

**Item No. 559S
Concrete Box Culverts**

559S.1 Description

This item governs the materials used and the constructing, furnishing and placing of concrete box culverts (boxes) on a prepared grade at the location shown on the Drawings and in accordance with Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts". Unless indicated otherwise on the Drawings, the Contractor shall have the option of furnishing cast-in-place, precast (formed) or precast (machine made) concrete box culverts.

When cast-in-place box culverts are used, they shall conform to the details indicated on the Drawings and Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts" along with the requirements for Standard Specification Item No. 403S, "Concrete for Structures" and Standard Specification Item No. 410, "Concrete Structures".

The manufacturing of precast box culverts shall conform to the requirements of the current version of ASTM C1577. When precast box culverts are used under traffic, the design loads shall consist of the impact load, dead load and live load [AASHTO LRFD Bridge Construction Design Specifications – greater of: Truck Axle load (32Kf {identical to HS-20load axial load of 32Kf}) or Tandem Axle load (2 at 25Kf each)].

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

559S.2 Submittals

The submittal requirements of this specification item include:

- A. The foundation plan and drilling/excavation details;
- B. Class C and S Portland cement concrete mix design for cast-in-place boxes;
- C. Anchor bolt plan and details;
- D. Reinforcing Steel details and placement drawings;
- E. Casing plan and details (if required);
- F. Certification of compliance with HL93 Liveload design standards;
- G. Bedding Material;
- H. Joint design;
- I. List of joint sizes showing the minimum size of sealant material to be used with each size joint, along with complete instructions on recommended installation procedures;
- J. Test results of the hydrostatic performance testing of the joints, if requested by the City;
- K. Box Culvert manufacturer's recommended final joint opening (gap) dimension on the inside of the installed box;
- L. Certification from the QCast Program, which provides a third party certification auditing firm to certify that the manufacturing plant is producing boxes based on the requirements of the National Precast Concrete Association;
- M. Inspection procedures to be used by the manufacturer for quality control and assurance for materials; and
- N. 5000 psi (34.475 mPa) Concrete mix design for machine made boxes.

559S.3 Quality Control

Manufacturers of concrete boxes shall have a quality management system certified by the QCast Program following the requirements of the American Concrete Pipe Association (ACPA) Plant Certification Manual. Manufacturers of concrete boxes, inlets and storm water manholes shall have a quality control program consisting of one or more of the following: 1) a quality management system certified by the QCast Program following the requirements of the ACPA Plant Certification Manual, 2) a quality management system certified by the National Precast Concrete Association. 3) a quality control program approved by the OWNER prior to submittal of bids for the PROJECT, or 4) an independent, third party quality control testing and inspection firm for testing and inspecting box culverts produced for the PROJECT and approved by the OWNER prior to submittal of bids for the PROJECT.

All such quality control programs shall be paid for by the manufacturer. It is the intent of this requirement that the manufacturer will document all appropriate tests and inspections with sampling and inspection criteria, frequency of testing and inspection, date of testing and inspection and date on which every piece was manufactured. Required testing and inspection, including that by an independent, third party, shall be performed full-time during production of box culverts for the PROJECT. When requested by the OWNER, the manufacturer will provide copies of test data and results and inspection reports with the shipment of box culverts for the PROJECT. Test data and results and inspection reports shall be traceable to specific box culverts lots or pieces. Owner approval of the manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval.

The quality of materials and, the process of manufacturing and furnishing box culverts shall be subject to inspection and approval by the E/A at the box culvert manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete box culverts and storm water manholes

559S.4 Materials

A. Concrete

Class C Concrete shall be used for cast-in-place and precast (formed) box culverts conforming to the requirements of Standard Specification Item No. 403S, "Concrete Structures" and Standard Specification Item No. 410S, "Concrete for Structures", except that Class S Portland cement Concrete will be required for the top slab of direct traffic boxes.

