



Advances in Corrugated Steel Pipe

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St. Regis Culvert, Inc.

CSP Specifications

- AASHTO M-36
- ASTM A760
- MDOT Division 4
- MDOT Division 9
- FHWA
- American Iron and Steel Institute



PRD D4 Mill



Diameters and Profiles

6"- 144" Round and 15"- 120" Arched Equivalents

Standard Corrugations

6"-10"	1-1/4" x 1/2" corrugations
12"-84"	2-2/3" x 1/2" corrugations
54"- 144"	3" x 1" corrugations

Smooth Pipe

Max Flow/Spiral Rib	18" – 102"
Dura Flow/Dual Wall	36" – 144"

Standard Profiles

2-2/3" X 1/2"



3" X 1"



Smooth Interior CSP



MAX FLOW POLYMER CTD.



DURA FLOW POLYMER CTD.



Arched Corrugated Steel Pipe

Steel is not strain sensitive
Deflection is not an issue



Durability Guide



NATIONAL CORRUGATED STEEL PIPE ASSOCIATION

CSP Durability Guide

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■ This Guide provides environmental ranges for CSP products. Service Life of CSP will vary within these ranges. For estimating average invert service life, refer to the Service Life Prediction section in this Guide or the Durability chapters of the AISI publication *Handbook of Steel Drainage & Highway Construction Products* or the *Modern Sewer Design*. ■ This Guide is not a substitute for professional engineering advice and is made without guarantee or representation as to results. Although every reasonable effort has been made to assure its accuracy, neither the National Corrugated Steel Pipe Association nor any of its members or representatives warrants or assumes liability or responsibility for its use or suitability for any given application.

Product Usage Guidelines for Corrugated Steel Pipe

COATING	WATERSIDE						
	Normal Conditions	Mildly Corrosive	Corrosive	Non-Abrasive Low Abrasion (Lvl. 1 & 2)	Moderate Abrasion (Level 3)	High Abrasion (Level 4)	Provides Additional Soil Side Protection
Zinc Coated (Galvanized)	★	★	○	○	○	○	○
Aluminum Coated Type 2	○	○	○	○	○	○	○
Asphalt Coated	○	○	○	○	○	○	○
Asphalt Coated and Paved	○	○	○	○	○	○	○
Polymerized Asphalt Invert Coated*	○	○	○	○	○	○	○
Polymer Precoated	○	○	○	○	○	○	○
Polymer Precoated and Paved	○	○	○	○	○	○	○
Polymer Precoated w/ Polymerized Asphalt	○	○	○	○	○	○	○
Aramid Fiber Bonded Asphalt Coated	○	○	○	○	○	○	○
Aramid Fiber Bonded and Asphalt Paved	○	○	○	○	○	○	○
High Strength Concrete Lined	○	○	○	○	○	○	○
Concrete Paved Invert (75mm (3") Cover)	○	○	○	○	○	○	○

* Use Asphalt Coated Environmental Ranges for Fully Coated Product

Note: Coatings listed under additional soil side protection are generally considered to provide 100 years service life from a soil side perspective within appropriate environmental conditions.¹

ENVIRONMENTAL RANGES:

- **Normal Conditions:** pH = 5.8 – 8.0 (for R > 2000 ohm-cm)
- **Mildly Corrosive:** pH = 5.0 – 5.8 and/or for R = 1500 to 2000 ohm-cm
- **Corrosive:** pH < 5.0 (for R < 1500 ohm-cm)

ABRASION

Invert Protection/Protective Coatings can be applied in accordance with the following abrasion criteria. Abrasion velocities should be evaluated on the basis of frequency and duration. Consideration should be given to a frequent storm such as a two year event (Q_2) or mean annual discharge ($Q_{2.33}$) or less when velocity determination is necessary.

ABRASION LEVELS

The following qualitative definitions are provided as guidance to evaluate abrasion conditions when necessary.

