

CMP SPECIFICATION GUIDE

PIPE MATERIAL

There are several ASTM specifications (AASHTO equivalents in parenthesis) used to identify the different CMP materials. Each specification makes provisions for the different corrugations and metal thicknesses available for CMP. Using height of cover tables the design engineer can relate the pipe size, corrugation and metal thickness to the varied structural and hydraulic parameters for the application. Each of the pipe specifications also makes use of an analogous classification system as follows:

- Type I** Round Pipe with Exterior and Interior Corrugations
- Type IR** Round Pipe with a Smooth Interior (i.e. Spiral Rib Pipe)
- TYPE II** Type I Pipe Reformed into a Pipe-Arch
- Type IIR** Type IR Pipe Reformed into a Pipe-Arch
- Type III** Type I Pipe with Class 1 or Class 2 Perforations

Once the pipe type, size, corrugation and metal thickness is determined the engineer can cite the desired ASTM standard to completely specify the piping material of choice:

- Specify ASTM A760 (AASHTO M36) for a galvanized or aluminized coated steel pipe*
- Specify ASTM A849 (AASHTO M190) for asphalt-coated galvanized ASTM A760 pipe*
- Specify ASTM A762 (AASHTO M245) for a polymer-coated galvanized steel pipe*
- Specify ASTM B745 (AASHTO M196) for corrugated aluminum alloy pipe*

Please refer to the *CMP Service Life Guide* for information and methods qualifying the selection of the appropriate corrugated steel pipe product.

PERFORATED PIPE

ASTM A760, A762 and B745 use a parallel classification system for perforated pipe depending on whether fully or partially (standard) perforated pipe is desired. Inherent in the classification systems are the size, spacing and placement of the perforations. Class 2 perforations provide a minimum open area of 3.3 in²/ft² of pipe surface.

- Specify Class 1 perforations for partially perforated pipe to be used for subsurface drainage*
- Specify Class 2 perforations for fully perforated pipe to be used for subsurface disposal*

JOINT PERFORMANCE

Each of the above-mentioned pipe standards also provides corresponding joint performance criteria based upon the ability of the joining system to control leakage and/or material infiltration.

- Soil Tight¹ - resists infiltration of soil particles larger than those passing a No. 200 Sieve*
- Silt Tight - resists infiltration of soil particles equivalent to an apparent opening size (AOS) of 70*
- Leak Resistant - leakage limited to 200 gal/in-dia/mile/day at a defined pressure head from 0-25ft*
- Special Design - zero leakage for 10 min at a defined pressure head from 10-25ft in a laboratory setting*

¹Soil tight joints are the default criteria for joint performance and will be used unless otherwise specified.

PIPE JOINING SYSTEMS

Typical joining systems included in the pipe standards involve wrap-around type metal bands with appropriate connecting hardware. Depending on the pipe size the connecting bands may be a one or two-piece assembly. Since pipe corrugations are typically helical the pipe standards allow the pipe ends to be reformed into annular corrugations to better engage certain coupling bands. The annular corrugated ends are reformed with a 2 $\frac{3}{8}$ "x $\frac{1}{2}$ " corrugation. Some of the more common connecting bands include the following:

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Corrugated Bands - annular corrugated bands for pipe with annular corrugated ends
Partially Corrugated Bands - flat bands with one annular corrugation along each edge
Dimple Bands - bands with dimple projections in annular rows
Flat Bands - bands with no corrugations or projections

Specify plain metal connecting bands (i.e. no fabric or gasket) for soil tight performance
Specify metal connecting bands with a fabric wrap for silt tight performance
Specify metal bands with an ASTM D1056 gasket for leak resistant and special design joints

CMP INSTALLATION

Corrugated metal pipe (CMP) is a flexible pipe material that derives structural rigidity from the strength and relative stiffness of the backfill envelope. The backfill-culvert interaction attained defines the ability of CMP to withstand service loads. Installation specifications illustrating backfill envelopes, addressing appropriate backfill material selection, and identifying proper compaction guidelines help ensure acceptable levels of backfill-culvert interaction are realized:

ASTM A798 Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers
ASTM B788 Practice for Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe
AASHTO LRFD Bridge Construction Specifications, Section 26, Metal Culverts
AREMA Manual for Railway Engineering, Section 4.12, Assembly and Installation of Pipe Culverts

CMP STRUCTURAL DESIGN

Standard methods of structural analysis are generally based on research adopted by AASHTO. Standards with slight variations have also been adopted by ASTM. The railway industry, represented by AREMA, maintains distinct material and design standards to ensure railway live loading (E80) and its effects are appropriately managed. The following standards are listed with the qualifying remark that the AASHTO method is, for all intents and purposes, used exclusively outside railway applications.

ASTM A796 Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
ASTM B790 Practice for Structural Design of Corrugated Aluminum Pipe, Pipe-Arches, and Arches for Culverts, Storm Sewers, and Other Buried Conduits
ASTM A998 Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
AREMA Manual for Railway Engineering, Section 4.9, Design Criteria for Corrugated Metal Pipes
AASHTO LRFD Bridge Design Specifications, Section 3, Loads and Load Factors
AASHTO LRFD Bridge Design Specifications, Section 12, Buried Structures and Tunnel Liners

CMP SPECIFICATION EXAMPLE

Pipe shall be a 16 Gage 48-in Diameter Aluminized-Coated Corrugated Steel Pipe with a 2 $\frac{3}{8}$ "x $\frac{1}{2}$ " corrugation in accordance with ASTM A760 for Type I pipe. Pipe joints shall meet the soil tight performance criteria of ASTM A760 and installation shall conform to Section 26 of the AASHTO LRFD Bridge Construction Specifications.

SUPPLEMENTAL PUBLICATIONS

NCSPA Corrugated Steel Pipe Design Manual
NCSPA Service Life Selection Guide (www.ncspa.org)
AREMA Manual for Railway Engineering, Section 4, Culverts