



Designation: A964/A964M – 23

Standard Specification for Corrugated Steel Box Culverts¹

This standard is issued under the fixed designation A964/A964M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers material, geometric, and wall section properties of steel box culverts manufactured from corrugated plate or sheet, with or without attached stiffeners, for field assembly. Appropriate fasteners and optional materials such as steel invert plates and headwalls are also described. Applications for steel box culverts include conduits for gravity flow drainage of surface water such as culverts and storm drains, as well as for small bridges and grade separation structures such as pedestrian or vehicular underpasses, and utility tunnels.

1.2 This specification does not include requirements for foundations, backfill, or the relationship between earth cover or live loads and strength requirements. These important design considerations are described in the AASHTO LRFD Bridge Design Specifications, Customary U.S. Units (LRFD Bridge Design Specifications, SI Units).

1.3 This specification does not include requirements for the hydraulic design of these structures. Hydraulic design, placement of footings or inverts, and end treatments to resist scour are described in FHWA HDS No. 5.

1.4 **Appendix X1** lists nominal dimensions of box culvert sizes commonly available for Type I, II, and IV box culverts. Also listed are cross-sectional area and hydraulic design parameters for these sizes. Geometries for Type III, V and VI box culverts are available from manufacturers.

1.5 **Appendix X2** lists manufacturers' suggested design properties for the box culvert types described in this specification, and for the spacing classes and material thicknesses typically available.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall

be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A36/A36M Specification for Carbon Structural Steel

A123/A123M Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A761/A761M Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches

A902 Terminology Relating to Metallic Coated Steel Products

A1113/A1113M Specification for Corrugated Steel Structural Plate, Polymer-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches

2.2 AASHTO Standard:

LRFD Bridge Design Specifications, Customary U.S. Units (LRFD Bridge Design Specifications, SI Units)³

2.3 FHWA Standard:

HDS No. 5, Hydraulic Design of Highway Culverts, Report No. FHWA-IP-85-15⁴

3. Terminology

3.1 *Definitions*—For definitions of general terms related to metallic coated steel products refer to Terminology **A902**.

¹ This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.17 on Corrugated Steel Pipe Specifications.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

⁴ Available from National Technical Information Service (NTIS), 5301 Shawnee Rd., Alexandria, VA 22312, <http://www.ntis.gov>.

*A Summary of Changes section appears at the end of this standard

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *box culvert, n*—a generally rectangular conduit having a cross section symmetric about a vertical axis, with a long radius crown segment, short radius haunch segments, and straight side segments, with or without stiffeners, footing plates, or invert plates.

3.2.2 *cross-corrugations, n*—shallow corrugations formed transverse to the main corrugations on the inside of deep corrugated haunch plates to facilitate curving. Cross-corrugations are not currently being fabricated. As such, cross-corrugated information may be found in historic standards only (A0964/A0964M – 17).

3.2.3 *crown, n*—the long radius top arc segment of a box culvert cross section (see Fig. 1).

3.2.4 *haunch, n*—the short radius segments at the upper corners of a box culvert cross section, making the transition between the long radius crown segment and the straight side segments (see Fig. 1).

3.2.5 *rise, n*—the clear inside vertical dimension from the bottom of the straight side segments of a box culvert to the crown, measured at the axis of symmetry (see Fig. 1).

3.2.6 *shell, n*—the continuous, structural enclosure of the box culvert consisting of modular, field assembled and bolted, corrugated plate members forming the crown, haunch and side segments (see Fig. 1).

3.2.7 *span, n*—the clear inside horizontal dimension of a box culvert, measured at the bottom of the straight side segments (see Fig. 1).

3.2.8 *stiffeners, n*—spaced, hot rolled or cold formed structural members, curved to the shape of the transverse cross section of box culverts and attached by field bolting to the corrugated plate shell (see Fig. 1).

3.2.9 *unit weight, n*—the force resulting from gravitational attraction on a mass having a unit volume.

