SPECIFICATION FOR 2-FLANGE TUNNEL LINER PLATE

1. DESIGN AND MANUFACTURING STANDARDS

1.1 All standards refer to the current ASTM & AASHTO specifications (with interims as applicable) unless otherwise noted.

1.2 Available materials & specifications

- Materials (Plates)- Steel: ASTM A 1011 & A 1018 uncoated, dip-galvanized ASTM A 123 (zinc applied at a rate of 2.0 ounces per square foot total for both sides), Pre-galvanized AASHTO M 218 or Aluminized Steel Type 2 AASHTO M 274. Aluminum per ASTM B 746, Alloy 5052-H141 temper.
- Materials (Bolts and Nuts) - Bolts and nuts shall be 5/8" diameter and length as recommended by the manufacturer. Bolts shall conform to ASTM A 449, Type 1 or ASTM A 307. For longitudinal seams, bolts shall be A 449, Type 1, for plate thickness equal to or greater than 0.209. For plate thickness less than 0.209, the bolts shall be A 307, Grade A. All circumferential bolts may be A 307, Grade A. Nuts shall conform to ASTM A 563, Grade A, Hex. All bolts and nuts are mechanically galvanized in accordance with the requirements of ASTM B 695, Class 50.
- Dip-galvanized plates may also be fully bituminous coated when required by the project specifications. The bituminous material, application method, and thickness meet the requirements of AASHTO M 190 for Corrugated Metal Culvert Pipe (CMP).
- Design - AASHTO LRFD Bridge Design Specifications - Section 12.
- Installation – AASHTO LRFD Bridge Construction Specifications – Section 25

1.3 Manufacturing

- All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete assembly from the inside of the tunnel. The longitudinal seam shall be of the lapped type, with an offset equal to the gage of metal for the full width of plate to allow the cross section of the plate to be continuous through the seam. Circumferential bolt hole spacing shall be 6-1/4".
- Grout holes shall be two inches (2") in diameter and shall be provided as shown on the plans to permit grouting as the assembly of the liner plate proceeds.

2. DEFINITIONS

2.1 Engineer - In these notes the word “engineer” shall mean the engineer of record or owner's designated engineering representative.

2.2 Manufacturer - In these notes the word “manufacturer” shall mean the manufacturer of the 2-flange tunnel liner plates, Contech Engineered Solutions at phone 800-338-1122.

2.3 Contractor - In these notes the word “contractor” shall mean the firm or corporation undertaking the execution of any installation work under the terms of these specifications.

3. 2-FLANGE TUNNEL LINER PLATE (TLP) ASSEMBLY

3.1 Assembly of the structure shall be in accordance with Section 25 (when applicable) of AASHTO LRFD construction specifications and any supplemental recommendations provided by the manufacturer.

3.2 All plates shall be unloaded and handled with reasonable care. Plates shall not be rolled or dragged over gravel rock and shall be prevented from striking rock or other hard objects during installation.
Galvanized coatings that have been compromised shall be restored with a minimum of two coats of cold galvanizing compound (spray or paint) in accordance with ASTM A 761, Section 7 or other measures as described in ASTM A 780.

3.3 For structures set on footings, plate assembly can begin after placement of structure footings has been approved by the engineer. Verification of proper spacing, alignment, and orientation of the foundations is strongly recommended prior to beginning plate assembly. Any modifications to the foundations shall be made prior to beginning plate assembly.

3.4 Any obstructions that may prevent the assembly of the new tunnel liner plate need to be removed by the contractor at the direction of the engineer.

3.5 The span and rise of the structure should be checked frequently during the early stages of assembly to verify that assembly tolerances are being achieved and to allow for adjustments to procedures, if necessary, before assembly is complete.

3.6 Assembly of the first ring may be completed in whole or in part on the ground and erected into place using means and methods determined most suitable by the contractor.

3.7 After the first ring has been assembled, the assembly of subsequent rings will begin at the crown or top of the structure with a no-offset plate and progress down each side with single-offset plates. Round or elliptical shapes will be completed by placing a double-offset plate in the invert or bottom. Arch structures will terminate with single-offset side plates having unpunched ends.

3.8 Longitudinal lap joints of adjacent rings should be staggered a minimum of 4 pi (2 bolt holes) as shown on the layout drawing. Exceptions apply to arch structures that are less than 48 pi. Pay close attention to the plate layout drawings for proper stagger.

3.9 The legs of arch structures may terminate in a slotted keyway (grouted after installation) or base channel which may be anchored into the footings.

