INTERNATIONAL

Designation: B 788/B 788M – 00

Standard Practice for Installing Factory-Made Corrugated Aluminum Culverts and Storm Sewer Pipe[1]

This standard is issued under the fixed designation B 788/B 788M; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This practice describes procedures, soils, and soil placement for the proper installation of corrugated aluminum culverts and storm sewers in either trench or projection installations. A typical trench installation is shown in Fig. 1, and a typical embankment (projection) installation is shown in Fig. 2. The pipes described in this practice are manufactured in a factory and furnished to the job in lengths ordinarily from 10 to 30 ft [3 to 9 m], with 20 ft [6 m] being common, for field joining.

1.2 This practice is applicable to either inch-pound units as B 788 or to SI units as B 788M. Inch-pound units are not necessary equivalent to SI units. SI units are shown in the text in brackets, and they are the applicable values for metric installation.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

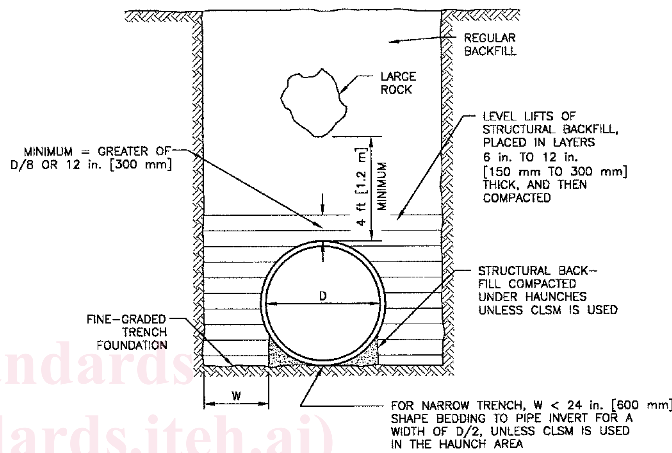

FIG. 1 Typical Trench Installation

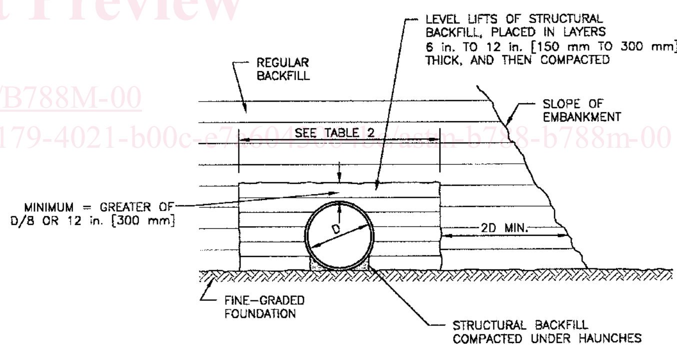

FIG. 2 Typical Embankment (Projection) Installation

2. Referenced Documents

2.1 *ASTM Standards:*

B 790/B 790M Practice for Structural Design of Corrugated Aluminum Pipe, Pipe Arches, and Arches for Culverts, Storm Sewers, and Other Buried Conduits[2]

D 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 [600 kN-m/m^3])

D 1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method[3]

D 2167 Test Method for Density and Unit Weight of Soil in Place by the Rubber-Balloon Method[3]

D 2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)[3]

D 2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)[3]

D 2937 Test Method for Density of Soil in Place by the Drive-Cylinder Method[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bedding, n*—the earth or other material on which a pipe is supported.

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[1] This practice is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.08 on Aluminum Culvert.

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[2] *Annual Book of ASTM Standards*, Vol 02.02.

[3] *Annual Book of ASTM Standards*, Vol 04.08.

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

3.1.2 *haunch*, *n*—the portion of the pipe cross section between the maximum horizontal dimension and the top of the bedding.

3.1.3 *invert*, *n*—the lowest point on the pipe cross section; also, the bottom portion of a pipe.

3.1.4 *pipe*, *n*—a conduit having full circular shape; also, in a general context, all structure shapes covered by this practice.

3.1.5 *pipe–arch*, *n*—a pipe with an approximate semicircular crown, small-radius corners, and large-radius invert.

4. Significance and Use

4.1 Corrugated aluminum pipe functions structurally as a flexible ring which is supported by and interacts with the compacted surrounding soil. The soil constructed around the pipe is thus an integral part of the structural system. It is therefore important to ensure that the soil structure or backfill is made up of acceptable material and is well-constructed. Field verification of soil structure acceptability using Test Methods D 1556, D 2167, D 2922, or D 2937, as applicable, and comparing the results with Test Method D 698 in accordance with the specifications for each project, is the most reliable basis for installation of an acceptable structure. The required density and method of measurement are not specified by this practice, but they must be established in the specifications for each project.