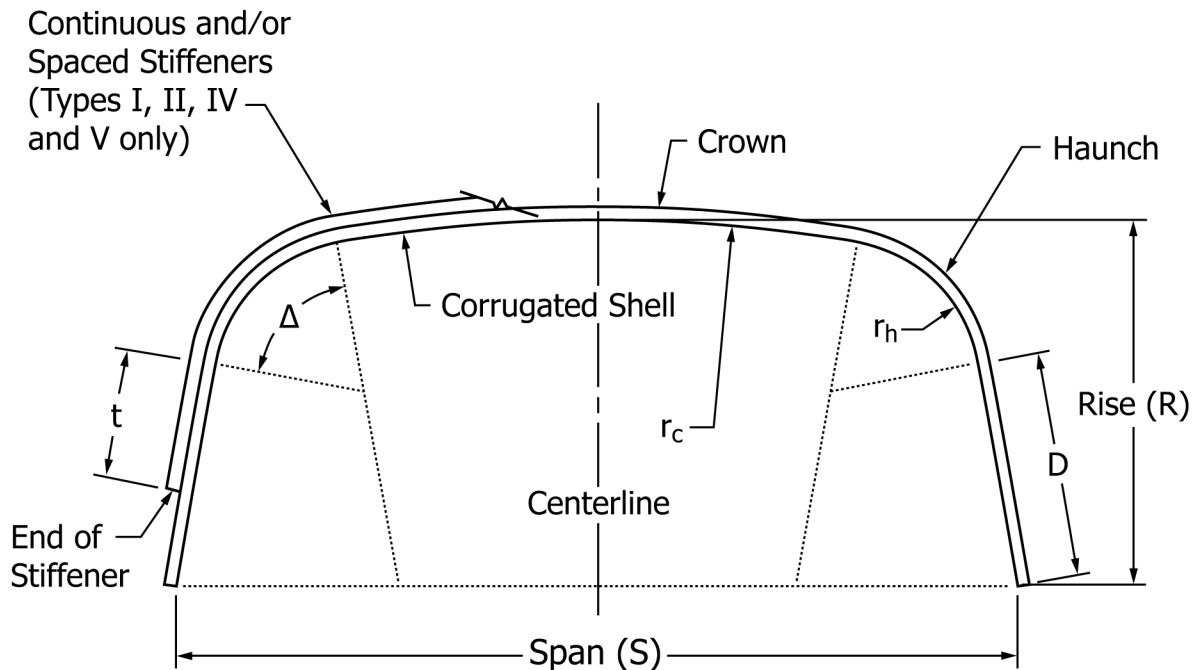
4. Classification

4.1 Steel box culverts are furnished in six types. Each type represents an alternate means of providing the required structural strength. The shell thickness and, where applicable, the stiffener thickness and spacing class at the crown and haunch of the box culvert are permitted to differ, provided they satisfy the ordering information and the design properties (see 5.1 and 6.1). Furthermore, while the box culvert structure shall be supplied in a consistent type throughout its length, the shell thickness and, where applicable, the stiffener thickness and spacing class also are permitted to be varied along the length, in accordance with cover and loading requirements, as agreed upon between the designer and the fabricator.

4.1.1 *Type I Box Culvert*, consisting of a corrugated plate shell having 6 in. by 2 in. [152 mm by 51 mm] corrugations in combination with spaced, cold formed, corrugated plate stiffeners as detailed in Fig. 2. Stiffener spacing classes shall be as defined below and as illustrated in Fig. 3.

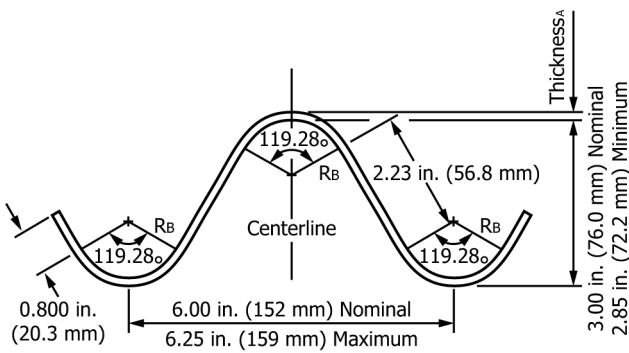
4.1.1.1 *Type I, Class A Spacing*, consisting of external stiffeners spaced at 24 in. [610 mm] center-to-center.

4.1.1.2 *Type I, Class B Spacing*, consisting of external stiffeners spaced at 12 in. [305 mm] center-to-center.



NOTE - See Table 1 for explanation of notation.

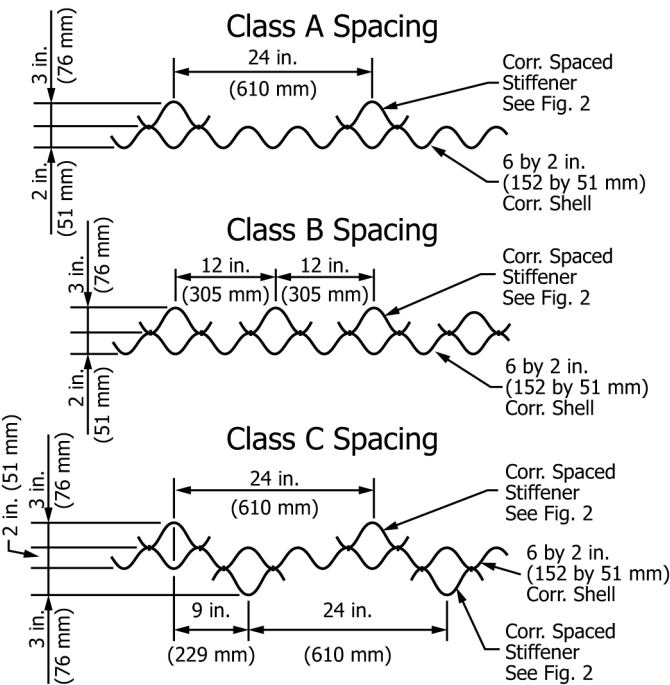
FIG. 1 Box Culvert Geometry



^A Rib Stiffener Thickness:
For thickness tolerances,
see ASTM A 761/A 761M.

