AASHTO-AGC-ARTBA Joint Committee

Task Force 13 Report

Guide to Standardized Highway Drainage Products

November 1999

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PREFACE

This document is disseminated upon sponsorship of the Joint Committee of the American Association of State Highway and Transportation Officials, the Associated General Contractors of America and the American Road and Transportation Builders Association (The Joint AASHTO-AGC-ARTBA Committee) in the interest of information exchange, based on the combined technical expertise of the authors. As such, the opinions and conclusions implied or expressed herein do not necessarily reflect the official views or policies of the Joint Committee or its member organizations.

This report was approved for publication by the three member organizations comprising the Joint Committee and was published on behalf of the Joint Committee by AASHTO.

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and Transportation Officials
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Washington, DC 20001

November 1999

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(Standardization of Details for Bridge and Road Hardware)

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ACKNOWLEDGEMENTS

The Task Force wishes to express its thanks to the personnel in the State Highway agencies who have assisted in the preparation of this guide through the submission of plans and their reviews of the guide in draft form.

Thanks are also extended to the manufacturers and associations that provided advice and many of the details incorporated in this guide.

CONTENTS

INTRODUCTION

This guide was prepared by Task Force No. 13 of the American Association of State Highway and Transportation Officials—Associated General Contractors of America—American Road and Transportation Builders' Association (AASHTO-AGC-ARTBA) Joint Committee's Subcommittee on New Materials. It supersedes the 1986 edition of this publication, *A Guide to Standardized Highway Drainage Products*. A new section, "Part 5-Plastic Drainage Products," has been added in this new edition of the publication. Please note, also, that, because of drawing deletions and additions, some of the drawing numbers in this edition do not match those for nominally the same items in the previous edition. This guide is one of a series of guides prepared by Task Force No. 13 in an effort to promote beneficial standardization of details for bridge and road hardware. There is no intent that this guide be viewed as a national standard. It is provided as a supplement to existing agency specifications. It is intended to provide guidance for users and specifiers of highway drainage products who may not have ready access to information contained herein or who may be looking for potentially more economical specifications or details that are in use for these products. It is hoped the guide will spare some from having to "reinvent the wheel." Additionally, the ultimate goal is to reduce highway costs to the public by reducing manufacturing and inventory costs. These costs are often higher than necessary because manufacturers cannot achieve the same efficiency in supplying several versions of essentially the same product as they can with one. Therefore, designers and specifiers of highway drainage products are invited to consider the products shown in this guide to see if they will efficiently meet their needs, especially before developing new specifications or details.

In general, the Task Force has not attempted to address the hydraulic, structural, or durability requirements associated with the items shown in this guide. These are beyond the scope of the guide and are the responsibility of the highway designer. For information on design or for sources of such information, see the *Standard Specifications for Highway Bridges* and the *Hydraulic Engineering Circular No. 1—Selected Bibliography of Hydraulic and Hydrologic Subjects*. These are available, respectively, from:

American Association of State Highway and
Transportation Officials
444 North Capitol Street, NW, Suite 249
Washington, DC 20001

and

Office of Engineering, HNG-31
Federal Highway Administration
Washington, DC 20590

A potential problem of standardization is stagnation. The Task Force is aware of this problem and wishes to avoid this resulting as a product of its activities. It, therefore, invites comments on the contents of this guide and information on needs and new developments in highway drainage products that should be considered in preparing future editions of this guide.

INDEX TO DRAWINGS

PART 1
CONCRETE DRAINAGE PRODUCTS (CP)

PART 2
CORRUGATED METAL DRAINAGE PRODUCTS (CM)

PART 3
STRUCTURAL PLATE DRAINAGE PRODUCTS (SP)

PART 4
DRAIN HARDWARE & ACCESSORIES (DH)

PART 5
PLASTIC DRAINAGE PRODUCTS (P)

PART 1

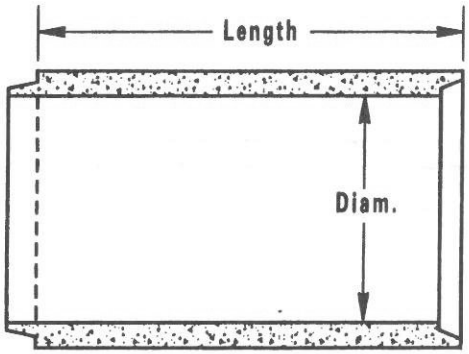
CONCRETE DRAINAGE PRODUCTS (CP)

NOTE:

Design information for concrete pipe and box sections may be obtained from Division 1, Section 17 of the American Association of State Highway and Transportation Officials (AASHTO) bridge specifications (*Standard Specifications for Highway Bridges*). Additional information on concrete pipe and box sections may be obtained from the American Concrete Pipe Association (*Concrete Pipe Handbook* and *Concrete Pipe Design Manual*).

SECTION CPS—SHAPES

BELL & SPIGOT



TONGUE & GROOVE

SPECIFICATIONS

Non–Reinforced Concrete Pipe:
Plain – AASHTO M 86M (ASTM C 14M) (ASTM C 985)
Porous – AASHTO M 176M (ASTM C 654M)
Perforated – AASHTO M 175M (ASTM C 444M)
Drain Tile – AASHTO M 178M (ASTM C 412M)
Reinforced Concrete Pipe:
AASHTO M 170M (ASTM C 76)*
AASHTO M 242M (ASTM C 655M) for D–Load Pipe
ASTM C 361 for Low–Head Pressure Pipe

Joints: See CPJ–2–96

*except that the use of elliptical reinforcement will not be permitted.

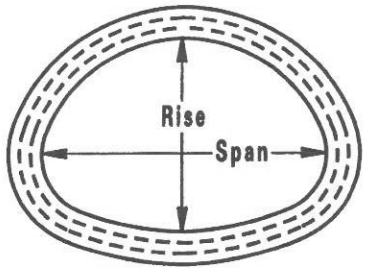
USE

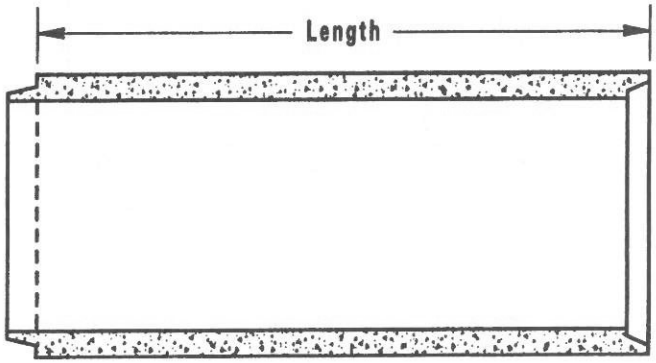
Non–Reinforced and Reinforced Concrete Pipe for Culverts, Storm Drains, Sewers and Underdrains.

CIRCULAR CONCRETE PIPE

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPS–1–96





SPECIFICATIONS

AASHTO M 206M (ASTM C 506M)

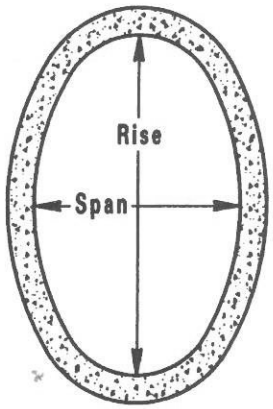
USES

Reinforced Concrete Arch Pipe for Culverts, Storm Drains and Sewers, where clearance above the pipe is critical.

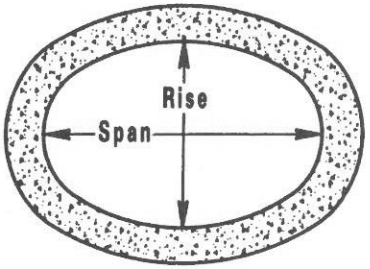
ARCH CONCRETE PIPE

AASHTO–AGC–ARTBA
TF–13 DRAWING

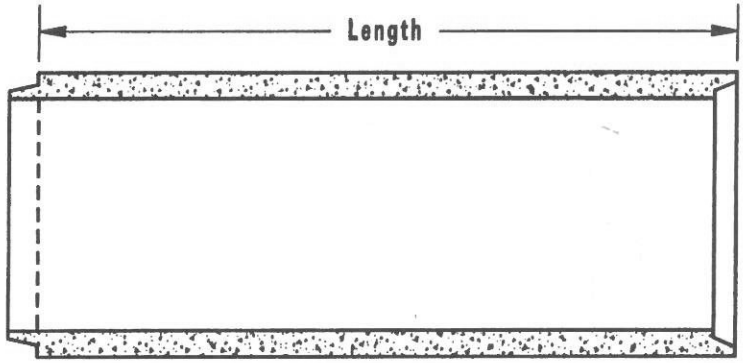
CPS–2–96



VERTICAL
ELLIPTICAL



HORIZONTAL
ELLIPTICAL



SPECIFICATIONS

AASHTO M 207M (ASTM C 507M)

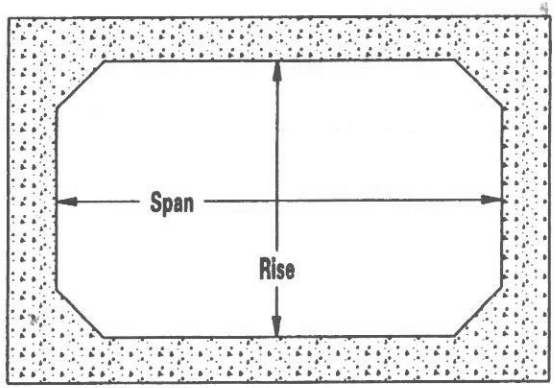
USES

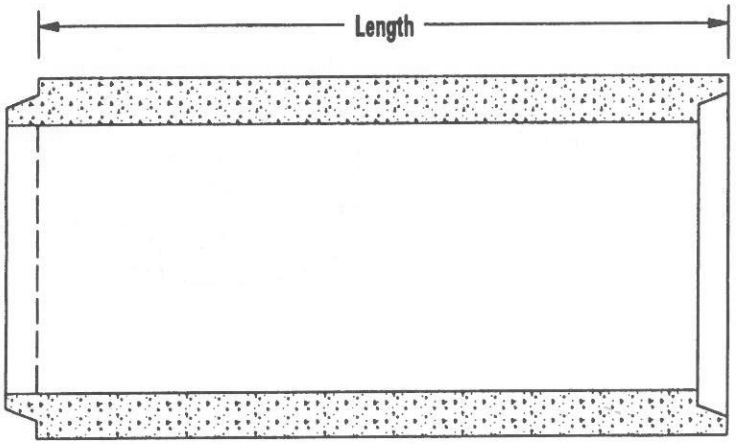
Reinforced Concrete Elliptical Pipe for Culverts, Storm Drains and Sewers.

ELLIPTICAL CONCRETE PIPE

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPS–3–96





SPECIFICATIONS

AASHTO M 259M (ASTM C 789M)

For fill heights less than 610 mm use AASHTO M 273M (ASTM C 850M)

USES

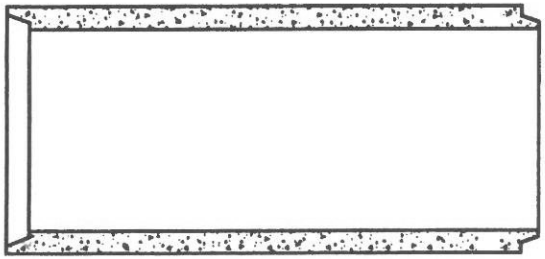
Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers.

PRECAST CONCRETE BOX SECTIONS

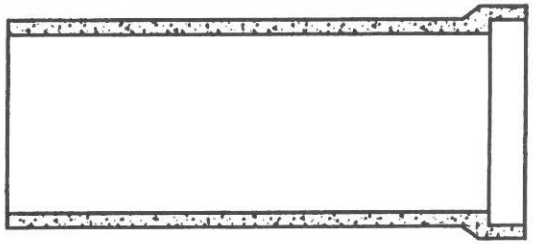
AASHTO–AGC–ARTBA
TF–13 DRAWING

CPS–4–96

SECTION CPJ—JOINTING MATERIALS



TONGUE & GROOVE



BELL & SPIGOT

BUTT-END (Drain Tile)

SPECIFICATIONS

Specifications are not available on dimensions of the various types of joints. Manufacturers develop their own dimensions and can supply this data, if necessary.

USES

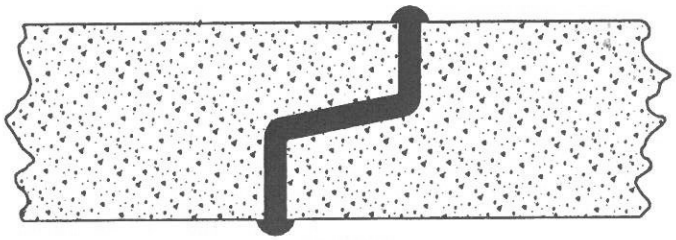
Tongue & Groove Joints provide smooth straight line pipe which creates fewer problems in excavation, laying or jacking.

Bell & Spigot joints require slightly more excavation and can be jacked. Butt-end joints (Tile) are used for underdrains where infiltration is desired.

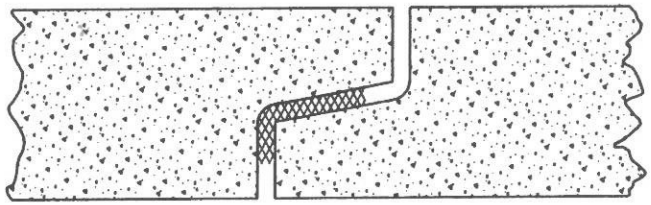
TYPES OF JOINTS FOR CONCRETE PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING

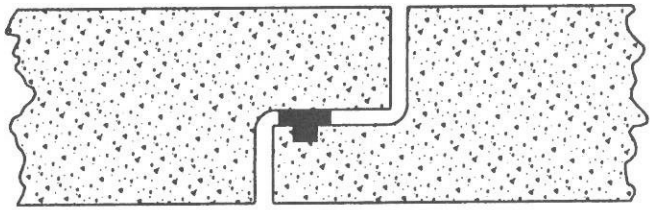
CPJ–1–96



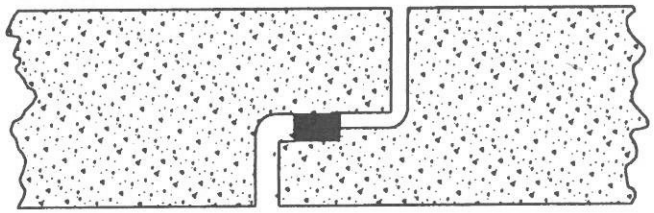
MASTIC



RUBBER GASKET*



O-RING GASKET



SINGLE OFFSET GASKET

* O-RING AND SINGLE OFFSET JOINTS USE RUBBER GASKETS

SPECIFICATIONS

Mastic: AASHTO M 198 ASTM C 990
Rubber Gasket: AASHTO M 315

ASTM C 443
ASTM C 361

USE

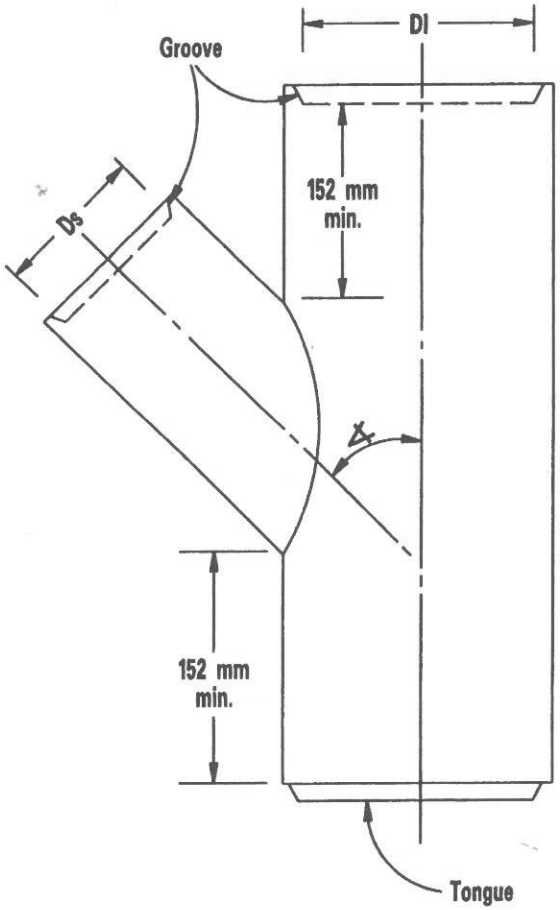
For sealing of joints in Concrete Pipe Sewers and Culverts to prevent infiltration, exfiltration or provide low-head pressure sealing.

JOINTING MATERIALS FOR CONCRETE PIPE

AASHTO-AGC-ARTBA
TF-13 DRAWING

CPJ-2-96

SECTION CPF—STANDARD FITTINGS



SPECIFICATIONS

"Y" Fittings to be produced from concrete pipe meeting the specifications for the type & class of pipe required. Consult a Producer for details.

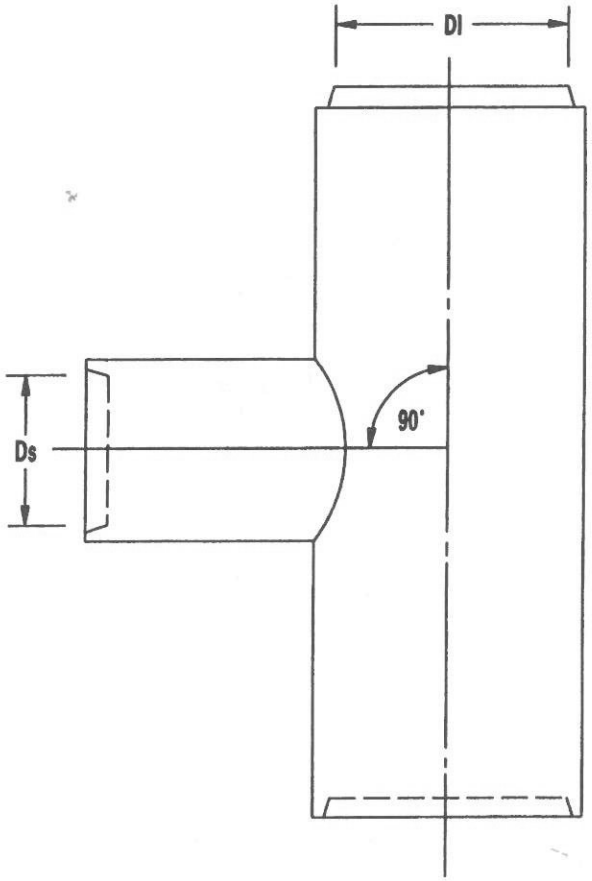
USES

To provide a prefabricated intersection of two lines of pipe.

CONCRETE PIPE "Y" FITTING

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPF–1–96



SPECIFICATIONS

Tee fittings are to be produced from concrete pipe meeting the specifications for the type & class of pipe required. Consult a Producer for details.

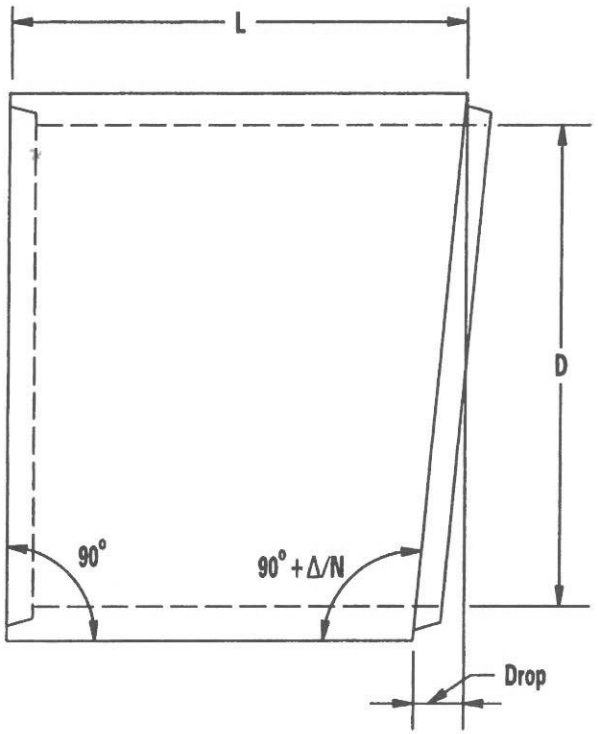
USES

To provide a prefabricated right angle intersection of two lines of pipe.

CONCRETE PIPE TEE FITTING

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPF–2–96



SPECIFICATIONS

Radius pipe shall be produced in accordance with the applicable specifications for circular pipe. Consult a producer for details.

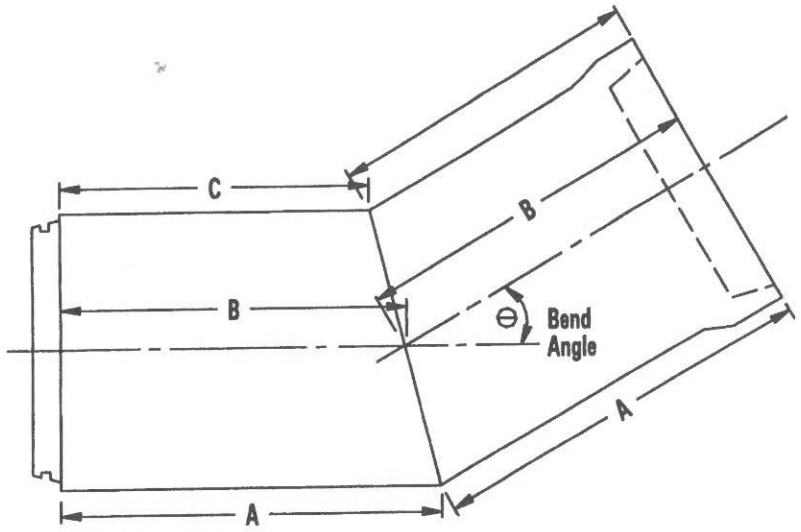
USES

For sharply curving lines of pipe which cannot be accommodated by the deflected straight pipe method or by other special precast fittings.

CONCRETE RADIUS PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING

CPF–3–96



SPECIFICATIONS

Bends to be produced from concrete pipe meeting the Specifications for the type & Class of pipe required.

ASTM C-76M ("O"-Ring Gasket, Bell and Spigot shown)

USE

For sharply curving lines of pipe or for redirection of line pipe.

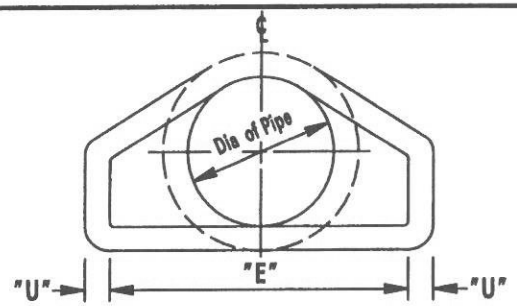
Bends normally produced with bend angles of 15°, 30°, 45°, & 90°.

CONCRETE PIPE BENDS

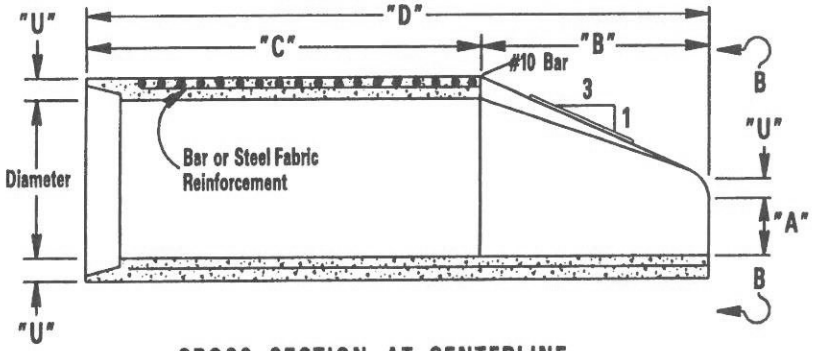
AASHTO-AGC-ARTBA
TF-13 DRAWING

CPF-4-96

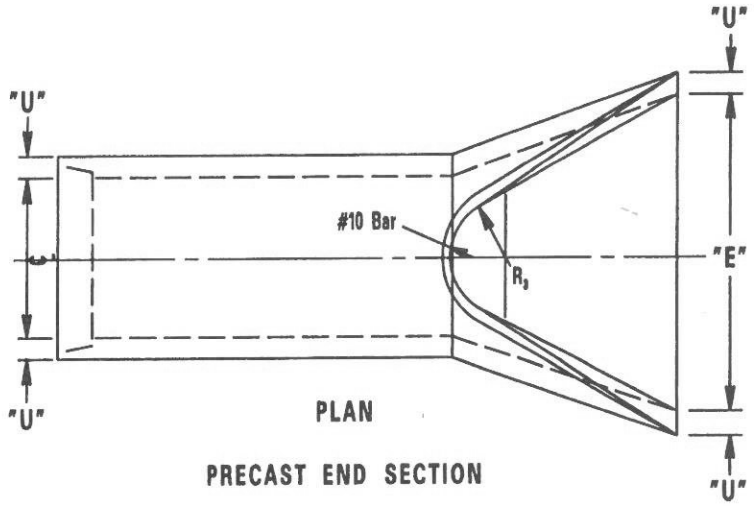
SECTION CPE—END TREATMENTS



VIEW B-B



CROSS SECTION AT CENTERLINE



PLAN

PRECAST END SECTION

APPLICABLE SPECIFICATIONS

Precast End Sections shall be of the same quality as the pipe with which they are to be used.

Precast reinforced concrete flared end sections shall be constructed in accordance with the applicable portions of AASHTO M 170M Class III, wall B reinforced concrete pipe.

USES

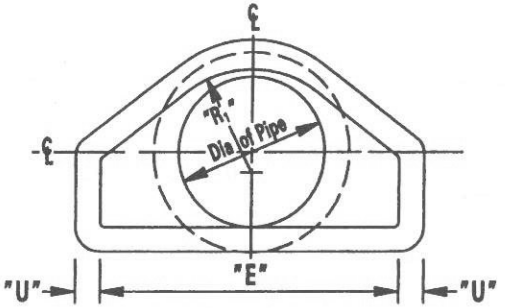
Precast End Sections serve as a Prefabricated Headwall for Culverts and Storm Sewers

TABLE OF DIMENSIONS (millimeters)

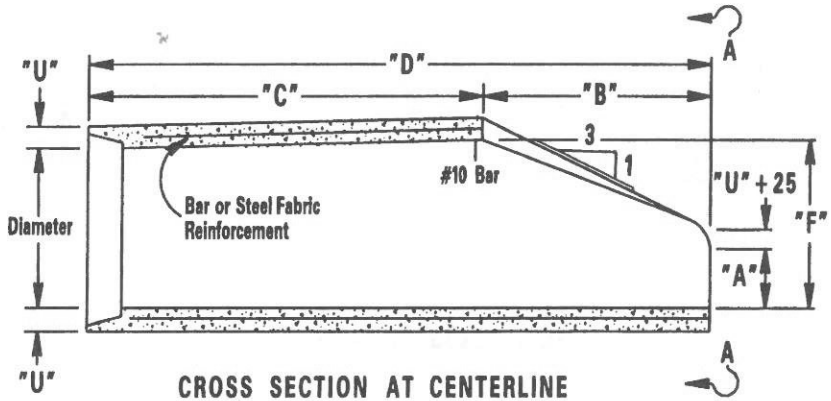
PIPE DIA.	"U"	"A"	"B"	"C"	"D"	"E"	"R_3"
300	50	100	600	1250	1850	600	100
375	57	150	675	1180	1855	750	150
450	63	225	675	1180	1855	900	188
525	69	225	900	955	1855	1050	125
600	75	241	1077	790	1867	1200	200
675	82	267	1224	643	1867	1350	225
750	88	300	1350	523	1873	1500	200
825	94	343	1446	954	2400	1650	225
900	100	381	1557	843	2400	1800	275
1050	113	533	1551	849	2400	1950	275
1200	125	600	1800	600	2400	2100	300

PRECAST CONCRETE END SECTION

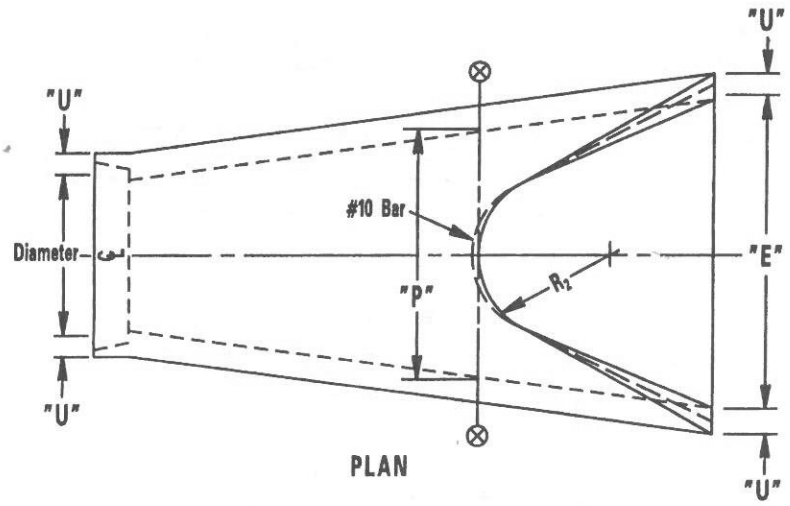
AASHTO–AGC–ARTBA TF–13 DRAWING / **CPE–1–96**



VIEW A-A



CROSS SECTION AT CENTERLINE



PLAN

PRECAST END SECTION

APPLICABLE SPECIFICATIONS

Precast End Sections shall be of the same quality as the pipe with which they are to be used.

Precast reinforced concrete flared end sections shall be constructed in accordance with the applicable portions of AASHTO M 170M Class III, wall B reinforced concrete pipe.

USES

Precast End Sections serve as a Prefabricated Headwall for Culverts and Storm Sewers

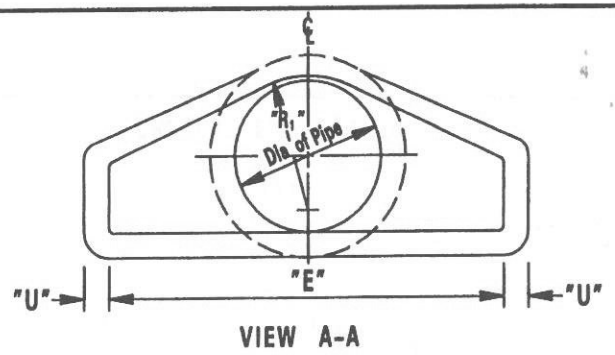
TABLE OF DIMENSIONS (millimeters)

PIPE DIA.	"U"	"A"	"B"	"C"	"D"	"E"	"F"	AT X-X ONLY "P"	AT X-X ONLY "R_1"	"R_2"
300	50	100	600	1250	1850	600	325	256	257	225
375	57	150	675	1180	1855	750	400	589	318	275
450	63	225	675	1180	1855	900	475	737	394	300
525	69	225	900	955	1855	1050	550	797	419	325
600	75	241	1077	790	1867	1200	625	843	427	350
675	82	267	1224	643	1867	1350	700	965	471	363
750	88	300	1350	523	1873	1500	775	940	470	375
825	94	343	1446	954	2400	1650	850	1148	603	438
900	100	381	1557	843	2400	1800	925	1156	589	500
1050	113	533	1551	849	2400	1950	1075	1359	699	550
1200	125	600	1800	600	2400	2100	1225	1441	724	550

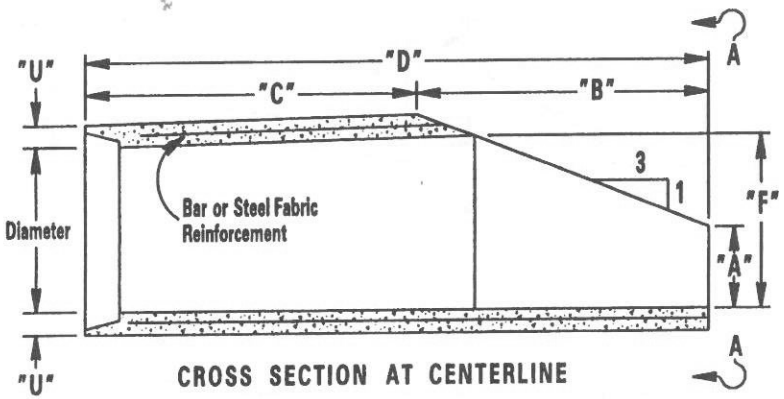
PRECAST CONCRETE END SECTION

AASHTO–AGC–ARTBA TF–13 DRAWING

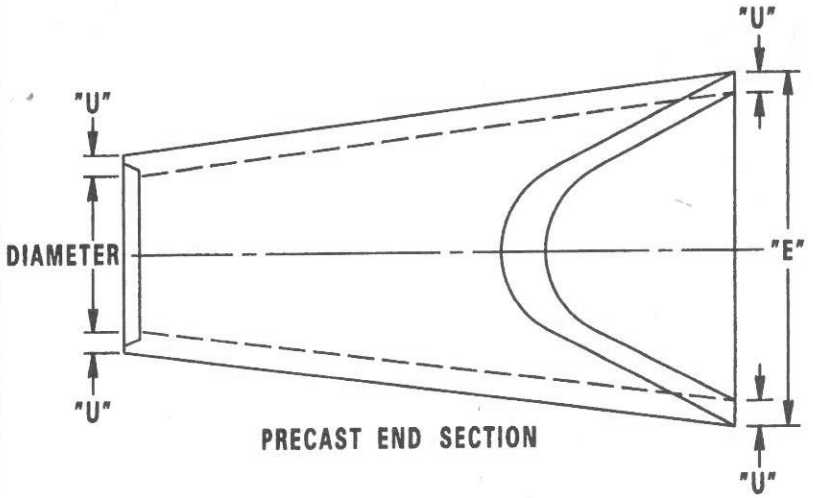
CPE–2–96



VIEW A-A



CROSS SECTION AT CENTERLINE



PRECAST END SECTION

APPLICABLE SPECIFICATIONS

Precast End Sections shall be of the same quality as the pipe with which they are to be used.

Precast reinforced concrete flared end sections shall be constructed in accordance with the applicable portions of AASHTO M 170M Class III, wall B reinforced concrete pipe.

BASIS OF PURCHASE

Pipe Diameter
Class or Quality
Material Requirements

USES

Precast End Sections serve as a Prefabricated Headwall for Culverts and Storm Sewers.
Optional to CPE-1 and CPE-2.

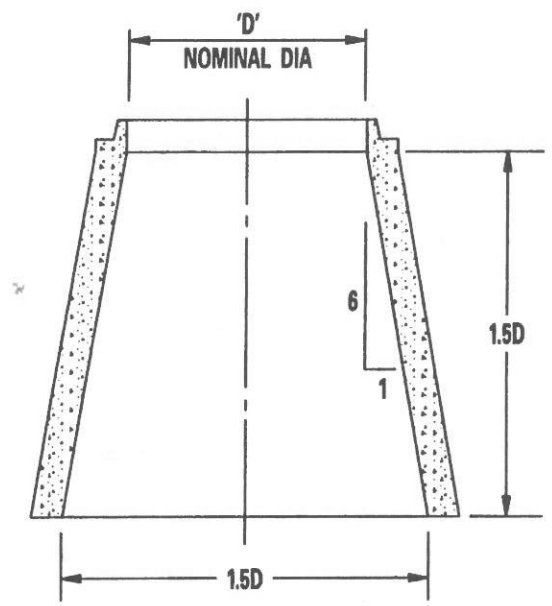
TABLE OF DIMENSIONS (millimeters)

PIPE DIA.	"U"	"A"	"B"	"C"	"D"	"E"	"F"	"R_1"
300	50	175	600	1250	1850	600	325	257
375	57	231	678	1177	1855	750	400	318
450	63	312	681	1174	1855	900	475	394
525	69	319	903	952	1855	1050	550	419
600	75	338	1086	781	1867	1200	625	427
675	82	369	1242	625	1867	1350	700	471
750	88	412	1356	517	1873	1500	775	470
825	94	456	1467	933	2400	1650	850	603
900	100	500	1575	825	2400	1800	925	589
1050	113	662	1581	819	2400	1950	1075	699
1200	125	750	1800	600	2400	2100	1225	724

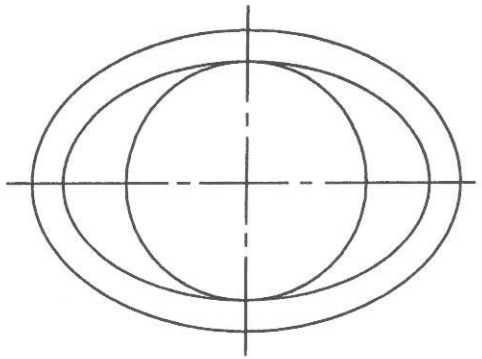
PRECAST CONCRETE END SECTION

AASHTO-AGC-ARTBA
TF-13 DRAWING

CPE-3-96



PLAN VIEW



END VIEW

APPLICABLE SPECIFICATIONS

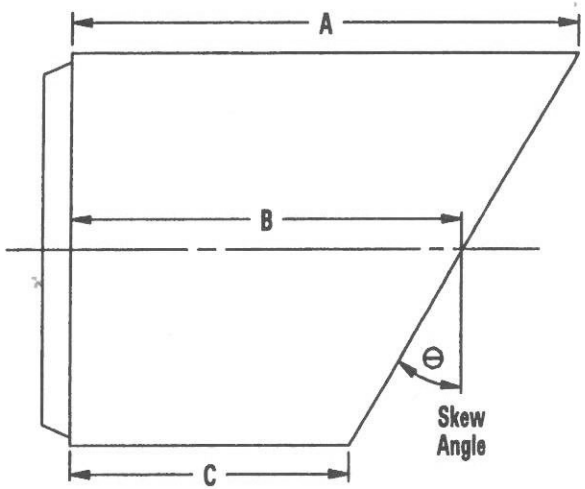
Flared inlet shall meet the applicable Sections of AASHTO M-207M (ASTM C 507M) for materials, reinforcement and concrete strength.

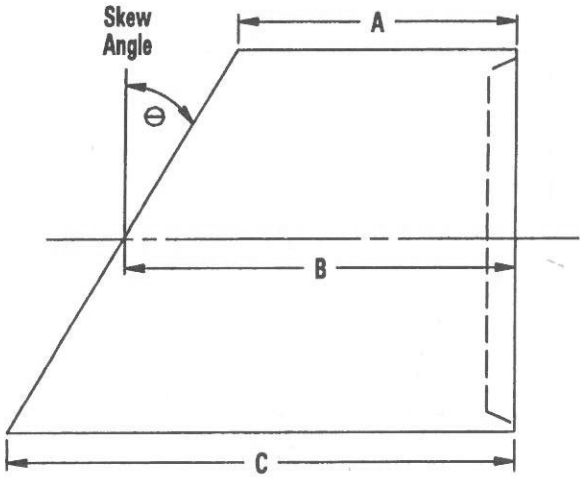
USES

Flared inlets are used on the upstream end of culverts or sewers to improve the hydraulic operation of the facility entrance.

PRECAST CONCRETE FLARED INLET

AASHTO-AGC-ARTBA TF-13 DRAWING	CPE-4-96





APPLICABLE SPECIFICATIONS

Skews to be produced from concrete pipe meeting the specifications for the type & Class of pipe required. ASTM C 76M (Tongue & Groove shown)

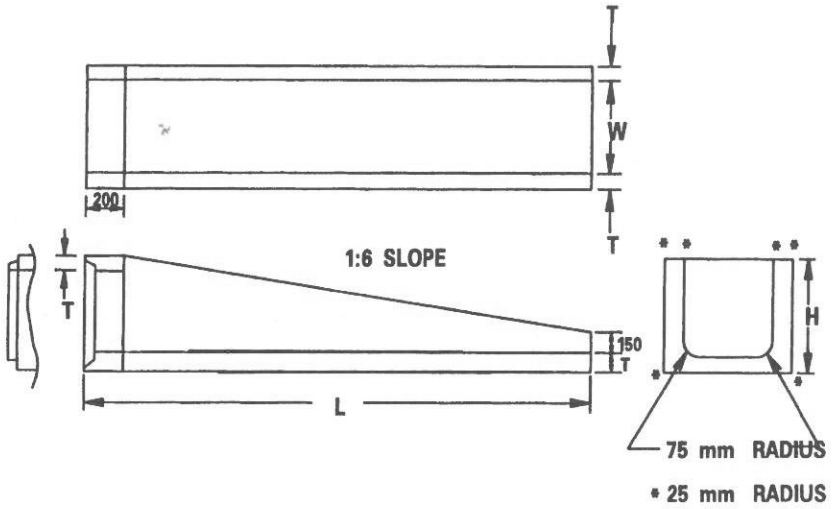
USE

To provide end finish to a line of pipe conforming to embankment contour.

CONCRETE PIPE SKEW JOINTS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPE–5–96



Pipe Dia.	T	W	H	L
375	75	375	525	1950
450	75	450	600	2400
600	75	600	750	3300
750	100	750	950	4350
900	100	900	1100	5250
1050	100	1050	1250	6150
1200	125	1200	1450	7200

Not to Scale

NOTE: ALL DIMENSIONS SHOWN ARE IN MILLIMETERS

APPLICABLE SPECIFICATIONS

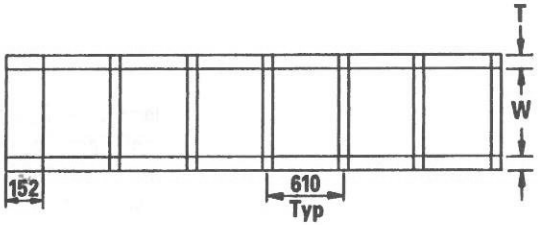
Precast reinforced concrete sloped end sections shall be in accordance with the applicable portions of AASHTO M 170M, with concrete strength and reinforcement equivalent to class II pipe except that an additional #13 bar shall be added in the top and bottom of each side.

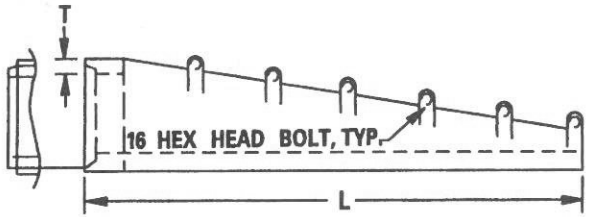
USES

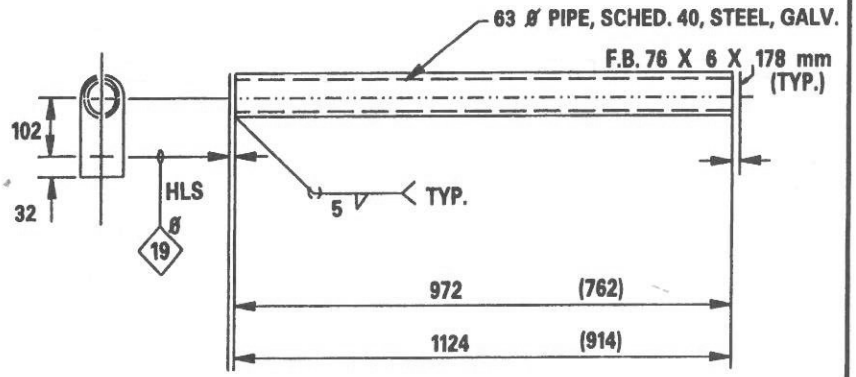
To provide inlets and outlets where a 1V:6H slope safety end treatment is required on culverts and storm sewers.

PRECAST CONCRETE 1:6 SLOPED END SECTION

AASHTO-AGC-ARTBA TF-13 DRAWING	CPE-6-96







Note: All dimensions are in millimeters.

