

Sample Specification for Evaluation of Newly Installed Culvert and Storm Drainage Pipe



American **Concrete Pipe** Association
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1.0 Rigid Pipe

This Sample Specification for the evaluation of newly installed Culvert and Storm Drainage Pipe has been written in order to provide an example specification for owners to insure national standards are followed and proper evaluation of all types of installed pipe can be accomplished. The most common issues of concern are cracks, misalignment, joint openings, buckling, and deflection for newly installed pipe of various materials.

1.1 Concrete Pipe and Culverts

1.1.1 Misalignment: Vertical and horizontal alignment of the pipe shall be checked for horizontal misalignment, faulting (differential alignment between joints of the pipe, creating a non-uniform profile of the pipe), sagging (ponding of water in invert due to vertical misalignment), and invert heaving. During Manual Inspections alignment shall be checked by sighting along the crown, invert and sides of the pipe and the inspector shall note any deviation in horizontal alignment or sagging as they progress through the pipe. When lines are inspected using the Remote Inspection Method, the inspection shall note any horizontal deviation in line as well as any faulting, sagging or invert heaving. The technician performing the inspection should take into account pipe or culvert laid with a designed camber or grade change in accordance with project or site requirements. Horizontal alignment shall be checked for straightness and smooth curvature.

1.1.1.1 Misalignment Evaluation Criteria: Any issues with vertical and/or horizontal misalignment shall be noted in the inspection report. If any issues are noted, a further evaluation shall be conducted by the Engineer to determine the impact of the misalignment on the joints and wall of the pipe to ascertain if corrective actions are needed.

1.1.2 Joints: Leaking joints may be detected during low flows by visual observation of the joints or checking around the ends of pipes or culverts for evidence of piping or seepage. Excessive differential movement, cracks greater than 0.10", spalling of areas that expose reinforcement or expose the joint sealing material, improper gasket placement, and leakage shall be noted in the Post Installation Report.

1.1.2.1 Silt Tight Joints Evaluation Criteria: Joint separation greater than the pipe manufactures recommended allowable joint gap shall be remediated. If joint separation is less than the pipe manufactures allowable joint gap and there is no evidence of soil migration through the joint, no corrective action necessary. If soil migration is apparent, the joint shall be sealed. Vertical or horizontal variations at the joint of a concrete pipe do not require remediation unless they exceed allowable manufac-

turing tolerances for the pipe and significantly reduce the flow characteristics of pipe system. Chipped or spalls at the face of the joint shall not require remediation unless reinforcement is exposed and the chipped area is large enough to allow backfill material to migrate through the joint.

1.1.2.2 Leak Resistant Joints Evaluation Criteria:

Joint separation greater than pipe manufactures recommended allowable joint gap shall require remediation. Pipe lines shall be tested to determine leakage rate. Pipe lines with Infiltration/Exfiltration exceeding 200 Gal/inch of pipe diameter/Mile/Day shall require evaluation as to which joints or areas of leakage shall require remediation. Any joint with continuous flow observed, or with evidence of soil migration through the joint, shall require remediation. Retesting and subsequent remediation shall be required as necessary to satisfy the leakage rate requirement. Vertical or horizontal variations at the joint of a concrete pipe do not require remediation unless they exceed allowable manufacturing tolerances and significantly decreases flow characteristics of the pipe system. Chips or spalls at the face of the joint shall not require remediation unless reinforcement is exposed or the chipped area is large enough to allow a continuous flow of water to migrate through the joint.

1.1.3 Cracks:

1.1.3.1 Longitudinal cracks: Longitudinal cracks with a width less than five-hundredths of an inch (0.05") are considered minor and are not a cause for remediation. Cracks of 0.05" or less do not penetrate through the pipe wall and are the smallest crack that can be measured with reasonable accuracy. Longitudinal cracks having a width equal to or greater than five-hundredths of an inch (0.05") but equal to or less than one tenth of an inch (0.1) shall be evaluated by the Engineer to determine if any remediation is required.