Portland cement concrete for precast (machine made) boxes shall conform to the current version of ASTM C 1577 and shall have a minimum 28-day compressive strength of 5,000 psi (34.475 mPa).

B. Reinforcement

Reinforcing steel for cast-in place and precast (formed) box culverts shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

Reinforcing steel for machine made boxes shall in accordance with ASTM C1577

C. Jointing Material

Unless otherwise shown on the drawings, when installing box culverts, the Contractor shall have the option of making joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for box culvert joints shall comply with ASTM C990, and rubber gaskets for box culvert joints shall comply with ASTM C1677. Mortar shall not be used to seal pre-fabricated joints. Box culvert joint shall be designed to prevent the flow of solids through the joint

D. Membrane Curing

Materials for membrane curing for cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 409S, "Membrane Curing". Materials for membrane curing for machine made boxes shall be in accordance with ASTM C1577.

E. Admixtures

Admixtures for all box culverts shall conform to Standard Specification Item No. 405S, "Concrete Admixtures". Air entraining admixtures shall be added to the mixture to produce concrete with not less than 4, nor more than 7 percent, air content by volume.

F. Granular Backfill

Materials for Granular Backfill shall conform to Standard Specification Item No. 210S, "Flexible Base".

G. Foundation Rock

Bedding material shall be 1-inch (25 mm) to 3-inch (75mm) diameter clean gravel or crushed gravel or crushed rock in conformance with Standard Specification Item No. 510 "Pipe."

H. Geotextile Filter Fabric for Bedding Material

Geotextile filter fabric for bedding material shall be Webtec, Terra Tex NO 4 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

559S.5 Fabrication

The fabrication of machine-made precast boxes shall comply with ASTM C1577.

Forms for precast (machine made) boxes shall be made of steel. Forms for precast (formed) boxes may be either wood or steel. Forms shall be mortar-tight and of sufficient strength to prevent bulging or misalignment of adjacent boxes. They shall be constructed to permit their removal without damage to the concrete. Offsets at form joints shall not exceed 1/8 inch (3.2-mm). Forms shall be clean and free of extraneous matter when Portland cement concrete is placed.

Positive means of supporting steel cages in place throughout forming and Portland cement concrete placement will be required and subject to the approval of the Engineer or designated representative. Welding of reinforcing steel will be permitted only where shown on the Drawings. Welding shall be done by a qualified welder.

Precast (machine made) boxes shall be cast by a process, which will provide for uniform placement of the Portland cement concrete in the forms and compaction by mechanical devices, that will assure dense concrete. Portland cement concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the Portland cement concrete can be assured. Transit-mixed concrete will not be acceptable for use in precast (machine made) boxes.

Curing of precast boxes made in a commercial plant shall be by any one or by a combination of the following methods, which are compatible with the joint materials selected or as directed by the Engineer or designated representative.

A. Steam Curing

Boxes will be placed in a curing chamber, free from outside drafts and cured in a moist atmosphere maintained by the injection of steam for such time and temperature as necessary for proper curing. The curing chamber shall be constructed to allow full circulation of steam around the entire box. Steam outlets shall be positioned so that live steam is not applied directly to the Portland cement concrete.

B. Water Curing

Boxes may be water cured by covering with water saturated cotton mats, polyethylene sheeting or polyethylene burlap blankets, by a system of perforated pipe or mechanical sprinklers, by porous hose or by other methods that will keep the boxes moist during the curing period. Water for curing shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

C. Membrane Curing

Type 1 membrane curing compound may be used for interim curing or for complete curing. All surfaces shall be kept moist prior to the application of the curing compound and shall be damp when the compound is applied.

When used for interim curing, the curing compound shall be applied to the outside surface of the box upon removal of forms. It shall also be applied to the inside surface or a suitable covering may be placed over the box opening to protect the inside of the box against rapid drying.

When used for complete curing, curing compound shall be applied to the inside surface of the box when interim curing is applied or when handling strength has been attained, but not later than 24 hours after casting.