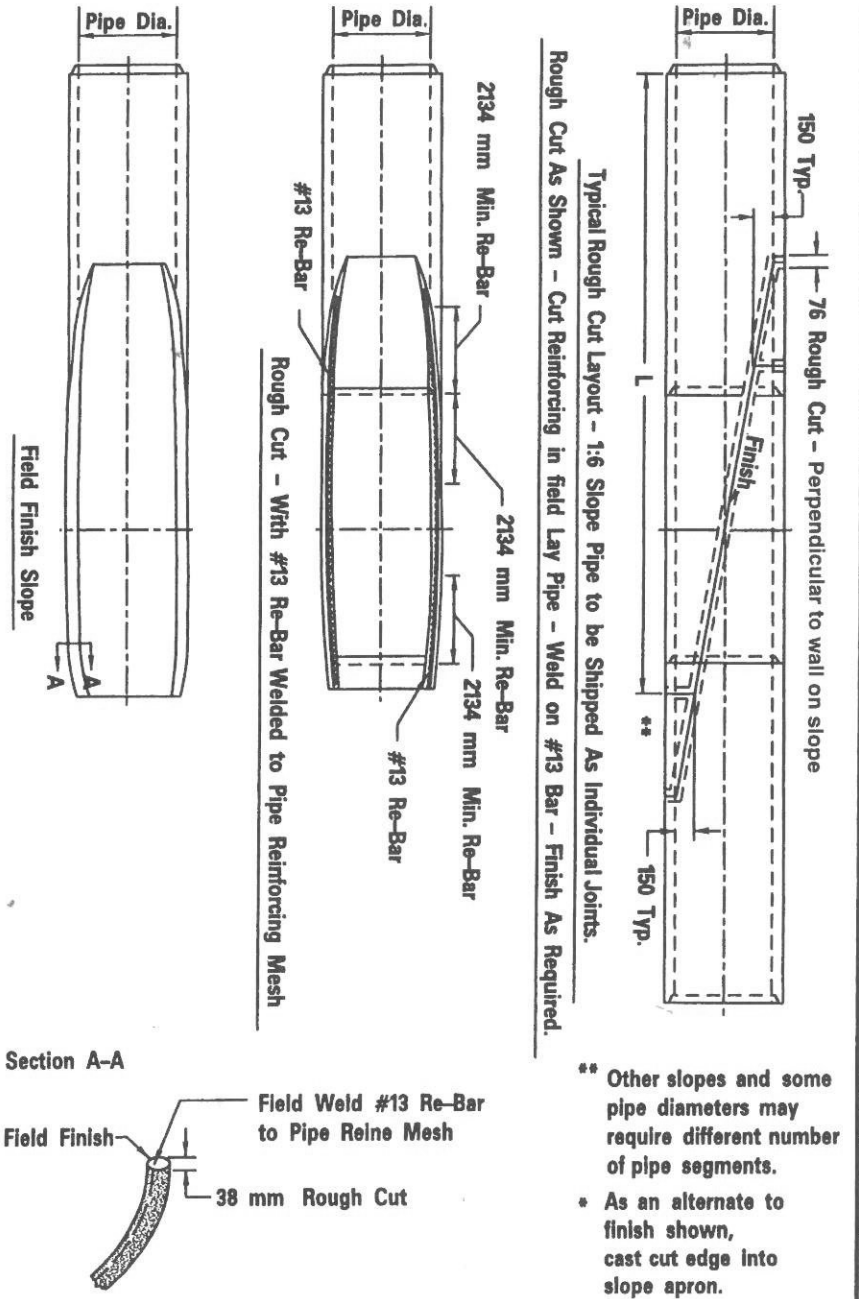
APPLICABLE SPECIFICATIONS

Note:
Sloped ends are typically used to reduce hazard of culvert end to errant vehicles. Grates or other devices may be required, especially on ≤ 750 mm diameter size of parallel drains and ≤ 1050 mm diameter size of cross drains. On parallel drains the grates are transverse, and on cross drains they are longitudinal.

PRECAST CONCRETE SLOPED END SECTION GRATE

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPE–7–96



** Other slopes and some pipe diameters may require different number of pipe segments.

* As an alternate to finish shown, cast cut edge into slope apron.

APPLICABLE SPECIFICATIONS

Sloped End Sections to be produced from Concrete Pipe meeting the specifications for the type and class of pipe required.

ASTM C 76M (Tongue & Groove shown)

NOTE: Sloped ends are typically used to reduce hazard of culvert end to errant vehicles. Grates or other devices may also be required to effect this end.

USES

To provide end finish to a line of pipe conforming to embankment contour. Various slopes may be specified.

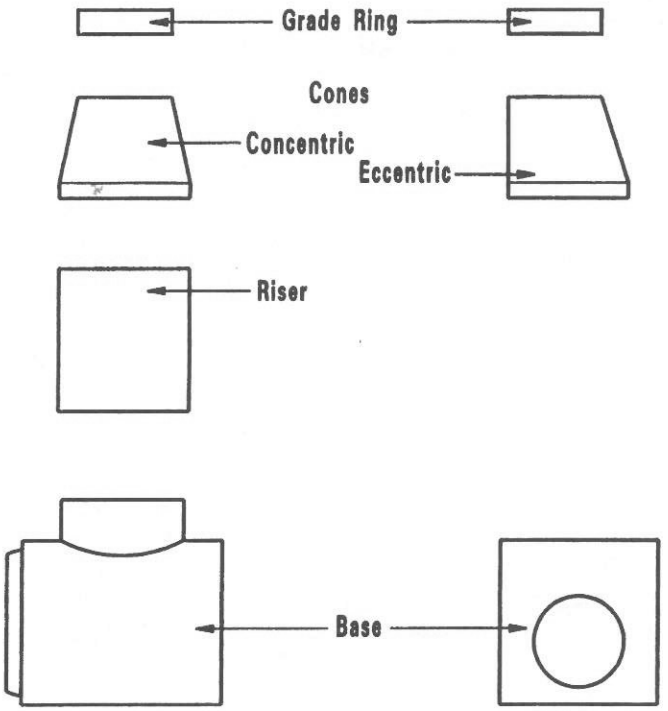
Note: All dimensions are in millimeters.

CONCRETE PIPE SLOPED END SECTIONS

AASHTO-AGC-ARTBA TF-13 DRAWING

CPE-8-96

SECTION CPA—APPURTENANCES



TYPICAL CONFIGURATION
OF
PRECAST MANHOLE SECTIONS

APPLICABLE SPECIFICATIONS

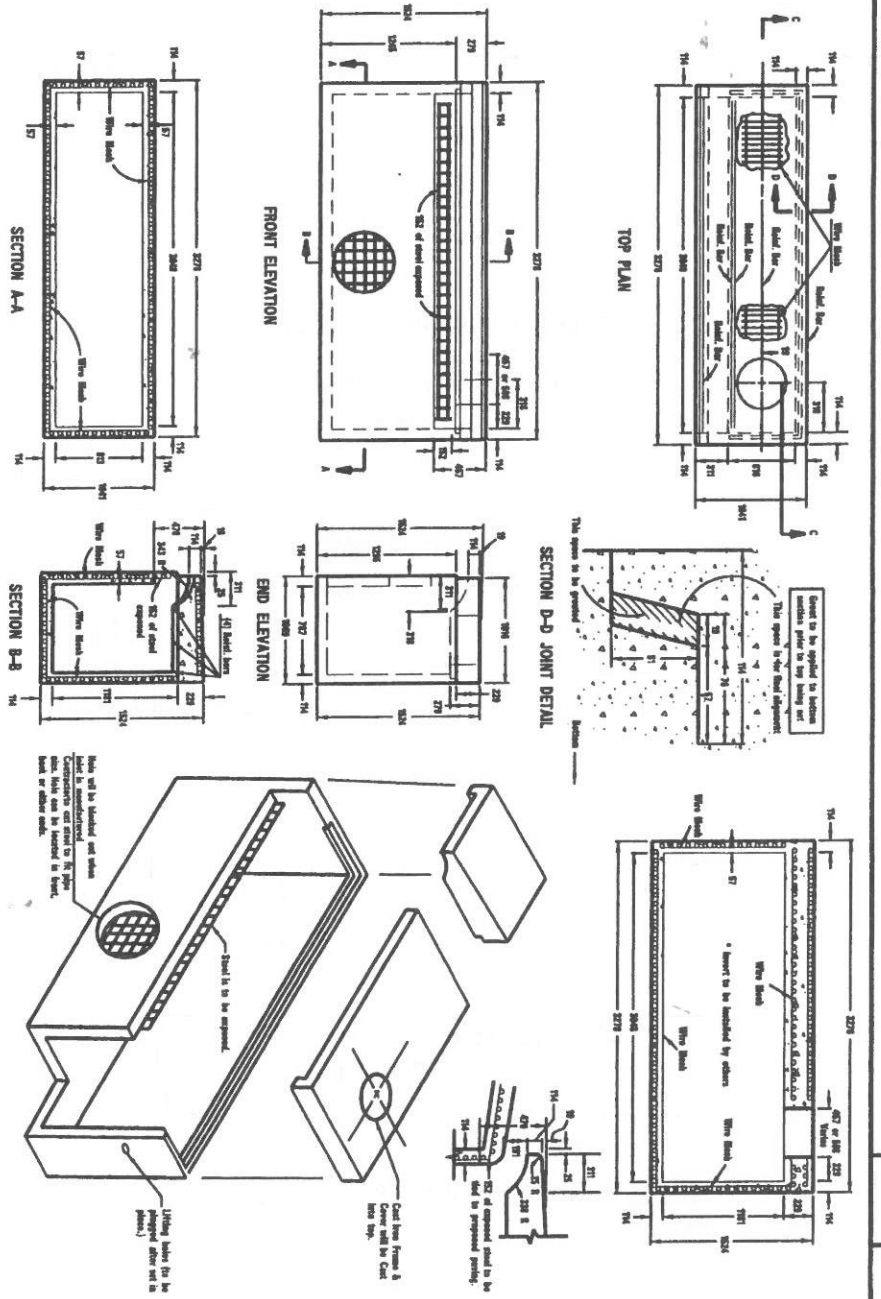
AASHTO M 199M (ASTM C 478M) except that the minimum wall thickness shall be 76 mm.

USE

Precast Manholes provide a vertical access to drainage structures and allow for intersection and junction.

PRECAST CONCRETE MANHOLE SECTIONS

AASHTO–AGC–ARTBA TF–13 DRAWING	CPA–1–96



NOTE: All dimensions shown are in millimeters.

APPLICABLE SPECIFICATIONS

AASHTO Standard Specifications for Highway Bridges. Section 8

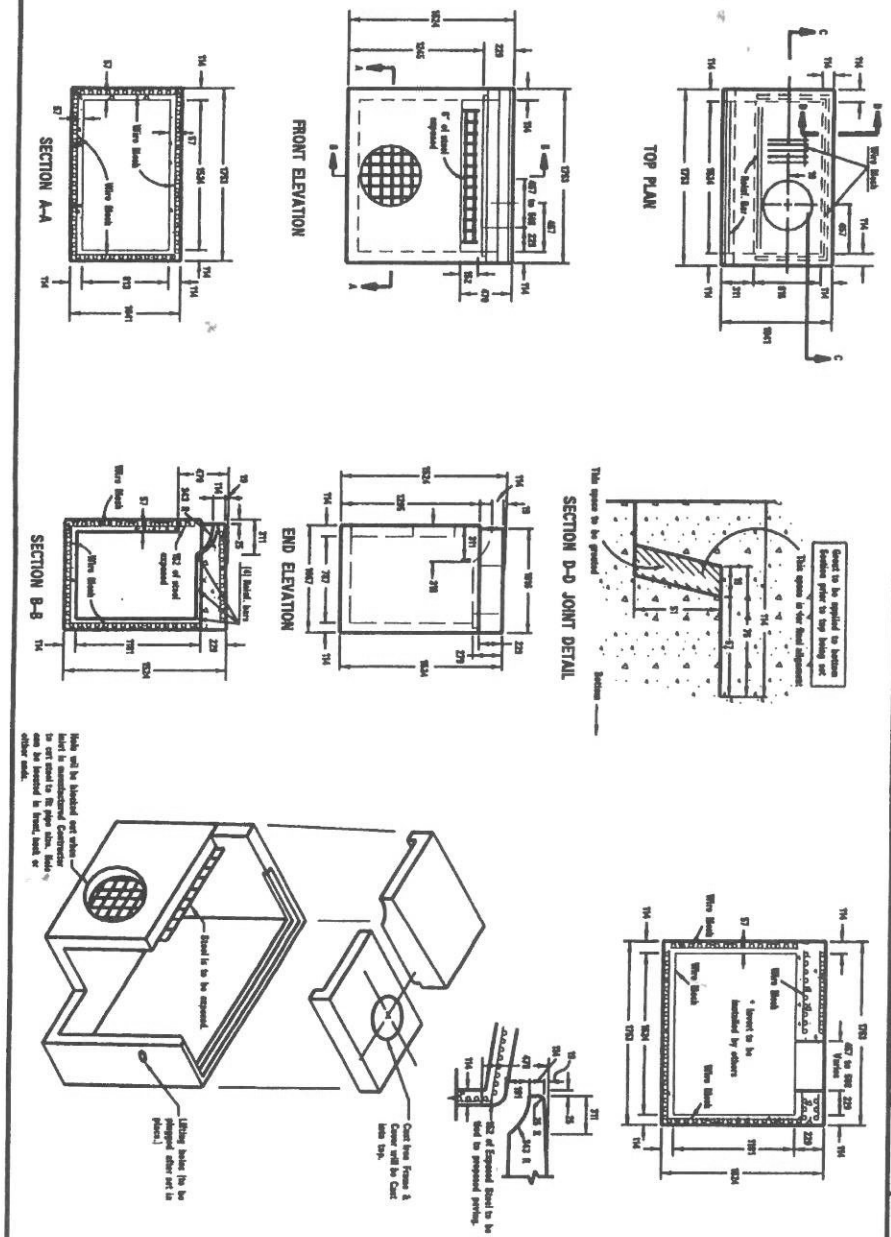
USE

Provide an entry for drainage water from a curbed gutter to a storm drain or culvert.

3-m 2-PIECE PRECAST CURB INLET

AASHTO-AGC-ARTBA
TF-13 DRAWING

CPA-2-96



NOTE: All dimensions shown are in millimeters.

APPLICABLE SPECIFICATIONS

AASHTO Standard Specifications for Highway Bridges. Section 8

USE

Provide an entry for drainage water from a curbed gutter to a storm drain or culvert.

1.5–m 2–PIECE PRECAST CURB INLET

AASHTO–AGC–ARTBA
TF–13 DRAWING

CPA–3–96

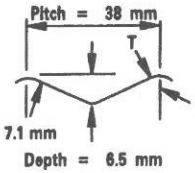
PART 2

CORRUGATED METAL DRAINAGE PRODUCTS (CM)

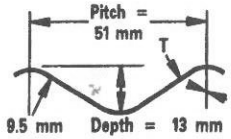
Design information for corrugated metal pipe may be obtained from Division I, Section 12 of the American Association of State Highway & Transportation Officials' (AASHTO) *Standard Specifications for Highway Bridges.*

Additional design information on CSP may be obtained from the American Iron & Steel Institute's *Handbook of Steel Drainage & Highway Construction Products.*

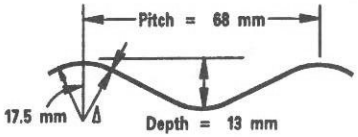
Additional design information on CORRUGATED ALUMINUM PIPE may be obtained from the Aluminum Association's *Aluminum Drainage Products Manual.*



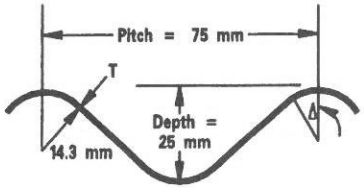
38x6.5 mm Corrugations (Helical)



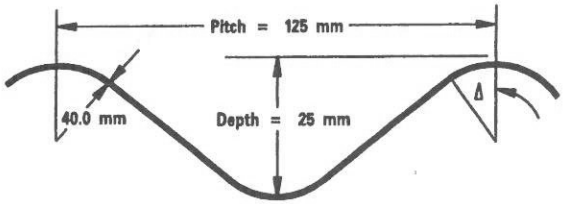
51x13 mm Corrugations (Helical)



68x13 mm Corrugations (Annular or Helical)



75x25 mm Corrugations (Annular or Helical)



125x25 mm Corrugations (Helical)

APPLICABLE SPECIFICATIONS

1. Corrugated Steel Pipe shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. The corrugations shall form smooth and continuous tangents. The corrugations may be annular, spiral, or a combination of annular and spiral.

3. Type 1 pipe is round pipe.

INTENDED USE

Pipe for culverts, underdrains and storm sewers

CORRUGATIONS & STANDARD THICKNESS

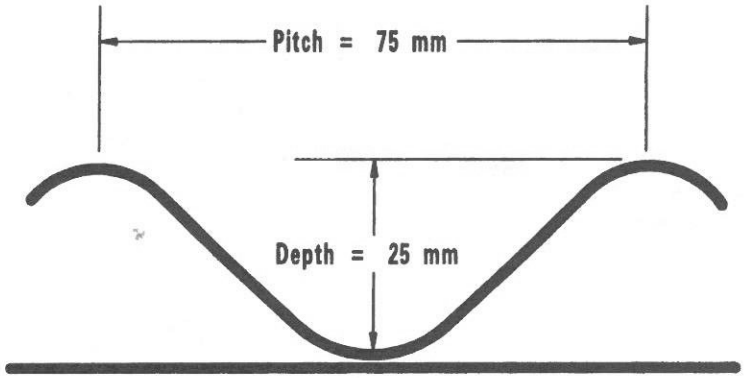
38 x 6.5	51 x 13	68 x 13	75 x 25	127 x 25
1.32	1.32	1.32	1.32	2.01
1.63	1.63	1.63	1.63	2.77
	2.01	2.01	2.01	3.51
	2.77	2.77	2.77	
	3.51	3.51	3.51	
	4.27	4.27	4.27	

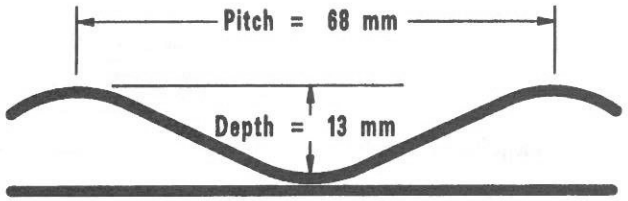
*Standard Thicknesses are in millimeters and include the base steel plus the zinc or aluminized coating on both sides. It does not include the thickness of polymer or bituminous coatings.

CORRUGATED STEEL PIPE—TYPE 1
STANDARD CORRUGATIONS

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMCS-1-96





APPLICABLE SPECIFICATIONS

1. Smooth lined corrugated steel pipe shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   ASTM A 796
2. The corrugations shall form smooth and continuous tangents. The corrugations shall be spiral (helical) with a smooth liner integrally attached at the lockseams spaced not more than 762 mm apart and extending from end to end of each length of pipe.
3. Type 1A pipe is round pipe with a smooth liner and helically corrugated shell.

INTENDED USES

Pipe for storm drains

STANDARD THICKNESS

EQUIVALENT TYPE 1 PIPE	TYPE A SMOOTH LINER	CORR. SHELL
1.63	1.02	1.32
2.01	1.02	1.32
2.77	1.02	2.01
3.51	1.02	2.77
4.27	1.02	3.51

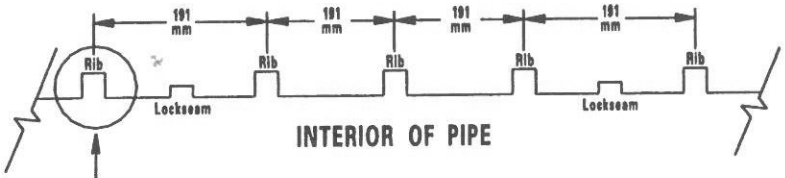
NOTE: All dimensions shown are in millimeters.

CORRUGATED STEEL PIPE—TYPE 1A
STANDARD CORRUGATIONS

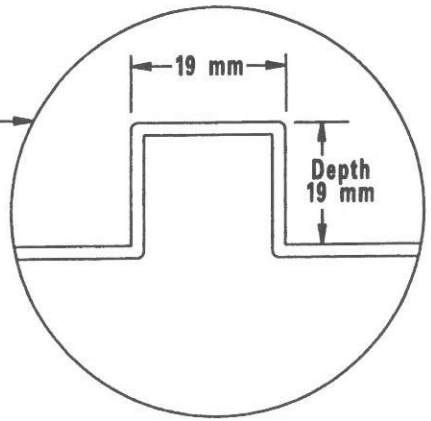
AASHTO-AGC-ARTBA
TF-13 DRAWING

CMCS-2-96

LONGITUDINAL SECTION
SPIRAL RIB CONFIGURATION



INTERIOR OF PIPE



Rib Detail

Note: All dimensions are in millimeters

APPLICABLE SPECIFICATIONS

1. Spiral Ribbed steel pipe shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   ASTM A 849
2. The pipe is fabricated from a single thickness of smooth sheet with helical spaced ribs projecting outwardly.
3. Type 1R pipe is round pipe.

INTENDED USES

Pipe for storm drains which require the hydraulic efficiency of smooth interior wall pipe. Polymer or Bituminous coatings may be required in addition to metallic coatings.

STANDARD THICKNESS*

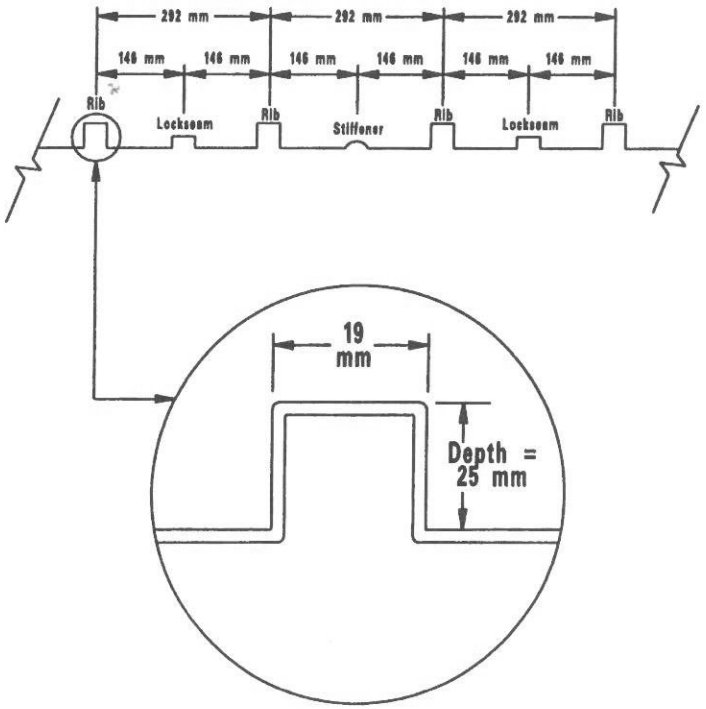
1.63
2.01
2.77
3.51

NOTE: Standard thickness includes the base steel plus the metallic coating on both sides. It does not include the thickness of the polymer or bituminous coatings.

CORRUGATED STEEL PIPE—TYPE 1R
191-mm SPIRAL RIB CONFIGURATION

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMCS-3-96



Rib Detail

APPLICABLE SPECIFICATIONS

1. Spiral Ribbed steel pipe shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)

2. The pipe is fabricated from a single thickness of smooth sheet with helical spaced ribs projecting outwardly.

3. Type 1R pipe is round pipe.

INTENDED USES

Pipe for storm drains which require the hydraulic efficiency of smooth interior wall pipe. Polymer or Bituminous coatings may be required in addition to metallic coatings.

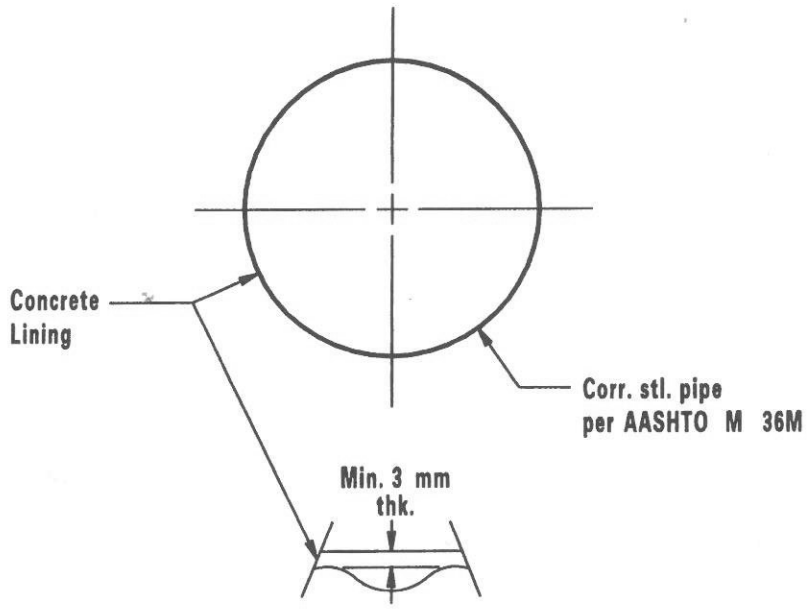
STANDARD THICKNESS*

1.63
2.01
2.77
3.51

NOTE: Standard thickness includes the base steel plus the metallic coating on both sides. It does not include the thickness of the polymer or bituminous coatings.

CORRUGATED STEEL PIPE—TYPE 1R
292-mm SPIRAL RIB CONFIGURATION

AASHTO-AGC-ARTBA TF-13 DRAWING	CMCS-4-96



CORRUGATIONS

CORRUGATIONS	STANDARD THICKNESS (mm)	STANDARD DIAMETERS (mm)
68 x 13	1.63,2.01, 2.77,3.50, 4.27	300,375,450,525,600,750, 900,1050,1200,1350,1500,1650, 1800,1950,2100,2250,2400
75 x 25	1.63,2.01, 2.77,3.50, 4.27	1350,1500,1650,1800,1950, 2100,2250,2400,2550,2700, 2850
125 x 25	1.63,2.01, 2.77,3.50, 4.27	1400,1500,1650,1800,2000, 2200,2250,2400,2550,2700, 2850,3000

Note: All dimensions in millimeters

APPLICABLE SPECIFICATIONS

1. Corrugated Steel Pipe shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Lining shall conform to ASTM A 849.

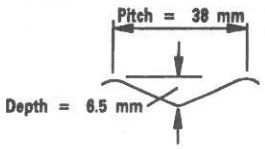
INTENDED USES

Pipe for storm sewer.

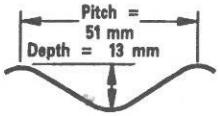
CONCRETE LINED—CORRUGATED STEEL PIPE

AASHTO–AGC–ARTBA
TF–13 DRAWING

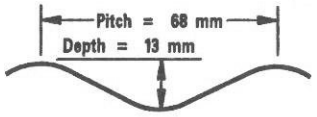
CMCS–5–96



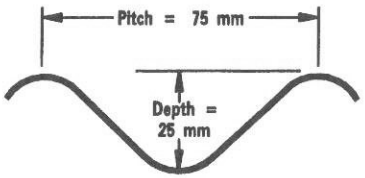
38x6.5 mm Corrugations (Helical)



51x13 mm Corrugations (Helical)



68x13 mm Corrugations (Annular or Helical)



75x25 mm Corrugations (Annular or Helical)

APPLICABLE SPECIFICATIONS

1. Corrugated aluminum pipe shall conform to the requirements of:

   AASHTO M 196M & M 197M (Aluminum)
   AASHTO M 190 (Bituminous Coated)

2. The corrugations shall form smooth and continuous tangents. The corrugations may be annular, spiral, or a combination of annular and spiral.

3. Type 1 pipe is round pipe.

INTENDED USES

Pipe for culverts, underdrains and storm sewers

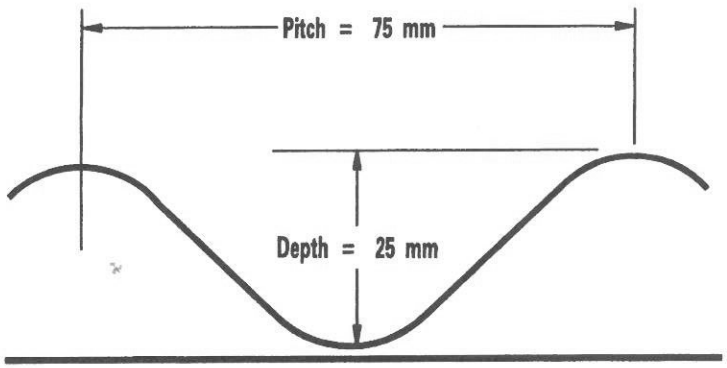
CORRUGATIONS & STANDARD THICKNESS

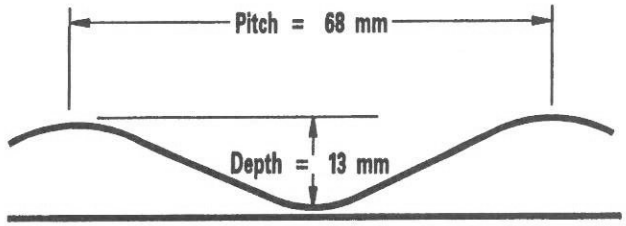
38x6.5 mm	51x13 mm	68x13 mm	75x25 mm
1.22	1.22	1.22	1.52
1.52	1.52	1.52	1.91
	1.91	1.91	2.67
	2.67	2.67	3.43
	3.43	3.43	4.17
	4.17	4.17	

CORRUGATED ALUMINUM PIPE—TYPE 1
STANDARD CORRUGATIONS

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMCA-6-96





APPLICABLE SPECIFICATIONS

1. Smooth lined corrugated aluminum pipe shall conform to the requirements of:

   AASHTO M 196M & M 197M (Aluminum)
   AASHTO M 190 (Bituminous Coated)

2. The corrugations shall form smooth and continuous tangents. The corrugations shall be spiral (helical) with a smooth liner integrally attached at the lockseams spaced not more than 760 mm apart and extending from end to end of each length of pipe.

3. Type 1A pipe is round pipe with a smooth liner and helically corrugated shell.

INTENDED USES

Pipe for storm drains.

STANDARD THICKNESS

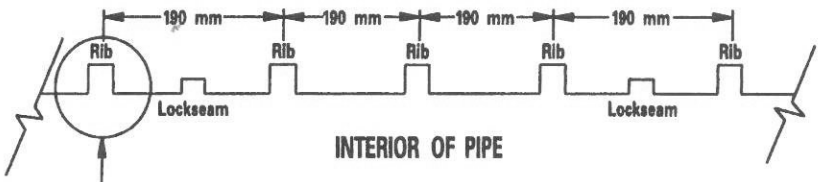
EQUIVALENT TYPE 1 PIPE	TYPE A SMOOTH LINER	CORRUGATED SHELL
1.52 mm	0.91 mm	1.22 mm
1.91	0.91	1.22
2.67	0.91	1.91
3.43	0.91	2.67
4.17	0.91	3.43

CORRUGATED ALUMINUM PIPE—TYPE 1A
STANDARD CORRUGATIONS

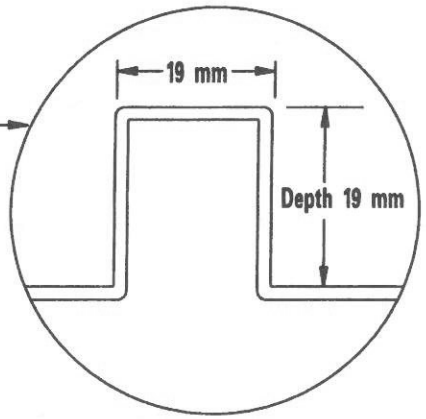
AASHTO–AGC–ARTBA
TF–13 DRAWING

CMCA–7–96

LONGITUDNAL SECTION
SPIRAL RIB CONFIGURATION



INTERIOR OF PIPE



Rib Detail

APPLICABLE SPECIFICATIONS

1. Spiral Ribbed aluminum alloy pipe shall conform to the requirements of: AASHTO M 196M & M 197M.
2. The pipe is fabricated from a single thickness of smooth sheet with helical spaced ribs projecting outwardly.
3. Type 1R pipe is round pipe.

INTENDED USES

Pipe for storm drains which require the hydraulic efficiency of smooth interior wall pipe.

STANDARD THICKNESS

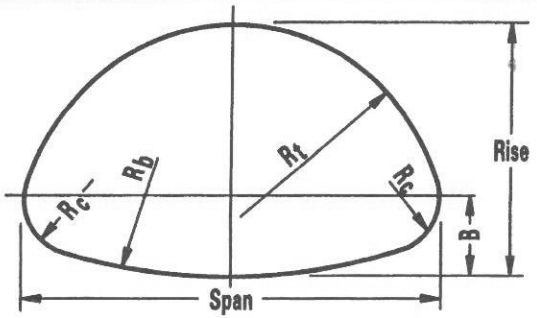
1.52 mm
1.91
2.67
3.43

CORRUGATED ALUMINUM ALLOY PIPE—TYPE 1R
SPIRAL RIB CORRUGATIONS

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMCA-8-96

SECTION CMF—PIPE ARCH DIMENSIONS & FITTINGS, CIRCULAR PIPE FITTINGS



Pipe Arches - 68 mm x 13 mm Corrugations

Pipe Arch Size mm	Equiv. Diam. mm	Span mm	Rise mm	Min. Corner Radius mm	Max. B mm
430 x 330	375	430	330	75	135
530 x 380	450	530	380	75	155
610 x 460	525	610	460	75	185
710 x 510	600	710	510	75	205
780 x 560	675	780	560	75	225
885 x 610	750	870	630	75	240
970 x 690	825	970	690	75	255
1060 x 740	900	1060	740	90	265
1240 x 840	1050	1240	840	100	290
1440 x 970	1200	1440	970	130	345
1620 x 1100	1350	1620	1100	155	380
1800 x 1200	1500	1800	1200	180	420
1950 x 1320	1650	1950	1320	205	460
2100 x 1450	1800	2100	1450	230	510

Pipe Arches -75 x 25 and 125 x 25 Corrugations

Pipe Arch Size mm	Equiv. Diam. mm	Span mm	Rise mm	Min. Corner Radius mm
1010 x 790	900	1010 - 45	790 + 45	130
1160 x 920	1050	1160 - 55	920 + 55	155
1340 x 1050	1200	1340 - 60	1050 + 60	180
1520 x 1170	1350	1520 - 70	1170 + 70	205
1670 x 1300	1500	1670 - 75	1300 + 75	230
1850 x 1400	1650	1850 - 85	1400 + 85	305
2050 x 1500	1800	2050 - 95	1500 + 95	355
2200 x 1620	1950	2200 - 110	1620 + 110	355
2400 x 1720	2100	2400 - 120	1720 + 120	410
2600 x 1820	2250	2600 - 130	1820 + 130	410
2840 x 1920	2400	2840 - 145	1920 + 145	460
2970 x 2020	2550	2970 - 150	2020 + 150	460
3240 x 2120	2700	3240 - 165	2120 + 165	460
3470 x 2220	2850	3470 - 175	2220 + 175	460
3600 x 2320	3000	3600 - 180	2320 + 180	460

SPECIFICATIONS

1. Corrugated steel pipe arch shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. A tolerance of plus or minus 25 mm or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise.

3. "B" is defined as the vertical dimension from a horizontal line across the widest portion of the arch to the lowest portion of the base.

4. All dimensions are measured from the inside crests of all corrugations.

5. Type II and IIA pipe are of the pipe arch shape.

INTENDED USES

Pipe for culverts, underdrains and storm sewers where the vertical allowable height is restricted.

STANDARD THICKNESS

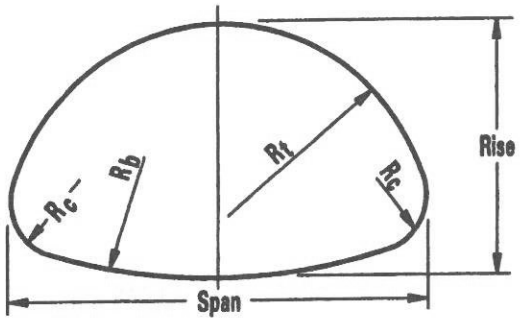
Corrugation	Type	Standard Thicknesses
68 x 13	II, IIA	1.63,2.01,2.77,3.51,4.27
75 x 25	II, IIA	2.01,2.77,3.51,4.27
125 x 25	II, IIA	2.77,3.51,4.27

Equiv. Type IA Pipe	Smooth Liner	Corrugated Shell
1.63	1.02	1.32
2.01	1.02	1.32
2.77	1.02	2.01
3.51	1.02	2.77
4.27	1.02	3.51

CORRUGATED STEEL PIPE ARCH (Type II, IIA)

AASHTO-AGC-ARTBA TF-13 DRAWING

CMFS-1-96



19 x 19 x 191 or 19 x 25 x 292 mm Corrugations

Pipe Arch Size mm	Equivalent Diameter mm	Span mm	Rise mm	Minimum Corner Radius mm
500 x 410	450	500 – 25	410 + 25	130
580 x 490	525	580 – 25	490 + 25	130
680 x 540	600	680 – 40	540 + 40	130
750 x 620	675	750 – 40	620 + 40	130
830 x 670	750	830 – 40	670 + 40	130
900 x 750	825	900 – 45	750 + 45	130
1010 x 790	900	1010 – 45	790 + 45	130
1160 x 920	1050	1160 – 55	920 + 55	155
1340 x 1050	1200	1340 – 60	1050 + 60	180
1520 x 1170	1350	1520 – 70	1170 + 70	205
1670 x 1300	1500	1670 – 75	1300 + 75	230
1850 x 1400	1650	1850 – 85	1400 + 85	305
2050 x 1500	1800	2050 – 95	1500 + 95	355

SPECIFICATIONS

1. Corrugated steel pipe arch shall conform to the requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Negative and positive numbers listed with span and rise dimensions are negative and positive tolerances, no tolerances in opposite direction.

3. All dimensions are measured from the inside crests of all corrugations.

4. Type IIR pipe is of the pipe arch shape.

INTENDED USES

Pipe for culverts, underdrains and storm sewers where the vertical allowable height is restricted.

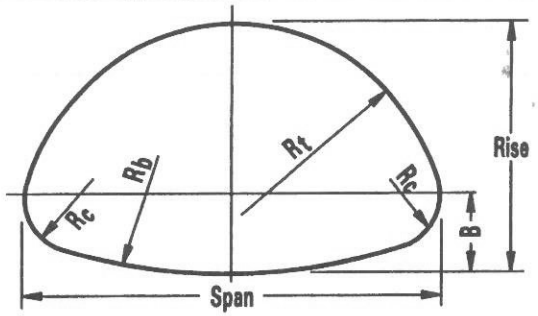
STANDARD THICKNESS

Corrugation	Type	Standard Thicknesses
19 x 19 x 191	IIR	1.63,2.01,2.77,3.51
19 x 25 x 292	IIR	1.63, 2.01,2.77,3.51

CORRUGATED STEEL PIPE ARCH (Type IIR)

AASHTO-AGC-ARTBA TF-13 DRAWING

CMFS-2-96



Pipe Arches - 68 mm x 13 mm Corrugations

Pipe Arch Size mm	Equiv. Diam. mm	Span mm	Rise mm	Min. Corner Radius mm	Max. B mm
430 x 330	375	430	330	75	135
530 x 380	450	530	380	75	155
610 x 460	525	610	460	75	185
710 x 510	600	710	510	75	205
780 x 560	675	780	560	75	225
885 x 610	750	870	630	75	240
970 x 690	825	970	690	75	255
1060 x 740	900	1060	740	90	265
1240 x 840	1050	1240	840	100	290
1440 x 970	1200	1440	970	130	345
1620 x 1100	1350	1620	1100	155	380
1800 x 1200	1500	1800	1200	180	420
1950 x 1320	1650	1950	1320	205	460
2100 x 1450	1800	2100	1450	230	510

Pipe Arches - 75 mm x 25 mm Corrugations

Pipe Arch Size mm	Equiv. Diam. mm	Span mm	Rise mm	Min. Corner Radius mm
1340 x 1050	1200	1340 - 60	1050 + 60	180
1520 x 1170	1350	1520 - 70	1170 + 70	205
1670 x 1300	1500	1670 - 75	1300 + 75	230
1850 x 1400	1650	1850 - 85	1400 + 85	305
2050 x 1500	1800	2050 - 95	1500 + 95	355
2200 x 1620	1950	2200 - 110	1620 + 110	355
2400 x 1720	2100	2400 - 120	1720 + 120	410
2600 x 1820	2250	2800 - 130	1820 + 130	410
2840 x 1920	2400	2840 - 145	1920 + 145	460
2970 x 2020	2550	2970 - 150	2020 + 150	460
3240 x 2120	2700	3240 - 165	2120 + 165	460
3470 x 2220	2850	3470 - 175	2220 + 175	460
3800 x 2320	3000	3600 - 180	2320 + 180	460

SPECIFICATIONS

1. Corrugated aluminum pipe arch shall conform to the requirements of:
   AASHTO M 196M & M 197M (Aluminum)
   AASHTO M 190 (Bituminous Coated)

2. For the 68 mm x 13 mm Corrugation Table a tolerance of plus or minus 25 mm or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise.

3. "B" is defined as the vertical dimension from a horizontal line across the widest portion of the arch to the lowest portion of the base.

4. Negative and positive numbers listed with span and rise dimensions are negative and positive tolerances, zero tolerance in oppositve direction.

5. All dimensions are measured from the inside crests of the corrugations.

6. Type II pipe is of the pipe arch shape.

INTENDED USES

Pipe for culverts, underdrains and storm sewers where the vertical allowable height is restricted.

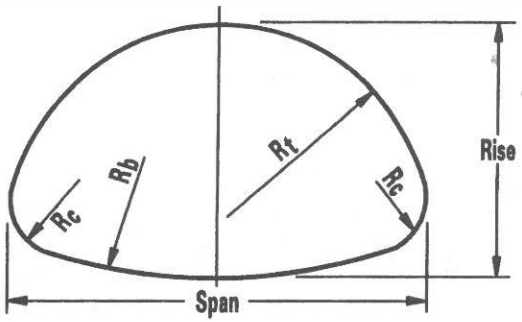
STANDARD THICKNESS

Corrugation	Type	Standard Thicknesses
68 x 13	II, IIA	1.22,1.52,1.91,2.67,3.43,4.19
75 x 25	II, IIA	1.52,1.91,2.67,3.43,4.19

CORRUGATED ALUMINUM PIPE ARCH (Type II, IIA)

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMFA-1-96



Pipe Arches
19 x 19 x 190 mm and 19 x 25 x 292 mm Rib Corrugations

Pipe Arch Size mm	Equiv. Diam. mm	Span mm	Rise mm	Min. Corner Radius mm
500 x 410	450	500 – 25	410 + 25	130
580 x 490	525	580 – 25	490 + 25	130
680 x 540	600	680 – 40	540 + 40	130
830 x 670	750	830 – 40	670 + 40	130
1010 x 790	900	1010 – 45	790 + 45	130
1160 x 920	1050	1160 – 55	920 + 55	155
1340 x 1050	1200	1340 – 60	1050 + 60	180
1520 x 1170	1350	1520 – 70	1170 + 70	205
1670 x 1300	1500	1670 – 75	1300 + 75	230
1850 x 1400	1650	1850 – 85	1400 + 85	305
2050 x 1500	1800	2050 – 95	1500 + 95	355

SPECIFICATIONS

1. Corrugated aluminum pipe arch shall conform to the requirements of:
   AASHTO M 196M & M 197M (Aluminum)
   AASHTO M 190 (Bituminous Coated)

2. Negative and positive numbers listed with span and rise dimensions are negative and positive tolerances, zero tolerance in opposite direction.

3. All dimensions are measured from the inside surface of the corrugations.

4. Type IIR pipe is of the pipe arch shape.

INTENDED USES

Pipe for culverts, underdrains and storm sewers where the vertical allowable height is restricted.

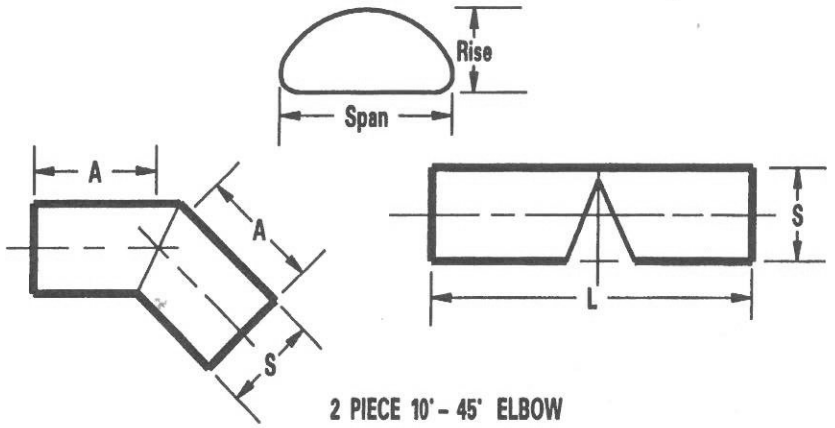
STANDARD THICKNESS

Corrugation	Type	Standard Thicknesses
19 x 19 x 190	IIR	1.22,1.52,1.91,2.67,3.43,4.19
19 x 25 x 292	IIR	

CORRUGATED ALUMINUM PIPE ARCH (Type IIR)

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMFA–2–96



2 PIECE 10° - 45° ELBOW

	CORRUGATIONS					
	75 x 25 & 125 x 25		68 x 13			
EQUIV. DIAM.	SPAN[A] S	RISE[A] R	SPAN[B] S	RISE[B] R	45° ELBOW 2 PIECE	
mm	mm	mm	mm	mm	A mm	L m
375			430	330		
450			530	380		
525			610	460	508	1.22
600			710	510	508	1.22
675			780	560	483	1.22
750			870	630	457	1.22
825			970	690	406	1.22
900	1010 - 45	790 + 45	1060	740	685	1.83
1050	1160 - 55	920 + 55	1240	840	635	1.83
1200	1340 - 60	1050 + 60	1440	970	610	1.83
1350	1520 - 70	1170 + 70	1620	1100	864	2.44
1500	1670 - 75	1300 + 75	1800	1200	838	2.44
1650	1850 - 85	1400 + 85	1950	1320	1092	3.05
1800	2050 - 95	1500 + 95	2100	1450	1067	3.05

[A]Negative and positive numbers listed with span and rise dimensions are negative and positive tolerances, no tolerance in opposite direction.