1.1.3.1.1 Longitudinal Cracks Evaluation Criteria:

Pipe with cracks less than 0.05" shall be noted in the inspection report; however, no remedial action is required. Pipe with cracks greater than 0.05" and less than or equal to 0.1" and in areas where soil and or runoff Ph is 5.5 or greater shall not require remediation. Pipe with cracks greater than 0.05" and less than or equal to 0.1" and in areas where soil and or runoff Ph is less than 5.5 shall require remediation. Remediate or replace pipe having longitudinal crack widths larger than 0.10". Prior to remediation or replacement of pipe with cracks exceeding 0.10", an engineering review shall be conducted to verify the class of pipe installed was adequate for the actual parameters of the project, such as, burial depth, additional loading requirements, and installation type.

1.1.3.2 Transverse Cracks (circumferential) Evaluation Criteria: Transverse cracks with no sign of backfill infiltration do not need remediation. If migration of backfill material is evident the transverse crack shall require remediation.

1.1.3.3 Reduced Payment Option: In lieu of the options noted above for remediation of longitudinal cracks in concrete pipe installations, the Contractor may elect to follow the payment schedule below if agreed to by the Engineer.

Remediation efforts and payment shall apply to the entire section(s) of the pipe experiencing the crack, joint to joint. Payment shall mean to include the complete installed unit bid price including the cost of the pipe, bedding material, backfill material, overfill, and other incidental costs included in the contractor's original bid amount.

Longitudinal Crack Width	Percent of Payment
< 0.05"	100% of Unit Bid Price
< 0.10" > 0.05" pH > 5.5	100% of Unit Bid
< 0.10" > 0.05" pH < 5.5	75% of Unit Bid + crack sealed
> 0.10"	Remove and Replace

1.1.4 Spalls: Spalling is defined as a localized delamination of concrete along the wall of the pipe or at the edges of longitudinal or circumferential cracks. Spalling may be detected by visual examination of the concrete along the edges of the crack. This section does not address spalled or chipped areas near the pipe joint: see section 1.1.2.

1.1.4.1 Spalling Evaluation Criteria: The person conducting the inspection shall visually check for delamination in areas where spalling is noted. If delamination is evident the pipe shall be remediated.

1.1.5 Slabbing: Slabbing is the result of radial or diagonal tension forces in the pipe. Slabbing is characterized by large slabs of concrete delaminating from the wall of the pipe and a straightening of the steel.

1.1.5.1 Slabbing Evaluation Criteria: Any pipe experiencing slabbing shall be evaluated by an engineer. If it is determined that the pipe can be stabilized, the pipe may be remediated. Where slabbing is of such magnitude that, the system cannot be stabilized or the service life of the pipe is severely compromised, the pipe exhibiting such deficiency shall be replaced. Prior to remediation or replacement of pipe exhibiting slabbing, an engineering review shall be conducted to verify the class of pipe installed was adequate for the actual parameters of the project, such as, burial depth, additional loading requirements, and installation type.

2.0 Flexible Pipe

2.1 HDPE, PVC, CMP Pipe and Culverts

2.1.1 Misalignment: Vertical and horizontal alignment of the pipe shall be checked for horizontal misalignment, sagging (ponding of water in invert due to vertical misalignment), faulting (differential alignment between joints of the pipe, creating a non-uniform profile of the pipe and invert heaving). During Manual Inspections alignment shall be checked by sighting along the crown, invert and sides of the pipe and the inspector shall note any deviation in horizontal alignment or sagging as they progress through the pipe. When lines are inspected using the Remote Inspection Method, the inspection shall note any horizontal deviation in line as well as any faulting, sagging and invert heaving. The technician performing the inspection should take into account pipes laid with a designed camber or grade change. Horizontal alignment shall be checked for straightness and smooth curvature.

2.1.1.2 Misalignment Evaluation Criteria: Any issues with horizontal and/or vertical alignment shall be noted in the Post Installation Inspection Report. If any vertical and/or horizontal misalignment problems are noted, a further evaluation shall be performed by the Engineer to determine the impact of the misalignment on the joints and wall of the pipe to ascertain what corrective actions are needed.

2.1.2 Cracks: Cracks or splits in the interior wall of the pipe are not acceptable.

2.1.2.1 Crack Evaluation Criteria: All cracks, tears or splits shall be remediated.

2.1.3 Coating (CMP): Areas of the pipe where the original coating has been scratched, scoured, peeled, or in some way damaged during the production or installation process shall be noted in the inspection report.