Non-Abrasive (Level 1): No bedload regardless of velocity; or storm sewer applications.

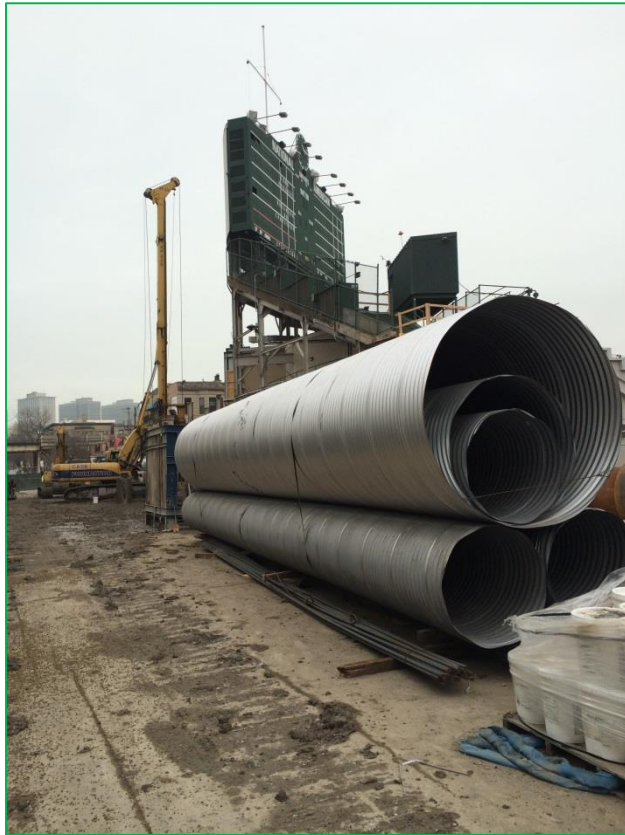
Low Abrasion (Level 2): Minor bedloads of sand and gravel and velocities of 5 ft./sec. or less.

Moderate Abrasion (Level 3): Bedloads of sand and small stone or gravel with velocities between 5 and 15 ft./sec.

Severe Abrasion (Level 4): Heavy bedloads of gravel and rock with velocities exceeding approximately 15 ft./sec.

Metallic Coatings

GALVANIZED M-218



ALUMINIZED M-274



Non-Metallic Coatings

ASPHALT COATED M-190



POLYMER COATED M-245



Polymer Film



- Alkaline bath.



- "Scotch Bright" system.



- Chemically treated.



- Pre-heating of steel strip to 400°F.



- Film lamination to steel strip.



- Cold water quenching.

Hydraulics



FHWA and Utah State Real Manning "n" values

- 2-2/3" x 1/2" 0.011-0.023
- "3 x 1" 0.022-0.027
- Max Flow 0.012-0.013
- Dura Flow 0.012-0.015
- MDOT a. *Permitted for 12"-18" in diameter 2-2/3" x 1/2" helically corrugated pipe only.*



CSP End Treatments

RE-CORRUGATED ENDS



SPIRAL ENDS



CSP End Treatments

- Spiral Ends
- Re-corrugated/Re-rolled Ends
- Circumferential Corrugations



Bands, Couplers and Connections for Corrugated Steel Pipe

- The performance and material requirements for CSP coupling systems are scattered among several ASTM and AASHTO specifications. The two most commonly used specifications for defining CSP coupling systems are Section 26 of the AASHTO LRFD Bridge Construction Specifications and ASTM A760, Standard Specification for Corrugated Steel Pipe, Metallic Coated for Sewers and Drains. The joint properties are divided into six categories given in AASHTO Table 26.4.



Hand Crafted Couplers

Each band is hand crafted using a minimum of 18ga material, with 12ga band angles and two 5/8" fully threaded carriage bolts. St Regis Culvert bands that are 60" and larger are installed onto pipe at the factory to ensure proper fit.