[B]A tolerance of 25 mm or 2% of equivalent diameter, whichever is greater, will be permissable in span and rise.

SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

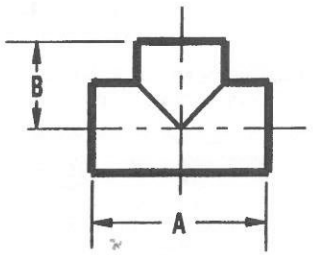
1. Culvert or storm sewer where change in alignment or grade occur or for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

PIPE ARCH CMP ELBOW FITTINGS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–3–96



Tee

DIA.	A	B	L
mm	meters		
150	0.61	0.61	1.22
200	0.61	"	1.22
250	0.61	"	1.22
300	1.22	"	1.83
375	"	"	"
450	"	"	"
525	"	"	"
600	"	"	"
675	"	"	"
750	1.22	0.61	1.83
825	1.83	1.22	3.05
900	"	"	"
1050	"	"	"
1200	"	"	"
1350	1.83	"	3.05
1500	2.44	"	3.66
1650	2.44	"	3.66
1800	2.44	1.22	3.66
1950	3.05	1.83	4.88
2100	"	"	"
2250	"	"	"
2400	3.05	1.83	4.88

L = Lineal Meters Pipe to Make Fitting

Stub Diameter Same As Main or Less

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USE

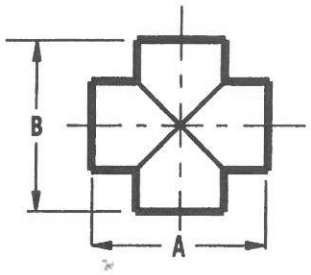
1. Culvert or storm drains where change in alignment or grade occur or for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP TEE FITTING

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMF-4-96



Cross

DIA.	A	B	L
mm	meters		
150	0.61	0.61	1.22
200	0.61	0.61	1.22
250	0.61	0.61	1.22
300	1.22	1.22	2.44
375	〃	〃	〃
450	〃	〃	〃
525	〃	〃	〃
600	〃	〃	〃
675	〃	〃	〃
750	1.22	1.22	2.44
825	1.83	1.83	3.66
900	〃	〃	〃
1050	〃	〃	〃
1200	〃	〃	〃
1350	1.83	1.83	3.66
1500	2.44	2.44	4.88
1650	2.44	2.44	4.88
1800	2.44	2.44	4.88
1950	3.05	3.05	6.10
2100	〃	〃	〃
2250	〃	〃	〃
2400	3.05	3.05	6.10

Stub Diameter Same As Main or Less

L = Lineal Meters Pipe to Make Fitting

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal–tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

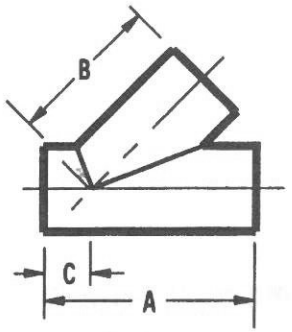
1. Culvert or storm drains where change in alignment or grade occur or for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP CROSS FITTINGS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–5–96



45° Lateral

DIA.	A	B	C	L
mm	meters		mm	meters
150	0.61	0.61	203	1.22
200	0.61	"	203	1.22
250	1.22	"	432	1.83
300	"	0.61	432	1.83
375	"	1.22	457	2.44
450	1.22	"	330	2.44
525	1.83	"	559	3.05
600	"	"	584	"
675	"	"	508	"
750	"	1.22	533	3.05
825	1.83	1.83	483	3.66
900	2.44	1.83	483	4.27
1050	2.44	1.83	533	4.27
1200	3.05	2.44	711	5.49
1350	3.05	2.44	584	5.49
1500	3.66	3.05	762	6.71
1650	3.66	"	813	6.71
1800	4.27	"	1143	7.32
1950	4.27	3.05	1168	7.32
2100	4.88	3.66	1194	8.53
2250	4.88	3.66	1245	8.53
2400	4.88	3.66	1270	8.53

Stub Diameter Same As Main or Less

L = Lineal Meters Pipe to Make Fitting

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

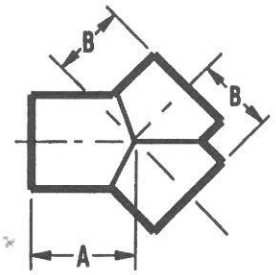
1. Culvert or storm drains for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP LATERAL FITTINGS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–6–96



45° Wye

DIA.	A	B	L
mm	meters		
150	0.61	0.61	1.83
200	"	"	"
250	"	"	"
300	"	"	"
375	"	"	"
450	"	"	"
525	"	"	"
600	"	"	"
675	"	"	"
750	0.61	0.61	1.83
825	0.61	0.91	2.44
900	"	"	"
1050	"	"	"
1200	0.61	0.91	2.44
1350	1.22	1.22	3.66
1500	"	"	"
1650	"	"	"
1800	"	1.52	4.27
1950	"	"	"
2100	"	"	"
2250	"	1.52	4.27
2400	1.22	1.83	4.88

Stub Diameter Same As Main or Less

L = Lineal Meters Pipe to Make Fitting

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

1. Culvert or storm drain where change in alignment or grade occur or for intersecting lines of pipe.

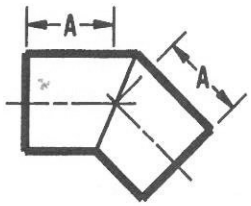
2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP WYE FITTINGS

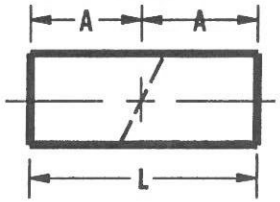
AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–7–96

DIA. mm	A m	L m
150–450	0.30	0.61
525–1200	0.61	1.22
1350–2400	0.91	1.83



2 Piece



10°– 45° Elbow

L = Lineal Meters of CMP Required to Fabricate Fitting

All Dimensions Nominal

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

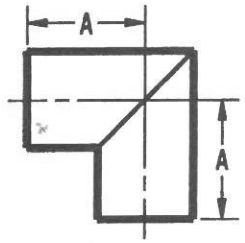
1. Culvert or storm drain where change in alignment or grade occur or for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

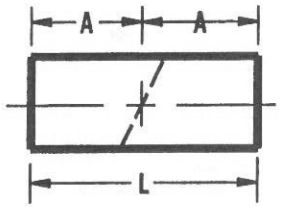
CIRCULAR CMP 10° – 45° ELBOWS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–8–96



2 Piece



50°– 90° Elbow

DIA. mm	A m	L m
150–250	0.30	0.61
300–675	0.61	1.22
750–1050	0.91	1.83
1200–1650	1.22	2.44
1800–2100	1.52	3.05
2250–2400	1.83	3.66

L = Lineal Meters of CMP Required to Fabricate Fitting

All Dimensions Nominal

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

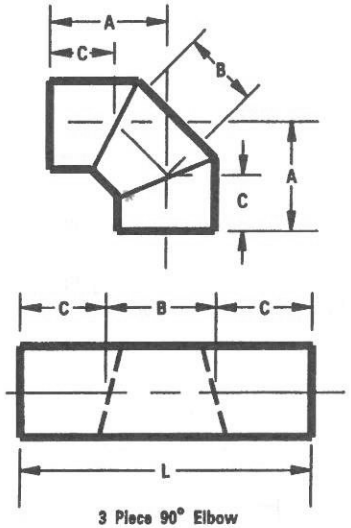
1. Culvert or storm drain where change in alignment or grade occur or for intersecting lines of pipe.

2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP 50° – 90° ELBOWS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–9–96



3 Piece 90° Elbow

L = Total meters of CMP required to fabricate fitting

All dimensions nominal

Diam. mm	A	B	C	L
	mm			m
150	343	203	203	0.61
200	356	229	191	0.61
250	356	254	178	0.61
300	648	279	470	1.22
375	673	305	457	1.22
450	686	356	432	1.22
525	686	381	419	1.22
600	699	406	406	1.22
675	699	432	394	1.22
750	1016	483	673	1.83
825	1016	508	660	1.83
900	1029	533	648	1.83
1050	1041	584	622	1.83
1200	1359	660	889	2.44
1350	1372	711	864	2.44
1500	1384	787	826	2.44
1650	1372	838	800	2.44
1800	1715	914	1067	3.05
1950	1727	991	1029	3.05
2100	1740	1041	1003	3.05
2250	1778	1168	940	3.05
2400	2083	1168	1245	3.66

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

INTENDED USES

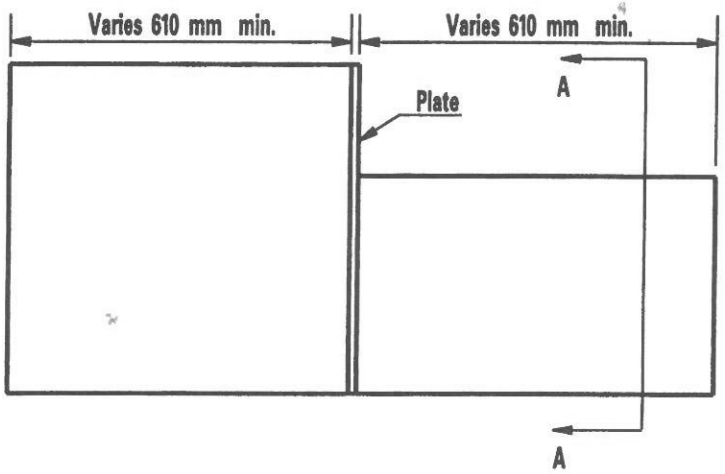
1. Culvert or storm drain where change in alignment or grade occur or for intersecting lines of pipe.

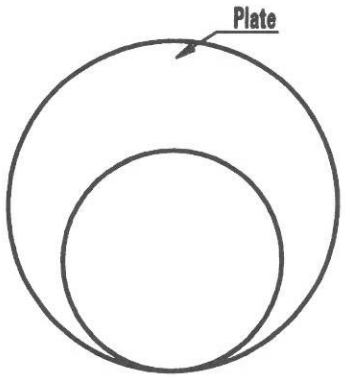
2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP 3-PIECE 90° ELBOW

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMF–10–96





SECTION A-A

APPLICABLE SPECIFICATIONS

1. Fittings shall meet the applicable requirements of:
   AASHTO M 36M & M 218 (Galvanized Steel)
   AASHTO M 196M (Aluminum)
   AASHTO M 36M & M 274 (Aluminum Coated (Type 2))
   AASHTO M 36M & M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 245M & M 246M (Polymer Coated Steel)
   AASHTO M 190 (Bituminous Coated)
   AASHTO M 36M & ASTM A 885 (Fiber Bonded)

2. Welding shall be in accordance with drawings and specifications as supplied by the manufacturer and approved by the purchaser.
   After completion of welding on galvanized or aluminum coated steel fittings, all welds and immediate surfaces of metal adjoining welds shall be repaired in accordance with AASHTO M 36M.
   When polymeric precoated pipe is specified, the polymeric coating only shall be repaired by the application of a coating meeting the performance requirements of AASHTO M 246M or a coal-tar base protective coating conforming to AASHTO M 243.

3. When specified, bituminous coating after fabrication shall conform to the requirements of AASHTO M 190, Type A or AASHTO M 243. Invert paved pipe or fully paved pipe shall conform to the requirements of AASHTO M 190, Type B, C, or D as specified.

4. Reinforcement as determined by the engineer.

INTENDED USES

1. Culvert or storm drain where change in pipe size occurs.

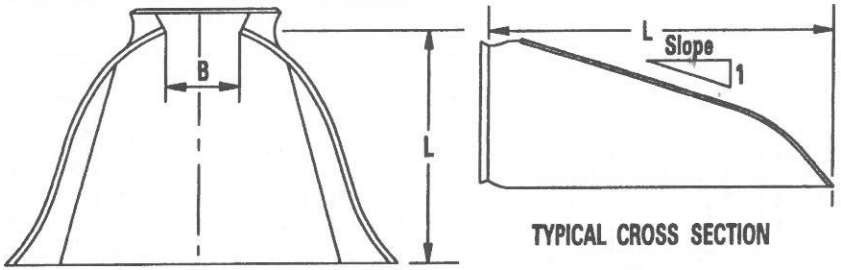
2. Underdrain and Recharge Patterns:
   a. Highway
   b. Airport
   c. Railroad
   d. Flood Protection
   e. Structures (abutments, walls, etc.)

CIRCULAR CMP REDUCER

AASHTO–AGC–ARTBA
TF–13 DRAWING

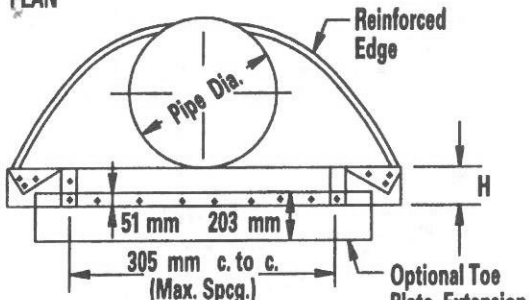
CMF–11–96

SECTION CME—END SECTIONS



PLAN

TYPICAL CROSS SECTION



ELEVATION

Pipe Diameter (mm)	Specified Thickness (mm)	A Min. (mm)	B Max. (mm)	H Min. (mm)	F Min. (mm)	L ± 2 (mm)	W Max Width (mm)	Approximate Average End Section Slope*
150	1.32	76	25	76	254	203	610	1 : 1.75
200	1.32	127	127	102	356	356	813	1 : 2.38
250	1.32	127	152	152	457	356	991	1 : 2.00
300	1.32	127	178	152	559	533	1118	1 : 2.25
375	1.63	152	203	152	711	660	1321	1 : 2.25
450	1.63	178	254	152	864	787	1473	1 : 2.13
525	1.63	203	305	152	1016	914	1676	1 : 2.13
600	1.63	229	330	152	1168	1041	1829	1 : 2.13
750	2.01	279	406	203	1397	1295	2235	1 : 2.13
900	2.01	330	483	229	1778	1524	2667	1 : 2.00
1050	2.77	381	635	254	2083	1524	3099	1 : 2.13
1200	2.77	432	737	305	2235	1981	3327	1 : 2.00
1350	2.77	432	838	305	2540	2134	3632	1 : 2.00
1500	2.77	432	914	305	2845	2210	3988	1 : 1.88
1650	2.77	432	991	305	2997	2210	4115	1 : 1.63
1800	2.77	432	1118	305	3048	2210	4267	1 : 1.50
1950	2.77	432	1219	305	3302	2210	4521	1 : 1.38
2100	2.77	432	1321	305	3454	2210	4674	1 : 1.33
2250	2.77	432	1473	305	3607	2210	4775	1 : 1.25
2400	2.77	432	1473	305	3658	2210	5004	1 : 1.13

*Fill slope need not match the end section slope. Fill can be shaped at each site to fit.
1. Some larger sizes may require field assembly.
2. Optional toe plates may be provided to depths specified.

APPLICABLE SPECIFICATIONS

1. The material used in the fabrication of End Sections shall conform to the applicable requirements of:

AASHTO M 218 (Galvanized Iron or Steel Sheets)
AASHTO M 274 (Aluminum Coated–Type 2)
AASHTO M 289 (Aluminum–Zinc Alloy Coated)
AASHTO M 197M (Aluminum Alloy Sheets)
AASHTO M 246M (Precoated Galvanized Steel Sheets)
AASHTO M 243 (When Specified–Field Applied Coating)
ASTM A 885 (Fiber Bonded)

2. All 3 piece bodies to have 2.77 mm sides and 3.51 mm center panels. Multiple panel bodies to have seams which are to be tightly joined by galvanized rivets or bolts for steel units and aluminum rivets or bolts for aluminum units.

3. For 1500 mm through 2100 mm sizes reinforced edges to be supplemented with galvanized or aluminized stiffener angles. The angles to be attached by galvanized nuts and bolts for steel units or aluminum nuts and bolts for aluminum units.

4. Galvanized Steel, Aluminized Steel or Aluminum toe plate to be available as an accessory, when specified, and will be the same thickness as the End Section.

5. Galvanized Steel, Aluminized Steel or Aluminum lifting lug available as an accessory, when specified.

6. End Sections can be used with any pipe or pipe arch wall thickness specified.

INTENDED USES

End Sections attached to the inlet and outlet ends of pipe and pipe arch:

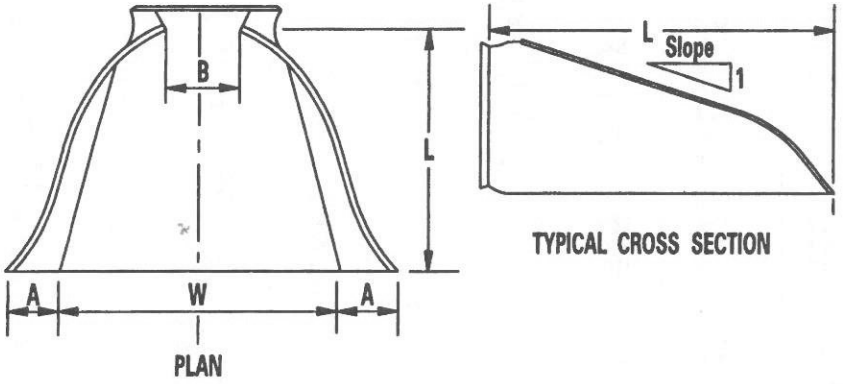
1. Prevent scour and undermining.
2. Prevent piping and burrowing.
3. Facilitates slope maintenance.
4. Aesthetically finishes ends of conduit.

NOTE: Thickness includes the base steel plus the zinc or aluminized coating on both sides. It does not include the thickness of polymer or bituminous coatings.

END SECTIONS FOR CIRCULAR PIPE
75 x 25, 68 x 13, 125 x 25, 19 x 19 x 190
and 19 x 25 x 292 CORRUGATIONS

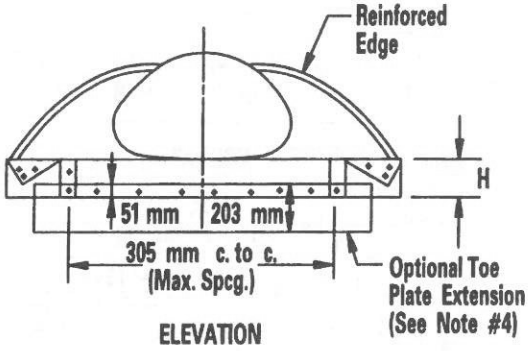
AASHTO–AGC–ARTBA
TF–13 DRAWING

CME–1–96



TYPICAL CROSS SECTION

PLAN



ELEVATION

Span x Rise (mm)	Equiv/ Round (mm)	THICKNESS GALV. STEEL	THICKNESS ALUM.	A Min. (mm)	B Max. (mm)	H Min. (mm)	F Min. (mm)	L ± 50 (mm)	W Max Width (mm)	Approximate Average End Section Slope*
430 x 330	375	1.63	1.52	127	229	152	711	508	1321	1 : 2.125
530 x 380	450	1.63	1.52	152	279	152	864	610	1473	1 : 2
610 x 460	525	1.63	1.52	178	305	152	1016	711	1600	1 : 2.125
710 x 510	600	1.63	1.52	178	406	152	1168	813	1778	1 : 2
885 x 610	750	2.01	1.91	229	406	152	1473	991	2159	1 : 1.875
1060 x 740	900	2.01	1.91	279	457	178	1854	1168	2642	1 : 1.875
1240 x 840	1050	2.77	2.67	305	533	229	2083	1346	2972	1 : 1.75
1440 x 970	1200	2.77	2.67	406	660	305	2235	1575	3353	1 : 1.875
1620 x 1100	1350	2.77	2.67	432	762	305	2540	1753	3658	1 : 1.875
1800 x 1200	1500	2.77	2.67	432	914	305	2845	1956	3962	1 : 1.875
1950 x 1320	1650	2.77	2.67	432	914	305	3150	1956	4242	1 : 1.625
2100 x 1450	1800	2.77	2.67	432	1118	305	3302	1956	4496	1 : 1.5

*Fill slope need not match the end section slope. Fill can be shaped at each site to fit.
1. Some larger sizes may require field assembly.
2. Optional toe plates may be provided to depths specified.

APPLICABLE SPECIFICATIONS

1. The material used in the fabrication of End Sections shall conform to the applicable requirements of:

AASHTO M 218 (Galvanized Iron or Steel Sheets)
AASHTO M 274 (Aluminum Coated–Type 2)
AASHTO M 289 (Aluminum–Zinc Alloy Coated)
AASHTO M 197M (Aluminum Alloy Sheets)
AASHTO M 246M (Precoated Galvanized Steel Sheets)
AASHTO M 243 (When Specified–Field Applied Coating)
ASTM A 885 (Fiber Bonded)

2. All 3 piece bodies to have 2.77 mm thick sides and 3.51 mm thick center panels. Multiple panel bodies to have seams which are to be tightly joined by galvanized rivets or bolts for steel units and aluminum rivets or bolts for aluminum units.

3. For the 1950 mm x 1320 mm and 2100 mm x 1450 mm size, reinforced edges to be supplemented with galvanized or aluminum stiffener angles. The angles to be attached by galvanized nuts and bolts for steel units and aluminum nuts and bolts for aluminum units.

4. Angle reinforcements will be placed under the center panel seams on the 1950 mm x 1320 mm and 2100 mm x 1450 mm sizes.

5. Galvanized steel, Aluminized Steel or Aluminum toe plate to be available as an accessory, when specified, and will be the same thickness as the End Section.

6. Galvanized Steel, Aluminized Steel or Aluminum lifting lug available as an accessory, when specified.

7. End Sections can be used with any pipe or pipe arch wall thickness specified.

INTENDED USES

End Sections attached to the inlet and outlet ends of pipe and pipe arch:

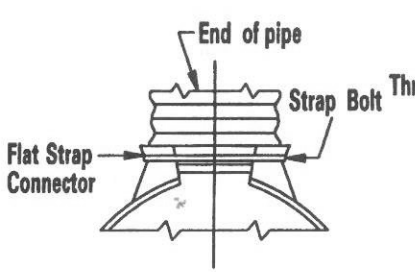
1. Prevent scour and undermining.
2. Prevent piping and burrowing.
3. Facilities slope maintenance.
4. Aesthetically finishes ends of conduit.

NOTE: Thickness includes the base steel plus the zinc or aluminized coating on both sides. It does not include the thickness of polymer or bituminous coatings.

END SECTIONS FOR PIPE ARCH
75 x 25, 125 x 25 and 68 x 13 CORRUGATIONS

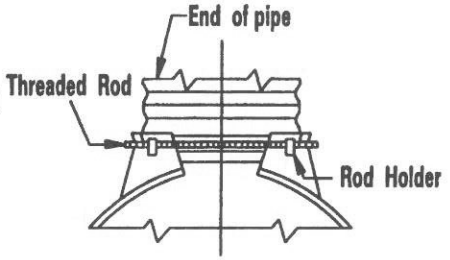
AASHTO–AGC–ARTBA
TF–13 DRAWING

CME–2–96



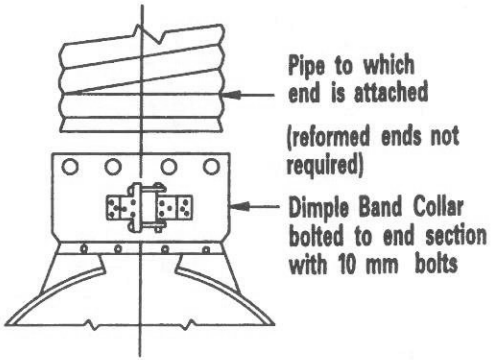
TYPE #1

Available in Sizes 300 mm Through 600 mm Round and 430 mm x 330 mm Through 710 mm x 510 mm Pipe-Arches



TYPE #2

Available in Sizes 750 mm Through 900 mm Round and 885 mm x 610 mm Through 1440 mm x 970 mm Pipe-Arches



TYPE #3

Available For All Round and Pipe-Arch Sizes Shown
(Type 1 and Type 2 Conditions are Recommended for the Smaller Sizes with Annular Ends)

SPECIFICATIONS

1. The material used in the fabrication of end sections shall conform to the applicable requirements of:

AASHTO M 218 (Galvanized Iron or Steel Sheets)
AASHTO M 274 (Aluminum Coated-Type 2)
AASHTO M 289 (Aluminum-Zinc Alloy Coated)
AASHTO M 197M (Aluminum Alloy Sheets)
AASHTO M 246M (Precoated Galvanized Steel Sheets)
AASHTO M 243 (When Specified-Field Applied Coating)
ASTM A 885 (Fiber Bonded)

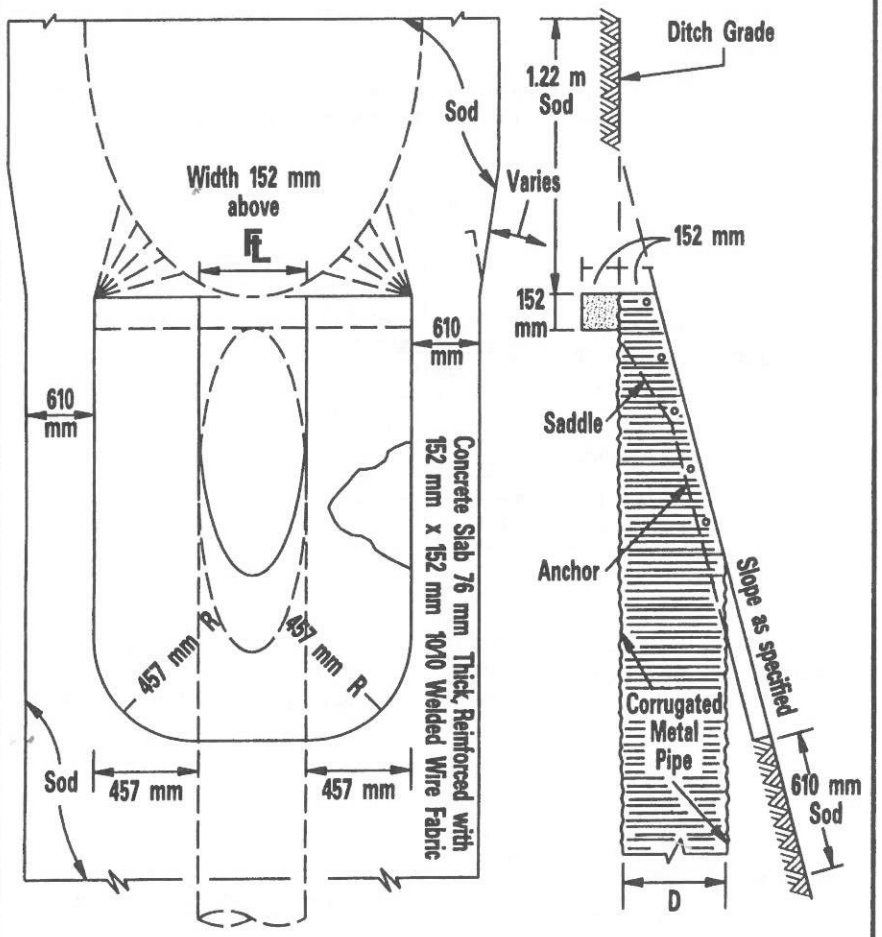
INTENDED USES

Connecting end sections to circular pipe and pipe arch shapes.

END SECTION CONNECTIONS CIRCULAR AND ARCH SHAPES

AASHTO-AGC-ARTBA TF-13 DRAWING

CME-3-96



SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Iron or Steel Sheets)
   AASHTO M 274 (Aluminum Coated–Type 2)
   AASHTO M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 197M (Aluminum Alloy Sheets)
   AASHTO M 246M (Precoated Galvanized Steel Sheets)
   ASTM A 885 (Fiber Bonded)

2. Sloped End Sections shall be fabricated from full circular pipe, may be formed into pipe arches when specified, and shall meet all requirements for corrugations, thickness and other applicable fabrication requirements.

3. Seams in the beveled portion of the end sections should be tack welded to provide proper handling and installation strength.

4. All cut edges shall be cleaned, deburred and coated with approved compound as recommended by the sheet manufacturer.

5. Type A sloped end sections shall be securely anchored to a concrete slope pavement and the toe cut-off foundation to prevent slope scouring and hydraulic uplift.

6. Sloped ends are typically used to reduce hazard of culvert end to errant vehicles. Grates or other devices may also be required to effect this end.

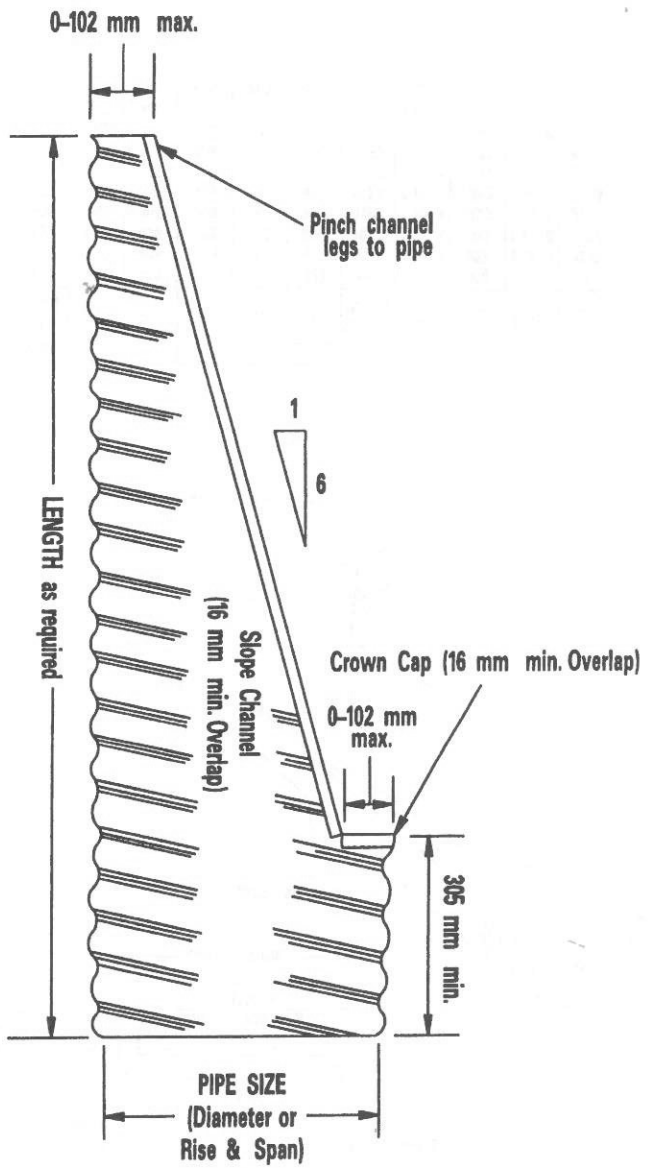
INTENDED USES

To provide end finish to a line of pipe conforming to embankment contour. Various slopes may be specified.

SLOPED END SECTION—TYPE A

AASHTO–AGC–ARTBA
TF–13 DRAWING

CME–4–96



SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Iron or Steel Sheets)
   AASHTO M 274 (Aluminum Coated–Type 2)
   AASHTO M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 197M (Aluminum Alloy Sheets)
   AASHTO M 256 (Polymer Coated Steel)
   ASTM A 885 (Fiber Bonded)

2. Sloped End Sections shall be formed from full circle pipe, may be formed into pipe arches when specified, and shall meet all requirements for corrugations, thickness and other fabrication requirements.

3. The exposed edge cut on the top (0–102 mm) shall be covered with a protective cap overlapping the top of the arch by not less than 16 mm. The 1 to 6 bevel shall be encased with a protective cap overlapping each side of the cut edge by not less than 16 mm. The protective cap is to the same material as the pipe and the same or larger thickness. Protective caps shall be welded with 13 mm welds alternating from side to side of the cap at 305 mm intervals. Welds shall be at the ends of all caps, regardless of spacing. Weld spatter and flux shall be removed prior to repair with compounds recommended by the sheet manufacturer.

4. Sloped ends are typically used to reduce hazard of culvert end to errant vehicles. Grates or other devices may also be required to effect this end.

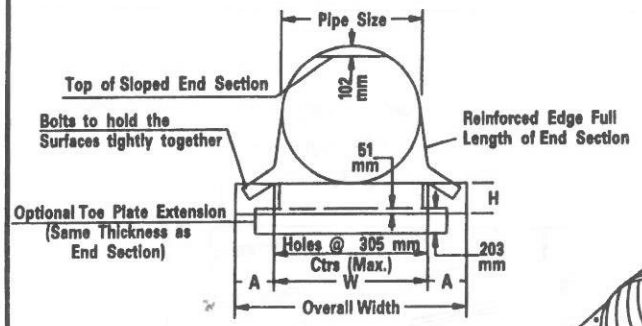
INTENDED USES

To provide end finish to a line of pipe conforming to embankment contour. Various slopes may be specified.

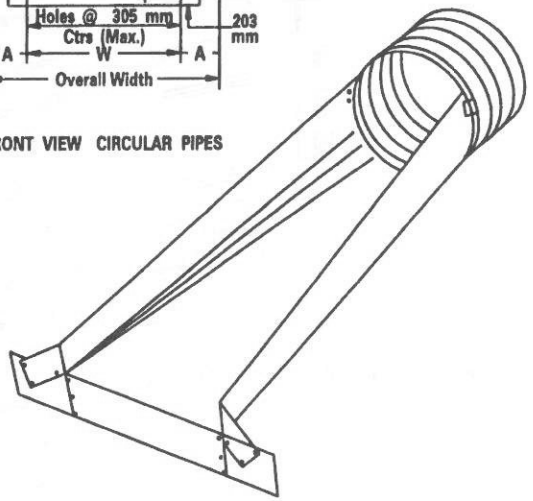
SLOPED END SECTION—TYPE B

AASHTO–AGC–ARTBA
TF–13 DRAWING

CME–5–96



FRONT VIEW CIRCULAR PIPES



Safety slope end section

Pipe Dia. (mm)	mm	Gage	A	H	W	Overall Width	Slope	Length (mm)	Slope	Length (mm)
375	1.63	406	203	152	533	940	1 to 4	508	1 to 6	762
450	1.63	406	203	152	610	1016	1 to 4	813	1 to 6	1219
525	1.63	406	203	152	686	1092	1 to 4	1118	1 to 6	1676
600	1.63	406	203	152	762	1168	1 to 4	1422	1 to 6	2134
750	2.77	305	305	229	914	1524	1 to 4	2032	1 to 6	3048
900	2.77	305	305	229	1067	1676	1 to 4	2642	1 to 6	3962
1050	2.77	305	406	305	1219	2032	1 to 4	3251	1 to 6	4877
1200	2.77	305	406	305	1372	2184	1 to 4	3861	1 to 6	5791
1350	2.77	305	406	305	1524	2337	1 to 4	4470	1 to 6	6706
1500	2.77	305	406	305	1676	2489	1 to 4	5080	1 to 6	7620

SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Iron or Steel Sheets)
   AASHTO M 274 (Aluminum Coated–Type 2)
   AASHTO M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 197M (Aluminum Alloy Sheets)
   AASHTO M 256 (Polymer Coated Steel)
   ASTM A 885 (Fiber Bonded)

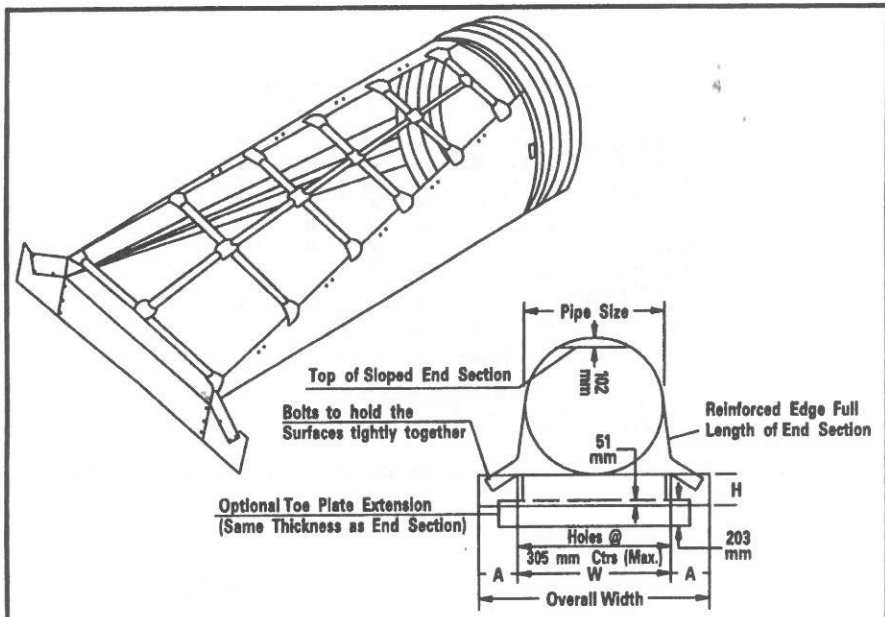
INTENDED USES

To provide end finish to a line of pipe conforming to embankment contour.

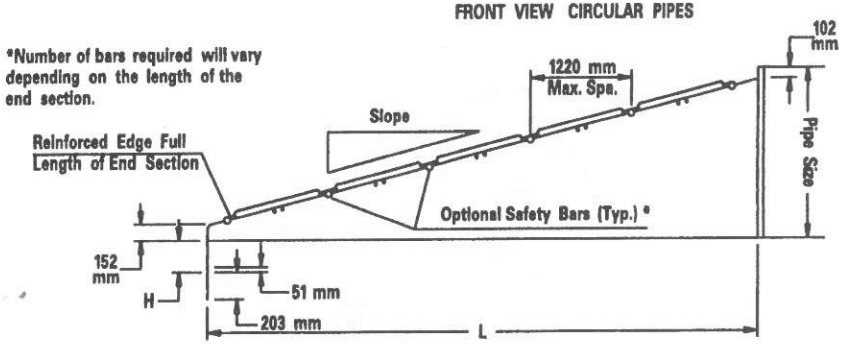
SLOPED END SECTION—TYPE B WITHOUT SAFETY BARS

AASHTO–AGC–ARTBA TF–13 DRAWING

CME–6–96



FRONT VIEW CIRCULAR PIPES



SIDE ELEVATION FOR CROSS DRAINAGE STRUCTURE

Dimensions of Galvanized Safety Slope End Sections for Round Pipe

Pipe Dia. (mm)	mm	Gage	A	H	W	Overall Width	Slope	Length (mm)	Slope	Length (mm)
375	1.63	16	203	152	533	940	1 to 4	508	1 to 6	762
450	1.63	16	203	152	610	1016	1 to 4	813	1 to 6	1219
525	1.63	16	203	152	686	1092	1 to 4	1118	1 to 6	1676
600	1.63	16	203	152	762	1168	1 to 4	1422	1 to 6	2134
750	2.77	12	305	229	914	1524	1 to 4	2032	1 to 6	3048
900	2.77	12	305	229	1067	1676	1 to 4	2642	1 to 6	3962
1050	2.77	12	406	305	1219	2032	1 to 4	3251	1 to 6	4877
1200	2.77	12	406	305	1372	2184	1 to 4	3861	1 to 6	5791
1350	2.77	12	406	305	1524	2337	1 to 4	4470	1 to 6	6706
1500	2.77	12	406	305	1676	2489	1 to 4	5080	1 to 6	7620

SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Steel)
   AASHTO M 274 (Aluminum Coated-Type 2)
   AASHTO M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 197M (Aluminum)
   AASHTO M 256 (Polymer Coated Steel)
   ASTM A 885 (Fiber Bonded)

INTENDED USES

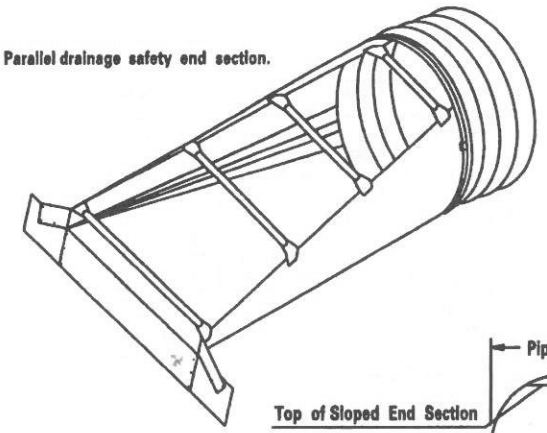
To provide end finish to a line of pipe conforming to embankment contour.

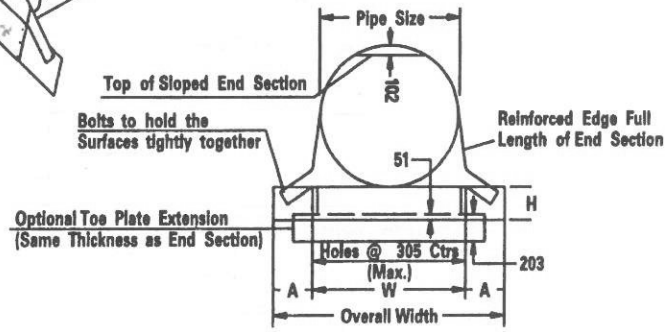
SLOPED END SECTION—TYPE C
CROSS DRAINAGE STRUCTURE WITH SAFETY BARS

AASHTO-AGC-ARTBA
TF-13 DRAWING

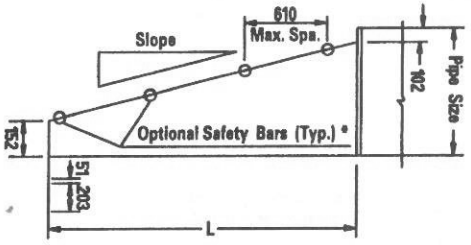
CME-7-96

Parallel drainage safety end section.





FRONT VIEW CIRCULAR PIPES



SIDE ELEVATION OF PARALLEL DRAINAGE STRUCTURE

Dimensions of Galvanized Safety Slope End Sections for Round

Pipe Dia. (mm)	Min. Thick (mm)	Dimensions (mm) A	H	W	Overall Width	L Dimensions Slope	Length (mm)	Slope	Length (mm)
375	1.63	203	152	533	940	1 to 4	508	1 to 6	762
450	1.63	203	152	610	1016	1 to 4	813	1 to 6	1219
525	1.63	203	152	686	1092	1 to 4	1118	1 to 6	1676
600	1.63	203	152	762	1168	1 to 4	1422	1 to 6	2134
750	2.77	305	229	914	1524	1 to 4	2032	1 to 6	3048
900	2.77	305	229	1067	1676	1 to 4	2642	1 to 6	3962
1050	2.77	406	305	1219	2032	1 to 4	3251	1 to 6	4877
1200	2.77	406	305	1372	2184	1 to 4	3861	1 to 6	5791
1350	2.77	406	305	1524	2337	1 to 4	4470	1 to 6	6706
1500	2.77	406	305	1676	2489	1 to 4	5080	1 to 6	7620

NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Steel)
   AASHTO M 274 (Aluminum Coated–Type 2)
   AASHTO M 289 (Aluminum–Zinc Alloy Coated)
   AASHTO M 256 (Polymer Coated Steel)
   AASHTO M 197M (Aluminum)
   ASTM A 885 (Fiber Bonded)

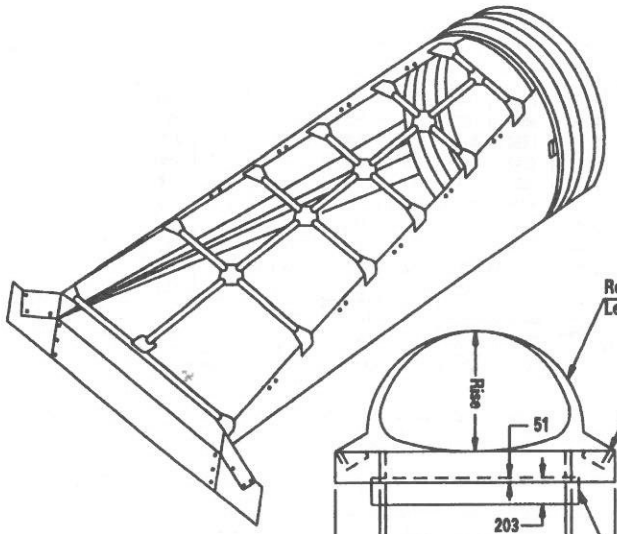
INTENDED USES

To provide end finish to a line of pipe conforming to embankment contour.

