall submit copies of its test report to the Company, with the number of copies specified in the Contract. The bound report shall contain, as a minimum, the following:

- Backflow prevention devices, if used
- Weather conditions and ambient temperature at the site during the test
- Test pressure
- Type of test gauges in the test section
- Placement of test gauges in the test section, test gauge location distances and elevations from the beginning of the section
- Test gauge calibration records
- Test pressures recorded during the test

- Pressure recording charts with appropriate information clearly noted and annotated. Charts shall be noted with date, line segment and signed by test engineer.
- Any adjustments made to test pressure for elevated temperatures
- Test duration
- Description of the test section length, elevations, and site location
- Description of the test section components
- Description of any leaks or failures and the corrective actions taken
- Date and time of day of the test
- Identification of the party conducting the test
- Permits acquired by the Contractor
- Depressurization Logs
- Records of chemical analysis and corrosion monitoring and inspection tests performed prior to and during hydrostatic-test and wet lay-up period
- The testing procedure actually used on site, marked up with any modifications differing from that previously approved prior to the tests
- All calculations

Schematic 1 - detail of typical equipment placement for a pressure test.



SCHEMATIC 1