Curing shall not be delayed longer than 1 hour after the Portland cement concrete has been placed in the forms or more than 1/2 hour after removal of forms, unless interim curing is applied.

Precast boxes made in a commercial plant shall be continuously cured for a period of 3 days after reaching handling strength or until the design strength has been attained. Curing may be interrupted for no more than 30 minutes for form removal and no more than 4 hours for removal to a storage area and resumption of curing. All precast boxes shall be protected from freezing during the curing period.

A curing day is a calendar day when the air temperature, taken in the shade away from artificial heat, is above 50°F (10°C) for at least 19 hours or for colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F (10°C) for the entire 24 hours.

Test cylinders shall be cured at the same time and in the same manner as the boxes.

Not more than 4 lifting holes may be provided in each box to facilitate handling. They may be cast-in, cut into the fresh Portland cement concrete after form removal or drilled and shall not be more than 2 inches (50-mm) in diameter or 2 inches (50-mm) square. Cutting or displacement of reinforcement will not be permitted. Spalled areas around the

holes shall be repaired. Concrete boxes shall be given an ordinary finish conforming to Standard Specification Item No. 410S, "Concrete Structures".

Precast boxes of either type, made in a plant, shall bear the following marking:

- The name or trademark of the manufacturer;
- The date of manufacture;
- The box size and height of fill.

When fitting holes are not provided, one end of each box section shall be clearly marked on the inside and outside walls to indicate the top and/or bottom as it will be installed.

Marking shall be indented into the box or may be painted thereon with waterproof paint.

D. Grout and Bentonite Slurry Injection Holes

Box culvert sections installed by trenchless tunneling and jacking method shall have drilled or fabricated grout injection holes and bentonite slurry injection holes as required by Standard Technical Specification Item No. 501S Jacking or Boring Pipe and its special provision. Injection holes shall be 1-1/2 inch (38 mm) minimum diameter with plugs cast into the box culvert at the time of manufacture.

559S.6 Testing

Precast box culverts made in a commercial plant shall be tested and accepted in accordance with ASTM C1577.

Testing of cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

559S.7 Fabricating Tolerances

Tolerances for precast boxes of either type shall conform to the following:

- A. The inside vertical and horizontal dimensions shall not vary from plan requirements more than + 1/2 inch (12.5-mm).
- B. The horizontal or vertical plane at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- C. The sides of a section at each end shall not vary from being perpendicular to the top and bottom by more than 1/2 inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- D. The thickness of walls and slabs shall not be less than that required by the Drawings, except that an occasional deficiency not greater than 1/4 inch (6.3-mm), will be acceptable. If proper jointing is not affected, thicknesses in excess of Drawing requirements are acceptable.
- E. The straightness of the tongue and groove at the mating surface shall not vary by more than 1/4 inch (6.3-mm).

Deviations from the above tolerances will be acceptable if the box sections can be fitted at the plant or job site and it is determined that an acceptable joint can be made. For this condition, an acceptable joint is:

When 2 box sections are fitted together on a flat surface in proper alignment and in the position they will be installed, the longitudinal opening at any point shall not exceed 1 inch (50-mm). Box sections accepted in this manner shall be match-marked for installation.

559S.8 Defects and Repair

Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks, which extend into the plane of the reinforcing steel, but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas, which are purely surface in nature, may be repaired. Excessive damage, honeycomb or cracking will be subject to structural review. Repairs shall be sound, properly finished and cured in conformance with the pertinent specifications.

When fine cracks or hairchecks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

559S.9 Storage and Shipment

Precast boxes shall be stored on level blocking in a manner acceptable to the Engineer or designated representative. No load shall be placed upon them until design strength is reached and curing completed. Shipment of boxes may be made when the design strength and curing requirements have been met.

559S.10 Construction Methods

Excavation and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill" and Standard Specification Item No. 510, "Pipe", except where tunneling or jacking methods are required or indicated on the Drawings.