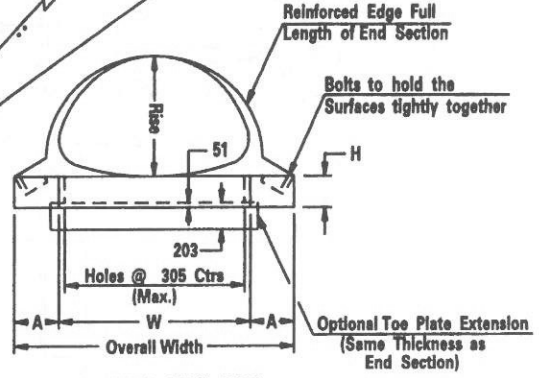
SLOPED END SECTION—TYPE C
PARALLEL DRAINAGE STRUCTURE WITH SAFETY BARS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CME–8–96

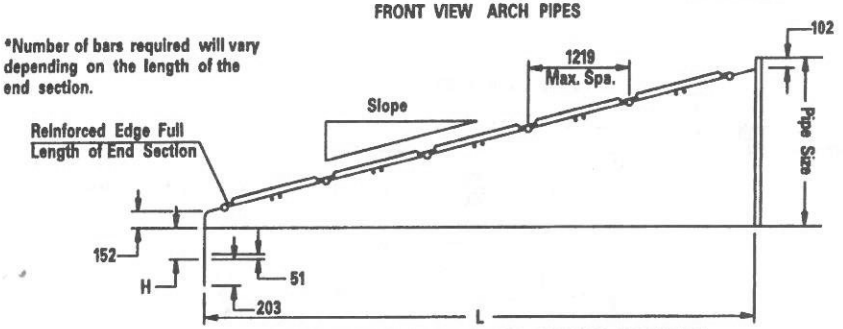


Cross drainage safety end section



FRONT VIEW ARCH PIPES

*Number of bars required will vary depending on the length of the end section.



SIDE ELEVATION FOR CROSS DRAINAGE STRUCTURE

Dimensions of Galvanized Safety Slope End Sections for Arch-Pipe

Dia. (mm)	Span (mm)	Rise (mm)	Thickness (mm)	A min. (mm)	H min. (mm)	W (mm)	Overall Width	Slope	Length (mm)	Slope	Length (mm)
450	530	380	1.63	203	152	686	1092	1 to 4	508	1 to 6	763
525	610	460	1.63	203	152	762	1168	1 to 4	813	1 to 6	1219
600	710	510	1.63	203	152	864	1270	1 to 4	1016	1 to 6	1524
750	885	610	2.01	305	229	1041	1651	1 to 4	1422	1 to 6	2134
900	1060	740	2.77	305	229	1219	1829	1 to 4	1930	1 to 6	2896
1050	1240	840	2.77	406	305	1397	2210	1 to 4	2337	1 to 6	3505
1200	1440	970	2.77	406	305	1600	2413	1 to 4	2845	1 to 6	4267
1350	1620	1100	2.77	406	305	1778	2591	1 to 4	3353	1 to 6	5029
1500	1800	1200	2.77	406	305	1956	2769	1 to 4	3759	1 to 6	5639
1800	2100	1450	2.77	406	305	2261	3073	1 to 4	4775	1 to 6	7163

NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

1. The material used in the fabrication of Sloped End Sections shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Iron or Steel Sheets)
   AASHTO M 274 (Aluminum Coated-Type 2)
   AASHTO M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 197M (Aluminum Alloy Sheets)
   AASHTO M 256 (Polymer Coated Steel)
   ASTM A 885 (Fiber Bonded)

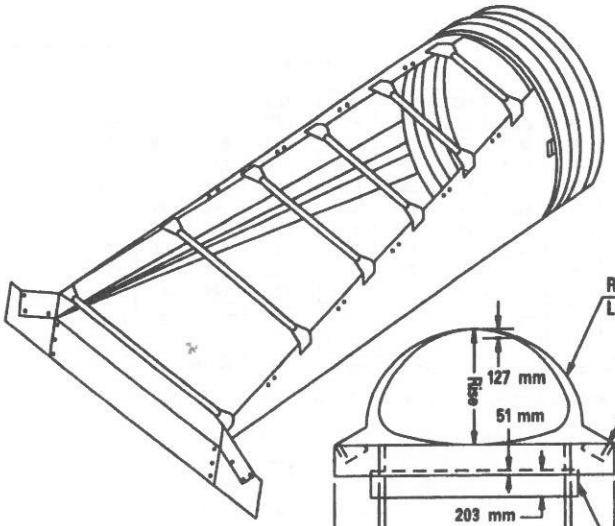
INTENDED USES

To provide end finish to a line of pipe conforming to embankment contour.

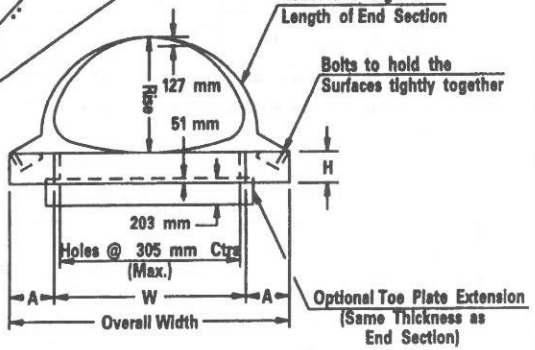
SLOPED END SECTION—TYPE C
PIPE ARCH CROSS DRAINAGE STRUCTURE WITH SAFETY BARS

AASHTO-AGC-ARTBA
TF-13 DRAWING

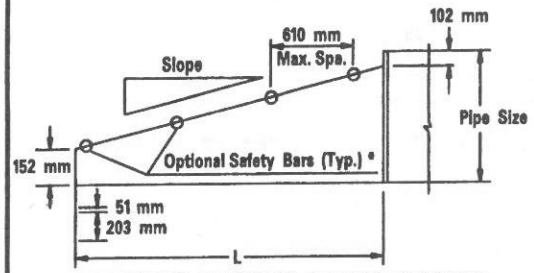
CME-9-96



Parallel drainage safety end section.



FRONT VIEW ARCH PIPES



SIDE ELEVATION OF PARALLEL DRAINAGE STRUCTURE

Dimensions of Galvanized Safety Slope End Sections for Arch-Pipe

Dia. (mm)	Span (mm)	Rise (mm)	Thickness (mm)	A min. (mm)	H min. (mm)	W (mm)	Overall Width	Slope	Length (mm)	Slope	Length (mm)
450	530	380	1.63	203	152	686	1092	1 to 4	508	1 to 6	763
525	610	460	1.63	203	152	762	1168	1 to 4	813	1 to 6	1219
600	710	510	1.63	203	152	864	1270	1 to 4	1016	1 to 6	1524
750	885	610	2.01	305	229	1041	1651	1 to 4	1422	1 to 6	2134
900	1060	740	2.77	305	229	1219	1829	1 to 4	1930	1 to 6	2896
1050	1240	840	2.77	406	305	1397	2210	1 to 4	2337	1 to 6	3505
1200	1440	970	2.77	406	305	1600	2413	1 to 4	2845	1 to 6	4267
1350	1620	1100	2.77	406	305	1778	2591	1 to 4	3353	1 to 6	5029
1500	1800	1200	2.77	406	305	1956	2769	1 to 4	3759	1 to 6	5639
1800	2100	1450	2.77	406	305	2261	3073	1 to 4	4775	1 to 6	7163

NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

1. The material used in the fabrication of Sloped End Section shall conform to the applicable requirements of:
   AASHTO M 218 (Galvanized Steel)
   AASHTO M 274 (Aluminum Coated-Type 2)
   AASHTO M 289 (Aluminum-Zinc Alloy Coated)
   AASHTO M 256 (Polymer Coated Steel)
   AASHTO M 197M (Aluminum)
   ASTM A 885 (Fiber Bonded)

INTENDED USES

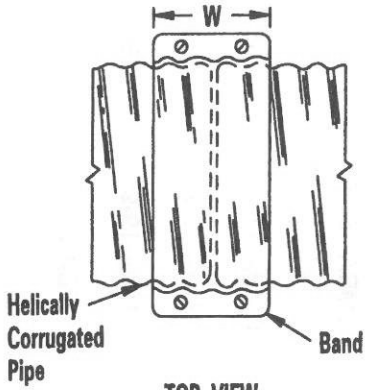
To provide end finish to a line of pipe conforming to embankment contour.

SLOPED END SECTION—TYPE C
PIPE ARCH PARALLEL DRAINAGE STRUCTURE WITH SAFETY BARS

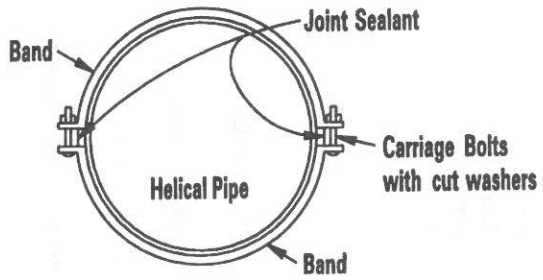
AASHTO-AGC-ARTBA
TF-13 DRAWING

CME-10-96

SECTION CMB-COUPLING BANDS



TOP VIEW



END VIEW

SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.

2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.

3. For pipe arches use the same width band as for circular pipe of equal periphery.

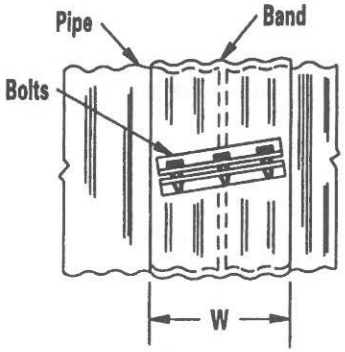
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.

INTENDED USES

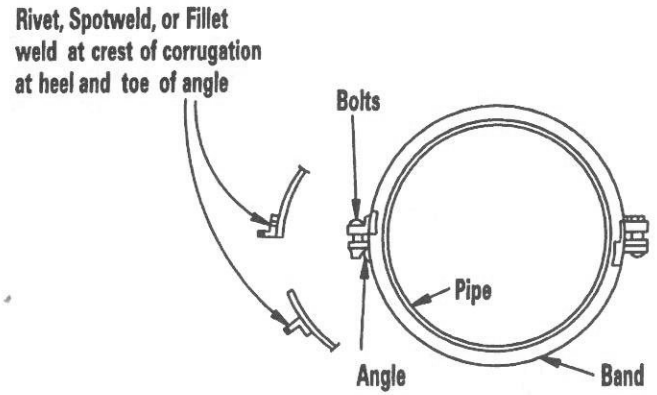
Coupling of corrugated steel pipe sections or appurtenances

CORRUGATED STEEL COUPLING BAND
2-PIECE INTEGRAL BAND

AASHTO-AGC-ARTBA TF-13 DRAWING	CMBS-1-96



SIDE VIEW



END VIEW

NOTE: second angle connection optional to 1050 mm diam., required above 1050 mm diam.

SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243 or ASTM A 885.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.
5. Use 32 mm thick line dimensions on attached angle leg for rivets and spot welds.
6. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used at the heel and toe of connection angles, with prior approval of the Engineer.
7. Dimensions shown are minimums.
8. Spot welds to develop minimum required strength of strap.

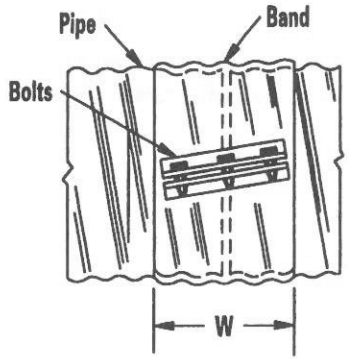
INTENDED USES

Coupling of corrugated steel pipe sections or appurtenances.

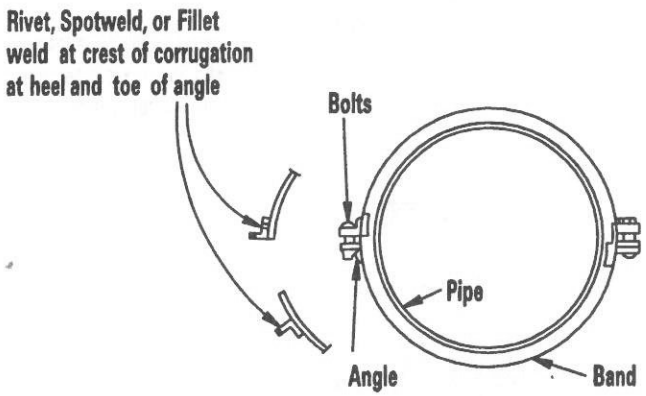
CORRUGATED STEEL COUPLING BAND ANNULAR BAND

AASHTO–AGC–ARTBA TF–13 DRAWING

CMBS–2–96



SIDE VIEW



END VIEW

NOTE: second angle connection optional to 1050 mm diam., required above 1050 mm diam.

SPECIFICATIONS

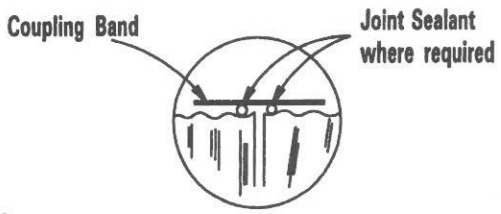
1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.
5. Use 32 mm thick line dimensions on attached angle leg for rivets and spot welds.
6. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used at the heel and toe of connection angles, with prior approval of the Engineer.
7. Dimensions shown are minimums.
8. For helically corrugated coupling bonds, the connection angles may be oriented parallel to the pipe axis, providing connecting holes are slotted lengthwise sufficiently to allow adjustment for the helix angle.

INTENDED USE

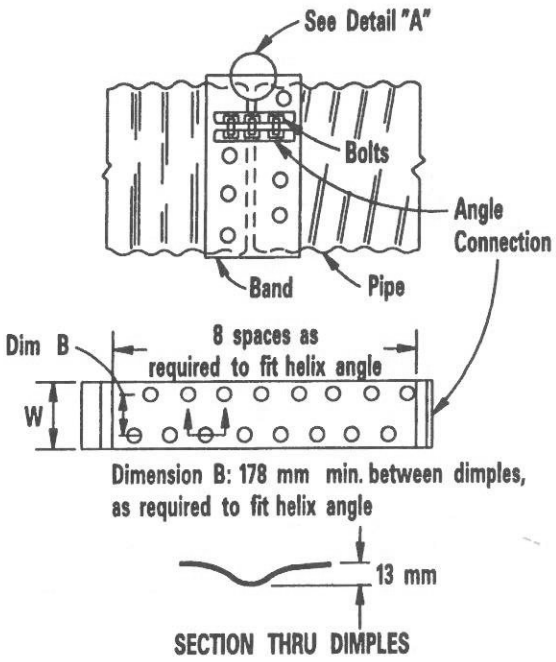
Coupling of corrugated steel pipe sections or appurtenances

CORRUGATED STEEL COUPLING BAND
HELICAL BAND

AASHTO–AGC–ARTBA TF–13 DRAWING	CMBS–3–96



DETAIL "A"



SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.

2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.

3. For pipe arches use the same width band as for circular pipe of equal periphery.

4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.

5. Use 32 mm thick line dimensions on attached angle leg for rivets and spot welds.

6. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used at the heel and toe of connection angles, with prior approval of the Engineer.

7. Dimensions shown are minimums.

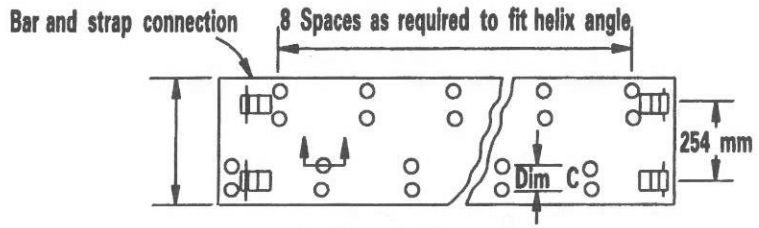
8. May be used with annular rolled ends.

INTENDED USES

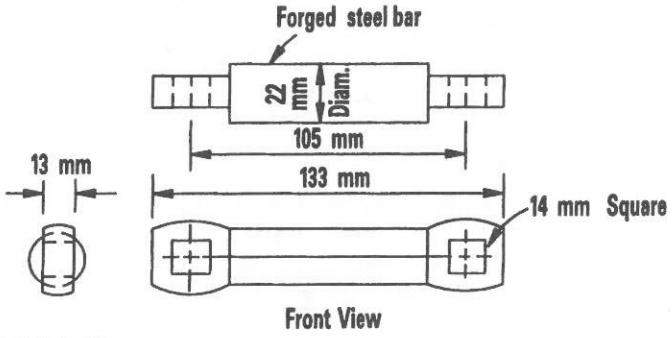
Coupling field cut pipe end(s) on helically corrugated pipe–wrap with geotextile as necessary to ensure soil tightness.

CORRUGATED STEEL COUPLING BAND
UNIVERSAL BAND—ANGLE CONNECTION

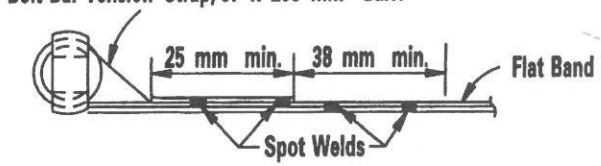
AASHTO–AGC–ARTBA TF–13 DRAWING	CMBS–4–96



Dimension C: as required to fit helix angle, 68 mm min. One place band optional on 1050 mm diameter, two piece band required above 1050 mm diameter.



BAR DETAIL



NOTE: minimum of two spot welds per connection

STRAP DETAIL

SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.
5. Dimensions shown are minimums.
6. Spot welds to develop minimum required strength of strap. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used with prior approval of the Engineer.
7. May be used with annular rolled ends.

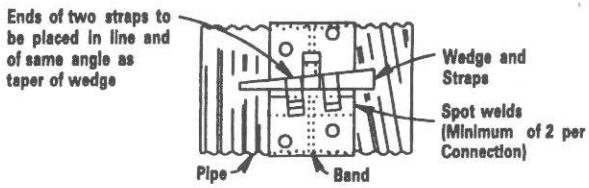
INTENDED USES

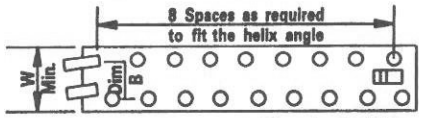
Coupling of corrugated steel pipe sections or appurtenances.

CORRUGATED STEEL COUPLING BAND
UNIVERSAL BAND—BAR AND STRAP CONNECTION

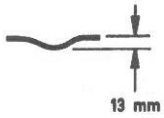
AASHTO–AGC–ARTBA
TF–13 DRAWING

CMBS–5–96

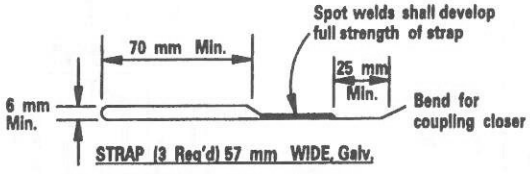




Dimension B: 178 mm Min. between dimples as required to fit the helix angle

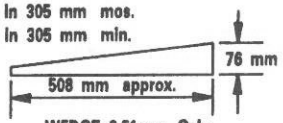


SECTION THRU DIMPLES



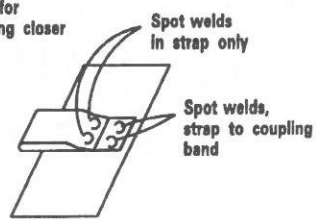
STRAP (3 Req'd) 57 mm WIDE, Galv.

Taper: 38 mm in 305 mm mos.
34 mm in 305 mm min.



WEDGE 3.51mm Galv.

ALTERNATIVE TYPE WEDGE
2.01 mm Galv. FOLDED 180 AND FLATTENED



STRAP DETAIL

SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.
5. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used with prior approval of the Engineer.
6. Dimensions shown are minimums.
7. Spot welds to develop minimum required strength of strap.
8. May be used with annular rolled ends.

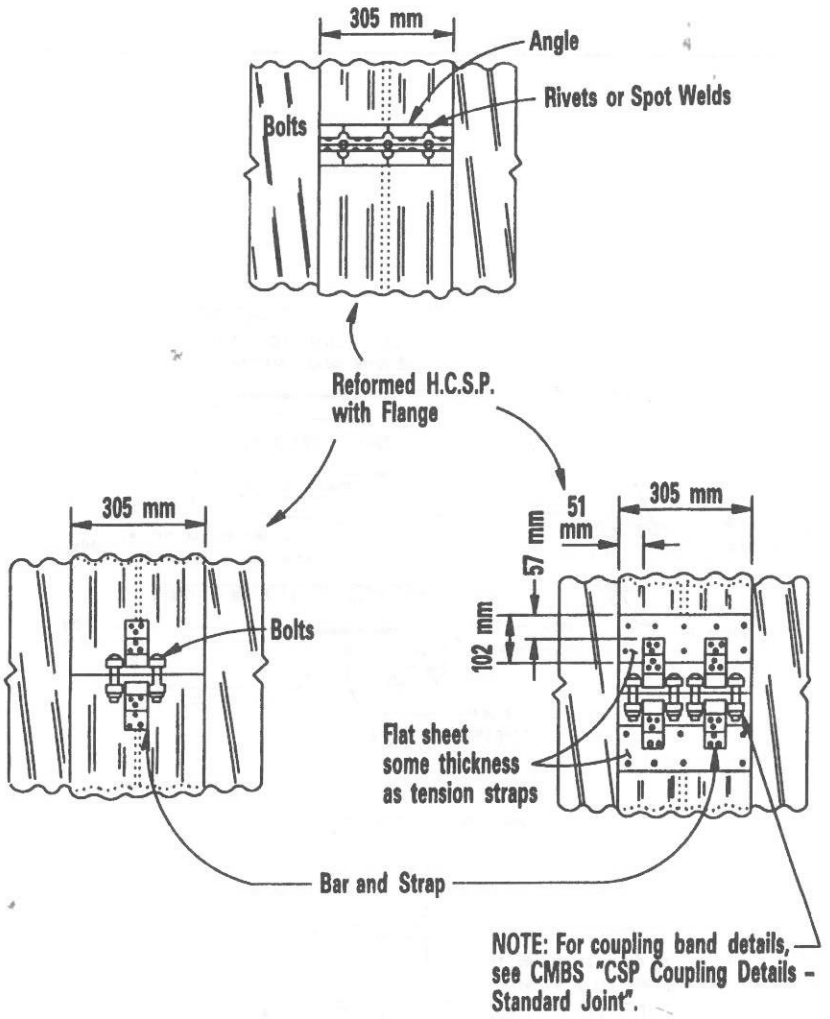
INTENDED USES

Coupling field cut Pipe end(s) on helically corrugated Pipe–wrap with geotextile as necessary to ensure soil tightness.

CORRUGATED STEEL COUPLING BAND
UNIVERSAL BAND—WEDGE AND STRAP CONNECTION

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMBS–6–96



SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.
5. In lieu of spot welds or rivets, as shown, fillet welds of equivalent strength may be used at the heel and toe of the connection angles, with prior approval of the Engineer.
6. Dimensions shown are minimums.
7. Spot welds to develop minimum required strength of strap.

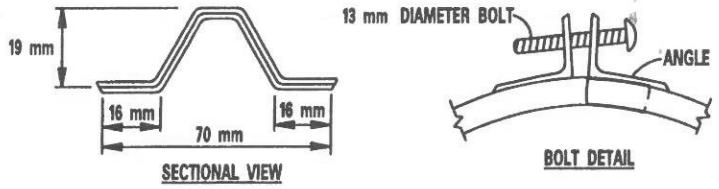
INTENDED USE

Coupling of corrugated steel pipe sections or appurtenances.

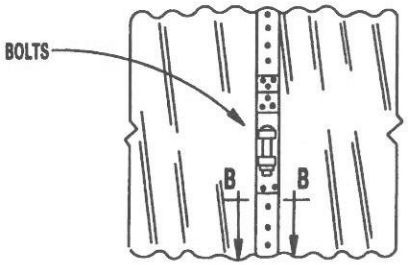
CORRUGATED STEEL COUPLING BAND FOR REFORMED HELICAL PIPE

AASHTO–AGC–ARTBA
TF–13 DRAWING

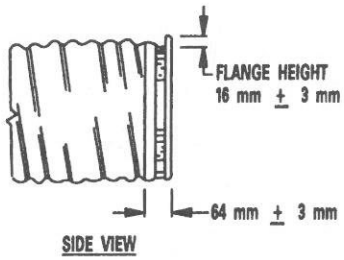
CMBS–7–96



HAT BAND COUPLER
ANGLE CONNECTOR SHOWN



SECTION B-B



FLANGE DETAILS

SPECIFICATIONS

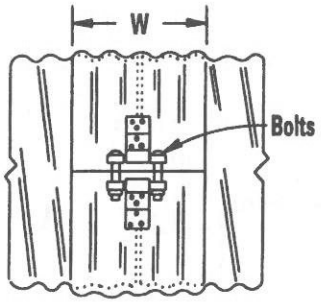
1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.
2. Hat material shall meet the requirements of AASHTO M 218, M 289 and M 274.
3. Hat band thickness shall be a minimum of 1.6 mm.
4. Hat bands shall be 70 mm wide.

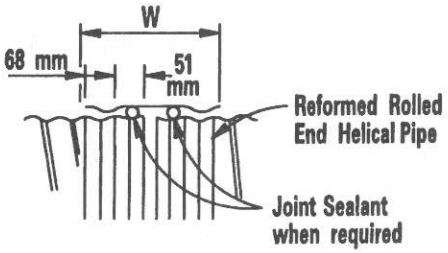
INTENDED USE

Coupling of corrugated steel pipe sections or appurtenances.

CORRUGATED STEEL COUPLING BAND
HAT BAND FOR FLANGED END PIPE

AASHTO-AGC-ARTBA TF-13 DRAWING	CMBS-8-96





JOINT CROSS SECTION

SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 23.

2. All Coupling bands shall be galvanized in conformance with AASHTO M 218, M 289 and M 274 and, if specified, coated in accordance with AASHTO M 190, M 245M or M 243.

3. For pipe arches use the same width band as for circular pipe of equal periphery.

4. Band thickness shall not be less than 1.32 mm and shall not be less than 3 standard thicknesses lighter than the thickness of the pipe.

5. Dimensions shown are minimums.

6. For hugger coupling band, a 2 piece band is required for pipe greater than 1050 mm diameter.

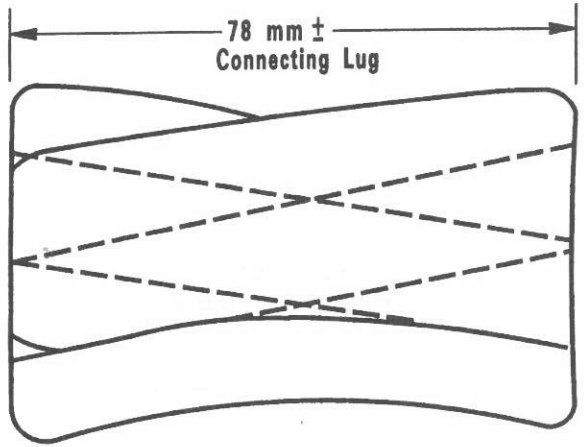
7. Spot welds to develop minimum required strength of strap.

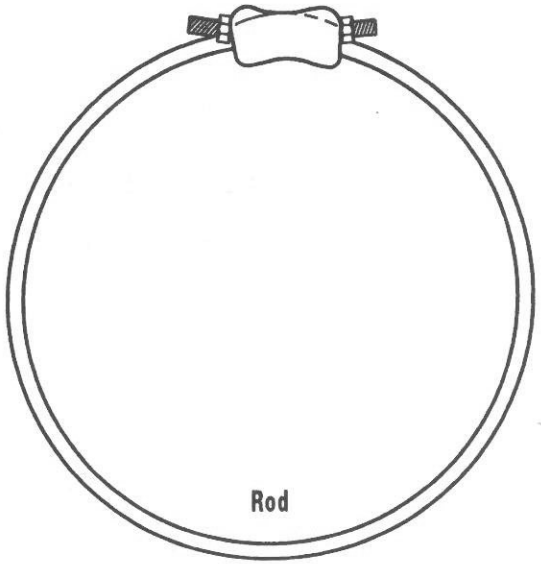
INTENDED USE

Coupling of corrugated steel pipe sections or appurtenances.

CORRUGATED STEEL COUPLING BAND
HUGGER BAND FOR ANNULAR OR REFORMED END HELICAL PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING	CMBS–9–96





Rod & Lug Details

SPECIFICATIONS

1. Rods shall be of hot rolled carbon steel curved and threaded on the ends to receive a standard 13 mm hex nut. Rods and cast steel lugs shall be galvanized in accordance with AASHTO M 232.

INTENDED USES

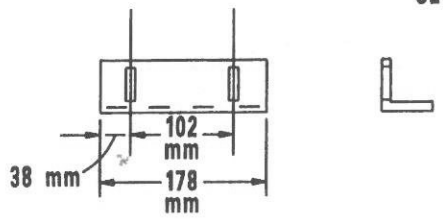
Rods and lugs are curved to conform to the pipe diameter specified. They supplement the standard connectors when positive circumferential clamping is desired.

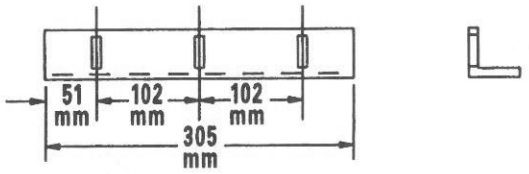
CORRUGATED STEEL COUPLING BAND
ROD AND LUG DETAILS

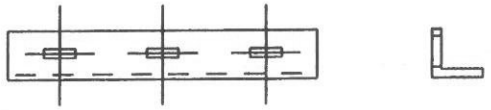
AASHTO–AGC–ARTBA
TF–13 DRAWING

CMBS–10–96

SLOT DIMENSION 14 X 29







HORIZONTAL SLOTS USED FOR
HELICAL BANDS ONLY

Note: All dimensions are in millimeters

SPECIFICATIONS

1. Angle clips for coupling bands shall be galvanized in accordance with AASHTO M 232.

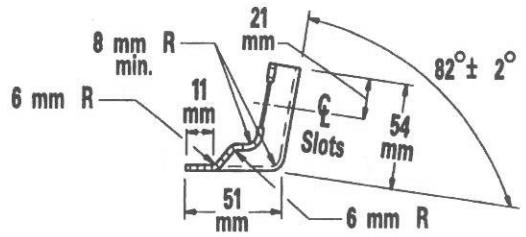
INTENDED USES

Connectors for coupling bands.

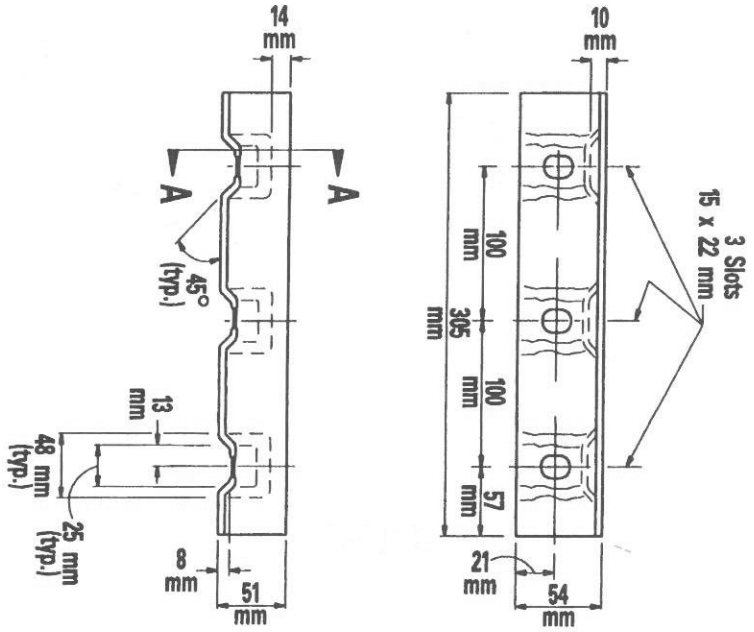
CORRUGATED STEEL COUPLING BAND
COUPLING DETAILS—51 x 51 x 5 mm ANGLE CLIPS

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMBS-11-96



SECTION A-A



305 mm BAND ANGLE

SPECIFICATIONS

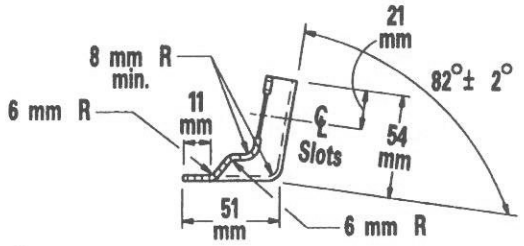
1. Angle clips for coupling bands shall be galvanized in accordance with AASHTO M 232.

INTENDED USES

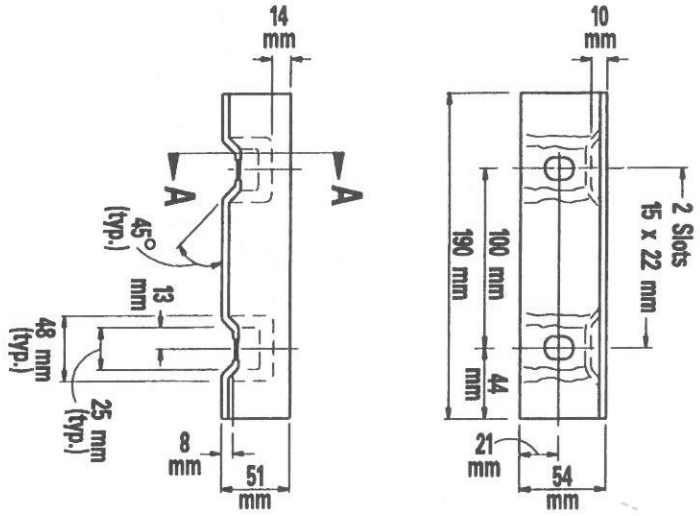
Connectors for coupling bands.

CORRUGATED STEEL COUPLING BAND—305 mm
51 x 54 x 2.77 mm "SCAFCO" ANGLE CLIP

AASHTO–AGC–ARTBA TF–13 DRAWING	CMBS–12–96



SECTION A-A



178-mm BAND ANGLE

SPECIFICATIONS

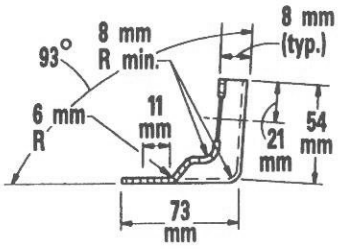
1. Angle clips for coupling bands shall be galvanized in accordance with AASHTO M 232.

INTENDED USES

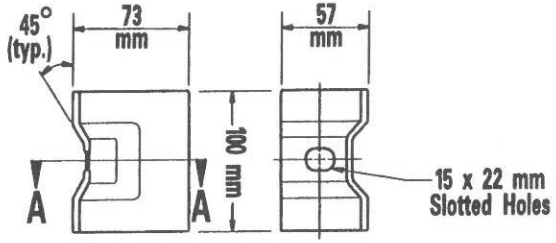
Connectors for coupling bands.

CORRUGATED STEEL COUPLING BAND—178 mm
51 x 54 x 2.77 mm "SCAFCO" ANGLE CLIP

AASHTO-AGC-ARTBA TF-13 DRAWING	CMBS-13-96



SECTION A-A



100 mm BAND ANGLE

SPECIFICATIONS

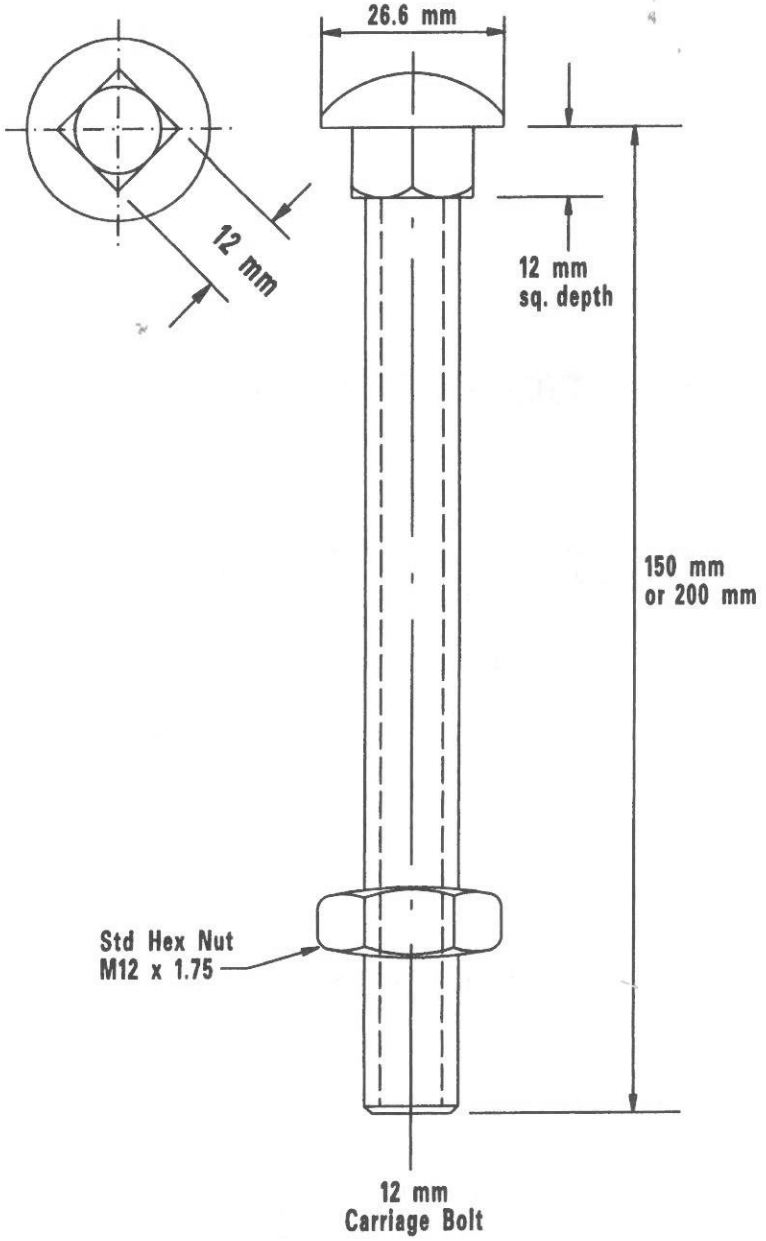
1. Angle clips for coupling bands shall be galvanized in accordance with AASHTO M 232.

INTENDED USES

Connectors for coupling bands.

CORRUGATED STEEL COUPLING BAND—100 mm
51 x 73 x 2.77 mm "SCAFCO" ANGLE CLIP

AASHTO-AGC-ARTBA TF-13 DRAWING	CMBS-14-96



APPLICABLE SPECIFICATIONS

1. Bolt—ANSI B 18.5.2.2M
   Metric Round Head, ASTM F 568M
   Square Neck Bolts, Property Class 4.6
   M 12 x 1.75 x 150
   M 12 x 1.75 x 200

2. Nut—ANSI B 18.2.4.1M
   Metric Hex Nuts, Style 1
   ASTM A 563M, Class 5.

3. Galvanized—AASHTO M 232

4. Aluminum—ASTM B 211M Alloy 6061-T6
   Bolts and nuts used with aluminum coupling bands may be aluminum coated steel in lieu of galvanizing.

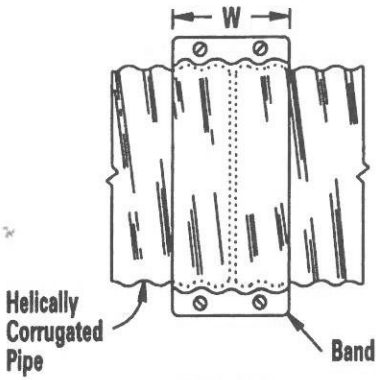
INTENDED USE

Connectors for coupling bands.

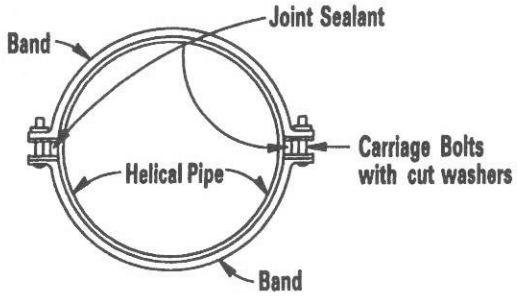
COUPLING BAND HARDWARE

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMB-15-96



TOP VIEW



END VIEW

SPECIFICATIONS

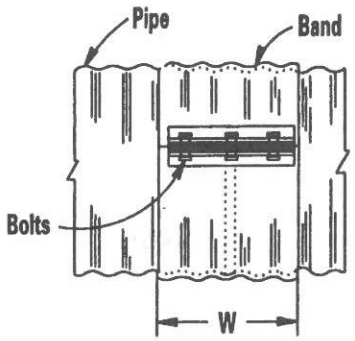
1. Coupling bands shall conform to the requirements of AASHTO Specifications M 196M.
2. Band thickness shall not be less than 1.22 mm and shall not be less than 2 standard thicknesses lighter than the thickness of the pipe.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. If W equals 300 mm use 3 bolts per flange in lieu of two shown as required for 180 mm width. The 180 mm width shall not be used when positive joint condition is specified.
5. Provide 50 mm x 300 mm x 3.81 mm strip on each flange under bolt heads or nuts when positive joint condition is specified.

INTENDED USES

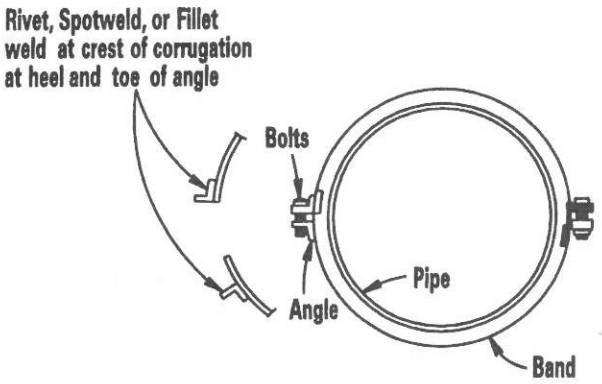
Coupling of corrugated aluminum pipe sections or appurtenances.

CORRUGATED ALUMINUM COUPLING BAND
2-PIECE INTEGRAL FLANGE BAND

AASHTO-AGC-ARTBA TF-13 DRAWING	CMBA-16-96



SIDE VIEW



END VIEW

NOTE: second angle connection optional to 1050 mm diam., required above 1050 mm diam.

SPECIFICATIONS

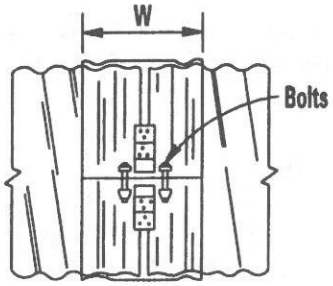
1. Coupling bands shall conform to the requirements of AASHTO Specifications M 196M.
2. Band thickness shall not be less than 1.22 mm and shall not be less than 2 standard thicknesses lighter than the thickness of the pipe.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Annular coupling band with angle connections may be supplied as one piece (one pair of angles) or two pieces (two pair of angles, as shown).

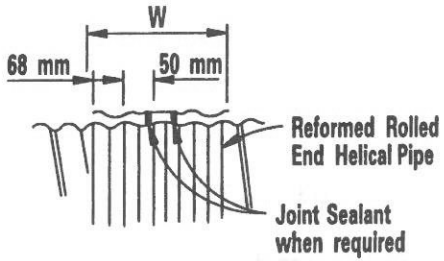
INTENDED USES

Coupling of corrugated aluminum pipe sections or appurtenances.

CORRUGATED ALUMINUM COUPLING BAND
ANNULAR BAND

AASHTO–AGC–ARTBA TF–13 DRAWING	CMBA–17–96





SPECIFICATIONS

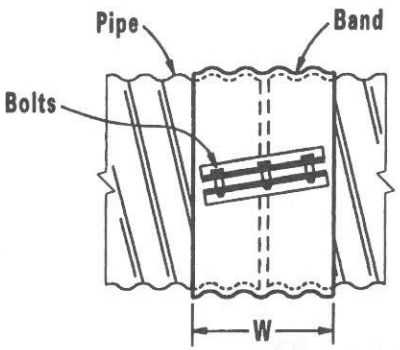
1. Coupling bands shall conform to the requirements of AASHTO Specifications M 196M.
2. Band thickness shall not be less than 1.22 mm and shall not be less than 2 standard thicknesses lighter than the thickness of the pipe.
3. For pipe arches use the same width band as for circular pipe of equal periphery.
4. Annular coupling band with angle connections may be supplied as one piece (one pair of angles) or two pieces (two pair of angles, as shown).

INTENDED USE

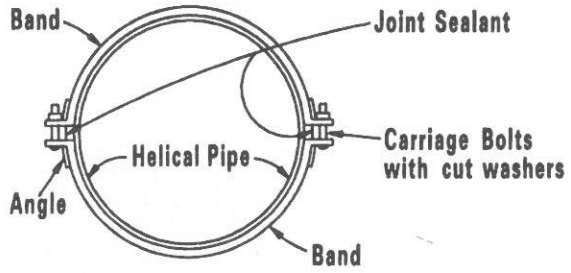
Coupling of corrugated aluminum pipe sections or appurtenances.