5. Trench Excavation

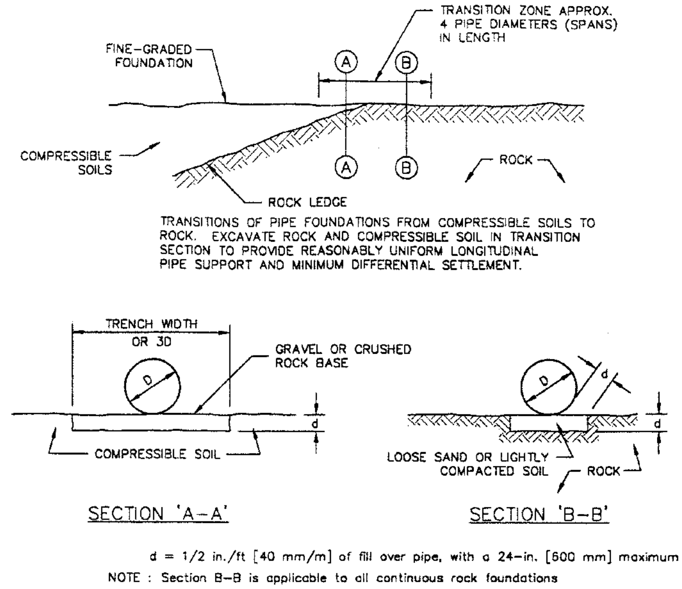
5.1 To obtain anticipated structural performance of corrugated aluminum pipe it is not necessary to control trench width beyond the minimum required for proper installation of pipe and backfill. However, the soil on each side beyond the excavated trench must be able to support anticipated loads. When a construction situation calls for a relatively wide trench, it may be made as wide as required, for its full depth if so desired. However, trench excavation must be in compliance with any local, state, and federal codes and safety regulations.

6. Foundation

6.1 The supporting soil beneath the pipe must provide a reasonably uniform resistance to the imposed load, both longitudinally and laterally. Sharp variations in the foundation must be avoided. When rock is encountered, it must be excavated and replaced with soil. If the pipe runs along a continuous rock foundation, it is necessary to provide a suitable soil bedding under the pipe. See Fig. 3.

6.2 Lateral changes in foundation should never be such that the pipe is firmly supported while the backfill alongside is not. When soft material is encountered during construction and must be removed in order to provide an adequate foundation, remove the soft material for a distance of three pipe widths, unless the engineer has set another limit. See Fig. 4.

6.3 Performance of buried pipe is enhanced by allowing the pipe to settle slightly under load compared to the columns of soil alongside. Thus, for larger pipes it can be beneficial to purposely create a foundation under the pipe itself which will yield under load more than will the foundation under the columns of soil to each side. It can usually be obtained by placing a layer of compressible soil of a suitable thickness, less densely compacted than the soil alongside, beneath the structure. This creates favorable relative movement between pipe and the soil on each side. It is of particular importance on pipe-arches.



d = ½ in./ft [40 mm/m] of fill over pipe, with a 24-in. [600-mm] maximum.

NOTE 1—Section B-B is applicable to all continuous rock foundations.

FIG. 3 Foundation Transition Zones and Rock Foundations

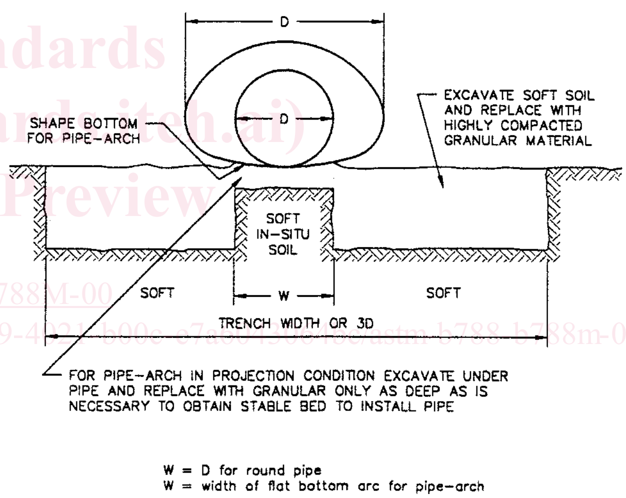


FIG. 4 Soft Foundation Treatment

6.4 *Pipe-Arches*—All pipe-arch structures must have excellent soil support at their corners by both the in-situ foundation and the structural backfill. See Fig. 4 and Fig. 5. They do not require the same degree of support under their large-radius inverts.

6.5 The engineer is encouraged to develop details specific to the site based on the general principles for foundation conditions given in 6.1 through 6.4.