3.10 Bolts should be preinstalled by the contractor in the no-offset ends with bolt heads oriented to the outside and held in place with push-on spring clips. No-offset ends are fabricated with square holes. The bolts have square shoulders which seat into the holes and prevent them from turning when the nuts are installed from the inside. Nuts shall be placed with the rounded face in contact with the plates unless noted otherwise.

3.11 The recommended installation bolt torque is 80-100 ft-lbs. Do not over torque the bolts.

3.12 Gaps will be present at the flanged connection between rings. Field caulking of the joints or other strategies to prevent leaking of the grout may be required to provide an adequate seal. This may vary depending on the properties of the grout material selected.

4. GROUTING

4.1 Voids occurring between the liner plate and the existing structure (or ground) shall be grouted until they are completely filled. The contractor shall prepare a grouting plan detailing the proposed grout mix design, number and depth of individual grout lifts, grout port locations, details for blocking and bracing the structure (if required), and all proposed equipment and procedures used to ensure that the annular space will be filled entirely without damaging the structure. The grouting plan will be reviewed and approved by the engineer.

4.2 The grout material shall be as specified by the engineer. Contech recommends low-density cellular grouts provided they can achieve minimum compressive strength properties. A flowable, low-strength, low-shrink grout consisting primarily of Portland cement, fly ash, sand, water, and admixtures to improve flowability and shrinkage properties is also an acceptable option. The grout shall have a minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C 495 or C 109. These are general recommendations. Contech does not review or approve specific grout mix designs.

4.3 Grouting equipment shall be capable of filling the entire annular space along the length of the structure.

4.4 Bulkheads are used to block off the annular space at each end of the structure to retain grout. Air vents may need to be incorporated into the bulkheads to allow air to escape

during grouting operations bulkhead shall be designed to entirely retain the grout material. Bulkhead design should be based on the fluid properties of the grout material utilized.

4.5 The grout shall be mixed and pumped according to the approved grouting plan. The gauged pumping pressure at the exterior of the liner pipe wall shall not exceed 5 psi at the point of injection, or the published limit for the specific product being used, whichever is less. If it becomes necessary to change the rate of pumping, the pressure will be increased at a rate not to exceed 1 psi per minute up to the equipment rate.

4.6 The grout shall be pumped in such a manner that the grout does not dilute or separate. The contractor should "sound" the structure to be able to determine grout placement and ensure all voids are completely filled.

4.7 In round structures, fluid grout will impose buoyant forces on the structure causing it to lift and potentially deform if not controlled. Buoyant forces can be managed by grouting in multiple lifts. Each lift shall reach initial set prior to the placement of subsequent lifts. Contech can provide buoyancy calculations to assist with determining lift heights upon request. Blocking or bracing of the structure may be utilized during grouting in order to prevent movement and deformation of the structure. The bracing design should consider the rate at which the grout is placed, the volume of grout being placed, the resulting lift height(s) of the grout, and the fluid unit weight of the grout. Contech does not design or supply temporary bracing.

4.8 Grout should be placed evenly on both sides of the structure. The grout elevation on opposite sides of the structure should have a maximum offset of 12 to 18 inches. Each grout lift must achieve initial set, in order to lessen the buoyant forces of subsequent lifts. The initial lift height may only be a minimal amount in order to prevent uplift of the new structure. Depending on the specific grout plan (by others), a second, third or fourth short lift may also be necessary.

5. CONSTRUCTION OBSERVATIONS AND TESTING

5.1 Observation and testing shall be performed during construction to verify compliance with these drawings, applicable project documents, and standards referenced in these notes.

5.2 The contractor is responsible for quality control procedures, verification measurements, adequate supervision, progress testing, evaluation of proposed grouting materials, and/or other measures as needed to ensure that the completed project complies with these drawings and notes.

5.3 The project owner (or their designated representative) is responsible for project oversight and final acceptance of the constructed structure. The owner may accept the contractor's quality control program or adopt an independent quality assurance program to verify compliance.

5.4 Observations and testing prior to structure assembly & grouting shall include but not be limited to:

- Verification that the proposed structure fits inside the existing structure, by either a field survey, a full 3-d laser survey or any other method approved by the engineer.
- Verification of proper alignment, grade, dimensions, and placement of foundations (if required).
- Evaluation and approval of the grouting plan.

5.5 Observations and testing during assembly & grouting shall include but not be limited to:

- Structure alignment.
- Plate tightness observations.
- Bolt torque measurements.
- Initial structure shape measurements (prior to starting grouting).
- Confirm that the structure has not uplifted (floated).
- Periodic structure shape measurements (during grouting).
- Grouting material sampling and testing.
- Observations of proper pumping pressure, proper grout placement and sounding procedures.