TECHNICAL BULLETIN B2.51.1

Guidelines For Post Installation Testing Of BOSS HDPE Pipe

Flexible Pipe

Through deflection, BOSS High Density Polyethylene (HDPE) flexible pipe reacts to vertical soil loads when buried in a trench. As such, deflection demonstrates that the pipe works with the surrounding soil (backfill) so it can easily withstand common and even extreme soil loads. While testing for deflection is important, it is also essential to proceed with post installation testing to validate the water tightness of the sewer pipe system.

Therefore, post installation testing of flexible pipes may include deflection testing and leak testing. It is recommended that deflection testing occurs after the final backfill and compaction has been in place at least 30 days and prior to putting the pipe in operation. Final deflection testing should be performed in the 12th month of operation and prior to expiration of the Contractor's warranty and performance bond (Ref. 1, 2).

A recommended sequence for testing of sewer systems follows (Ref. 2):

1. Cleaning and flushing with high-pressure water blasting
2. Deflection testing
3. Watertightness (leakage) testing
4. Laser profiling and Closed Circuit Television (CCTV) testing

DEFLECTION TESTING

Deflection testing determines whether the internal diameter of the barrel has been reduced more than the acceptable limit. Proper backfill and compaction of the backfill envelope are vital to control pipe deflection. CSA B182.11 establishes the allowable deflection limit for thermoplastic pipes at 7.5% of the pipe's internal diameter. There are several acceptable methods for measuring BOSS HDPE pipe deflection.

Visual Inspection / Direct Measurement

Visual inspection is practical for diameters larger than 600mm (24in). A visual inspection can be performed by examining the pipe surface for shape issues such as cracking and localized flattening. Direct measurement of vertical deflection can be made using a measuring tape or any other acceptable method. Often a vertical measurement is recorded every 3.0 m (10.0 ft) or at a pipe joint and in the middle of the pipe length. A minimum of four measurements per pip installation is required (Ref. 3).

The base diameter used in the assessment of deflection must take into account allowable out-of-roundness manufacturing tolerances. Base diameter is shown in **Table 1** and is calculated using Equation 1:

Equation 1

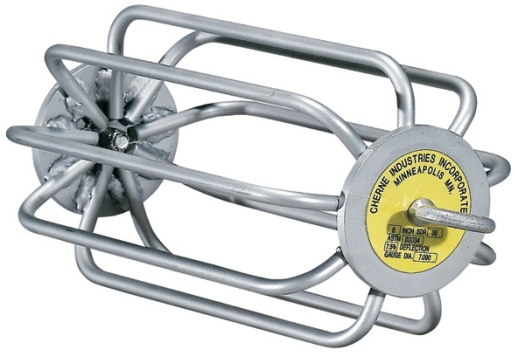
$$D_B = D_i - \sqrt{A^2 + B^2}$$

Where: D_B = base inside diameter
D_i = nominal inside diameter (ID)
A = ID manufacturing tolerance (4.5% oversize or 1.5% undersize as per AASHTO)
B = shipping ovality = $0.03D_i$

For pipe diameters less than 600 mm (24 in) lamping can be used to perform a visual test for deflection. A high intensity light source is directed into one end of the pipe and the inspector observes the shape from the other end of the pipe segment. The reflective nature of HDPE pipe intensifies deflection of the pipe or other faults such as joint misalignment or obstructions. If evidence suggests deflection values exceed allowable tolerances a more detailed inspection can be performed using laser profiling and CCTV testing.

Pipe deflection can also be measured using a mandrel **(Figure 1)**. A mandrel is a simple go / no-go device that is driven through the interior of the pipe to determine whether the pipe meets the minimum size requirements and contains no major obstructions to flow. They are pre-set with the minimum allowable inside diameter based on either a 5% or 7.5% deflection limit.

FIGURE 1: Typical mandrel (ref. Cherne Industries, Incorporated)



The maximum mandrel diameter used for testing is calculated using equation 2:

Equation 2

$$D_M = D_B - \frac{D_{B\times}y}{100}$$

Where: D_M = mandrel setting
y = allowable deflection, percent

Table 1 summarizes the mandrel settings for BOSS HDPE pipe. If the mandrel passes through the pipe, deflection is considered acceptable.