CORRUGATED ALUMINUM COUPLING BAND
HUGGER BAND FOR ANNULAR OR REFORMED END HELICAL PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING	CMBA–18–96



SIDE VIEW



END VIEW

NOTE: second angle connection optional to 1050 mm diam., required above 1050 mm diam.

SPECIFICATIONS

1. Coupling bands shall conform to the requirements of AASHTO Specifications M 196M.
2. Band thickness shall not be less than 1.22 mm and shall not be less than 2 standard thicknesses lighter than the thickness of the pipe.
3. For pipe arches, use the same width band as for circular pipe of equal periphery
4. Helical coupling bands with angle connections may be supplied as one piece (one pair of angles) or two pieces (two pair of angles as shown).
5. Corrugated band sheet may be produced as a corrugated and curved strip or cut from helical pipe. If band is cut from helical pipe, it may be produced from oversize pipe or a flap of some pipe configuration may be used if "lapping joint" is required.

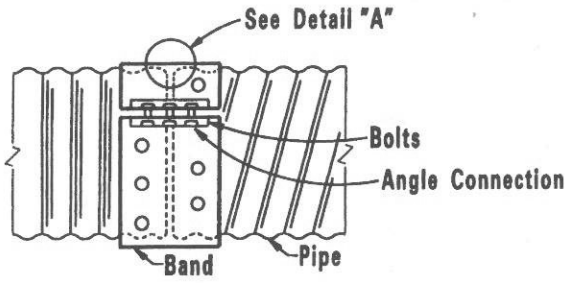
INTENDED USE

Coupling of corrugated aluminum pipe sections or appurtenances.

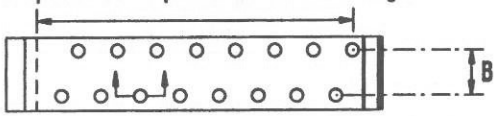
CORRUGATED ALUMINUM COUPLING BAND HELICAL BAND

AASHTO–AGC–ARTBA TF–13 DRAWING

CMBA–19–96

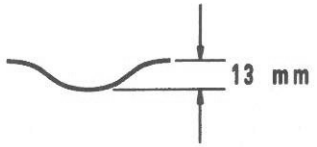


8 spaces as required to fit helix angle



Dimension B: 178 mm min. between dimples, as required to fit helix angle.

DETAIL "A"



SECTION THRU DIMPLES

SPECIFICATIONS

1. Coupling bands shall conform to the requirements of AASHTO Specifications M 196M.
2. Band thickness shall not be less than 1.22 mm and shall not be less than 2 standard thicknesses lighter than the thickness of the pipe.
3. For pipe arches, use the same width band as for circular pipe of equal periphery

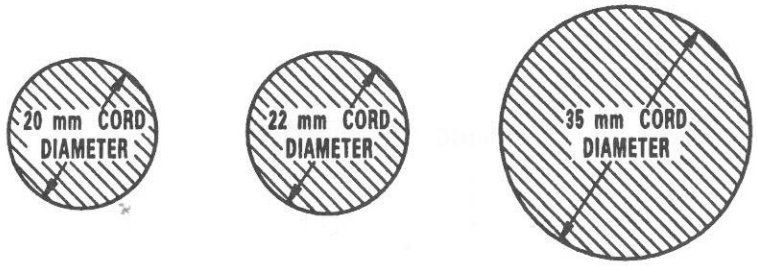
INTENDED USE

Coupling of field cut pipe end(s) on helical corrugations. Pre-wrap with geotextile as necessary to ensure soil tightness.

CORRUGATED ALUMINUM COUPLING BAND
UNIVERSAL BAND

AASHTO-AGC-ARTBA
TF-13 DRAWING

CMBA-20-96



O-RING GASKET CROSS SECTION

CORRU-GATION	68 X 13 mm	68 X 13 mm	125 X 25 mm	75 X 25 mm
CORD DIA.	20 mm	22 mm	22 mm	35 mm
NOMINAL PIPE I.D.	300 375 450 525 600 675 750 825 900	1050 1200 1350 1500 1650 1800 1950 2100 2250 2400	1350 1500 1650 1800 1950 2100 2250 2400 2550 2700 2850 3000	900 1050 1200 1350 1500 1650 1800 1950 2100 2250 2400 2550 2700 2850 3000

Note: All dimensions are in millimeters

SPECIFICATIONS

1. Ring gaskets used on corrugated metal pipe shall be in accordance with AASHTO M 198.
2. 20–mm cord diameter is used on 68 mm x 13 mm corrugation for either reformed ends of helical pipe or riveted pipe.
3. 22–mm cord diameter is used on 75 mm x 25 mm or 125 mm x 25 mm corrugations for reformed ends of helical pipe.
4. 35–mm cord diameter is used on 75 mm x 25 mm corrugation riveted pipe.
5. AASHTO M 198A (O–Ring) Gasket is used on round pipe shapes.
6. AASHTO M 198B (plastic) gasket may be used on round pipe or pipe arch shapes.

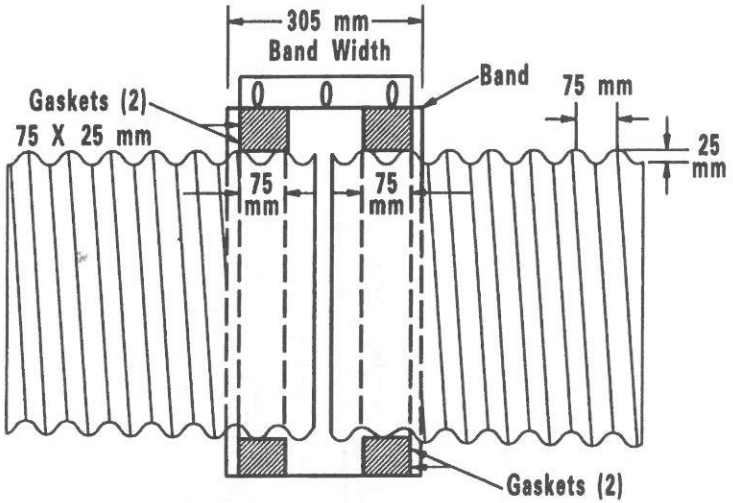
INTENDED USES

Use with annular type band couplers when watertight joints are required.

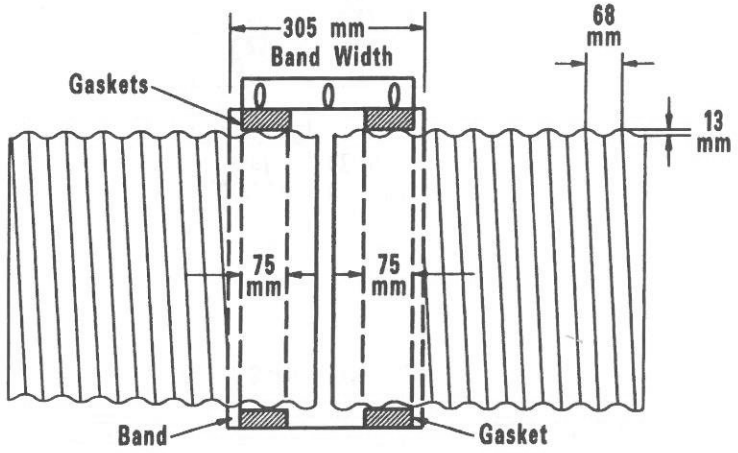
RING GASKETS

AASHTO–AGC–ARTBA TF–13 DRAWING

CMBS–21–96



Cross Section Thru Pipe Joints



Note: All measurements are in millimeters

General purpose– ASTM D 1056, RE41 closed cell neoprene gasket showing 2 /side 75 mm wide x 25 mm thick continuous

75 x 25 mm Corrugation

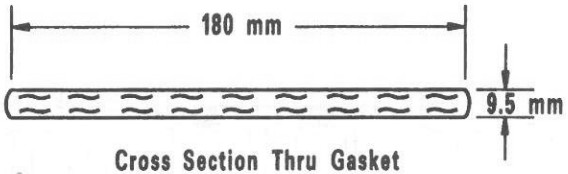
General purpose– ASTM D 1056, Type RE41 75 mm x 25 mm continuous closed cell neoprene gasket showing 1 /side

68 x 13 mm Corrugation

FLAT BANDS & GASKETS

AASHTO–AGC–ARTBA
TF–13 DRAWING

CMBS–22–96



Cross Section Thru Gasket

NOMINAL PIPE DIAMETER	GASKET LENGTH (mm)
375	1118
450	1359
525	1600
600	1829
675	2032
750	2286
825	2464
900	2718
1050	3200
1200	3658
1350	4064
1500	4547
1650	5029
1800	5436
1950	5893
2100	6299
2250	6782
2400	7264

SPECIFICATIONS

Gaskets shall be closed cell neoprene, skinned all four sides and meeting the requirements of ASTM specification D 1056 Grade SCE-43L. Gaskets shall be of 1-piece continuous construction.

INTENDED USES

Use with corrugated or flat band couplers when watertight joints are required.

SLEEVE GASKETS

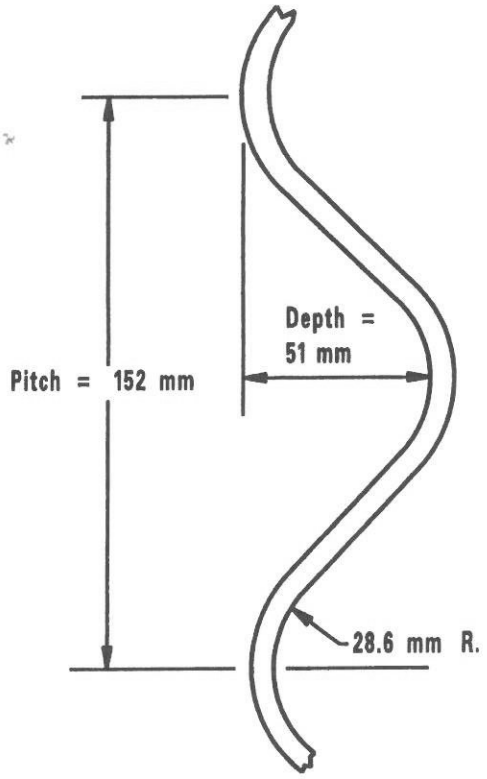
AASHTO-AGC-ARTBA
TF-13 DRAWING

CMBS-23-96

PART 3

STRUCTURAL PLATE DRAINAGE PRODUCTS (SP)

SECTION SPC—STANDARD CORRUGATIONS



152 mm X 51 mm Corrugation

APPLICABLE SPECIFICATIONS

Corrugated steel structural plate pipe shall conform to the requirements of:

AASHTO M 167M (galvanized steel)

AASHTO M 243 (bituminous coated)

AASHTO M 111 (hot dip galvanize after fabrication)

INTENDED USE

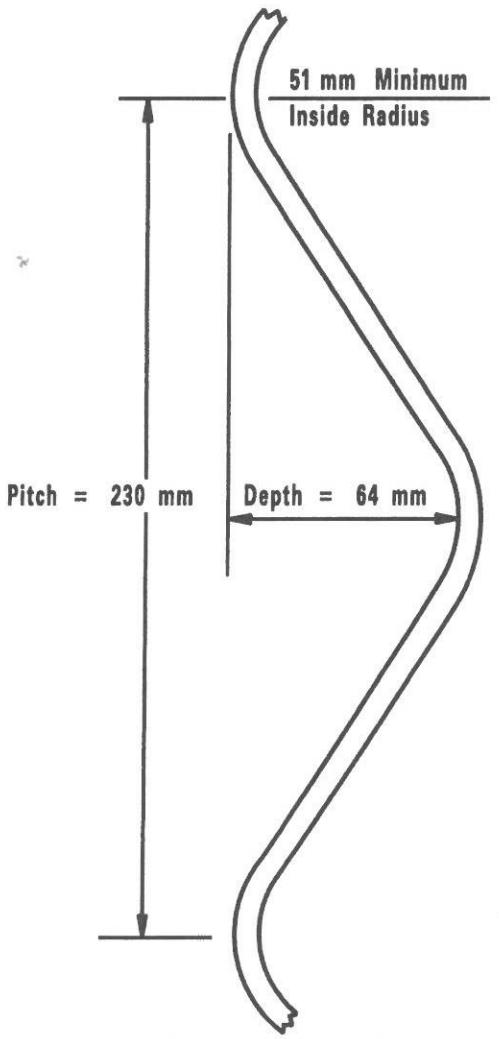
Culverts, short bridges, underpasses, storm sewers and bridge replacement.

NOMINAL GALVANIZED THICKNESS

2.82 mm
3.56
4.32
4.79
5.54
6.32
7.11
7.87
9.65

STEEL STRUCTURAL PLATE
STANDARD CORRUGATIONS

AASHTO–AGC–ARTBA TF–13 DRAWING	SPCS–1–96



230 mm X 64 mm Corrugation

APPLICABLE SPECIFICATIONS

Corrugated aluminum alloy structural plate pipe shall conform to the requirements of:

AASHTO M 219M (aluminum)
AASHTO M 243 (bituminous coated)

INTENDED USE

Culverts, short bridges, bridge replacement, underpasses, and storm sewers.

STANDARD THICKNESS

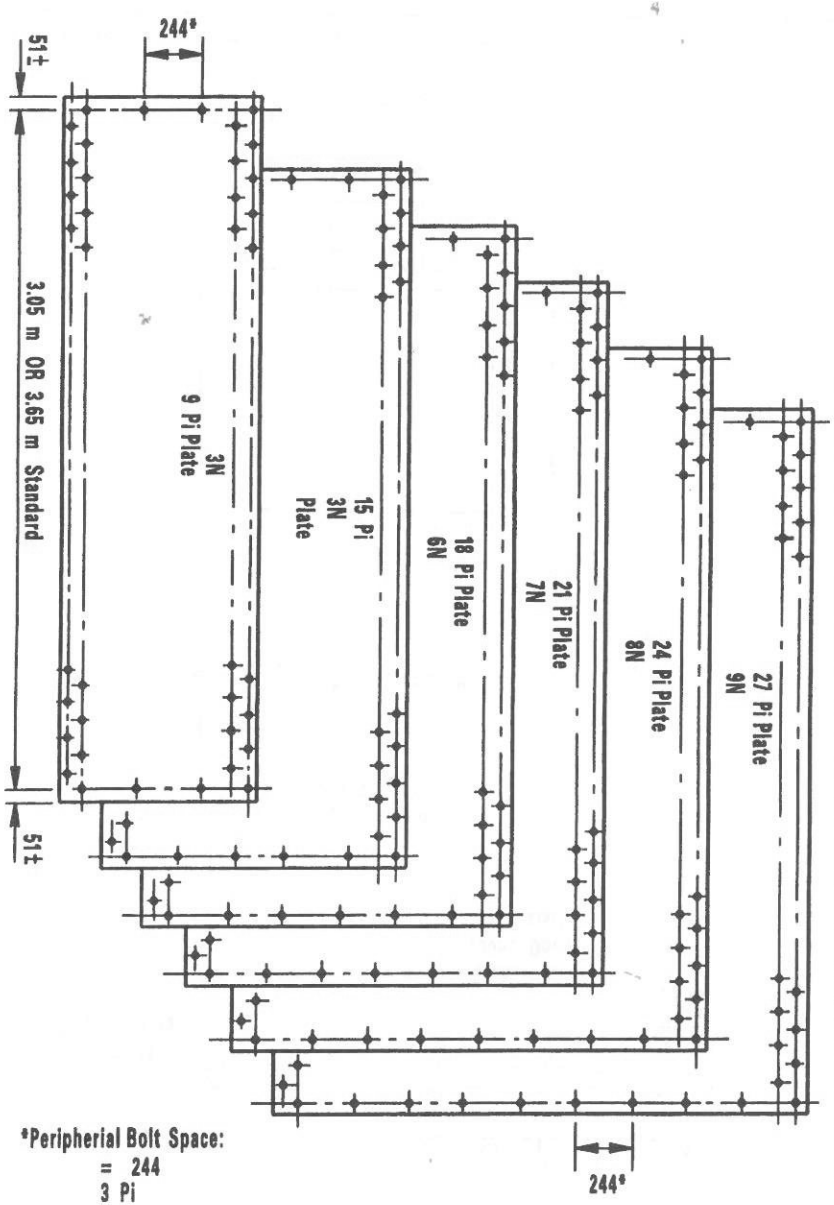
2.54 mm
3.18
3.81
4.44
5.08
5.72
6.35

ALUMINUM ALLOY STRUCTURAL PLATE STANDARD CORRUGATIONS

AASHTO–AGC–ARTBA TF–13 DRAWING

SPCA–2–96

SECTION SPP—STANDARD PARTS



*Peripherial Bolt Space:
= 244
3 Pi
N

Note: All dimensions are in millimeters unless otherwise noted.

APPLICABLE SPECIFICATIONS

1. Corrugated steel structural plate pipe shall conform to the requirements of:

AASHTO M 167M (Galvanized Steel)
AASHTO M 243 (Bituminous Coated)
AASHTO M 111 (Hot Dip Galvanized After Fabrication)

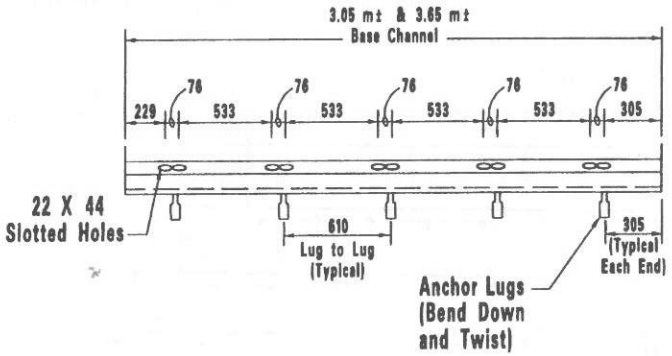
INTENDED USES

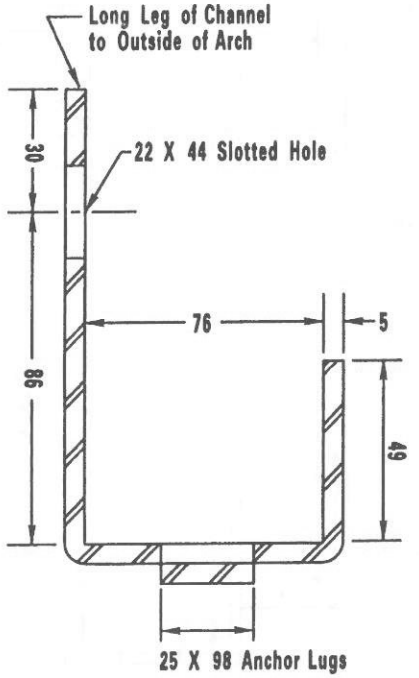
Pipe
Arch
Pipe Arch
Pedestrian Underpass
Vehicular Underpass
High-Profile Arch
Horizontal Ellipse
Low-Profile Arch
Pear Shape
Box Culvert

STEEL STRUCTURAL PLATE STANDARD PLATE DETAILS

AASHTO-AGC-ARTBA TF-13 DRAWING

SPPS-1-96





Cross Section

Note: All dimensions in millimeters unless otherwise noted

APPLICABLE SPECIFICATIONS

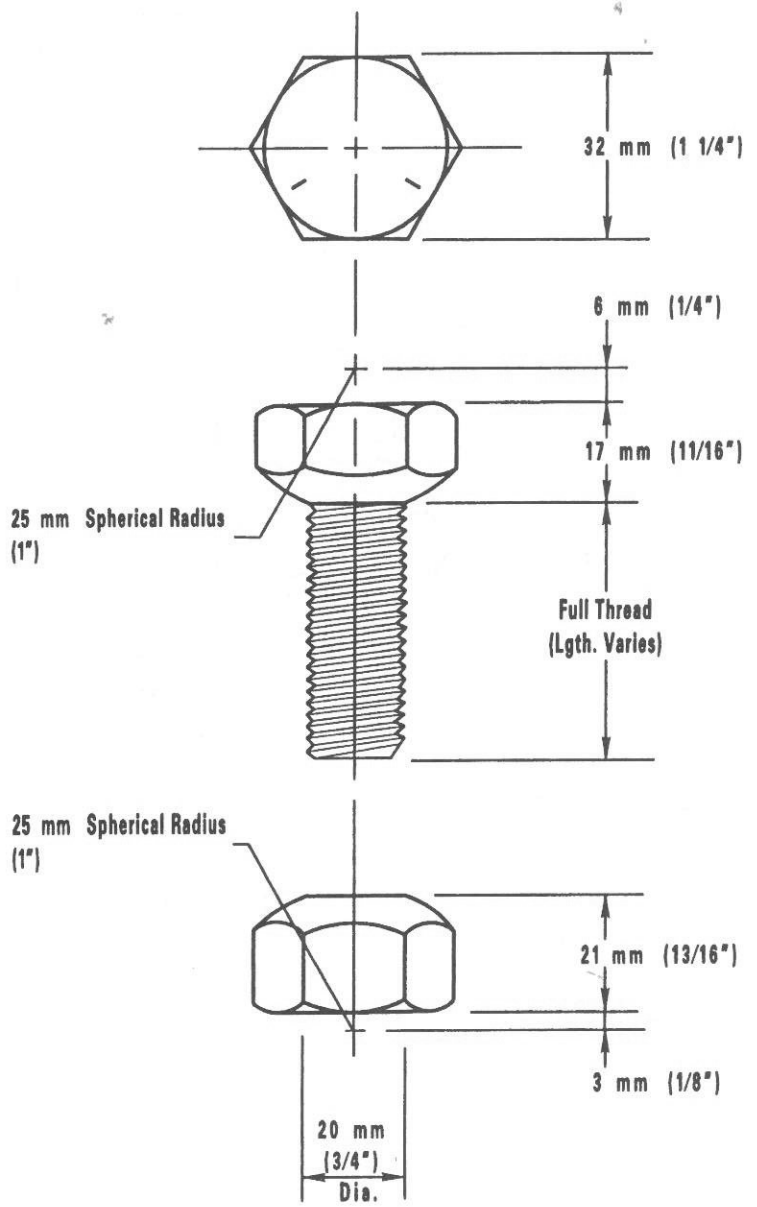
Structural quality steel – AASHTO M 111 (Galvanize after fabrication)

INTENDED USE

Arch shape steel structural plate structures, the connection of the corrugated plate to the footing.

STEEL STRUCTURAL PLATE
UNBALANCED CHANNEL DETAIL

AASHTO–AGC–ARTBA TF–13 DRAWING	SPPS–2–96



SPECIFICATIONS

1. Hex Bolts—ANSI B 18.2.3.5M
   ASTM F 568M – Property Class 8.8

2. Nuts—ANSI B 18.2.4.2M
   ANSI B 18.2.4.4M
   ASTM A 563M – Class 9

3. Galvanize—AASHTO M 232

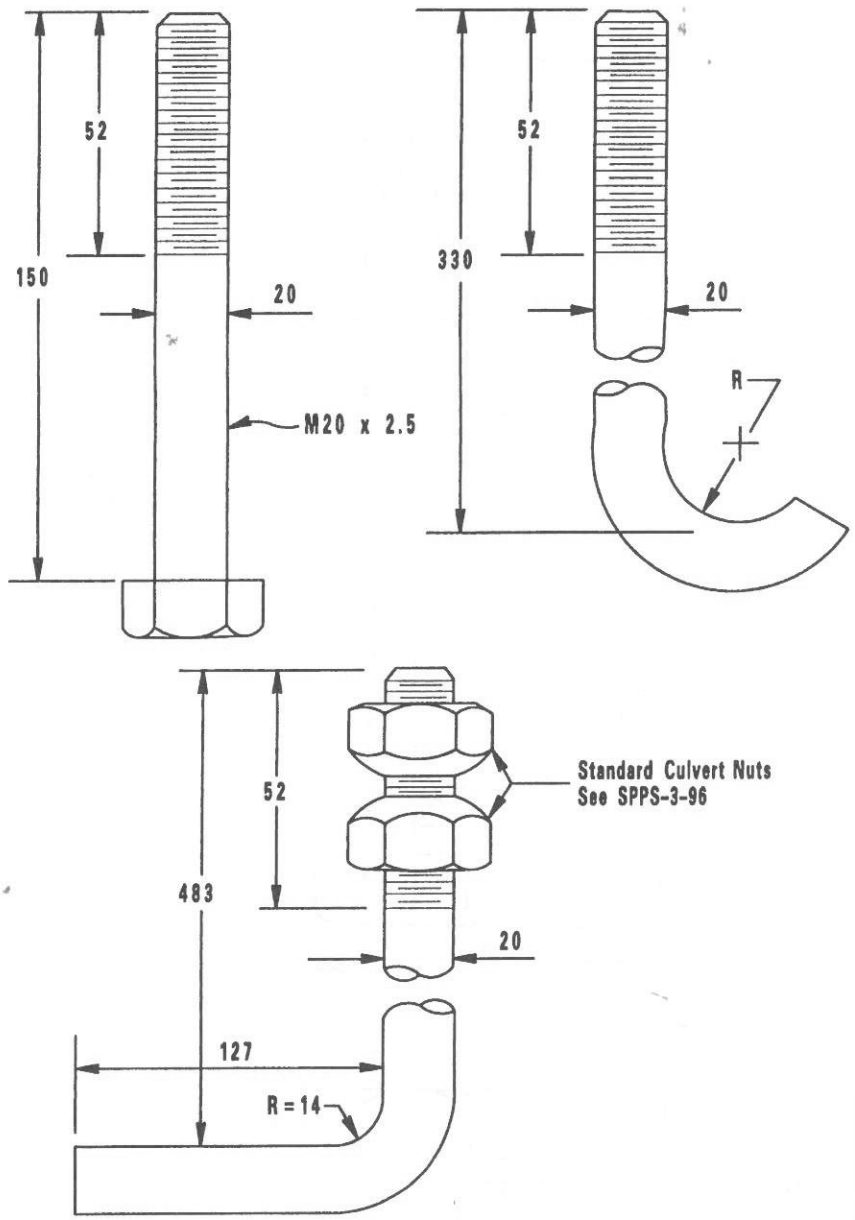
INTENDED USES

Connection of 152 mm x 51 mm corrugated galvanized steel plates.

STEEL STRUCTURAL PLATE
CULVERT BOLT AND NUT

AASHTO–AGC–ARTBA
TF–13 DRAWING

SPPS–3–96



Note: All dimensions in millimeters

SPECIFICATIONS

1. Bolt—ANSI B 18.2.3.5M ASTM F 568M – Class 8.8
2. Nut—ANSI B 18.2.4.2M ASTM A 563M – Class 9
3. Galvanize—AASHTO M 232
4. Aluminum Bolt—ASTM B 211M Alloy 6061-T6

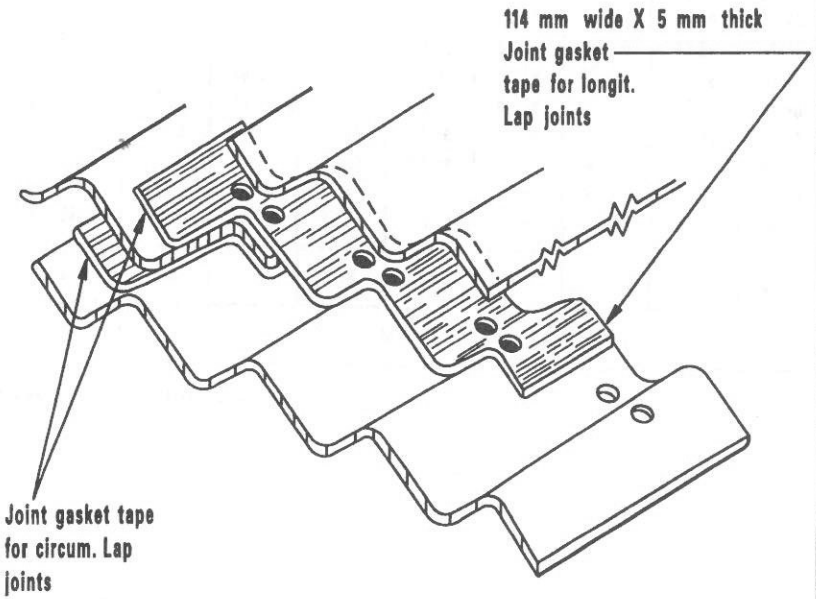
INTENDED USES

To anchor structural plate structure to concrete end treatments when they are specified.

ALUMINUM OR STEEL STRUCTURAL PLATE ANCHOR BOLTS

AASHTO–AGC–ARTBA TF–13 DRAWING

SPP–4–96



APPLICABLE SPECIFICATIONS

Joint Sealant Tape shall be a tough, flow resistant, flexible, permanently elastic, adhesive tape made of a butyl–rubber or a vulcanized elastomeric rubber base. The tape may contain a cloth or fiber scrim insert. The tape, when applied in the specified thickness between the joining surfaces of structural plate structures shall, after assembly is completed, seal the joints from water. The tape shall be weather resistant and withstand temperatures (range to be specified) without loss of adhesion and without slipping and shall maintain joint water tightness through the range of plate movements anticipated from temperature variations and service loadings. The tape shall be supplied in rolls with a removable paper or cloth backing on the tape.

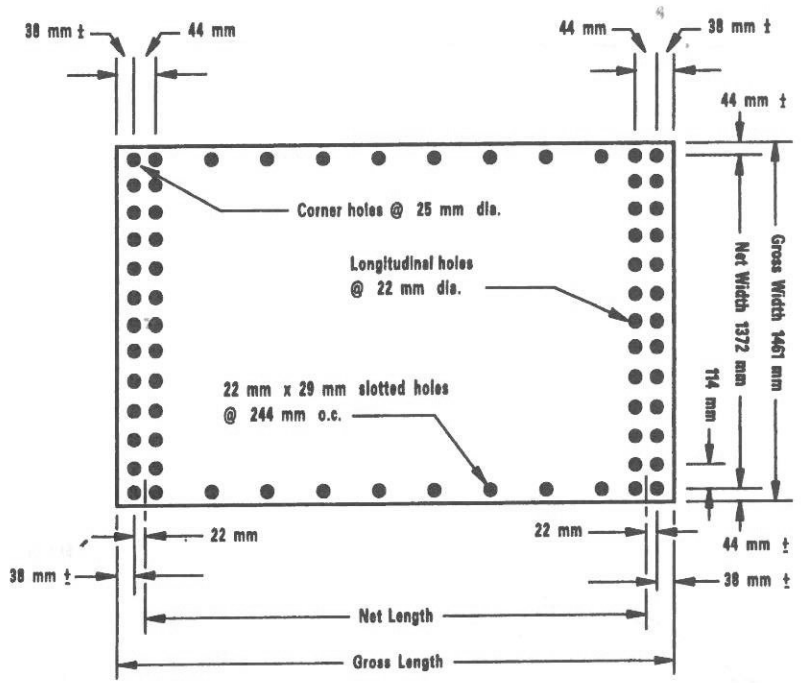
Note: Products known as 1202-T Sealant Tape, available from the 3M Company of St. Paul, Minnesota, and Elastomeric Resilient Tape 757-L3D-760, available from Tremco, Inc. of Cleveland, Ohio, have been used to seal structural plate joints.

INTENDED USE

As a sealant tape between circumferential and longitudinal lap joints of structural plates when water infiltration or exfiltration is of concern.

ALUMINUM OR STEEL STRUCTURAL PLATE JOINT SEALANT TAPE

AASHTO–AGC–ARTBA TF–13 DRAWING	SPP–5–96



Standard Sizes and Weights

Length °N	Net Length mm	Gross Length mm	Weight per Plate Thickness (kg)						
			2.54	3.18	3.81	4.44	5.08	5.72	6.35
9N	2199	2320	26.67	33.34	40.01	46.67	53.34	60.01	66.68
10N	2443	2564	29.48	36.85	44.23	51.60	58.97	66.34	73.71
11N	2688	2808	32.30	40.37	48.44	56.52	64.59	72.67	80.74
12N	2932	3053	35.11	43.88	52.66	61.44	70.22	78.99	87.77
13N	3177	3297	37.92	47.40	56.88	66.36	75.84	85.32	94.80
14N	3421	3542	40.73	50.92	61.10	71.28	81.46	91.65	101.83
15N	3665	3786	43.54	54.43	65.32	76.20	87.09	97.98	108.86
16N	3910	4030	46.36	57.95	69.54	81.12	92.71	104.30	115.89
17N	4154	4275	49.17	61.46	73.75	86.05	98.34	110.63	122.92
18N	4398	4519	51.98	64.98	77.97	90.97	103.96	116.96	129.95

Notes: (1) Weights based on nominal thickness. (2) Bolt holes have not been deducted.
°N = 244 mm

SPECIFICATIONS

1. Corrugated aluminum structural plate shall conform to the requirements of AASHTO specifications M 219M and AASHTO M 243.

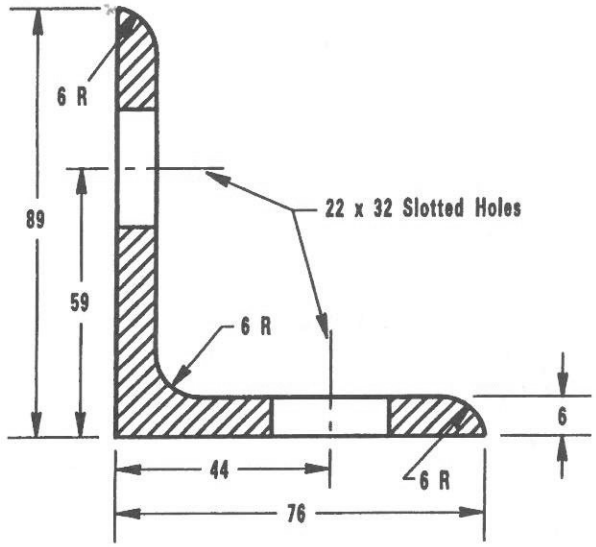
INTENDED USES

Pipe
Arch
Pipe Arch
Pedestrian Underpass
Vehicular Underpass
High-Profile Arch
Horizontal Ellipse
Low-Profile Arch
Pear Shape
Box Culvert

ALUMINUM STRUCTURAL PLATE
STANDARD PLATE DETAILS

AASHTO-AGC-ARTBA
TF-13 DRAWING

SPPA-6-96



Included Angle 80° or 90°

NOTE: All Dimensions are in millimeters

SPECIFICATIONS

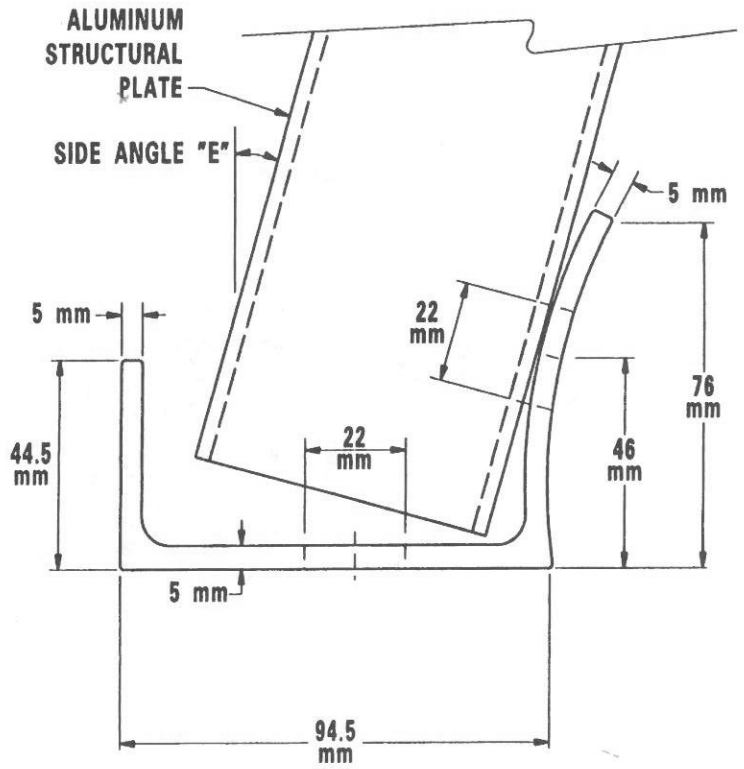
Material shall conform to the requirements of ASTM B 221M alloy 6063–T6.

INTENDED USE

To connect the shell of arch to corrugated footing pads.

ALUMINUM STRUCTURAL PLATE
FOOTING CONNECTION ANGLE

AASHTO–AGC–ARTBA TF–13 DRAWING	SPPA–7–96



SPECIFICATIONS

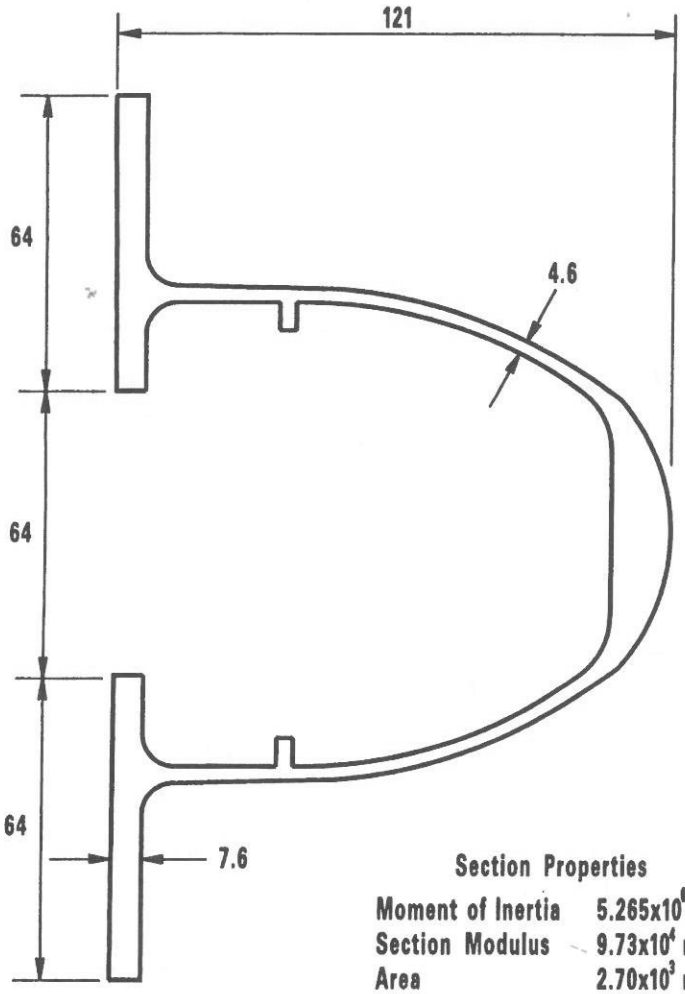
Material shall conform to the requirements of ASTM B 221M. Alloy 6063–T6.

INTENDED USE

To connect the shell of box culverts to corrugated footing pads.

ALUMINUM STRUCTURAL PLATE
BOX CULVERT RECEIVING CHANNEL

AASHTO–AGC–ARTBA TF–13 DRAWING	SPPA–8–96



Section Properties

Moment of Inertia	5.265×10^6 mm^4
Section Modulus	9.73×10^4 mm^3
Area	2.70×10^3 mm^2
Weight	7.47 kg/m
Allow. Mom. Cap	12.74 N · m

1. All dimensions are in millimeters.

SPECIFICATIONS

The material used for aluminum wale beams shall conform to the requirements of ASTM B 221M. Alloy 6061-T6.

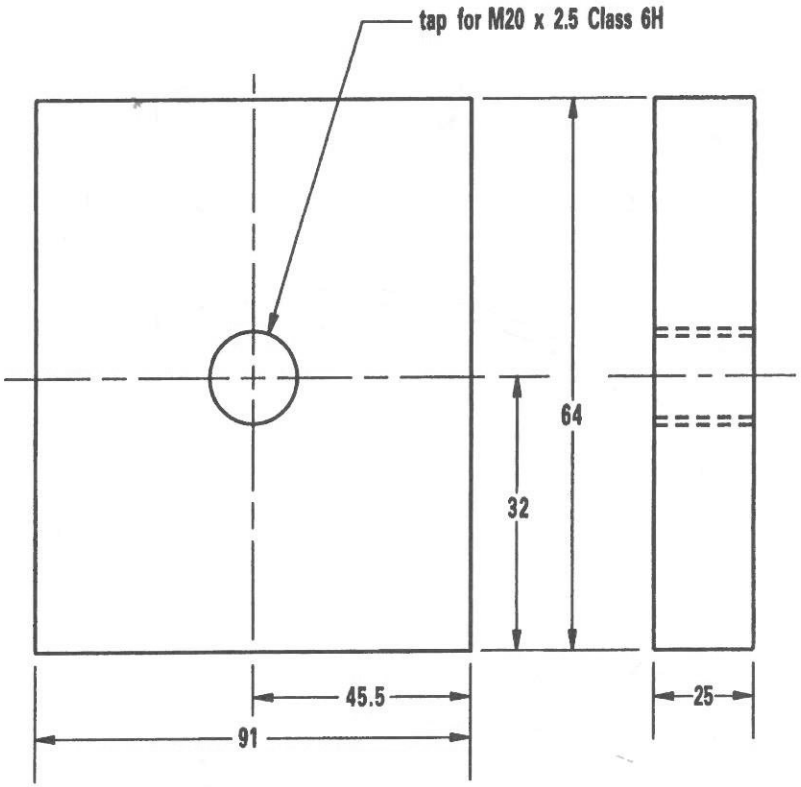
INTENDED USE

To reinforce, when connected to haunch plates, box culvert structures furnished with short footing pads.

ALUMINUM STRUCTURAL PLATE
WALE BEAM

AASHTO-AGC-ARTBA
TF-13 DRAWING

SPPA-9-96



NOTE: All dimensions are in millimeters

APPLICABLE SPECIFICATIONS

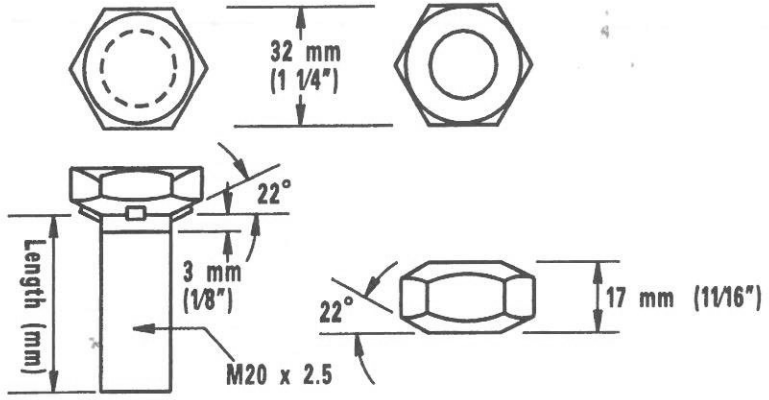
Material shall conform to the requirements of ASTM B 221M Alloy 6061-T6.

INTENDED USE

Connecting plate for use with wale beam part SPPA-9-96.

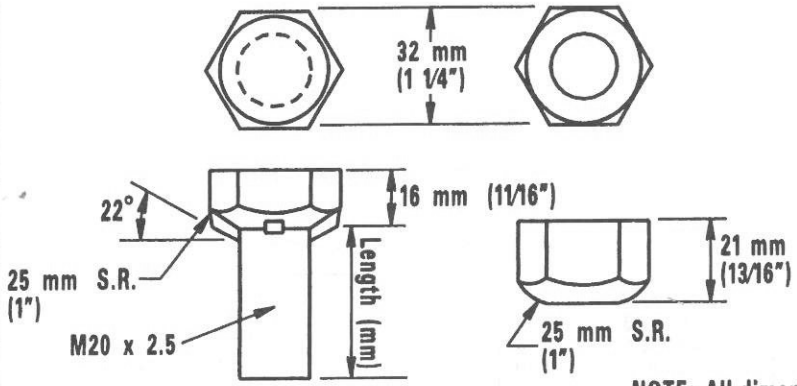
ALUMINUM STRUCTURAL PLATE
CONNECTING PLATE FOR WALE BEAM

AASHTO-AGC-ARTBA TF-13 DRAWING	SPPA-10-96



Aluminum

Length (mm)	Weight (kg 100 pcs.)	Allow. Plate Thickness	
		Two Plate	Three Plate
32	4.54	2.54-4.44	--
38	4.94	5.08-6.35	2.54-4.44
52	5.76	--	5.08-6.35



Aluminized and Galvanized Steel

NOTE: All dimensions are in millimeters.