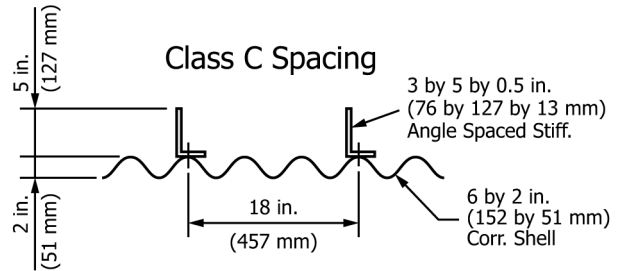
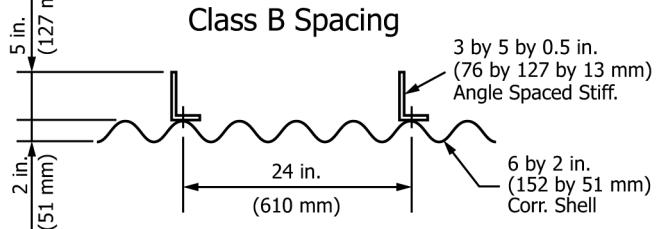
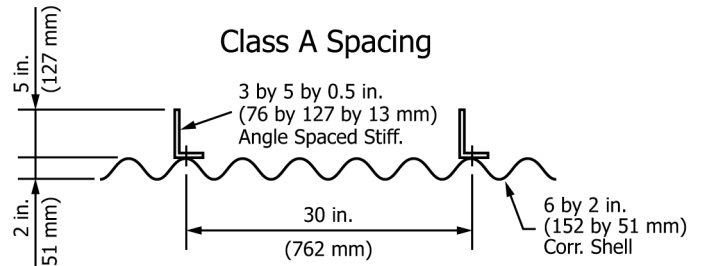
^B Inside Radius:
1.00 in. (25.4 mm) nominal,
0.938 in. (23.8 mm) minimum.

FIG. 2 Type I Rib Stiffener Geometry



NOTE 1—All dimensions are nominal.

FIG. 3 Type I Rib Spacing Classes



NOTE 1—All dimensions are nominal.

FIG. 4 Type II Rib Spacing Classes

4.1.3 *Type III Box Culvert*, consisting of a 15 in. by 5.5 in. [381 mm by 140 mm] corrugated plate shell without stiffeners.

4.1.4 *Type IV Box Culvert*, consisting of a corrugated plate shell having 6 in. by 2 in. [152 mm by 51 mm] corrugations in combination with continuous corrugated plate stiffeners. The stiffener placement and cross section shall be as detailed in Fig. 5.

4.1.5 *Type V Box Culvert*, consisting of a corrugated plate shell having 15 in. by 5.5 in. [381 mm by 140 mm] corrugations. When required by design, cold formed, corrugated plate stiffeners may be added for increased flexural strength. Stiffener spacing may vary between the crown and haunches, and may be continuous or discontinuous around the perimeter of

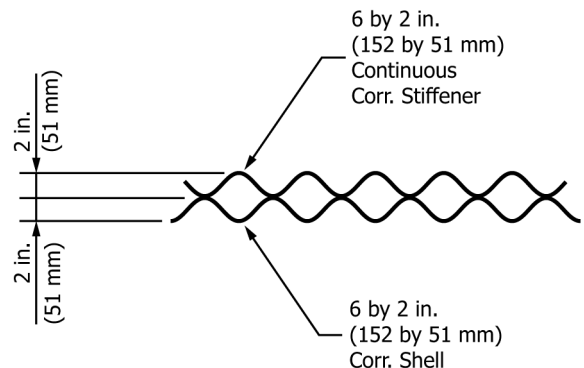
4.1.1.3 *Type I, Class C Spacing*, consisting of both external and internal stiffener groups, each spaced at 24 in. [610 mm] center-to-center, with the outer group offset 9 in. [229 mm] from the inner group.

4.1.2 *Type II Box Culvert*, consisting of a corrugated plate shell having 6 in. by 2 in. [152 mm by 51 mm] corrugations in combination with spaced, hot rolled, angle stiffeners as detailed in Fig. 4. Stiffener spacing classes shall be as defined below and as illustrated in Fig. 4.

4.1.2.1 *Type II, Class A Spacing*, consisting of external stiffeners spaced at 30 in. [762 mm] center-to-center.

4.1.2.2 *Type II, Class B Spacing*, consisting of external stiffeners spaced at 24 in. [610 mm] center-to-center.

4.1.2.3 *Type II, Class C Spacing*, consisting of external stiffeners spaced at 18 in. [457 mm] center-to-center.



NOTE 1—All dimensions are nominal.

FIG. 5 Type IV Stiffener