Precast concrete boxes shall be bedded on a foundation of firm stable material accurately shaped to conform to their base. When indicated on the Drawings, special bedding materials shall be provided.

The envelope shall extend the full trench width from a depth of 6" (150 mm) and shall rise to at least 12" (300 mm) above the box. Geotextile filter fabric shall be placed within the bedding envelope approximately 8" (200 mm) above the top of the box and covered with a minimum of 4" (100 mm) of bedding material to protect fabric during placement of compaction and backfill. Damaged fabric should be removed and replaced or overlapped at least 12" (300 mm).

Joints sealed with preformed flexible joint sealants shall comply with ASTM C990. Joints sealed with rubber gaskets shall comply with ASTM C1677. Install joint sealants in accordance with the box culvert and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the box culvert with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the box culvert to be flush and smooth with the inside surface of the box culvert. Protrusion of joint material greater than 1/8" (3.13 mm) into the interior of the box culvert shall be grounds for rejection of the box as installed. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to box culvert joint immediately before placing box culvert section in trench, and then connect box culvert section to previously laid box culvert section.

When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details indicated on the Drawings. Materials to be used between barrels shall be as indicated on the Drawings.

Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap or other structures shall conform to the details indicated on the Drawings.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the Engineer or designated representative.

559S.11 Measurement

A. Cast in Place Box Culverts

The quantities of Portland cement concrete of the various classifications, which will constitute the completed and accepted "Box Culverts" in place will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards) , based on the dimensions indicated on the Drawings.

B. Precast

Concrete box culverts of each size and type shall be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.28 lineal feet). The measurement will be made between the ends of the box along the central axis. For concrete boxes used in multiple barrel structures, the measured length will be the sum of the lengths of all barrels measured as described above.

559S.12 Payment

"Concrete Box Culverts" shall be full compensation for constructing, furnishing and transporting boxes; excavation; disposal of surplus or unusable excavated material; providing, hauling, placing, preparing and shaping bedding material and leveling courses; concrete, reinforcing steel; jointing of boxes; connections to existing systems or structures; connections to new systems or structures; preparing, shaping, pumping for dewatering up to 360 gpm; particle migration measures including geotextile filter fabric; hauling, moving, placing and compacting backfill materials; installation and maintenance of temporary pavement repairs; temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks, and any other improvements damaged or removed during construction;; and all other items of material, labor, equipment, tools and incidentals necessary to complete this work in accordance with the Drawings and specifications.

Payment will be made under one of the following:

Item No. 559S:	Precast Concrete Box Culverts, ___Ft. x ___Ft.	Per Lineal Foot.
Item No. 559S-A:	Cast in Place Concrete Box Culverts	Per Cubic Yard.

End

<i>SPECIFIC</i> Cross Reference Materials
Standard Specification Item No. 559S, "Concrete Box Culverts"

City of Austin Standard Details

<u>Designation</u>	<u>Description</u>
Detail No. 559S-1	Fabrication Tolerances for Precast Box Culverts

City of Austin Standard Specifications

<u>Designation</u>	<u>Description</u>
Item No. 210S	Flexible Base
Item No. 403S	Concrete for Structures
Item No. 405S	Concrete Admixtures
Item No. 406S	Reinforcing Steel
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 509S	Trench Safety Systems
Item No. 510	Pipe

American Society for Testing and Materials,

<u>ASTM Designation</u>	<u>Description</u>
C 1577	Standard Specification for Precast reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD

Texas Department of Transportation, Manual of Testing Procedures

<u>Test Method</u>	<u>Description</u>
Tex 704-1	Making, Curing, and Testing Compression Test Specimens in Precast Concrete

<i>Related</i> Cross Reference Materials
Standard Specification Item No. 559S, "Concrete Box Culverts)

Texas Department of Transportation: Standard Specifications for Construction, Maintenance Of Highways, Streets and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 420	Concrete Structures
Item No. 421	Portland Cement Concrete
Item No. 440	Reinforcing Steel