7. Bedding

7.1 Corrugated aluminum pipe may be placed directly on the fine-graded foundation for the pipe line. Material in contact

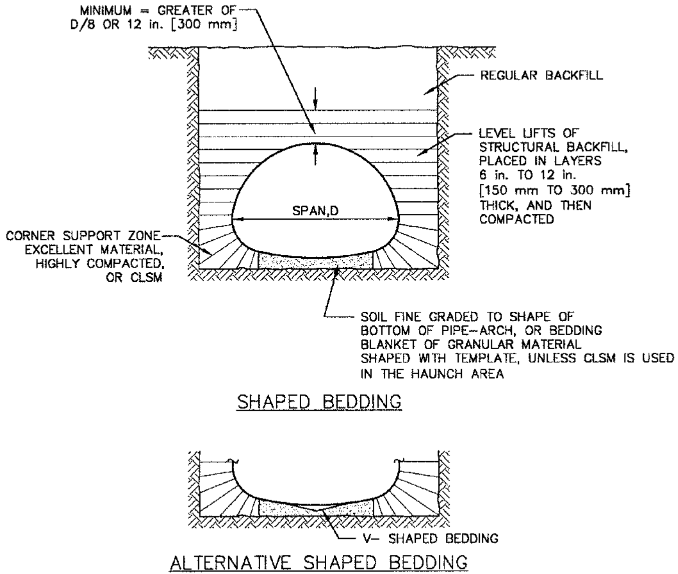


FIG. 5 Bedding and Corner Zone Treatment for Pipe-Arch Structures

with the pipe shall not contain rock retained on a 3-in. [75-mm] ring, frozen lumps, chunks of highly plastic clay, organic matter, corrosive material, or other deleterious material. It is not required to shape the bedding to the pipe geometry. However, for pipe-arches, it is recommended to either shape the bedding to the relatively flat bottom arc or fine-grade the foundation to a slight v-shape. This avoids the problem of trying to backfill the difficult area beneath the invert of pipe-arches. See Fig. 5.

8. Pipe Installation

8.1 All pipe shall be unloaded and handled with reasonable care. Pipe shall not be rolled or dragged over gravel or rock and shall be prevented from striking rock or other hard objects during placement on bedding. Pipe with protective coatings shall be handled with special care to avoid damage. Paved inverts shall be placed and centered in the invert.

8.2 *Field Joints*:

8.2.1 Transverse field joints shall be of such design that the successive connection of pipe sections will form a continuous line free of appreciable irregularities in the flow line. Each successive length of pipe in a field joint should be adjusted longitudinally or circumferentially when necessary so that coupling bands with projections, helical corrugations, or annular corrugations will properly engage the corrugations in both lengths of pipe. In addition, the joints shall meet the general performance requirements described herein. Suitable transverse field joints, which satisfy the requirements for one or more of the subsequently defined joint performance categories, can be obtained with the following types of connecting bands furnished with the suitable band-end fastening devices:

8.2.1.1 Corrugated bands.

8.2.1.2 Bands with projections.

8.2.1.3 Flat bands.

8.2.1.4 Bands of special design that engage factory reformed ends of corrugated pipe.

8.2.1.5 Other equally effective types of field joints may be used with the approval of the engineer.

8.2.2 *Joint Types*—Applications may require either standard or special joints. Standard joints are for pipe not subject to large soil movements or disjointing forces. These joints are satisfactory for ordinary installations, where simple slip-type joints are typically used. Special joints are for more adverse requirements such as the need to withstand soil movements or resist disjointing forces. Stab joints are for pipes subject to minimal settlement or disjointing forces. Special designs must be considered for unusual conditions such as in poor foundation conditions.

NOTE 1—Examples of stab joints are bell and spigot, and tongue and groove.

8.2.3 *Soil Conditions*:

8.2.3.1 The requirements of the joints are dependent upon the soil conditions at the construction site. Pipe backfill that is not subject to piping action is classified as nonerodible. Such backfill typically includes granular soil (with grain sizes equivalent to coarse sand, small gravel, or larger) and cohesive clays.

8.2.3.2 Structural backfill that is subject to piping action, and would tend either to infiltrate the pipe or to be easily washed by exfiltration of water from the pipe, is classified as erodible. Such backfill typically includes fine sands and silts.

8.2.4 *Joint Properties*—The requirements for joint properties are divided into six categories. The properties are defined in 8.2.4.1-8.2.4.6, and requirements (except for watertightness) are shown in Table 1. The values for various types of pipe can be determined by a rational analysis or a suitable test.

8.2.4.1 *Shear Strength*—The shear strength required of the joint is expressed as a percent of the calculated shear strength of the pipe on a transverse cross section remote from the joint.

8.2.4.2 *Moment Strength*—The moment strength required of the joint is expressed as a percent of the calculated moment capacity of the pipe on a transverse cross section remote from the joint.

8.2.4.3 *Tensile Strength*—Tensile strength is required in a joint when the possibility exists that a longitudinal load could develop that would tend to separate adjacent pipe sections.

8.2.4.4 *Joint Overlap*—Standard joints that do not meet the moment strength alternatively shall have a minimum sleeve width overlapping the abutting pipes. The minimum total sleeve width shall be as shown in Table 1. Any joint meeting the requirements for a special joint may be used instead of a standard joint.

8.2.4.5 *Soiltightness*—Soiltightness refers to openings in the joint through which soil may infiltrate. Soiltightness is influenced by the size of the opening (maximum dimension normal to the direction that the soil may infiltrate) and the length of the channel (length of the path along which the soil may infiltrate). No opening may exceed 1 in. [25 mm]. In addition, for all categories, if the size of the opening exceeds ⅛ in. [3 mm], the length of the channel must be at least four times the size of the opening. Furthermore, for nonerodible or erodible soils, the ratio of D_{85} soil size to size of opening must be greater than 0.3 for medium to fine sand or 0.2 for uniform sand; these ratios need not be met for cohesive backfills where