2.1.3.1 Coating Evaluation Criteria: All damage to coating shall require remediation. Remediation shall satisfy the requirements for coating repair as detailed in the appropriate manufacturing specification for corrugated metal pipe and be acceptable to the Engineer.

2.1.4 Joints: Differential movement, improper joint sealing, movement or settlement of pipe sections, crushing/buckling, and leakage shall be noted in the inspection report.

2.1.4.1 Silt Tight Joints Evaluation Criteria: Joint separation greater than the pipe manufactures recommended allowable joint gap shall be remediated. If joint separation is less than the pipe manufactures allowable joint gap and there is no evidence of soil migration through the joint, no corrective action necessary. If soil migration is apparent, the joint shall be sealed.

2.1.4.2 Leak Resistant Joints Evaluation Criteria: Joint separation greater than pipe manufactures recommended allowable joint gap shall require remediation. Pipe lines shall be tested to determine leakage rate. Pipe lines with Infiltration/Exfiltration exceeding 200 Gal/inch of pipe diameter/Mile/Day shall require evaluation as to which joints or areas of leakage shall require remediation. Any joint with continuous flow observed, or with evidence of soil migration through the joint, shall require remediation. Retesting and subsequent remediation shall be required as necessary to satisfy the leakage rate requirement.

2.1.5 Buckling, Bulging, and Racking: Flat spots or dents at the crown, sides or flow line of the pipe due to racking, wall buckling, and or inverse curvature shall be noted in the inspection report.

1.5.1 Buckling, Bulging, and Racking Evaluation Criteria: Flat spots, dents or racking that will reduce flow in any way shall be remediated. Flat spots, dents or racking that are determined to be detrimental to the long-term performance of the pipe by the Engineers review shall be replaced. Any pipe exhibiting wall buckling or inverse curvature shall be replaced.

2.1.6 Deflection (x and y plane)/Ovality (out of plane deflection): Laser profiler or mandrel for remote inspections or direct measurement for manual inspections may be used to measure deflection and ovality of thermoplastic pipe. Pipe deflection and ovality shall be calculated and based upon actual field measured diameter if laser profiler or direct manual measurements are utilized. If a mandrel is used the mandrel shall be sized to the required percent deflection based upon the actual certified mean diameter as supplied by the pipe producer. The actual certified mean diameter shall be supplied in writing by the pipe manufacturer to the contractor and the engineer when the product is shipped to job site and recorded in the Post Installation Report. All measurements and subsequent deflections shall be noted in the inspection report.

2.1.6.1 Deflection Evaluation Criteria: Deflections or Ovality of less than 5% of the actual pipe diameter, either measured or certified, shall not require remediation. If the pipe experiences additional deficiencies combined with deflection or ovality greater than 5% but less than 7.5% of the certified mean diameter, the pipe shall be evaluated by an engineer to determine whether it should be remediated or replaced. The evaluating Engineer shall include an analysis of the measured deflection/buckling compared to anticipated deformation/buckling and wall stress per the Engineer of record's design.

Pipe that is deflected or exhibits ovality exceeding 7.5% of the original diameter shall be replaced. Any area of pipe that cannot be physically checked by a 7.5% mandrel due to over-deflection in other areas of the pipe that inhibits progression of the mandrel, or be physically measured shall be assumed to have deflection greater than 7.5% and shall be removed or deflection tested by laser profiling.

Use of mechanical re-rounding technology on installed pipe is not an acceptable remediation technique.

2.1.6.2 Reduced Payment Option: In lieu of the options noted above for remediation of deflection in Thermoplastic pipe installations, the Contractor may elect to follow the payment schedule below if agreed to by the Engineer.

Remediation efforts and percentage of payment shall apply to the entire section of the deflected pipe, joint to joint. Payment shall mean to include the complete installed unit bid price including the cost of the pipe, bedding material, backfill material, overfill, and other incidental costs included in the contractors original bid amount.

Amount of Deflection/Ovality	Percent of Payment
0.0 % TO 5.0%	100% of Unit Bid Price
Greater than 5.0% but < 7.5%	75% of Unit Bid Price
Greater than 7.5%	Remove and Replace at Contractor's Expense

Please note that this is a sample specification and modifications may be needed to adhere to local and project specific specifications.