Coupling Systems for Re-corr Ends

ANNULAR BAND



HUGGER TYPE BAND



Coupling Systems



SRC SPIRAL BANDS



SRC SPIRAL BANDS



Universal Band



Universal band

JOIN TWO SECTIONS OF PIPE



INSTALL 8" BOLTS AND SECURE



Universal band



CSP Coupler Benefits



- Maintains pipe alignment during installation.
- 11" to 27" wide
- Shear strength
- Tensile/Pull Apart strength
- Soil tight
- Water tight
- Special couplers can be tailored to a variety of installation circumstances.

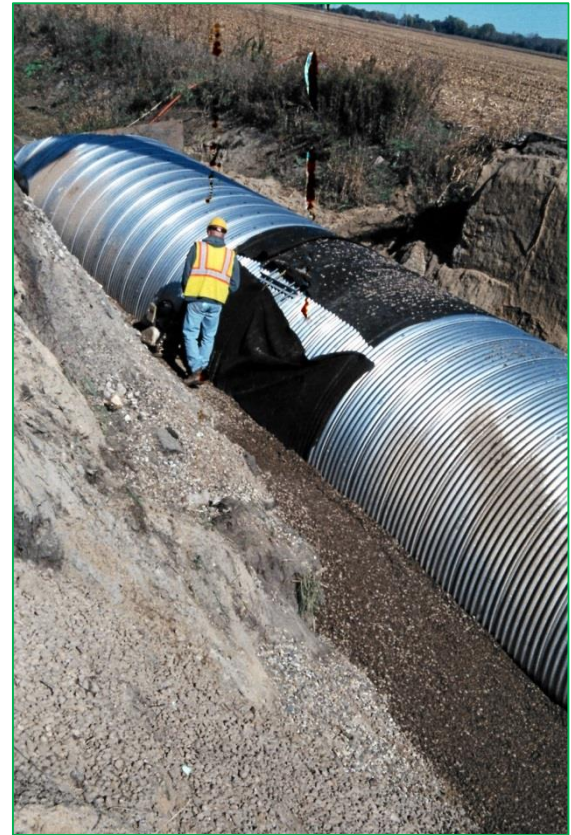


Installation

**STANDARD SPECIFICATIONS FOR HIGHWAY
BRIDGES-DIVISION II, SECTION 26
LRFD BRIDGE CONSTRUCTION SPECIFICATIONS**



**STANDARD PRACTICE FOR INSTALLING
FACTORY MADE CORRUGATED STEEL PIPE FOR
SEWERS AND OTHER APPLICATIONS – ASTM
A798**



Trench Installation



Installation

Key to all pipe performance is good installation and backfill

- Quality Granular Structural Backfill.
- Placement in 8" – 10" lifts, bring fill up in a balanced manner.
- Compaction: 95% Proctor Density
- Protect ends from erosion
- Maintain adequate minimum cover for heavy construction and highway loads.

Height of Cover



AASHTO LRFD

"S"/8, no less than 12"

Min. cover 12"-36"

Max Cover 248'-35'

Construction Loads

2'-4'