TABLE 1: Recommended mandrel settings for BOSS pipe

Size	Pipe ID	Pipe Base ID	Pipe ID (5% deflection)	Pipe ID (7.5% deflection)
(mm)	(mm)	(mm)	(mm)	(mm)
100	103	99.6	94.6	92.1
150	154	149.1	141.6	137.9
200	203	196.4	186.6	181.6
250	254	245.8	233.5	227.4
300	305	295.1	280.3	272.9
375	382	368.8	350.4	341.2
450	455	430.8	409.2	398.4
525	530	501.4	476.3	463.8
600	609	576.3	547.5	533.1
750	759	718.0	682.1	664.1
900	913	863.2	820.0	798.4

A mandrel is a ‘stop-start’ device that will either pass through the pipe or will not. It is unable to measure the magnitude of the deflection or recognize the difference between pipe deflection and simple obstructions such as a protruding fitting or joint misalignment. Mandrels are also cumbersome to handle and must be dismantled and reassembled when entering via manhole structures. Because of this limited functionality, mandrels should be considered as a last resort for deflection testing. If a mandrel is selected, a 5-fin design is recommended in order to minimize the potential for false readings.

Laser Profiling

Used in conjunction with Closed Circuit Television (CCTV) equipment, laser profiling is an acceptable tool for pipe inspection. CCTV inspection alone can identify cracks or faulty joints within the pipe however combined with laser profilers the two provide valuable information for identifying pipe distortion including vertical and horizontal deflections. The use of laser profilers in post-installation testing is growing amongst municipalities. The measurements taken provide an indication of whether the pipe system meets ovality specifications and if cracks or joint defects are present. Laser profiling equipment is available from a variety of manufacturers. For best results, the pipe should be free of obstructions, water and debris prior to inspection. Only qualified and trained personnel should be used to evaluate CCTV images.

LEAK TESTING

Leak testing is performed to determine joint integrity and ensure there will be no infiltration or exfiltration in a water-tight pipe system. Points for leakage measurement and the method of testing shall be specified by the engineer. Tests are performed using either air or water to create a constant pressure within the system.

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Air Exfiltration Testing

Pressure testing of non-pressure systems using air should be conducted in accordance with ASTM F1417 *Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air*. Either mechanical or pneumatic plugs may be used to isolate sections of the pipe to be tested. Air is introduced into the system until a stable pressure of 4.0 psi (or 35 kPa as per CSA 182.11-15) is reached. The pressure is then decreased to 3.5 psi and monitored to ensure no more than a 0.5 – 1.0 psi (or 3.5 kPa as per CSA 182.11-15) pressure drop is measured (depending on pipe diameter and length).

Water Infiltration/Exfiltration Testing

Pressure testing using water is performed in accordance with ASTM F2487 *Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines*. If the groundwater level along the length of the pipe section to be tested is above the top of the pipe throughout its length, an infiltration test is used to measure leakage. Exfiltration testing is an accepted method of testing in dry areas only. During exfiltration testing the maximum internal pipe pressure at the lowest end shall not exceed 7.6m of water head or 75 kPa and the internal water head shall be 0.6m higher than the top of the pipe (CSA 182.11-15).

Allowable Leakage Rate

The leakage criteria for the infiltration and exfiltration testing shall be determined by the design engineer based on the application and design requirements of the system. The maximum leakage allowed for storm sewers is 200 gallons / (in. pipe ID)(miles of pipeline)(24 hours) which is equivalent to 18.52 liters / (mm pipe ID)(km of pipeline)(24 hours)) and 4.6 liters/(mm pipe ID)(km of pipeline)(24 hours) for sanitary sewers (CSA 182.11-15).

Manholes should not be included in testing of the pipelines. They should be tested separately according to project specifications. If the water level is measured in the manhole for the exfiltration test, leakage rates from the manhole should be subtracted from the overall leakage of the test section to establish a pass or fail grade for the pipe.

References

1. ASTM Standard D2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications
2. Sanitary Sewer System Inspection Testing and Acceptance Guideline. York Region, October 2011
3. CSA Standard B182.11 Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings
4. ASTM F1417 Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air, ASTM 2015
5. ASTM F2487 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene Pipelines, ASTM 2013