Length (mm)	Weight (kg 100 pcs.)	Allow. Plate Thickness	
		Two Plate	Three Plate
32	14.06	2.54-4.44	--
38	14.97	5.08-6.35	2.54-4.44
52	17.24	--	5.08-6.35

SPECIFICATIONS

Bolts and nuts for aluminum structural plate shall conform to the following specifications:

1. Bolt—ANSI B 18.2.3.5M ASTM F 568M - Class 8.8
2. Nut—ANSI B 18.2.4.2M ASTM A 563M - Class 9
3. Galvanize—AASHTO M 232
4. Aluminum—ASTM B 211M Alloy 6061-T6

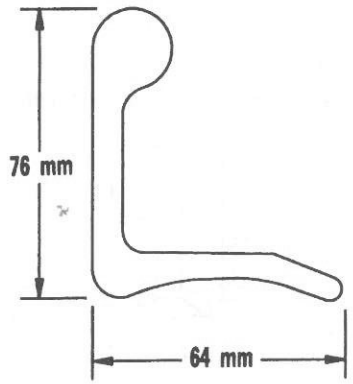
INTENDED USE

To connect 230 mm x 64 mm corrugated aluminum structural plate.

ALUMINUM STRUCTURAL PLATE BOLTS AND NUTS

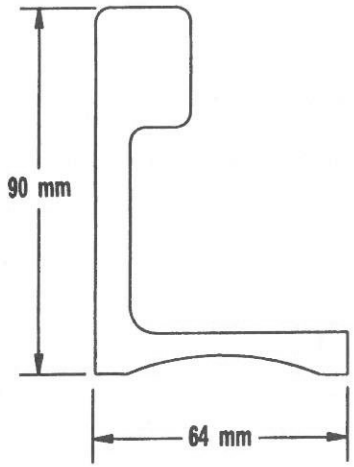
AASHTO-AGC-ARTBA TF-13 DRAWING

SPPA-11-96



Type II Rib

Rib	Type II
Alloy	6061-T6
fy min	240 MPa
fu min	260 MPa
A	1116 mm^2
I	8.32×10^5 mm^4



Type IV Rib

Rib	Type IV
Alloy	6061-T6
fy min	240 MPa
fu min	260 MPa
A	1510 mm^2
I	1.55×10^6 mm^4

SPECIFICATIONS

1. Circumferential Stiffeners shall conform to the requirements of ASTM B 221M Alloy 6061-T6.

2. Location, spacing and length should be clearly noted on drawing.

INTENDED USE

To reinforce box culverts or to allow increased span of structural plate structures.

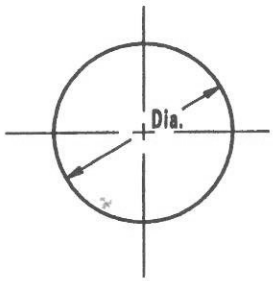
This stiffener may be applied to all shapes of structural plate structures.

ALUMINUM STRUCTURAL PLATE CIRCUMFERENTIAL STIFFENER

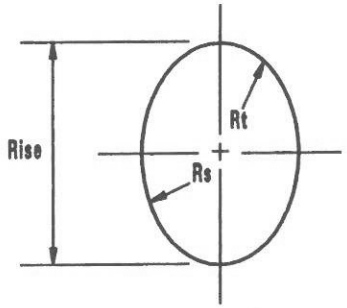
AASHTO-AGC-ARTBA TF-13 DRAWING

SPPA-12-96

SECTION SPC—STANDARD SHAPES



Round Pipe



Elliptical Pipe

Round Pipe is available in standard sizes from 1500 mm to 7800 mm diameter in 150 mm increments providing flow areas from 1.86 m^2 to 49.33 m^2.

Elliptical pipe is available in the same nominal diameter specified above but with the radii adjusted to produce a rise greater than the nominal diameter. This adjustment of the radii has minimal effect on the flow area.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges*. Section 12.

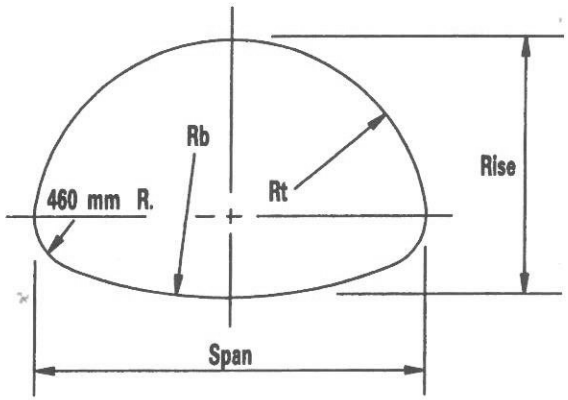
INTENDED USES

Provide a conduit within soil backfill for passage of fluids or other material. The round pipe shape is selected when the only criteria for shape selection is to provide a maximum flow area to periphery ratio.

ALUMINUM OR STEEL STRUCTURAL PLATE PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING

SPS–1–96



Pipe Arch – Series I

Series I pipe arches are available in sizes ranging from 1850 mm span x 1400 mm rise to 5055 mm span x 3070 mm rise with increments in rise of 51 mm providing flow areas from 2 m^2 to 12 m^2.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USES

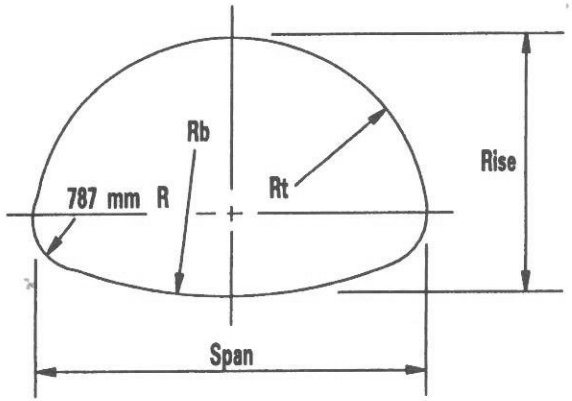
Provide a conduit within soil backfill for passage of fluids or other materials.

The series I pipe arch shape is selected when the consideration of headroom makes it necessary to maximize the flow area to rise ratio.

STEEL STRUCTURAL PLATE
PIPE ARCH—SERIES I

AASHTO–AGC–ARTBA
TF–13 DRAWING

SPSS–2–96



Pipe Arch - Series II

Series II pipe arch are available in sizes ranging from 4040 mm span x 2840 mm rise to 6270 mm span x 4010 mm rise with increments in rise of 51 mm providing flow areas from 9 m^2 to 19.9 m^2.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USES

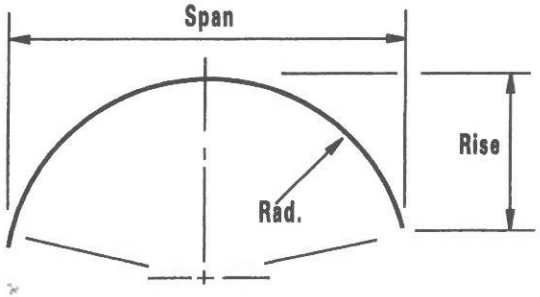
Provide a conduit within soil backfill for passage of fluids or other materials.

The series II pipe arch shape is selected when the consideration of headroom makes it necessary to maximize the flow area to rise ratio.

STEEL STRUCTURAL PLATE
PIPE ARCH—SERIES II

AASHTO-AGC-ARTBA
TF-13 DRAWING

SPSS-3-96



Arch

Arches are available in sizes from 1500 mm spans to 7920 mm spans in increments of 300 mm with variable rises providing flow areas from 0.60 m^2 to 25 m^2.

Note: Aluminum structural plate arches are limited to spans of 5790 mm.

APPLICABLE SPECIFICATIONS

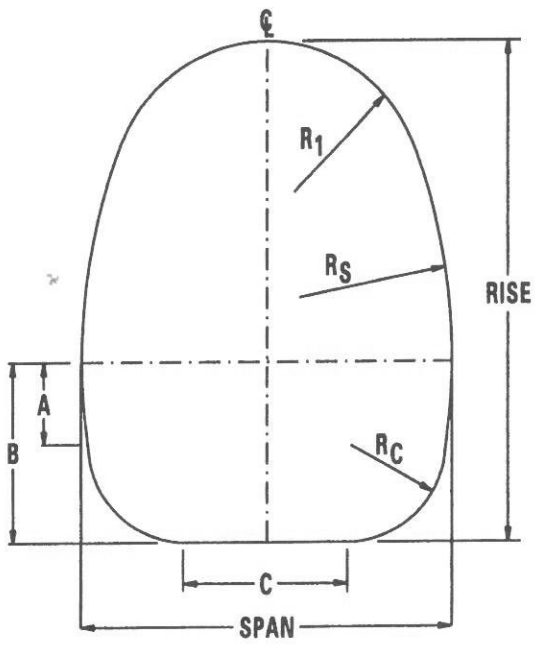
AASHTO *Standard Specifications for Highway Bridges*. Section 12.

INTENDED USES

Provide a conduit within soil backfill for passage of fluids or other materials. An arch is selected when site conditions, aesthetic considerations or other criteria make it desirable and/or economical to place the structure on footings rather than use a closed conduit.

ALUMINUM OR STEEL STRUCTURAL PLATE ARCH

AASHTO–AGC–ARTBA TF–13 DRAWING	SPS–4–96



TYPICAL SECTION

Structural Plate Steel Underpasses

Pedestrian Underpasses are available in sizes from 1730 mm span x 1750 mm rise to 1780 mm span x 2490 mm rise.

APPLICABLE SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USE

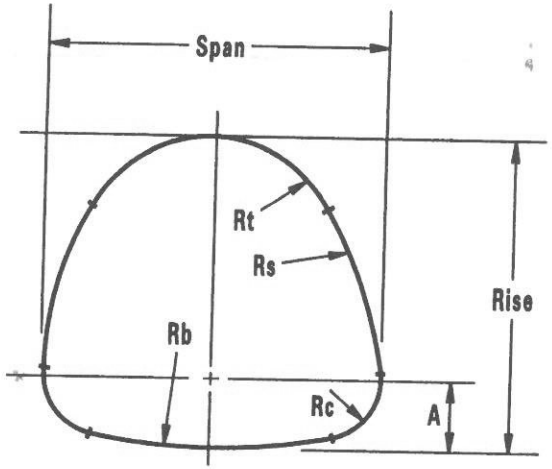
Provide a conduit within soil backfill for passage of fluids or other materials.

The pedestrian underpass is selected when the clearance configuration is of maximum concern.

STEEL STRUCTURAL PLATE
PEDESTRAIN UNDERPASS

AASHTO–AGC–ARTBA
TF–13 DRAWING

SPSS–5–96



Structural Plate Steel Underpasses
Sizes and Layout Details

Vehicular underpasses are available in sizes from 3710 mm span to 3350 mm rise to 6200 mm span to 5440 mm rise.

APPLICABLE SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

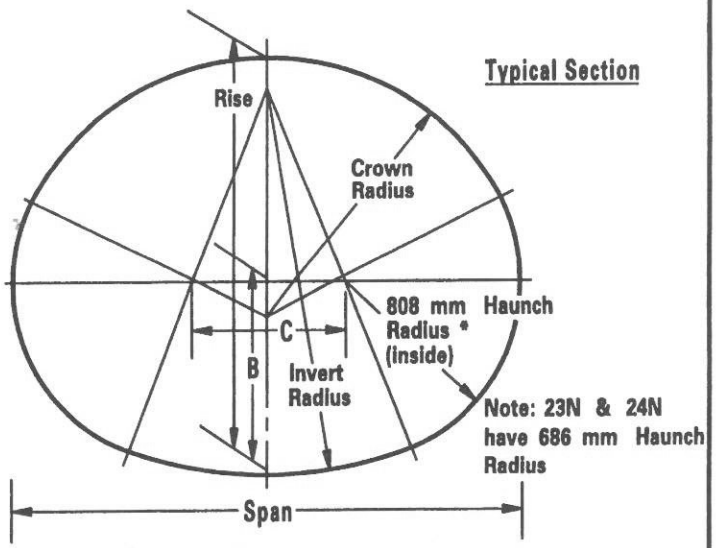
INTENDED USE

Provide a conduit within soil backfill for passage of vehicles and materials.

The vehicular underpass is selected when the clearance configuration is of maximum concern.

STEEL STRUCTURAL PLATE
VEHICULAR UNDERPASS

AASHTO–AGC–ARTBA TF–13 DRAWING	SPSS–6–96



Series III pipe is available in sizes from 2010 mm span x 1730 mm rise to 4980 mm span x 3050 mm rise; from 2.8 m^2 to 12.5 m^2.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

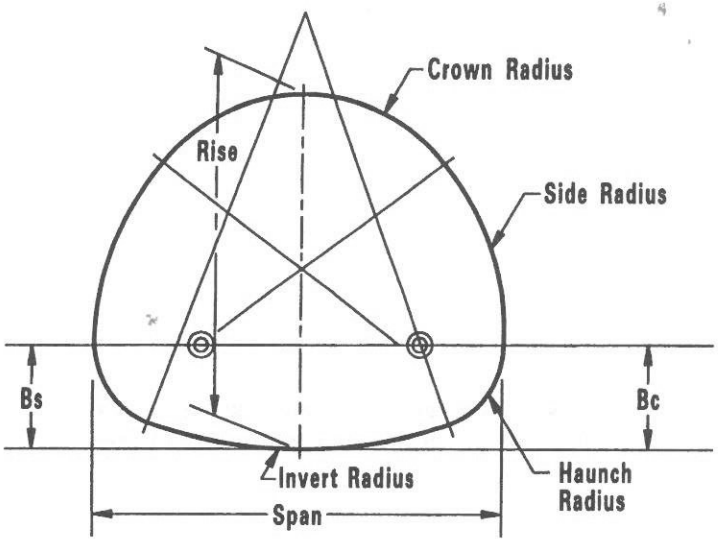
INTENDED USE

To provide a conduit within soil backfill for passage of fluids or other materials.

The Series III pipe arch is selected when the consideration of headroom makes it necessary to maximize the flow area to rise ratio.

ALUMINUM STRUCTURAL PLATE PIPE ARCH

AASHTO-AGC-ARTBA TF-13 DRAWING	SPSA-7-96



Vehicular underpasses are available in sizes from 3710 mm span x 3350 mm rise to 6200 mm span x 5440 mm rise.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges*. Section 12.

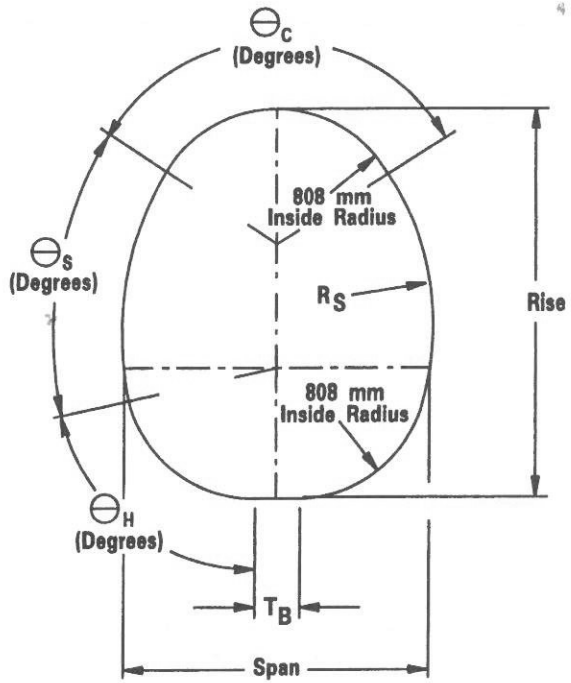
INTENDED USE

Provide a conduit within soil backfill for passage of vehicles or other materials.

The vehicular underpass is selected when the clearance consideration is of greater concern than the flow area.

ALUMINUM STRUCTURAL PLATE
VEHICULAR UNDERPASS

AASHTO–AGC–ARTBA TF–13 DRAWING	SPSA–8–96



Typical Section

Pedestrian Underpasses are available in sizes from 1850 mm span x 1750 mm rise to 1960 mm span x 2460 mm rise.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USE

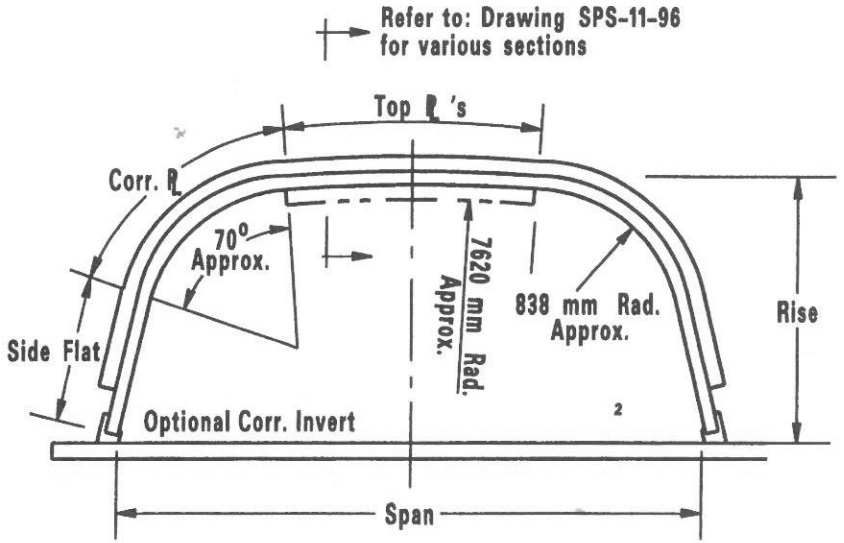
To Provide a conduit within soil backfill for passage of pedestrians.

The pedestrian underpass is selected when the clearance configuration is of greater concern than the flow area.

ALUMINUM STRUCTURAL PLATE
PEDESTRAIN UNDERPASS

AASHTO-AGC-ARTBA
TF-13 DRAWING

SPSA-9-96



Box Culvert

Metal Box Culverts are available in sizes ranging from 2515 mm span x 686 mm rise to 7747 mm span x 3099 mm rise; from 1.5 m^2 to 20.7 m^2.

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.8.

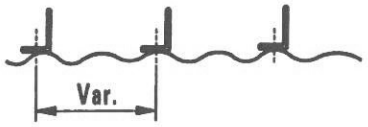
INTENDED USES

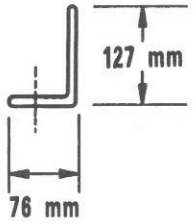
To provide a conduit within soil backfill for passage of fluids or other materials.

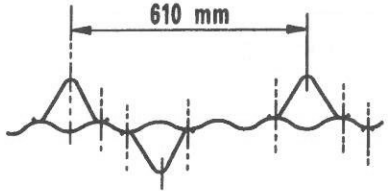
Box culvert is selected when the consideration of headroom makes it necessary to maximize the flow area to rise ratio. Footing plates or concrete footings can be used in lieu of optional invert.

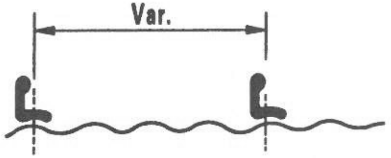
ALUMINUM OR STEEL STRUCTURAL PLATE BOX CULVERT

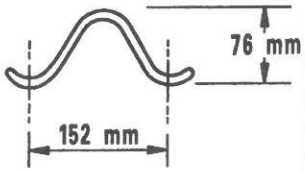
AASHTO–AGC–ARTBA TF–13 DRAWING	SPS–10–96

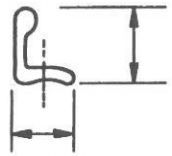












See SPPA-12-96 for aluminum reinforcing ribs available

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.8.

INTENDED USE

To reinforce corrugated structural plates for use on box culverts.

VARIOUS SECTIONS THRU STEEL OR ALUMINUM STRUCTURAL PLATE BOX CULVERTS

AASHTO–AGC–ARTBA TF–13 DRAWING	SPS–11–96

SECTION SPL—LONG SPANS

Comments on Long Span Structural Plate Structures

Long span structural plate structures are short span bridges and are defined in the AASHTO Standard Specifications for Highway Bridges (revised through 1996) as:

(1) Structural plate structures (pipe, pipe arch, and arch) which exceed maximum sizes imposed by the design requirements for structural plate pipe structures.

(2) Special shapes of any size which involve a relatively large radius of curvature in crown or side plates. Vertical ellipses, horizontal ellipses, underpasses, low profile arches, high profile arches, and inverted pear shapes are the terms describing these special shapes.

Long span structures shall include acceptable special features.

Acceptable special features (are):

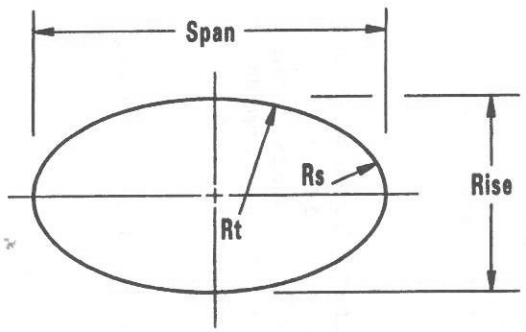
(1) Continuous longitudinal structural stiffeners (reinforced concrete) connected to the corrugated plates at each side of the top arc.

(2) Reinforcing ribs formed from structural shapes curved to conform to the curvature of the plates, fastened to the structure as required to insure integral action with the corrugated plates, and spaced at such intervals as necessary to increase the moment of inertia of the section to that required by the design.

Drawings SPS-1-96, SPSS-3-96, and SPS-4-96 and SP-7-96 show structure shapes (round and elliptical aluminum or steel or aluminum structural plate arch, respectively) that can be designed either as structural plate pipe structures or as long span structures, the latter requiring special features. Drawings SPL-2-96, SPL-3-96, SPL-4-96, and SPL-5-96 show structure shapes (horizontal ellipse, low-profile arch, high-profile arch and inverted pear, respectively) that are normally designed as long span structural plate structures requiring special features.

Drawing SPL-6-96 and SPPA-11-96 show the special features applicable for steel and aluminum long span structures respectively.

Upon special request to the manufacturers, any of the long span shapes may be available in sizes larger or smaller than the ranges shown in this guide.



Horizontal Ellipse

The horizontal ellipse is available in sizes ranging in size from 5890 mm span x 3890 mm rise to 11 330 mm span x 6760 mm rise providing flow areas of 18.1 m^2 thru 58.6 m^2.

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges*. Section 12.

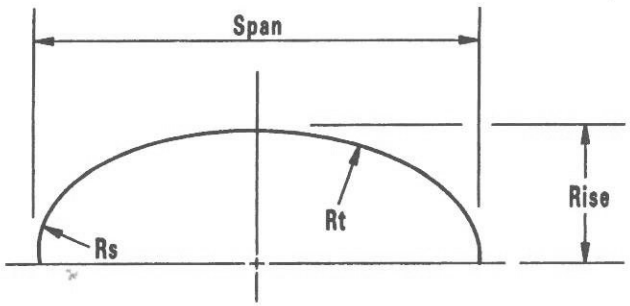
INTENDED USE

Provide a conduit within soil backfill for passage of fluids or other materials.

The horizontal ellipse is selected when the consideration of headroom makes it necessary to maximize the flow area to rise ratio.

ALUMINUM OR STEEL STRUCTURAL PLATE
HORIZONTAL ELLIPSE

AASHTO–AGC–ARTBA TF–13 DRAWING	SPL–2–96



Low Profile Arch

The low profile arch in sizes ranging from 6120 mm span x 2290 mm rise to a maximum of 11 790 mm span x 4800 mm rise providing a flow area of 11.1 m^2 to 45.5 m^2.

APPLICABLE SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USES

Provide a conduit within soil backfill for passage of fluids or other materials.

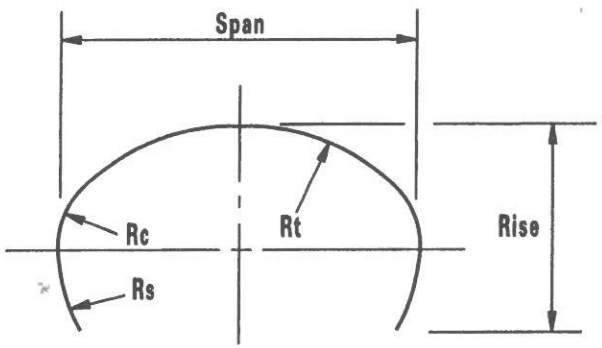
An arch shape is selected when site conditions, aesthetic considerations or other criteria make it desirable and/or economical to place the structure on footings rather than use a closed conduit.

A low profile arch is selected when the consideration of head room makes it necessary to maximize the flow area to rise ratio.

ALUMINUM OR STEEL STRUCTURAL PLATE
LOW-PROFILE ARCH

AASHTO–AGC–ARTBA
TF–13 DRAWING

SPL–3–96



High Profile Arch

High profile arch are available in sizes ranging from 6120 mm span x 2770 mm rise to 10 720 mm span x 6100 mm rise providing a flow areas from 14.1 m^2 to 56.4 m^2.

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

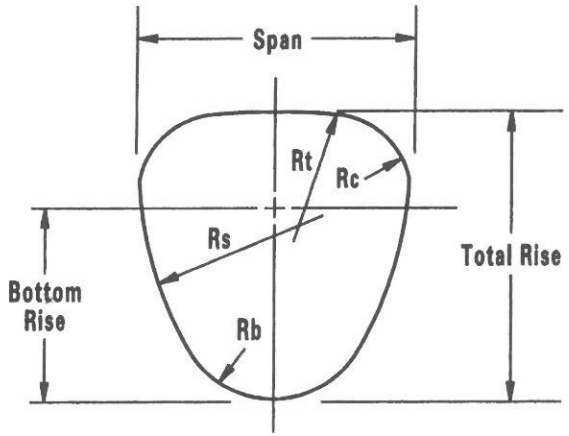
INTENDED USES

Provide a conduit within soil backfill for passage of fluids or other materials.

An arch shape is selected when site conditions, aesthetic considerations or other criteria make it desirable and/or economical to place the structure on footings rather than use a closed conduit.

ALUMINUM OR STEEL STRUCTRAL PLATE
HIGH-PROFILE ARCH

AASHTO-AGC-ARTBA TF-13 DRAWING	SPL-4-96



Pear Shape

Pear shapes are available in sizes from 7210 mm span x 7820 mm rise to 9140 mm span x 9500 mm rise.

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges*. Section 12.

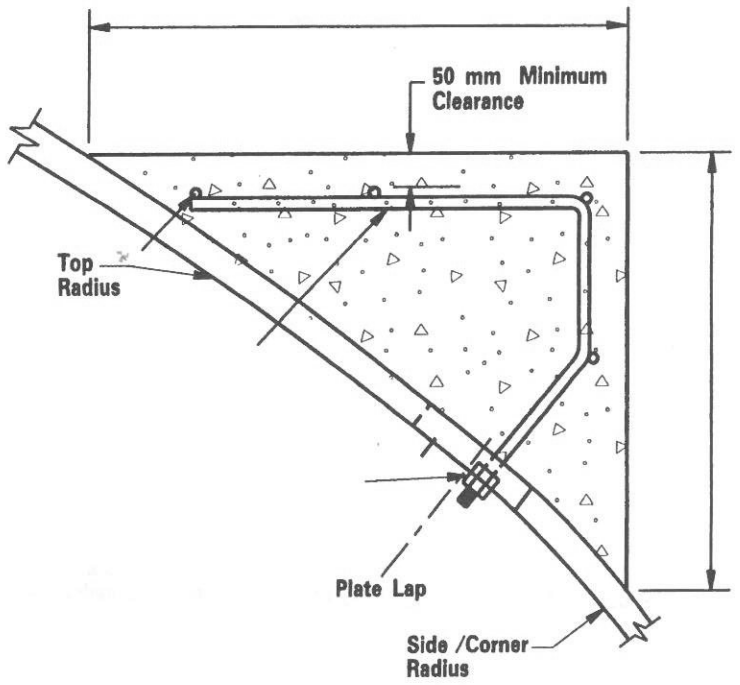
INTENDED USES

Provide a conduit within soil backfill for passage of fluids or other materials.

The pear shape is selected when the clearance configuration is of greater concern than the flow area.

STEEL STRUCTURAL PLATE
PEAR SHAPE

AASHTO-AGC-ARTBA TF-13 DRAWING	SPL-5-96



LONGITUDINAL STIFFENER

SPECIFICATIONS

AASHTO *Standard Specifications for Highway Bridges.* Section 12.8.

INTENDED USE

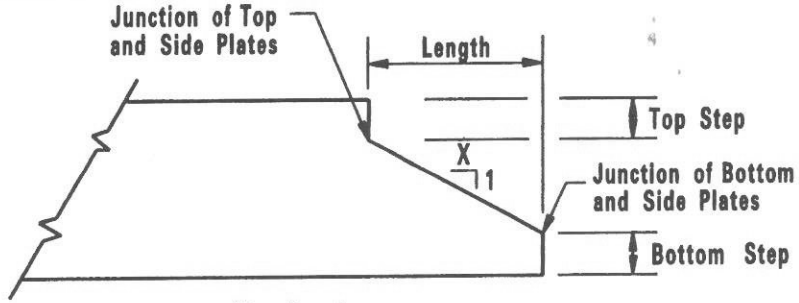
To provide the "Special Feature" requirement of a long span structure. The special feature reinforces the structural plate structures, allowing it to be designed and function as a long span structure.

Note: On aluminum structures, black steel bars must not be in contact with aluminum.

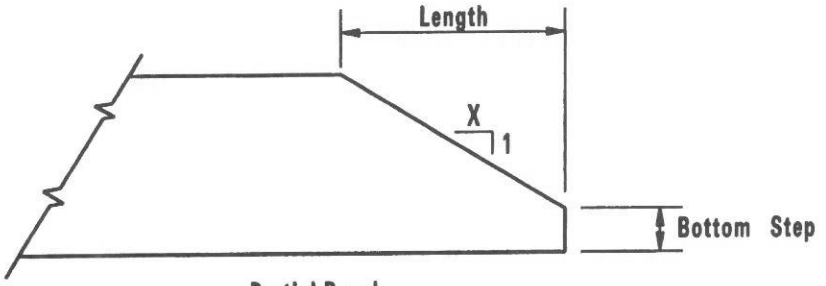
SECTION THRU STEEL AND ALUMINUM STRUCTURAL PLATE LONG SPAN STRUCTURES

AASHTO-AGC-ARTBA TF-13 DRAWING	SPL-6-96

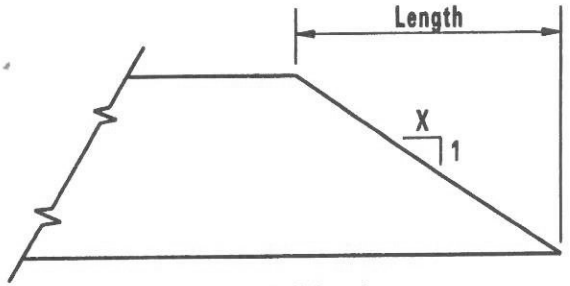
SECTION SPE—END TREATMENTS AND SPECIAL FABRICATION



Step Bevel



Partial Bevel



Full Bevel

Partial Elevations Views

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USES

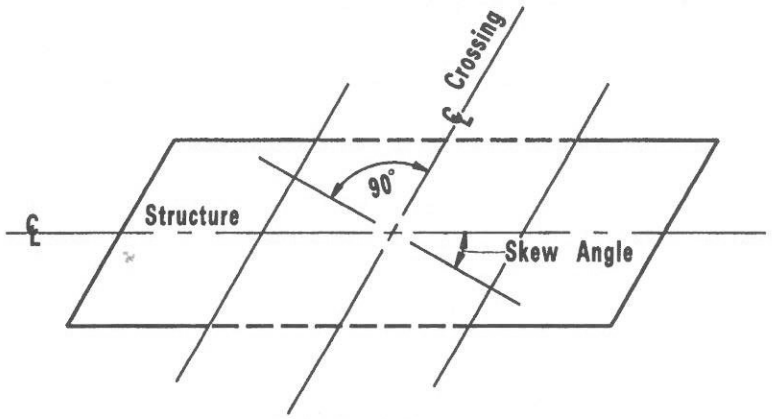
Beveled ends are specified to conform to the slope of the fill.

A beveled end should be reinforced & stabilized with concrete or rip-rap headwall and in no case should the bevel slope be greater than 1 V. to 2 H.

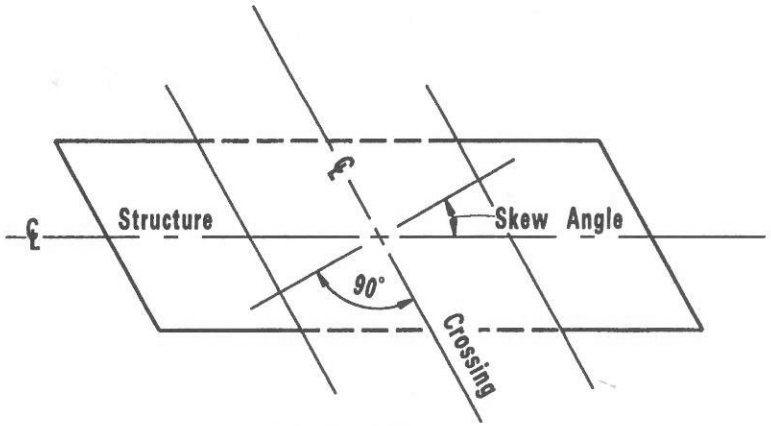
ALUMINUM OR STEEL STRUCTURAL PLATE END CONDITIONS—BEVEL

AASHTO-AGC-ARTBA
TF-13 DRAWING

SPE-1-96



Right-Hand Skew



Left-Hand Skew

Plan Views

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges*. Section 12.

INTENDED USES

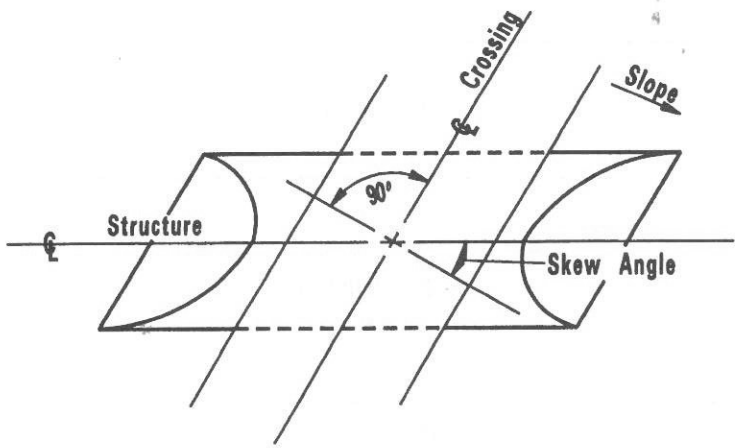
Skewed ends are specified to conform to the alignment of the fill.

Skewed and Beveled ends should be avoided. If absolutely necessary, careful attention must be given to their design.

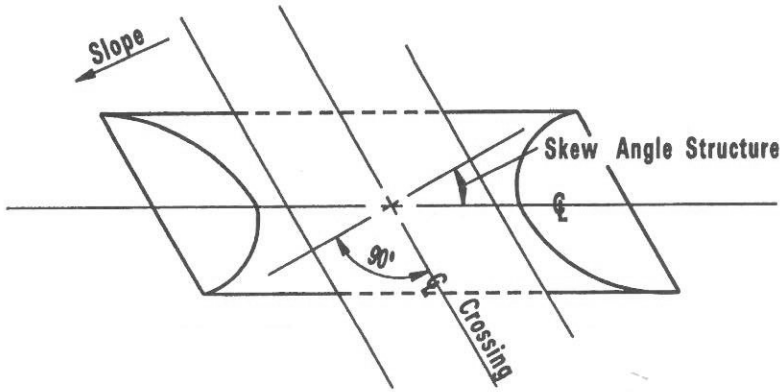
ALUMINUM OR STEEL STRUCTURAL PLATE END CONDITIONS—SKEWS

AASHTO–AGC–ARTBA TF–13 DRAWING

SPE–2–96



Right Hand Skew - Bevel



Left Hand Skew - Bevel

Plan Views

Drawings show a skew combined with a partial bevel. Skews can also be combined with step bevels or full bevels.

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

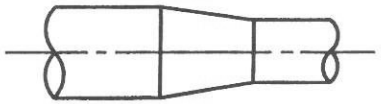
INTENDED USES

Skew-beveled ends are specified to conform to both the slope and alignment of the fill. Cutting the ends of a corrugated metal drainage structure to a skew or a bevel to conform to the embankment slope, destroys the ability of the end portion of the structure to act as a ring in compression. Headwalls, rip-rap slopes, slope paving, or stiffening of the pipe may be required to stabilize these ends. In general, the end of a pipe should not be cut to a skew greater than 35 degrees or beveled to a slope greater than 1 V. to 2 H.

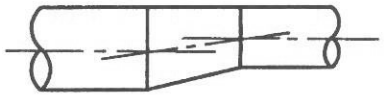
Skewed and beveled ends should be avoided. If absolutely necessary, careful attention must be given to their design.

ALUMINUM OR STEEL STRUCTURAL PLATE
END CONDITIONS—SKEW BEVEL

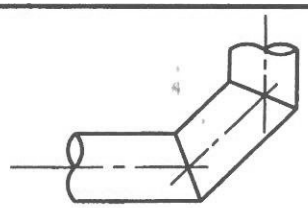
AASHTO-AGC-ARTBA TF-13 DRAWING	SPE-3-96



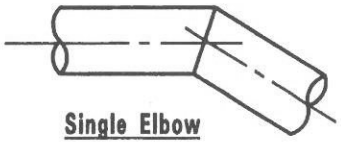
Concentric Reducer



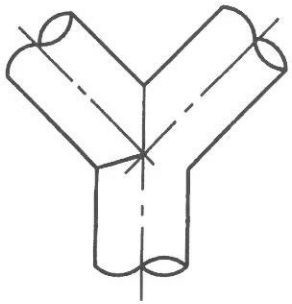
Eccentric Reducer



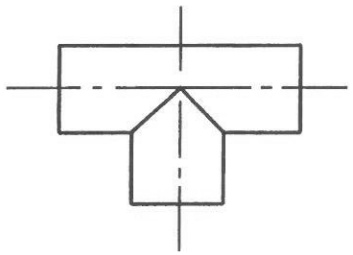
Multiple Elbow



Single Elbow

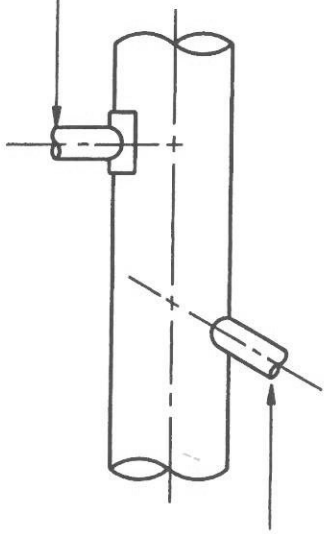


Wye



Tee

Stub w/saddle plate



Welded Stub

APPLICABLE SPECIFICATION

AASHTO *Standard Specifications for Highway Bridges.* Section 12.

INTENDED USES

When site and design requirements necessitate special structure adaptations they can often be met with the use of special shop fabricated items such as:

- **Reducers**
- **Vertical Elbows**
- **Horizontal Elbows**
- **Risers (Stub)**
- **Inlets**
- **Wyes**
- **Tees**
- **Etc.**

ALUMINUM OR STEEL STRUCTURAL PLATE SPECIAL FABRICATIONS

AASHTO–AGC–ARTBA TF–13 DRAWING	SPE–4–96

PART 4

DRAIN HARDWARE & ACCESSORIES (DH)

PART 4
DRAIN HARDWARE & ACCESSORIES (DH)
DESIGN CONSIDERATIONS

The selection of inlets and grates by the designer should be based on consideration of the following factors:

1. Hydraulic efficiency. This information will normally be obtained from the manufacturer or current literature.

2. Clogging characteristics.

3. Structural requirements will be dictated by location of placement.

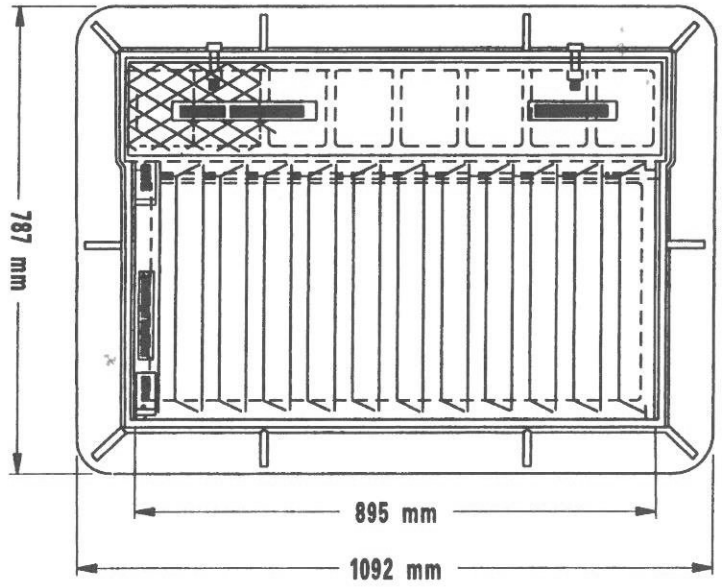
4. Safety requirements for bicycle and pedestrian traffic including the use of vane grates, transverse bars or ribs, if necessary.

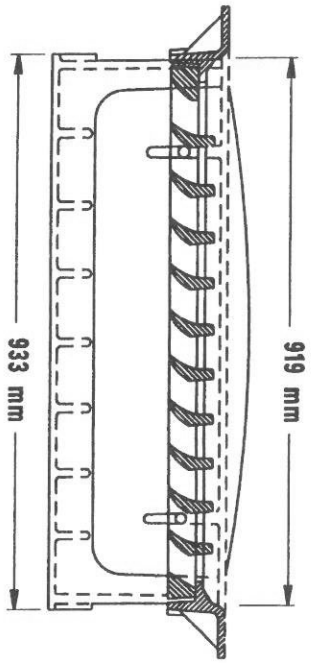
5. Esthetics and maintenance.

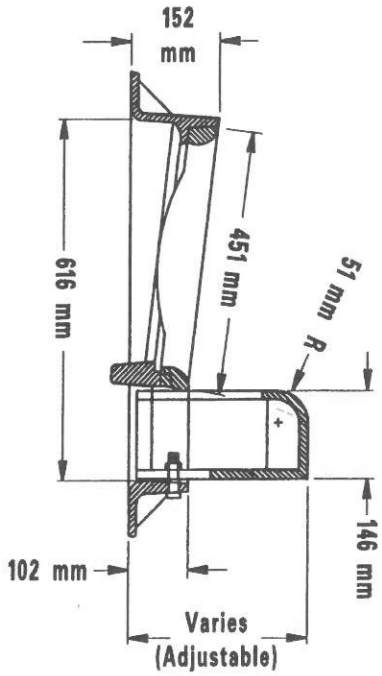
The designer can help ensure proper drainage hardware components are used by writing specifications which relate the extent to which testing and certification of materials should be done. It is expected such specifications would include tolerances which would be in accordance with industry standards and marking of items with visible and permanent identification for testing and certification procedures. Including as an appendix to this section is a "Specification for Cast Frames, Covers, Gratings, Steps and Catch Basin, Manhole." It is intended to be a suggested specification which will ensure adequate tensile strength of materials, be representative of the current practice and trends, and further contribute to drainage hardware standardization.

The dimensions shown in this section are nominal only and may not reflect the detail dimensions required for proper foundry practice.

SECTION DHD—DRAINS







SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 35B

BASIS OF SPECIFYING

Item description and grate configuration.
(See DHD-6 for possible configurations.)

Base metal (i.e. Gray Iron)

Size.

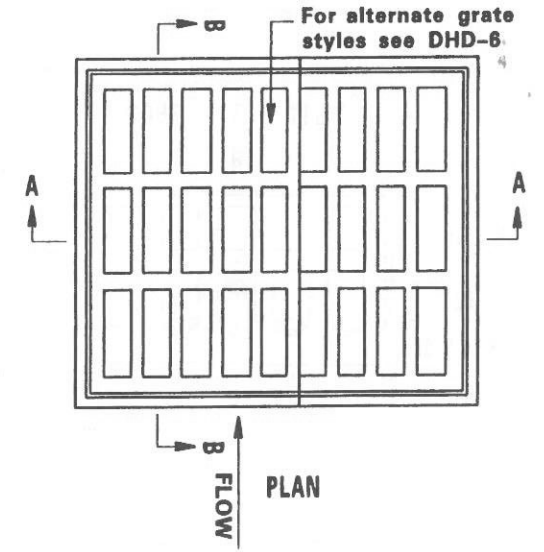
USE

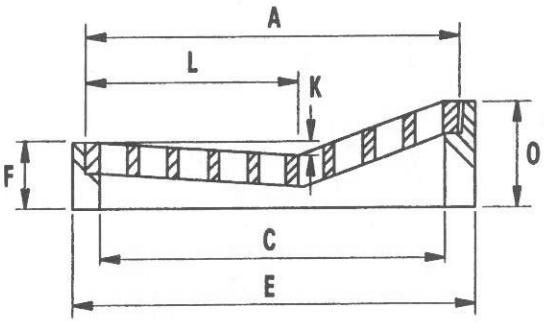
For Pavement drop inlet.