Live Loads

H20

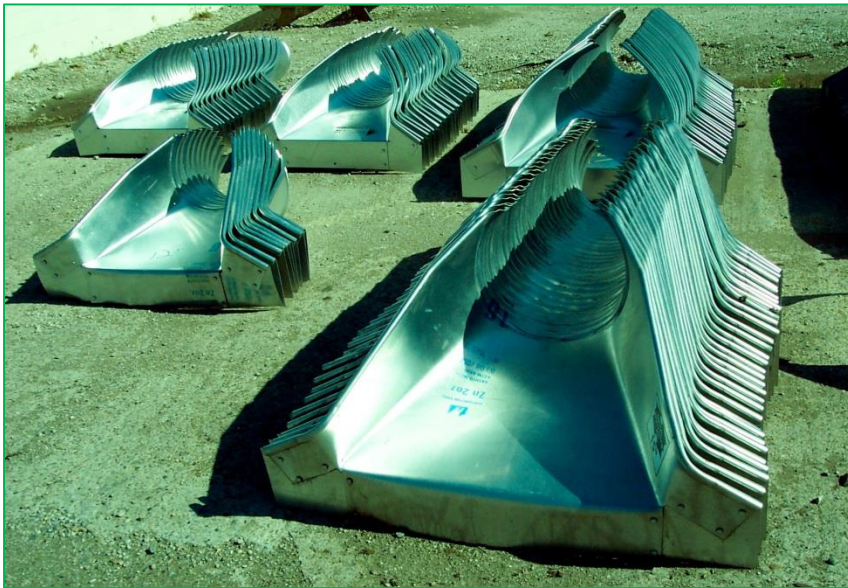
H25

E80



End Treatments

METAL END SECTIONS



SAFETY SLOPE 4:1 OR 6:1



Fabricated hinged Grates



End Treatments

BEVELED END



BEV. END & STONE RIP-RAP



End Treatments

POURED IN PLACE



LOCAL MATERIALS



End Treatments



ENDLESS OPTIONS



CULVERT TERRACE



Replace or Repair

Good Question....some concerns to think through



Replace

with Polymer Coated Steel Pipe



Repair

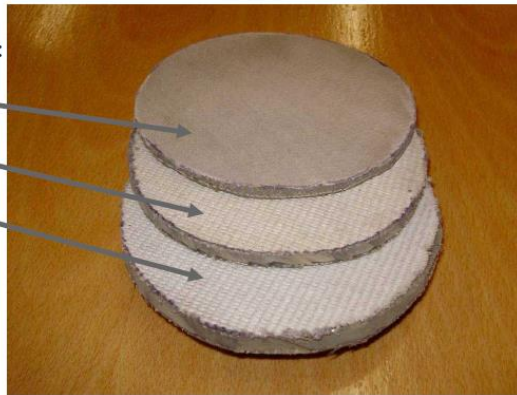
Geosynthetic Cementitious Composite Mat (GCCM)

3 thicknesses available are:

CC5 (5mm)

CC8 (8mm)

CC13 (13mm)



CC	Thickness in(mm)	Roll Width ft(m)	Weight Unset lb/sf(kg/sm)	Batch Roll Length ft(m)	Batch Roll Area sf(sqm)	Batch Roll Weight Unset lbs(kg)	Bulk Roll Length ft(m)	Bulk Roll Size sf(sqm)	Bulk Roll Weight Unset lbs(kg)
CC5	0.2 (5)	3.5 (1.1)	1.4 (7)	30 (9.1)	105 (10)	147 (68)	615 (187)	2152 (200)	3013 (1404)
CC8	0.3 (8)	3.6 (1.1)	2.5 (12)	15 (4.6)	54 (5)	135 (60)	373 (114)	1346 (125)	3358 (1499)
CC13	0.5 (13)	3.6 (1.1)	3.9 (19)	n/a	n/a	n/a	239 (73)	862 (80)	3354 (1521)

Repair

PORTABLE ROLL



BULK ROLL



Repair



CLOTH LAID LONGITUDINALLY



SELF-TAPPING SCREWS



Repair

INVERT INTACT



C88 MATT INSTALLED



Re-Line

DEEP FILLS OR TRAFFIC
CONCERNS



MAX FLOW



Re-Line



GROUT NEGATIVE SPACE



STRUCTURALLY SOUND



Re-Line

ARCHED MAX FLOW LINER



STRUCTURALLY SOUND



Re-Line

BOX LINERS



STRUCTURAL PLATE



Corrugated Steel Pipe

Advances in Corrugated Steel Pipe

1. CSP proven history.
2. Strength and durability of steel.
3. CSP provides variety of sizes, profiles, thicknesses and protective coatings to fit your service life and site demands.

Thank you