CAST CURB INLET, FRAME AND GRATE

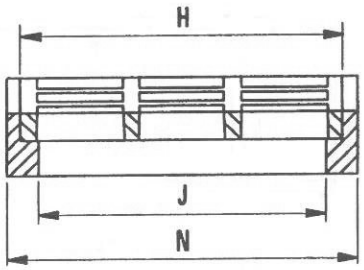
AASHTO-AGC-ARTBA
TF-13 DRAWING

DHD-1-96





SECTION AA



SECTION BB

FRAME AND GRATE

SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 30B or 35B

BASIS OF SPECIFYING

Item description and grate configuration.
(See DHD-6 for possible configurations.)

Base metal (i.e. Gray Iron)

Size.

Use Standard Sizes

For Pavement drop inlet.

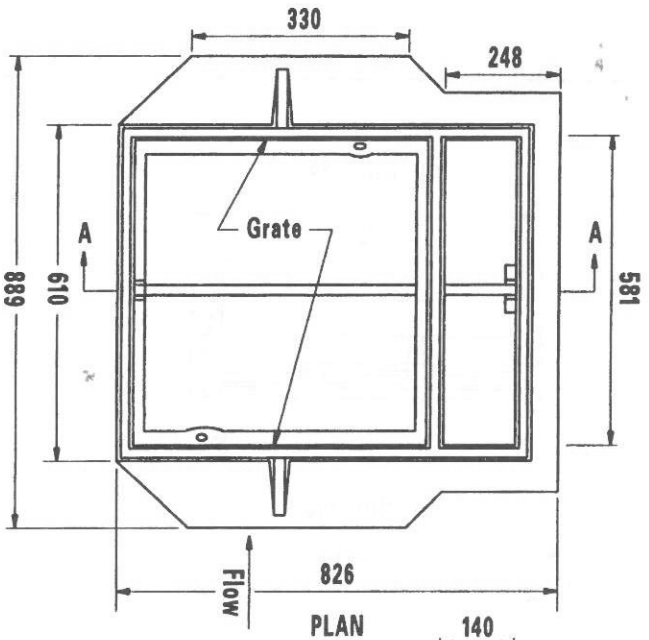
A	H	C	J	K	L	E	N	F	O
670	572	597	495	13	375	733	619	114	178
670	572	597	495	13	375	714	1219*	114	178

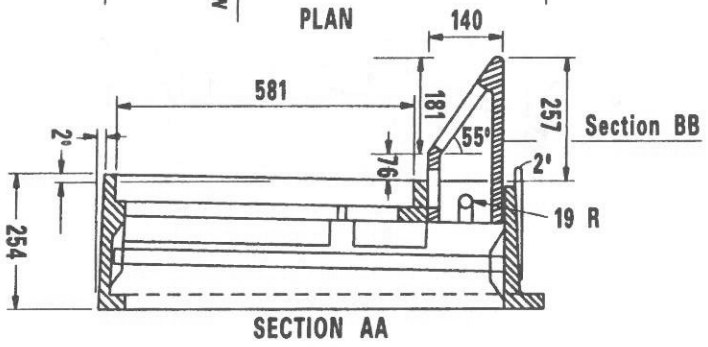
*Size of frame: Double Grates (End-to-End)
NOTE: All dimensions shown are in millimeters

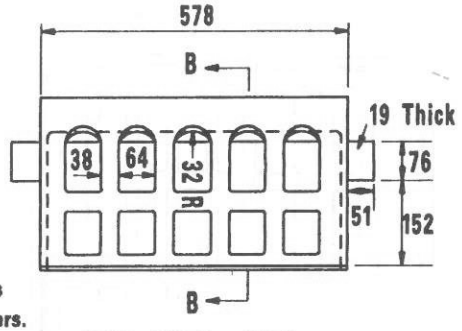
CAST CURB INLET, FRAME AND GRATE

AASHTO-AGC-ARTBA TF-13 DRAWING

DHD-2-96







NOTE: All dimensions shown are in millimeters.

CURB INLET - ELEV.

SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 30B or 35B

BASIS OF SPECIFYING

Item description and grate configuration.
Use type 6 grate configuration only (See DHD–6)

Base metal (i.e. Gray Iron) and class.

For pairs remove mating flanges.

Size.

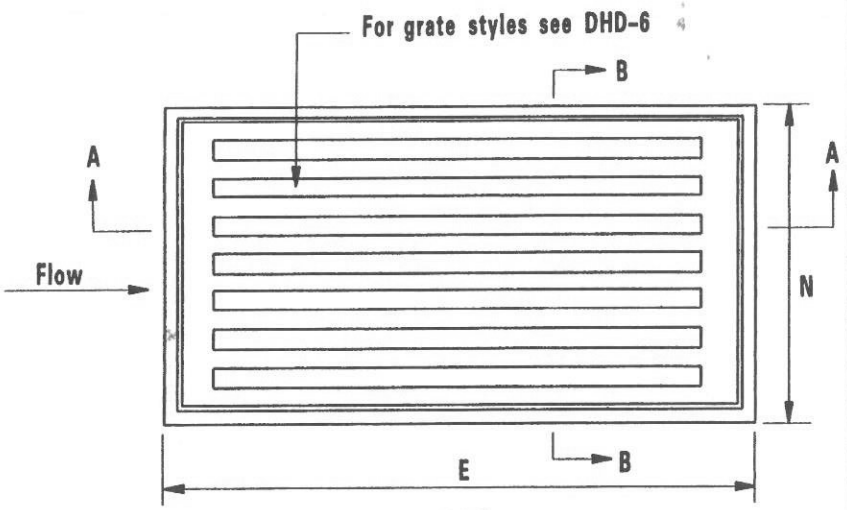
Use

For Pavement drop inlet in conjunction with concrete barrier. (MB–5)

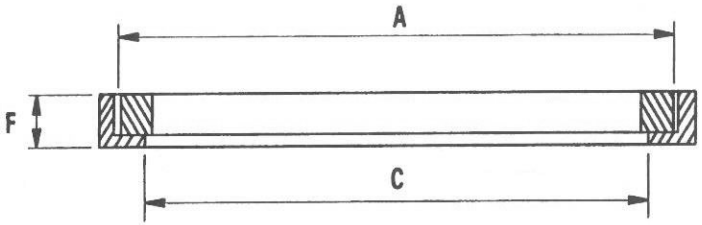
CAST CURB INLET, FRAME AND GRATE

AASHTO–AGC–ARTBA TF–13 DRAWING

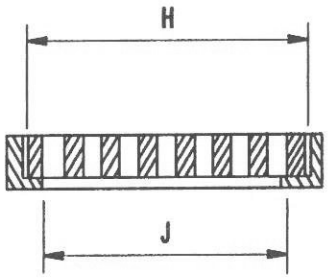
DHD–3–96



PLAN



SECTION AA



SECTION BB

FRAME AND GRATE

SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 30B or 35B

BASIS OF SPECIFYING

Item description and grate configuration.
(See DHD-6 for possible configuration.)

Base metal (i.e. Gray Iron) and class

Size.

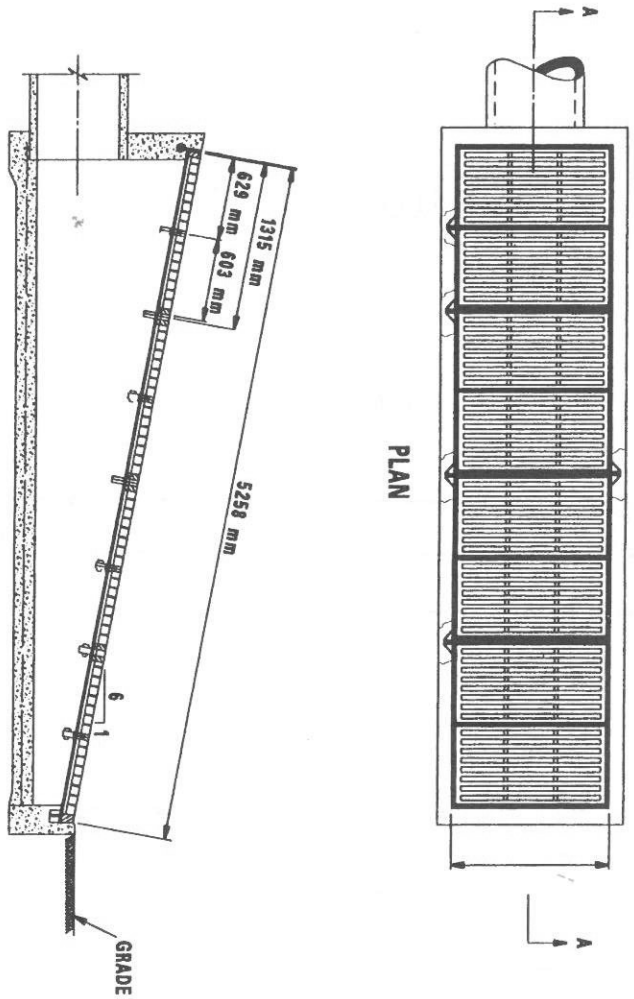
A	H	C	J	E	N	F
457	305	406	254	495	343	64
610	305	559	254	648	343	64
914	610	864	559	953	648	64

NOTE: All dimensions shown are in millimeters.

CAST FRAME AND GRATE

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHD–4–96



SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 35B

BASIS OF SPECIFYING

Item description and grate configuration.
(See DHD-6 for possible configuration.)

Base metal (i.e. Gray Iron, Ductile Iron) and class, grade or alloy.

Size.

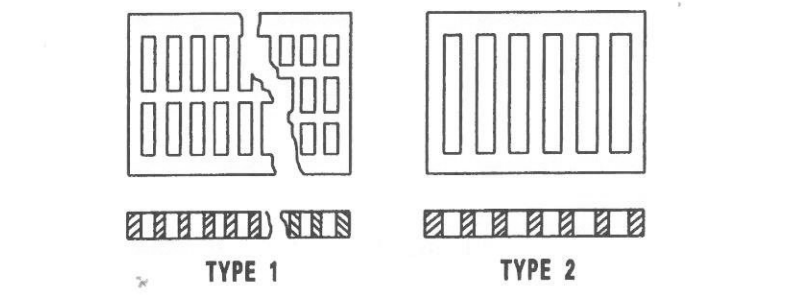
USE

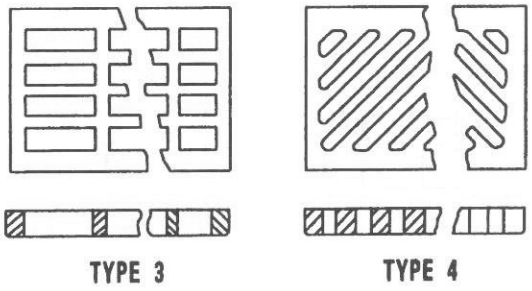
For safety section and 1 V. to 6 H. side slopes

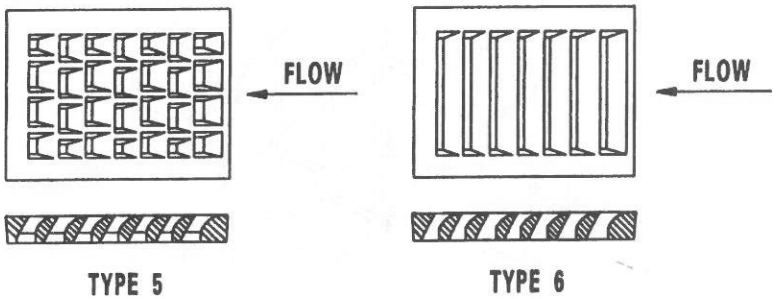
CAST FRAME AND GRATE

AASHTO-AGC-ARTBA TF-13 DRAWING

DHD-5-96







FOR RETANGULAR AND SQUARE FRAMES

SPECIFICATIONS

Cast Gray Iron: ASTM A 48 (AASHTO M 105 & M 306) Class 30B or 35B

BASIS OF SPECIFYING

Grate configuration.

Base metal (i.e. Gray Iron) and class

Size in accordance with frame.

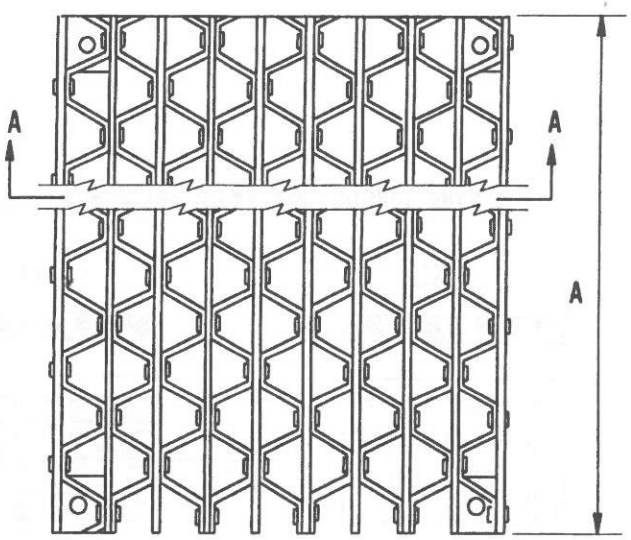
USES

For inlets.

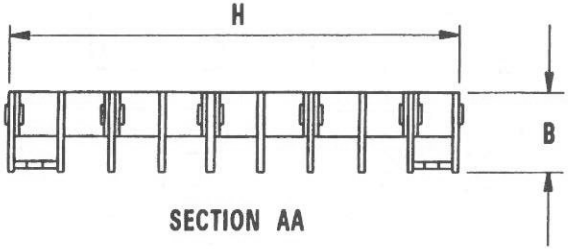
GRATE CONFIGURATIONS
RECTANGULAR AND SQUARE FRAMES

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHD–6–96



PLAN



SECTION AA

RETICULINE CONFIGURATION

SPECIFICATIONS

1. Steel for grate shall conform to AASTO M 183M, ASTM A 36M or AISI Grade 1020 or 1025
2. Rivets shall conform to AASHTO M 228, Grade 1.
3. Steel grate shall be galvanized in accordance with AASHTO M111.

BASIS OF SPECIFYING

Item description.

Size.

USES

For structure, pavement and sidewalk drainage.

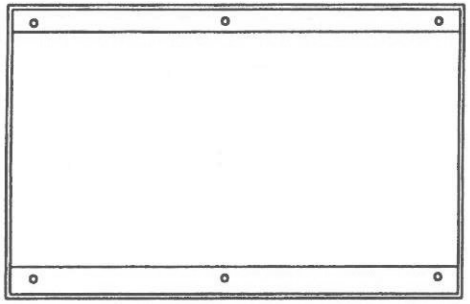
A	H	B
457	305	51
610	305	51
914	610	51

NOTE: All dimensions shown are in millimeters.

STEEL GRATE
RETICULINE CONFIGURATION

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHD–7–96



PLAN
FRAME

Flow

B

A

A

H

B

PLAN
GRATE

A

B

SECTION AA

SECTION BB

FRAME AND GRATE

SPECIFICATIONS

Steel for frame and grate shall conform to ASSHTO M 183M.

Steel frame and grate shall be galvanized in accordance with ASSHTO M 111.

BASIS OF SPECIFYING

Item description.

Size.

USES

For pavement drop inlet.

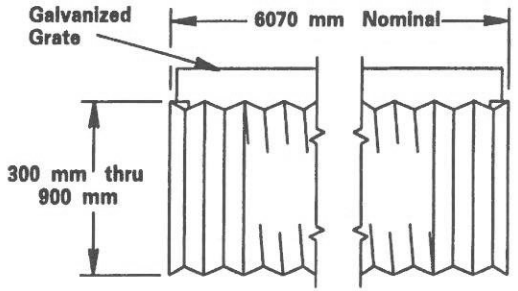
A	H	B
457	305	51
610	305	51
914	610	51

NOTE: Dimensions shown are in millimeters.

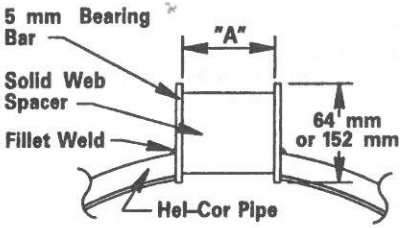
STEEL FRAME AND GRATE

AASHTO–AGC–ARTBA
TF–13 DRAWING

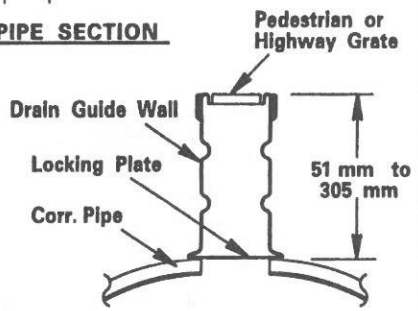
DHD–8–96



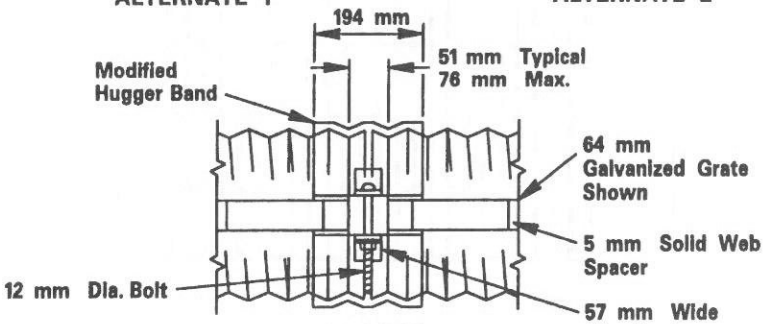
TYPICAL PIPE SECTION



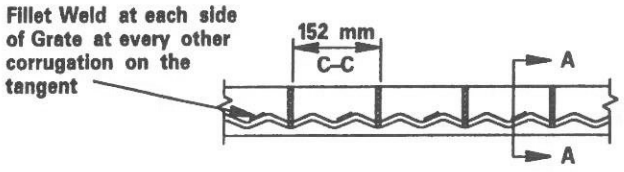
SECTION A-A
STANDARD DETAIL
ALTERNATE 1



SLOT DETAIL
ALTERNATE 2



TOP VIEW
MODIFIED HUGGER BAND



GRATE WELDING DETAIL

SPECIFICATIONS

1. Corrugated steel pipe shall meet applicable portions of AASHTO M 36M, AASHTO M 274 or AASHTO M 218 or AASHTO M 245M, AASHTO M 246M and ASTM A 825.

   PLATE GRATE – ALTERNATE 1
   Grate assemblies shall be a weldable grate of steel complying to the mechanical requirements of AASHTO M 183M. They shall be hot-dipped galvanized in accordance with AASHTO M 111.

   FORMED SHEET – ALTERNATE 2 STEEL
   Components formed from 2.01 mm material meeting the requirements of AASHTO M 218.

   FORMED SHEET – ALTERNATE 2A ALUMINUM
   Components formed from 1.91 mm material meeting the requirements of AASHTO M 196M.

2. Asphalt coated pipe shall conform to AASHTO M 190, Type A or C.

BASIS OF SPECIFYING

Item description.

Size and thickness.

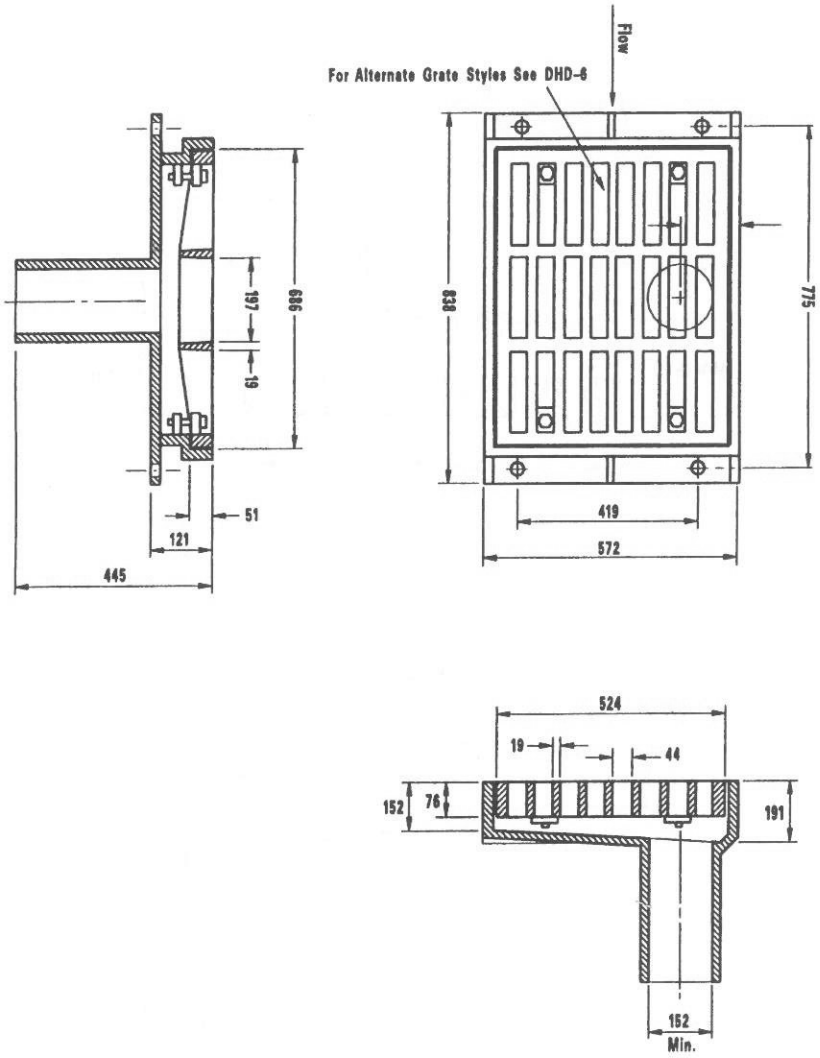
USES

Collect and remove surface water from roadways, parking lots and other paved areas.

CORRUGATED METAL SLOTTED DRAIN
ALUMINUM OR STEEL

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHD-9-96



NOTE: All dimensions shown are in millimeters

SPECIFICATIONS

Cast Gray Iron:

ASTM A 48 (AASHTO M 105 & M 306)
Class 30B or 35B

BASIS OF SPECIFYING

Item description.
Base metal (i.e. Gray Iron) and class.

Size.
Grate type (See DHD-6-96 for grates that may be available).

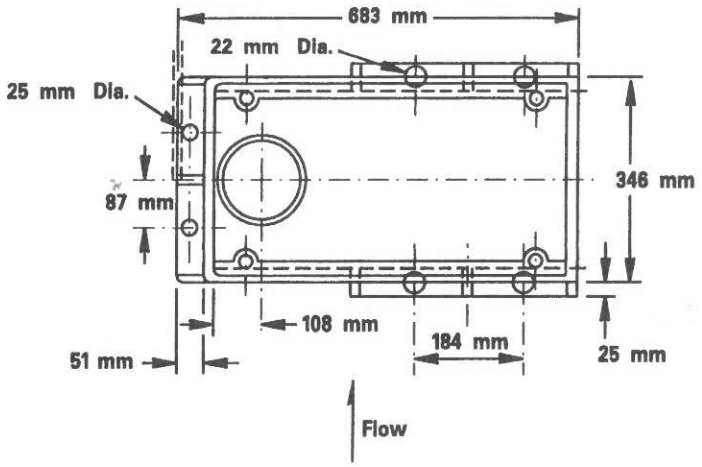
USES

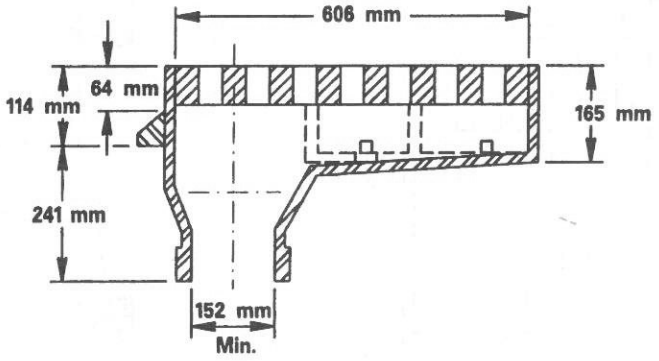
For bridge deck.

CAST IRON BRIDGE DRAIN

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHD-10-96





SPECIFICATIONS

Cast Gray Iron:

ASTM A 48 (AASHTO M 105 & M 306)
Class 30B or 35B

BASIS OF SPECIFYING

Item description.
Base metal (i.e. Gray Iron) and class.

Size.
Grate type (See DHD-6-96 for grates that may be available).

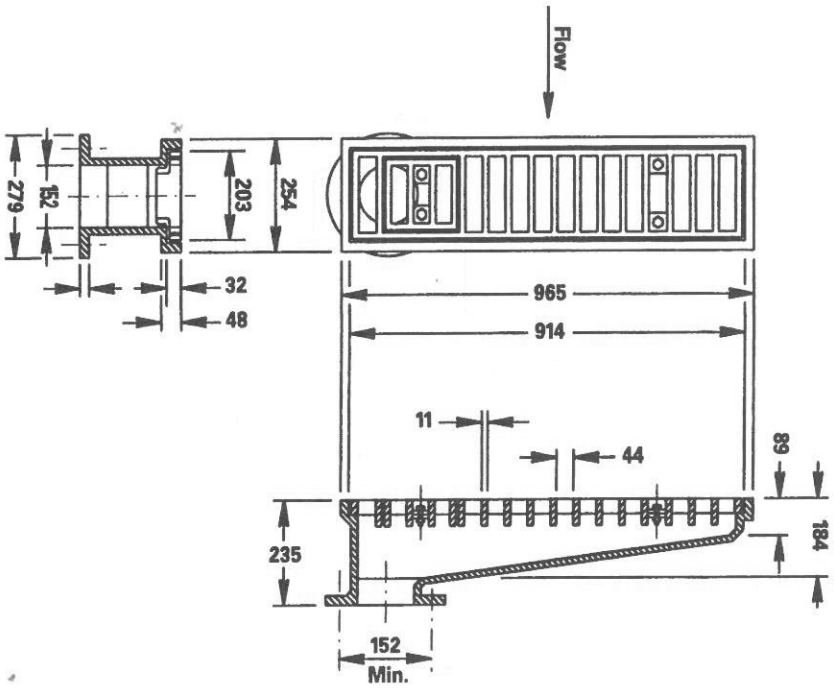
USES

For bridge deck.

CAST IRON BRIDGE DRAIN

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHD-11-96



NOTE: All dimensions shown are in millimeters

SPECIFICATIONS

Cast Gray Iron:

ASTM A 48 (AASHTO M 105 & M 306)
Class 30B or 35B

BASIS OF SPECIFYING

Item description.
Base metal (i.e. Gray Iron) and class.

Size.

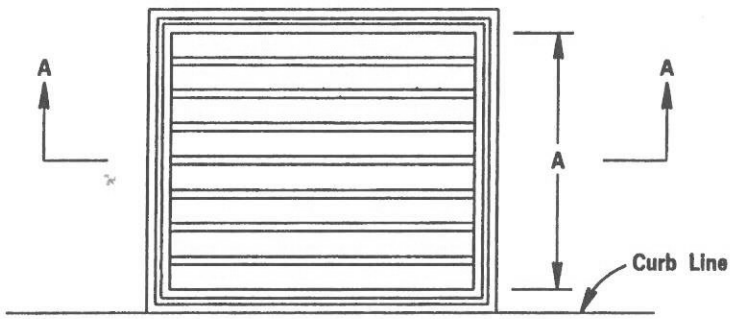
USES

For bridge deck.

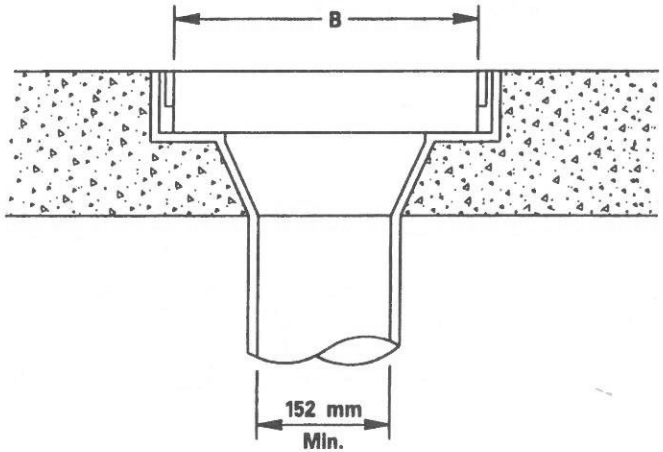
CAST IRON BRIDGE DRAIN

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHD–12–96



PLAN



SECTION A-A

SPECIFICATIONS

Cast Gray Iron:

ASTM A 48 (AASHTO M 105 & M 306)
Class 30B or 35B

BASIS OF SPECIFYING

Item description.
Base metal (i.e. Gray Iron) and class.

Size.

Grate type. (See DHD-6-96 for grates that may be available).

USES

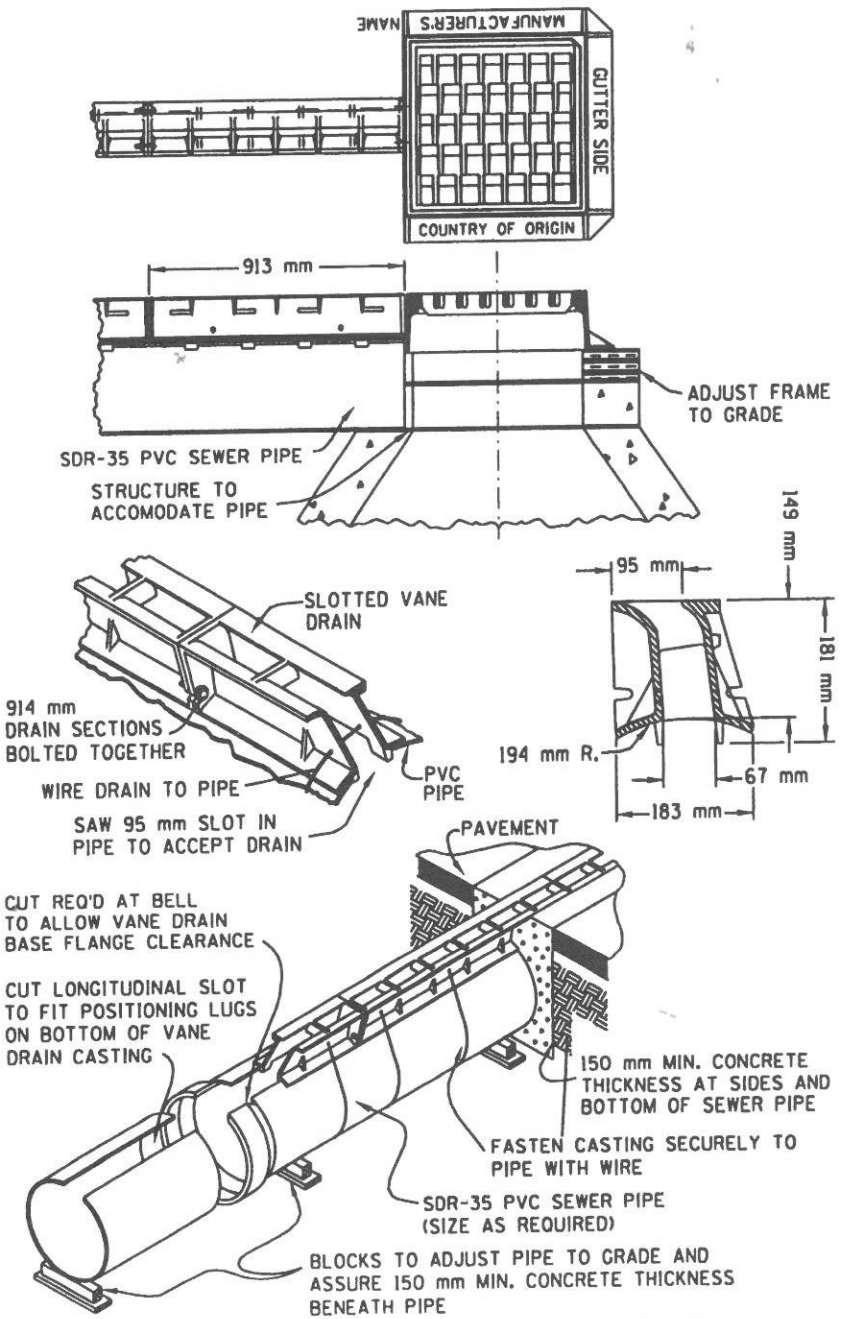
For bridge deck.

A	B
229 mm	305 mm
330 mm	330 mm
381 mm	406 mm
406 mm	610 mm

CAST IRON BRIDGE DRAIN

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHD-13-96



SPECIFICATIONS

Cast Gray Iron:

ASTM A 48 (AASHTO M 105 & M 306)
Class 35B

EFFICIENCY

The slotted vane drain removes sheet flow at a rate of 46.45 L /sec per lineal meter of drain for longitudinal slopes of 0% to 6%.

USES

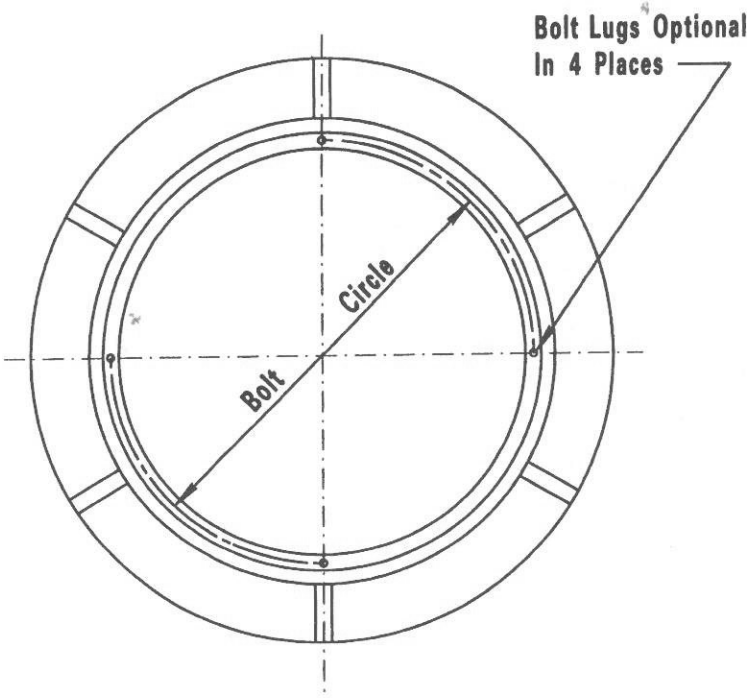
The slotted vane drain is installed perpendicular to the flow either as a free-standing unit or ideally extending from a gutter inlet frame and grate into the street. It is intended to maximize flow capture at specific inlet locations, thereby increasing efficiency of individual inlets and reducing the number of structures required downstream.

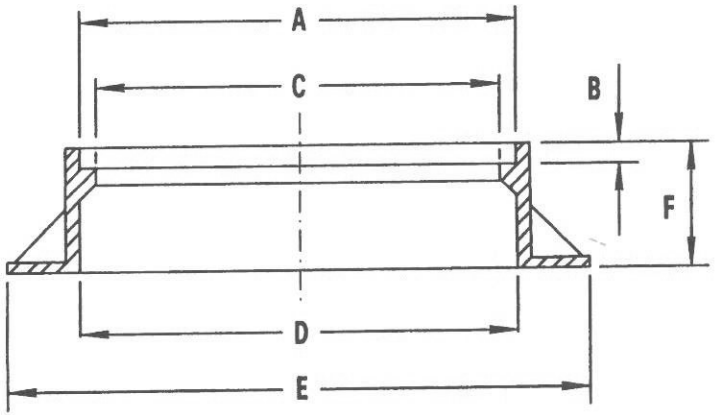
SLOTTED VANE DRAIN

AASHTO-AGC-ARTBA TF-13 DRAWING

DHD-14-96

SECTION DHMF—MANHOLE FRAMES





SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e. Gray Iron) and Class.
Machined bearing surface

USE

Use with Style 1 & 2 lids (DHML-1, DHML-2)
Sanitary and storm drain manhole access.

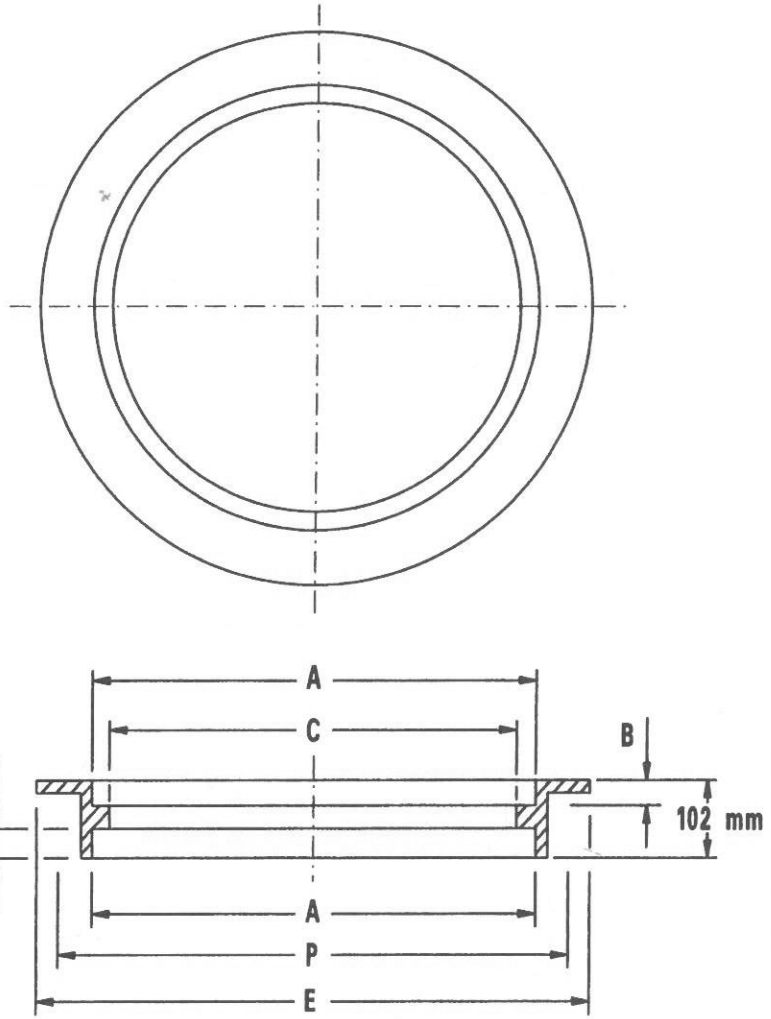
A	B	C	D	E	F
610	38 to 44	533		864	152 to 229
670	38 to 44	610		914	152 to 229
813	38 to 44	762		991	152 to 229

NOTE: All dimensions shown are in millimeters.

STYLE "A" FRAME

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHMF-1-96



SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e. Gray Iron) and Class.
May be ordered reversible – Bearing surface(s) to be machined as specified.

USE

Use with Style 1 & 2 lids (DHML–1, DHML–2)
Sanitary and storm drain drain manhole access.
May be used for access to pipe sections of precast manholes.

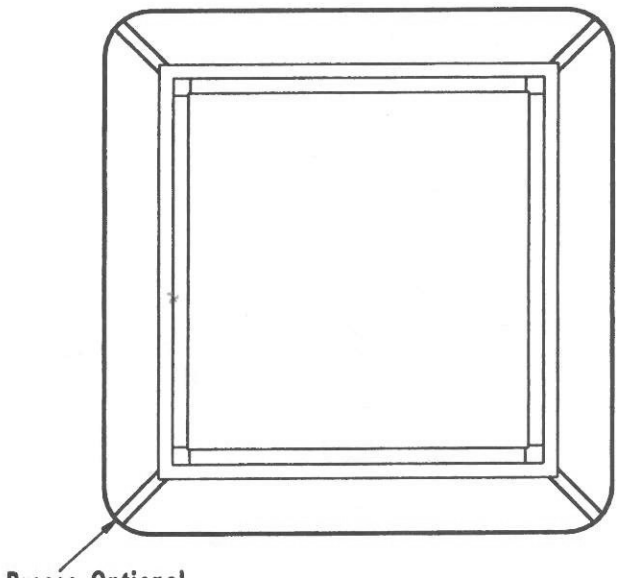
A	B	C	E	P*
419	38	368	521	457
473	38	419	572	508
575	38	521	673	610
651	38	597	749	686
727	38	673	823	762
879	38	826	978	914
1026	38	978	1130	1067
1175	38	1130	1283	1219
*P dimension is pipe size				

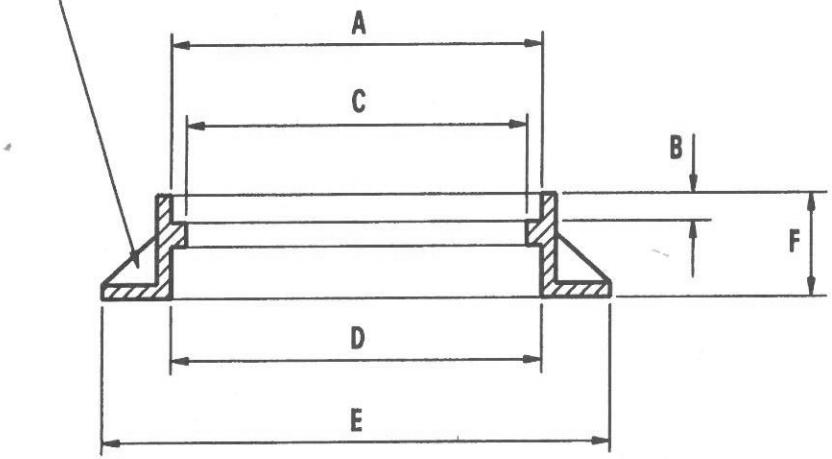
NOTE: All dimensions shown are in millimeters.

STYLE "B" FRAME

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMF–2–96





NOTE: All dimensions shown are in millimeters unless otherwise noted.

SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e. Gray Iron) and Class.

USE

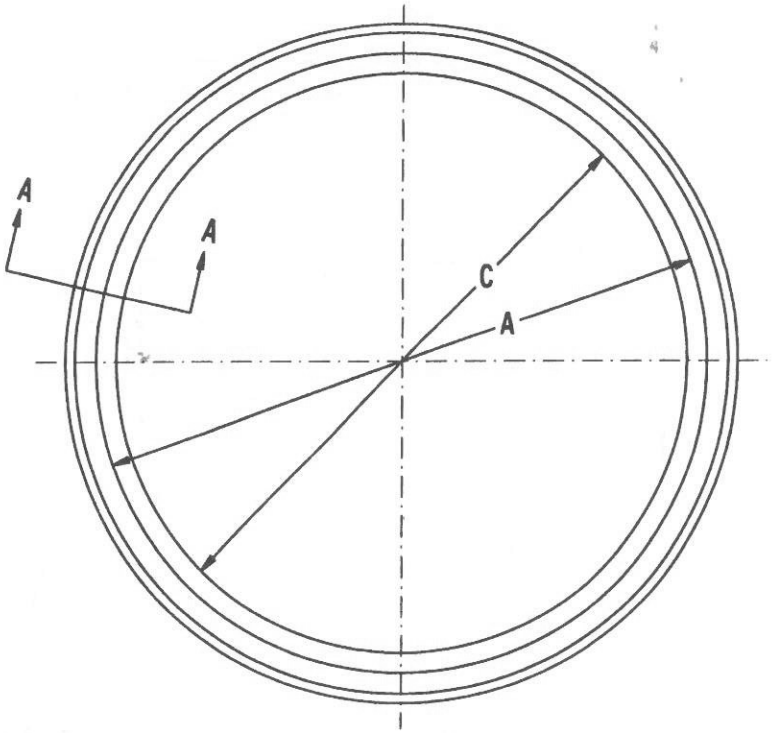
Electrical and drainage manhole access.

A	B	C	D	E	F
359 Sq.	38	305 Sq.	359 Sq.	457 Sq.	102
518 Sq.	38	457 Sq.	518 Sq.	610 Sq.	102
613 Sq.	38	559 Sq.	613 Sq.	711 Sq.	102
708 Sq.	38	660 Sq.	708 Sq.	813 Sq.	102
816 Sq.	38	762 Sq.	816 Sq.	914 Sq.	102
949 Sq.	38	914 Sq.	949 Sq.	1067 Sq.	102

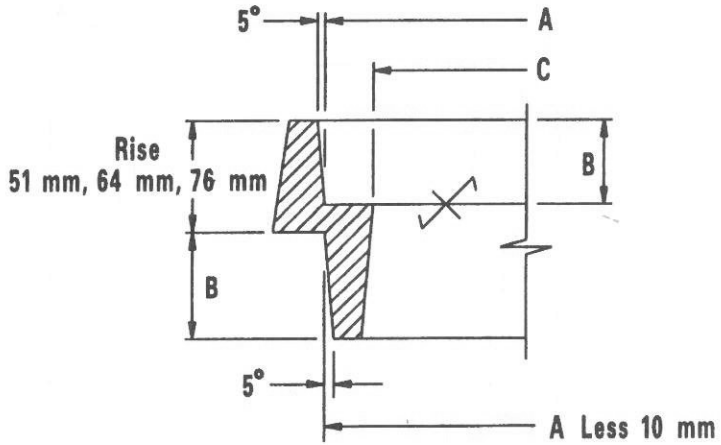
STYLE "D" FRAME

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMF–3–96



PLAN VIEW



SECTION A-A

SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e. Gray Iron) and Class.
Machined bearing surface

USE

To raise top of manhole frame. (DHMF-1, DHMF-2)
Use with styles A & B Frames

Propriety products available for adjusting diameter and height. Consult manufacturers catalogs.

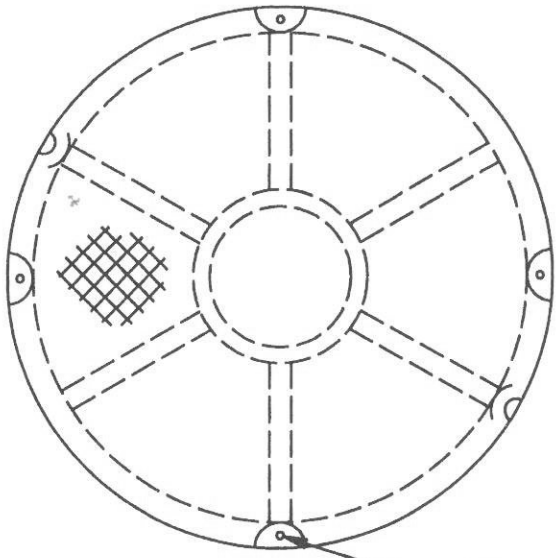
FRAME ADJUSTING RING

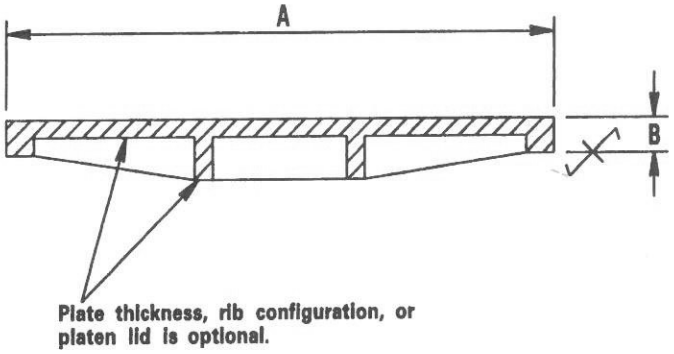
AASHTO-AGC-ARTBA
TF-13 DRAWING

DHMF-4-96

SECTION DHML—MANHOLE LIDS

ROADWAY TYPE





SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e., Gray Iron) and class,
Lid surface design DHML-7
Lifting method DHML-5
Locking device DHML-6
Gasket if necessary
Machined bearing surface

Sanitary or storm manhole cover (DHMF–1, DHMF–2)
Use with Style A & B Frames,
Heavy duty for roadway traffic.

A	B
578	38 to 44
660	38 to 44
806	38 to 44

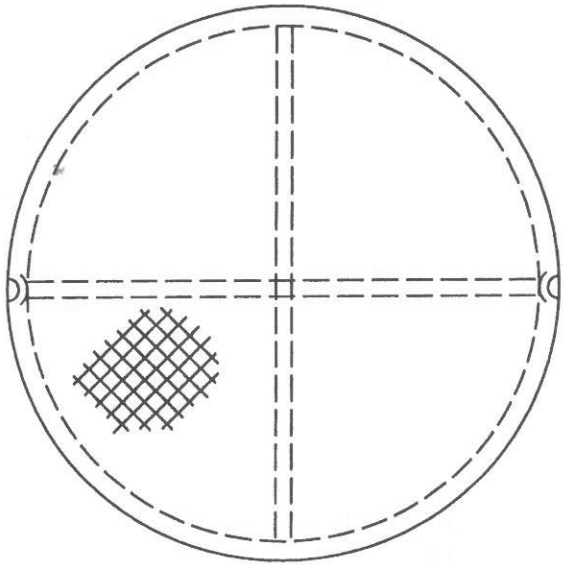
NOTE: All dimensions shown are in millimeters.

STYLE 1 LID

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHML–1–96

SIDEWALK TYPE



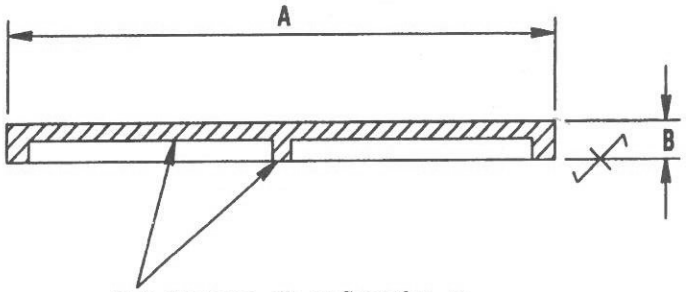


Plate thickness, rib configuration, or platen lid is optional.

SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e., Gray Iron) and class,
Lid surface design DHML-7
Lifting method DHML-5
Locking device DHML-6
Gasket if necessary
Machined bearing surface

Pull box or clean-out lid

Use with Style A & B Frames. (DHMF-1, DHMF-2)

Lightweight for pedestrian traffic only,

A	B
406	38
457	38
559	38
635	38
711	38
863	38
1016	38
1165	38

NOTE: All dimensions shown are in millimeters.

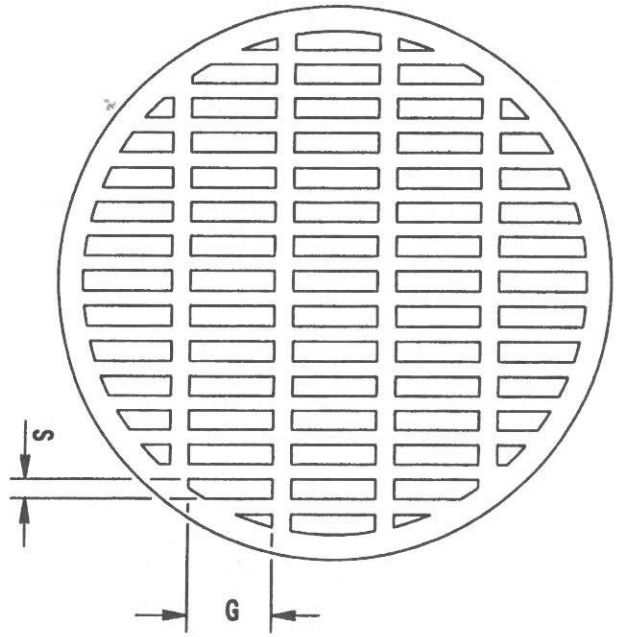
STYLE 2 LID

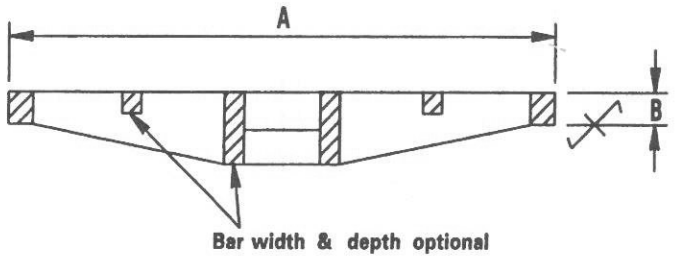
AASHTO-AGC-ARTBA
TF-13 DRAWING

DHML-2-96

STYLE 4 OPEN LID
ROADWAY TYPE

STYLE 5 OPEN LID
SIDEWALK TYPE





Bar width & depth optional

SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e., Gray Iron) and class,
Surface configuration
Machined bearing surface
Lid surface design DHML-8

USE

Style 4 Lid – Roadway Type : Area drainage, Parking lots.
Style 5 Lid – Sidewalk Type : Mail and Alley drainage.

Use with Styles A & B Frames DHMF–1, DHMF–2

A	B	S	G
559	38	25 Max	229 Max
584	38	25 Max	229 Max
610	38	25 Max	229 Max
660	38	25 Max	229 Max
737	35		
813	38		
1016	38		
1165	38		

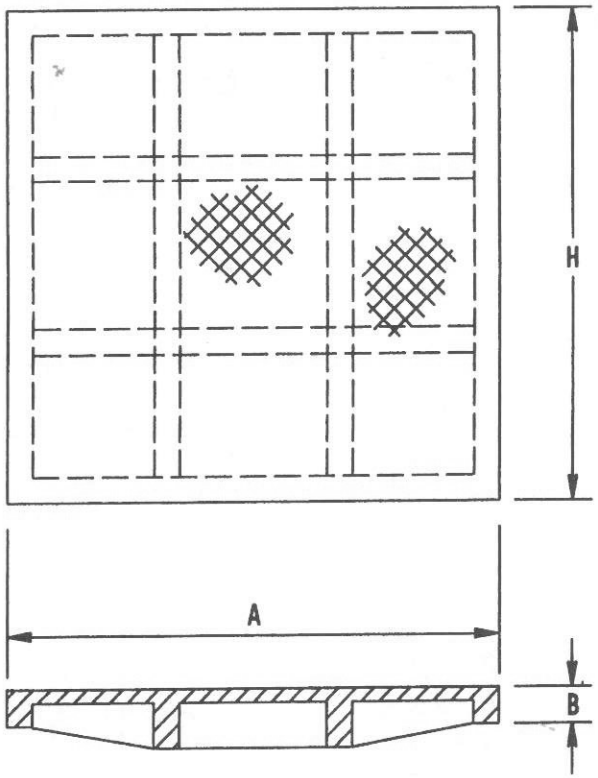
NOTE: All dimensions shown are in millimeters.

STYLE 4 & 5 LIDS

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHML–3–96

ROADWAY TYPE



SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Item description
Style or type
Size
Base Metal (i.e., Gray Iron) and class,
Lid surface design DHML-7
Lifting method DHML-5
Locking device DHML-6
Gasket if necessary

USE

Electrical and drainage manhole lid.

Use with Style D Frame DHMF–4

A	H	B
349	349	38
508	508	38
603	603	38
699	699	38
806	806	38
940	940	38

NOTE: All dimensions shown are in millimeters.

STYLE 6 LID

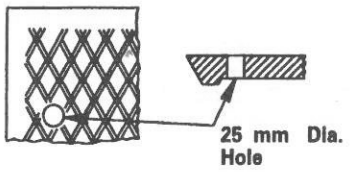
AASHTO–AGC–ARTBA TF–13 DRAWING

DHML–4–96

THROUGH THE LID

ROUND HOLE

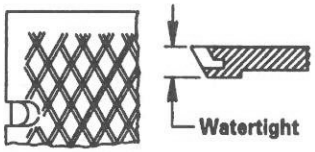
TOP SECTION



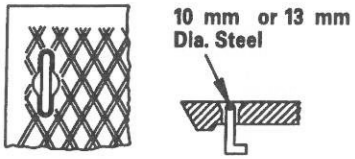
IN THE LID

CONCEALED

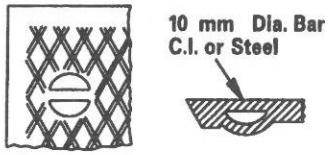
TOP SECTION



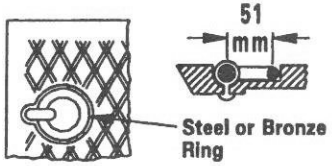
TOP SECTION



TOP SECTION



TOP SECTION



TOP SECTION

SPECIFICATIONS

As required or furnished with the lid.

BASIS OF SPECIFYING

Specify type as required.
Consult manufacturer catalogs for availability of each type for specific lids.

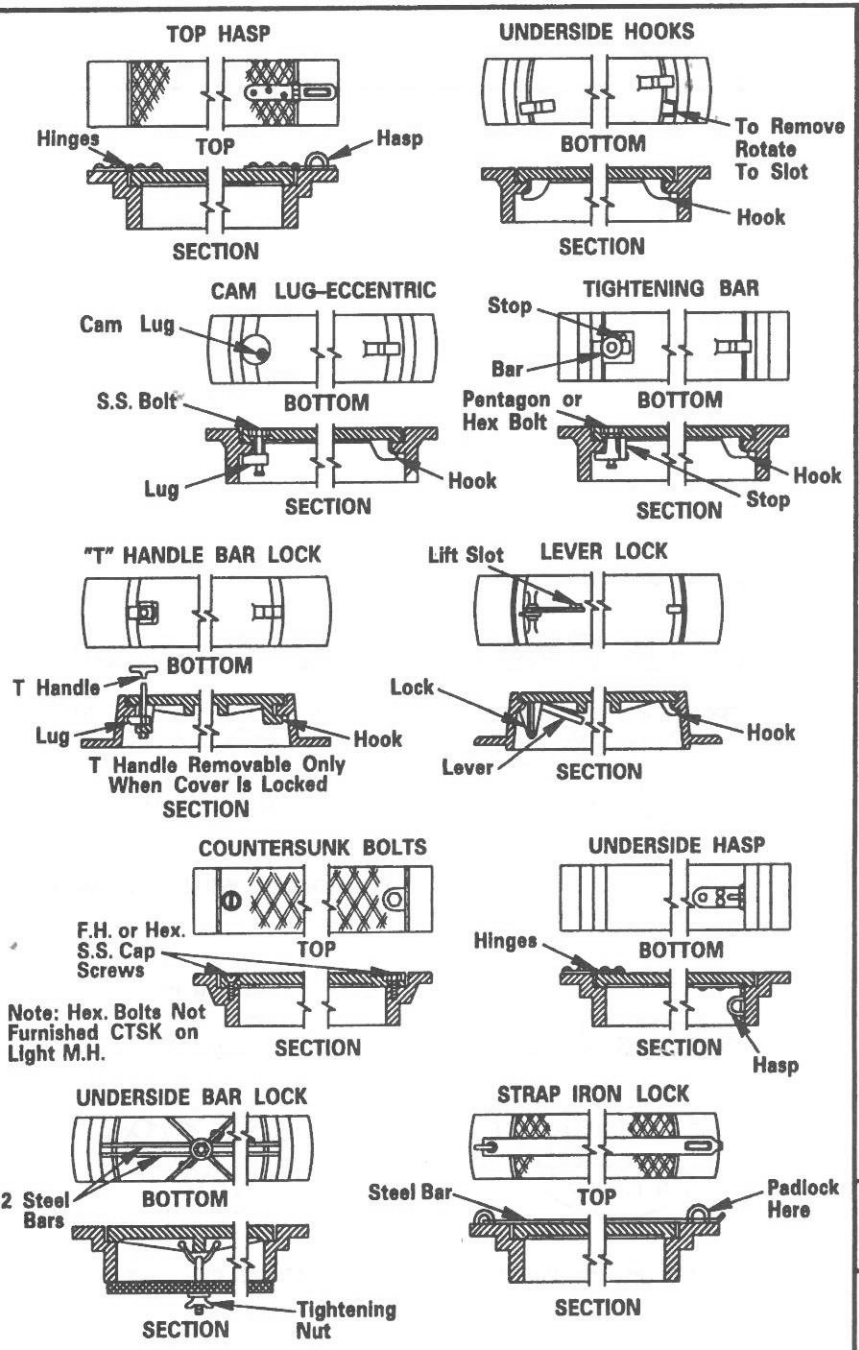
USE

Lifting of lids from frames.

LID LIFTING DEVICES

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHML–5–96



SPECIFICATIONS

As required or furnished with the lid and frame.

BASIS OF SPECIFYING

Specify type as required.
Consult manufacturers catalogs for availability of each type for specific lids and frames.

USE

Prevent lids from being removed by unauthorized personnel.

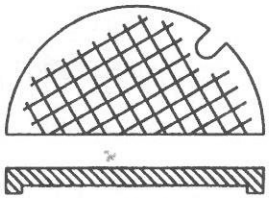
To provide anchorage under traffic.

LID LOCKING DEVICES

AASHTO-AGC-ARTBA TF-13 DRAWING

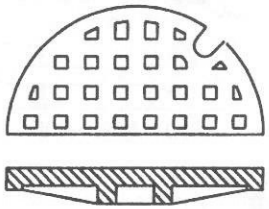
DHML-6-96

PLATEN LID DESIGN

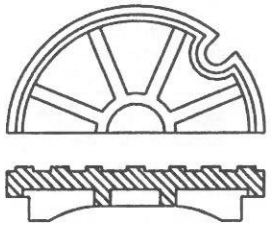


No Ribbing

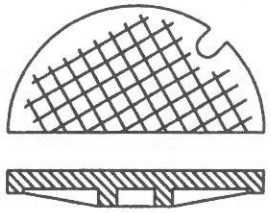
INDENTED TOP DESIGN



SHOWING BOTTOM REINFORCING



CHECKERED TOP DESIGN



SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Lid style required.
May also include custom names and designs.
Consult manufacturer catalogs for availability of styles.

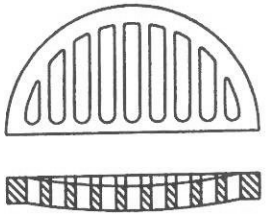
USE

Lids for manhole access frames.

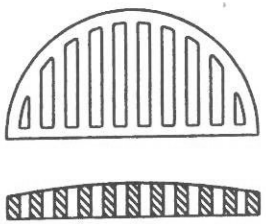
SELECTED SOLID LID STYLES

AASHTO-AGC-ARTBA
TF-13 DRAWING

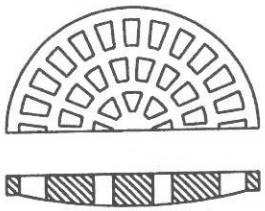
DHML-7-96



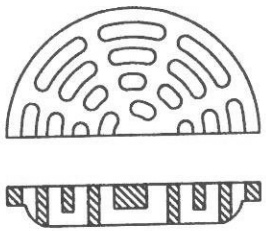
STANDARD CONCAVE



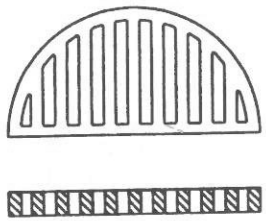
STANDARD CONVEX



STANDARD RADIAL



STANDARD FLAT



STANDARD FLAT

SPECIFICATIONS

CAST GRAY IRON: ASTM A 48 (AASHTO M 105 & M 306)

CLASS 30 B
CLASS 35 B

BASIS OF SPECIFYING

Lid style required.
Consult manufacturers catalogs for availability of styles.

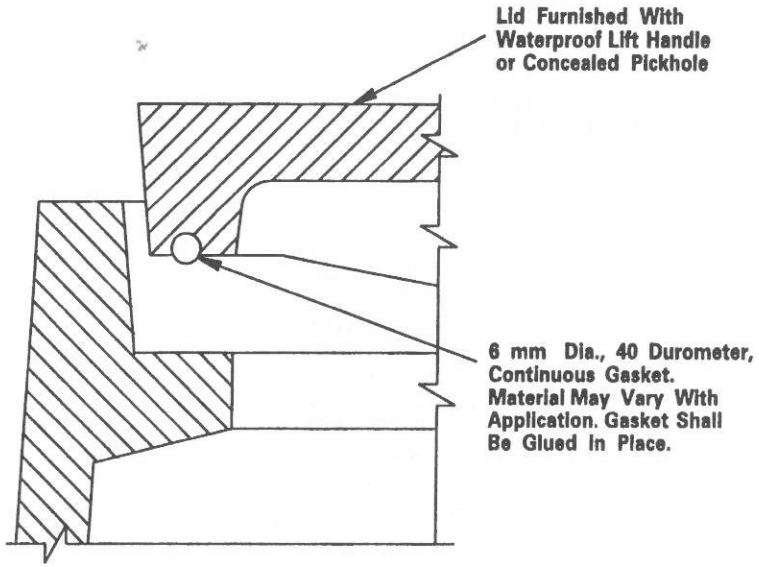
USE

Lids for manhole access frames.
Catch Basin lid.

SELECTED GRATE LID STYLES

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHML–8–96



SPECIFICATIONS

Sealing system gasket to be 6.22 mm diameter, 40 durometer continuous gasket. Material may vary with application, consult with manufacturer.

BASIS OF SPECIFYING

Specify Gasket sealed lid.

USE

Gasket sealing system is used for sealing lid to prevent surface water inflow without bolting.

Gasket sealing system used on Style 1 and 2 lids DHML-1, DHML-2.

GASKET SEALING SYSTEM FOR LIDS

AASHTO-AGC-ARTBA
TF-13 DRAWING

DHML-9-96

SECTION DHMS—MANHOLE STEPS

Guidelines for Specifying:

1. Steps may be cast iron, aluminum alloy or polypropylene-coated reinforcing steel. A specific type may be specified if desired.

2. The minimum width of rungs or cleats shall be 254 mm, and rungs of cleats shall be shaped to prevent the foot from slipping off the side. A slip-resistant surface shall be provided on the rung by a means of grooves, scores, grit, etc.

3. Steps shall project a minimum of 102 mm from the wall at the point of embedment. Steps shall be embedded a minimum of 76 mm. The portion embedded in the wall shall have a configuration such that it will prevent pull out.

4. Steps shall be spaced vertically a maximum distance of 400 mm.

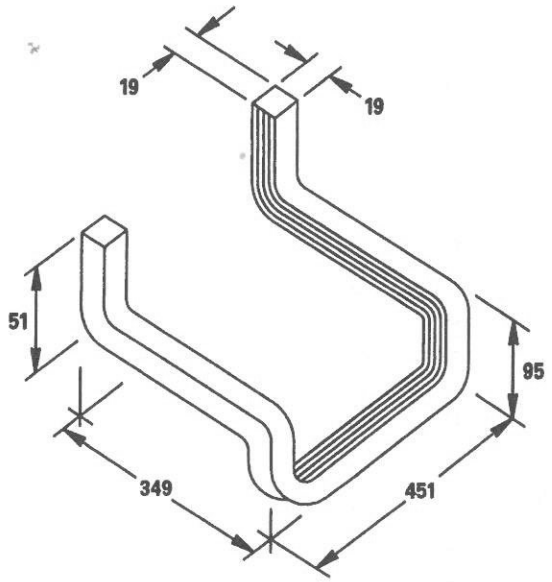
5. Steps shall have properties such that they will withstand a single concentrated load of 136 kg without distortion.

6. Metal steps shall be coated with asphalt or an approved mastic when subjected to chlorides or other detrimental environments.

7. Dimensional tolerances are intended to be consistent with the function of the part, appearance and accepted manufacturing practices.

8. Dimension lines are shown to indicate those dimensions which may be secured from the manufacturer of the specific item.

9. Aluminum steps must be coated when in contact with concrete.



NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

Extruded Aluminum: ASTM B 221M, Alloy 6005–T5 or 6061–T6.

The manhole steps shall be extruded and cold–formed to the required shape. They must be coated when in contact with concrete.

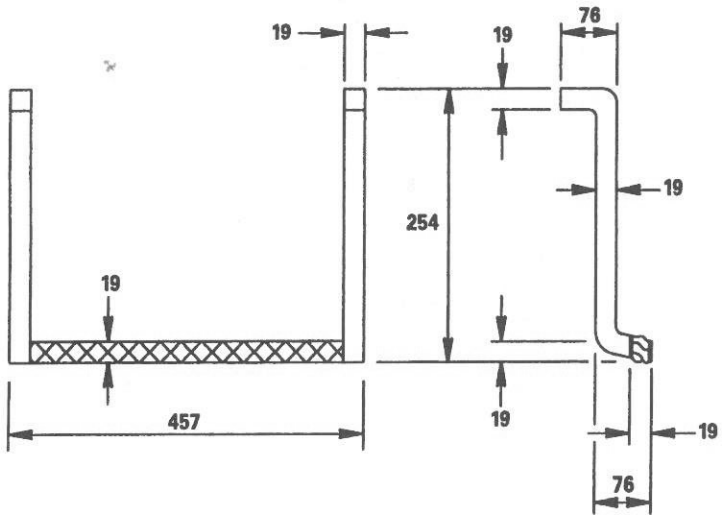
USE

Steps for manhole and drop inlet access. Rungs can be set into precast concrete, mortared into brick structures or cemented in place wherever needed.

EXTRUDED ALUMINUM MANHOLE STEP

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMS–1–96



NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

Cast Aluminum: ASTM B 26M, Alloy 356.0–T6

Cast Gray Iron: ASTM A 48
ASHTO M 105
Class 30B or 35B

Cast Ductile Iron: Grade 65–45–12

USES

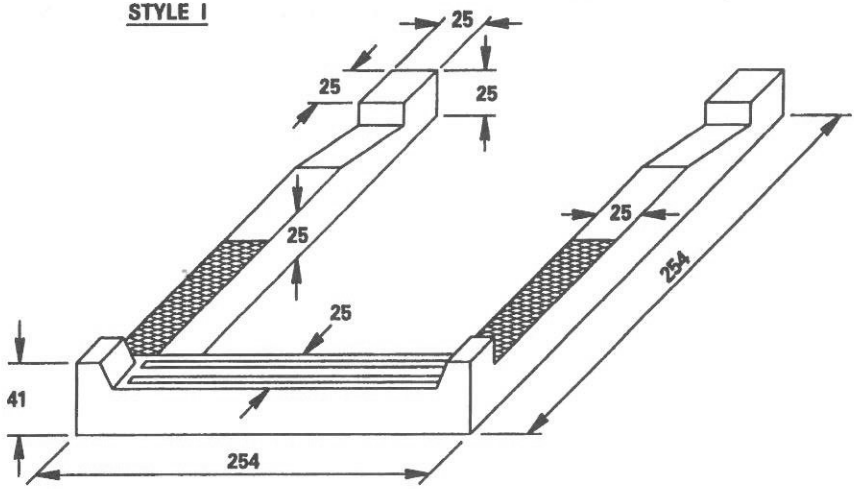
Steps for manhole and drop inlet access. Rungs can be set into precast concrete, mortared into brick structures or cemented in place wherever needed.

CAST METAL MANHOLE STEP

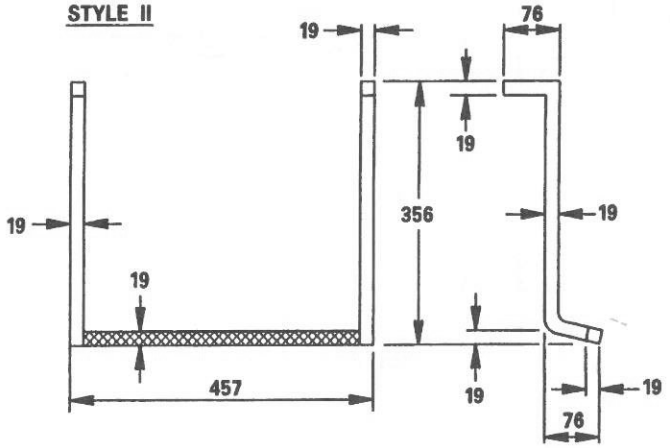
AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMS–2–96

STYLE I



STYLE II



NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

STYLE I

Cast Ductile Iron: ASTM A 536, Grade 65–45–12

Cast Gray Iron: ASTM A 48, Class 35B

STYLE II

Cast Ductile Iron: ASTM A 536, Grade 65–45–12

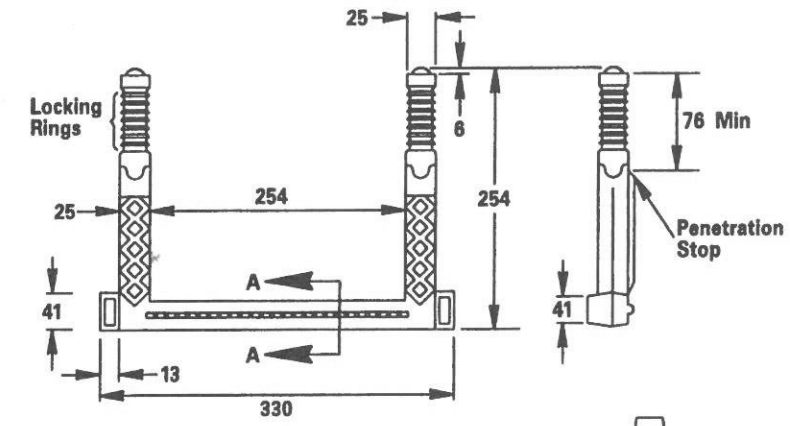
USE

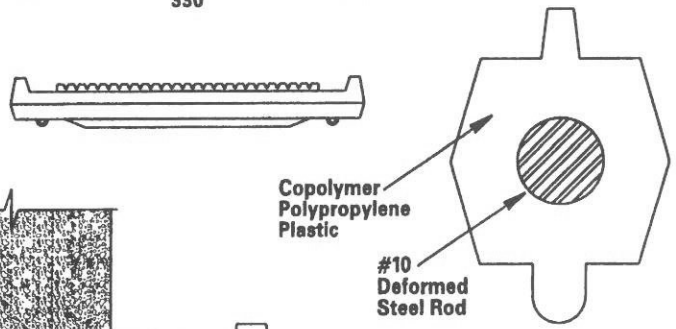
Steps for manhole and drop inlet access. Rungs can be set into precast concrete, mortared into brick structures or cemented in place wherever needed.

CAST IRON MANHOLE STEP

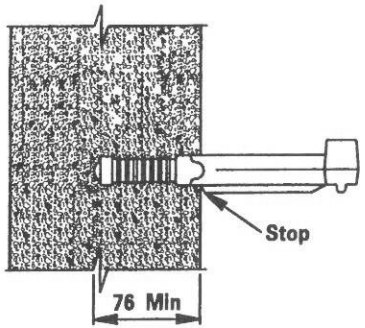
AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMS–3–96





SECTION A-A



PENETRATION

NOTE: All dimensions shown are in millimeters.

SPECIFICATIONS

Plastic:

ASTM D 2146, Type II,
Grade 16906

Steel Reinforcing Bar:

ASTM D 615M, Grade 60

In cold climates Plastics meeting ASTM D4101 is recommended.

USE

Steps for manhole and drop inlet access. Rungs can be set into precast concrete, mortared into brick structures or cemented in place wherever needed.

Plastic coated steel steps may be proprietary.

PLASTIC – STEEL REINFORCED MANHOLE STEP

AASHTO–AGC–ARTBA
TF–13 DRAWING

DHMS–4–96

PART 5

PLASTIC DRAINAGE PRODUCTS (P)

PART 5 PLASTIC DRAINAGE PRODUCTS (P)
DESIGN CONSIDERATIONS

Plastic pipe for drainage applications is available in sizes through 1220 mm in both polyethylene (PE) and polyvinyl chloride (PVC) materials. These products are offered in a wide variety of wall configurations (ribbed, corrugated or solid) which often vary from manufacturer to manufacturer. These pipes must only be used with fittings, couplings, etc. provided by the pipe manufacturer.

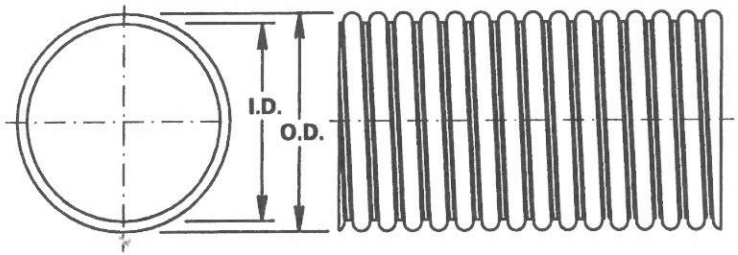
The primary products available are tabulated below. Products made to ASTM specifications typically provide a constant pipe stiffness across the diameter range. Products covered by AASHTO specifications provide stiffness levels that are reduced as diameters increase. It is up to the engineer to determine an appropriate minimum stiffness level for the application.

Installation shall be in accordance with ASTM D 2321. Section 18 of the *AASHTO Standard Specification for Highway Bridges* provides the appropriate design method, design properties, etc.

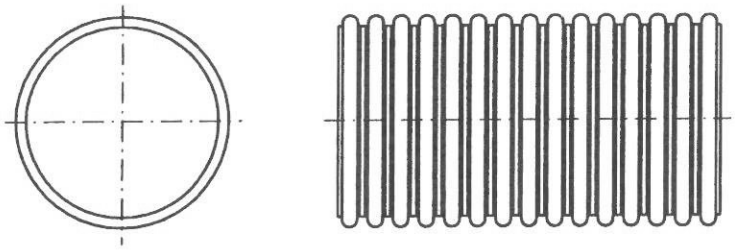
MATERIAL	SPECIFICATION	
	ASTM	AASHTO
PVC—Solid Wall PVC—Profile Wall	D 3034 F 679 F 794 F 949	M 278 M 304M
PE—Solid Wall PE—Corrugated or Ribbed	F 714 F 405 F 667 F 894	M 252 M 294

SECTION PE—POLYETHLENE

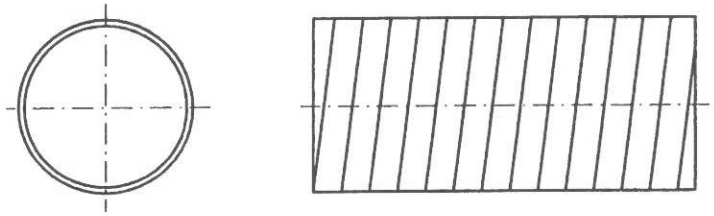
SPIRAL



ANNULAR



SMOOTH



APPLICABLE SPECIFICATIONS

1. Smooth interior shall conform to the requirements of :

   AASHTO M 294 (Type S & SP)
   AASHTO M 294 (Type D & DP)

2. Standard I.D. in 300 mm, 375 mm, 450 mm, 600 mm, 750 mm, 900 mm, 1050 mm, and 1200 mm.

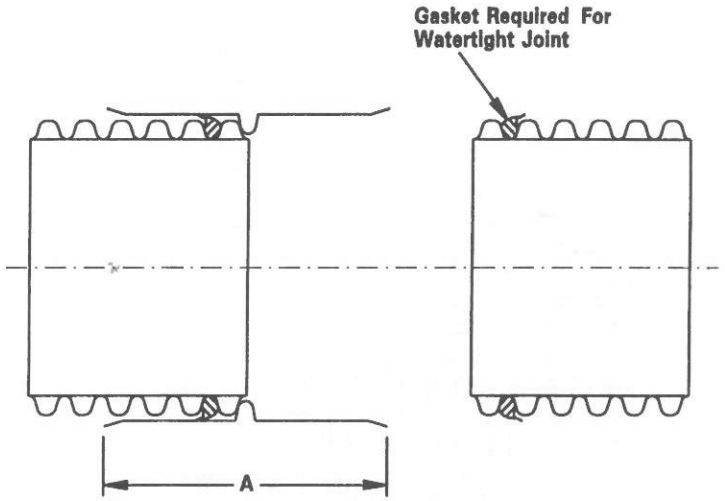
INTENDED USE

Pipe for surface and subsurface drainage uses include culverts, storm sewers, and underdrains.

SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE

AASHTO-AGC-ARTBA
TF-13 DRAWING

PE-1-96



DIA.	A
mm	
300 375 450 600	355 405 460 610

APPLICABLE SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 26.
2. **Watertight Joints shall meet AASHTO D 3212 performance requirements.**

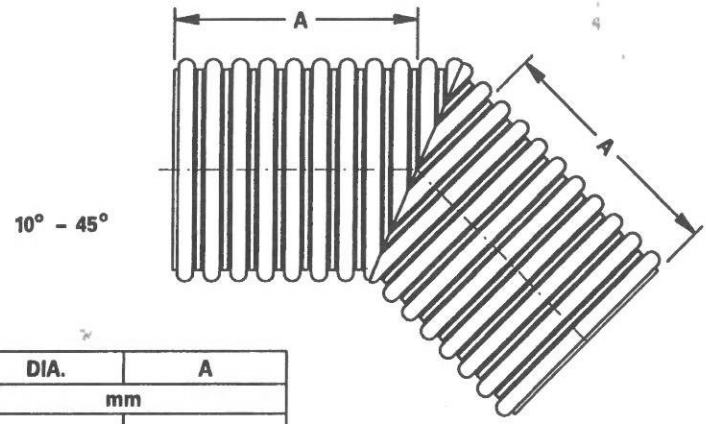
INTENDED USE

Coupling of SLCPP sections or appurtenances.

BELL COUPLERS FOR SLCPP

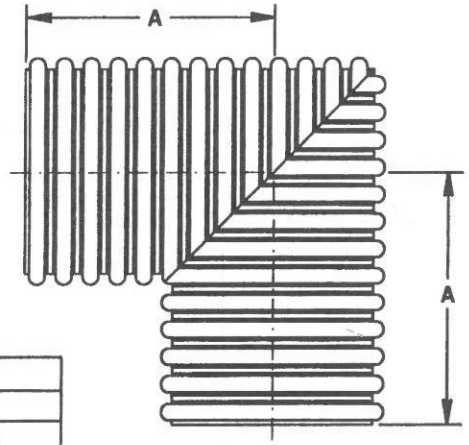
AASHTO–AGC–ARTBA TF–13 DRAWING

PE–2–96



10° - 45°

DIA.	A
mm	
300	310
375	420
450	415
600	500
750	545
900	600



46° - 90°

DIA.	A
mm	
300	425
375	515
450	560
600	770
750	940
900	980

APPLICABLE SPECIFICATIONS

1. Smooth interior shall conform to the requirements of : AASHTO M 294 (Type S & SP).
2. Welding shall be in accordance with drawings and specifications supplied by the manufacturer and approved by the purchaser.
3. Reducing Branches shall be stubbed first with solid wall HDPE where practical.

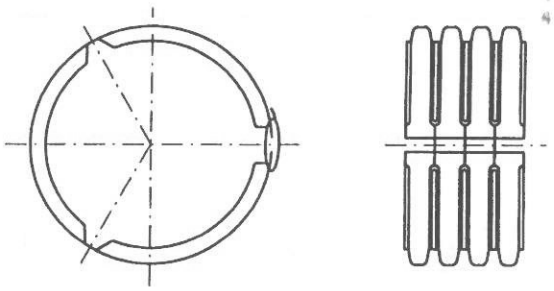
INTENDED USES

1. In culvert, storm sewer, or underdrains for making intersecting lines of pipe.
2. Underdrain and recharge patterns:
   - A. Highway
   - B. Airport
   - C. Railroad
   - D. Flood protection
   - E. Structures (Abutments, Walls, etc.)

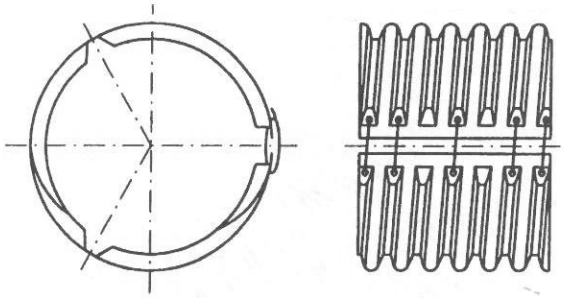
SLCPP BENDS

AASHTO–AGC–ARTBA
TF–13 DRAWING

PE–3–96



DIA	A	B
	mm	
300	200	375
375	265	450
450	260	545
600	320	710



DIA	A	B
	mm	
600	575	730
750	500	950
900	710	1130

APPLICABLE SPECIFICATIONS

1. Coupling bands shown meet the performance requirements of the AASHTO *Standard Specifications for Highway Bridges*, Division 2 Section 26.

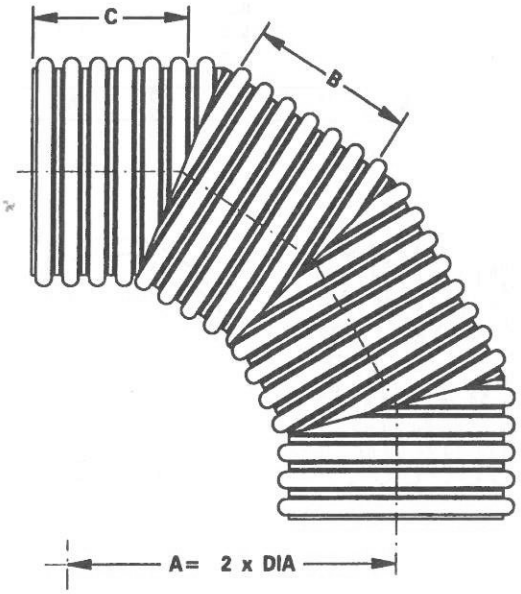
INTENDED USE

Coupling of SLCPP Sections or Appurtenances.

SPLIT COUPLERS FOR SLCPP

AASHTO–AGC–ARTBA
TF–13 DRAWING

PE–4–96



DIA	B	C
	mm	
600	710	430
750	870	495
900	1060	870

APPLICABLE SPECIFICATIONS

1. Smooth interior shall conform to the requirements of : AASHTO M 294 (Type S & SP).
2. Welding shall be in accordance with drawings and specifications supplied by the manufacturer and approved by the purchaser.
3. Reducing Branches shall be stubbed first with solid wall HDPE

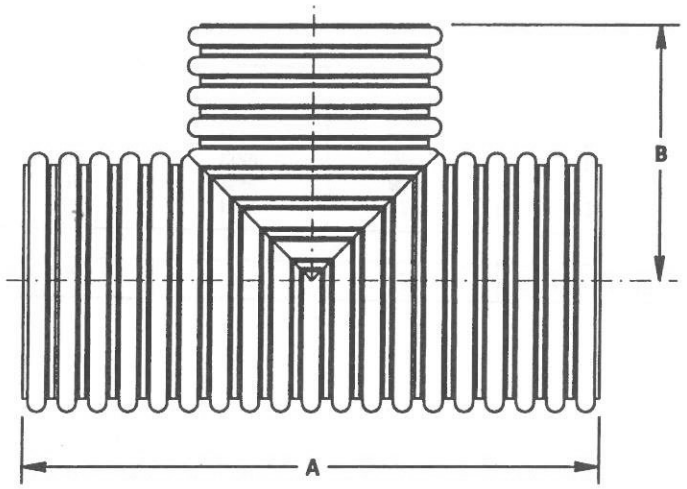
INTENDED USES

1. In culvert, storm sewer, or underdrains for making intersecting lines of pipe.
2. Underdrain and recharge patterns:
   - A. Highway
   - B. Airport
   - C. Railroad
   - D. Flood protection
   - E. Structures (Abutments, Walls, etc.)

SLCPP 4–PIECE 90° BEND

AASHTO–AGC–ARTBA
TF–13 DRAWING

PE–5–96



DIA	A	B
mm		
300	790	400
375	985	490
450	1050	555
600	1525	760
750	1980	985
900	2135	1065

BRANCH DIAMETER SAME AS MAIN RUN OR LESS

APPLICABLE SPECIFICATIONS

1. Smooth interior shall conform to the requirements of : AASHTO M 294 (Type S & SP).
2. Welding shall be in accordance with drawings and specifications supplied by the manufacturer and approved by the purchaser.
3. Reducing Branches shall be stubbed first with solid wall HDPE

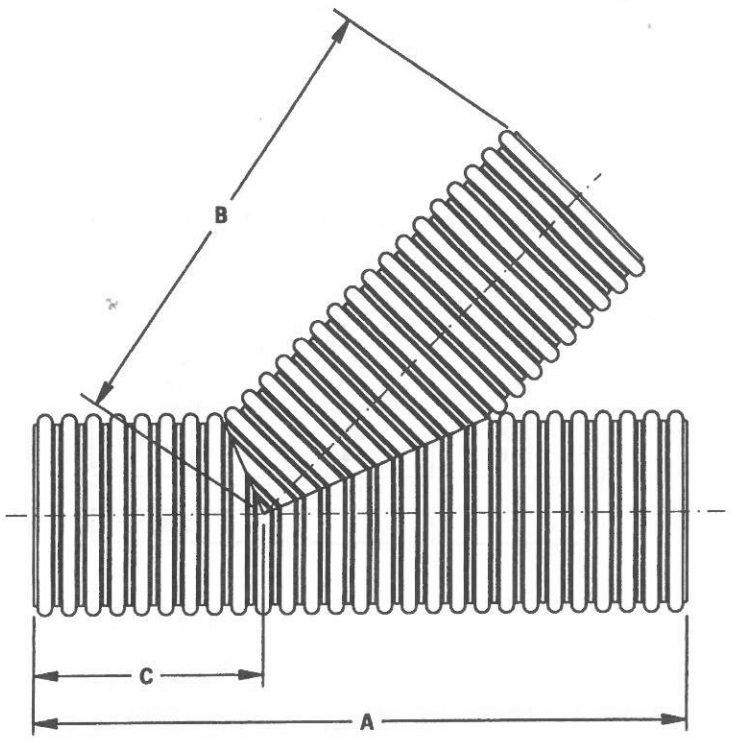
INTENDED USES

1. In culvert, storm sewer, or underdrains for making intersecting lines of pipe.
2. Underdrain and recharge patterns:
   A. Highway
   B. Airport
   C. Railroad
   D. Flood protection
   E. Structures (Abutments, Walls, etc.)

SLCPP TEE FITTINGS

AASHTO–AGC–ARTBA
TF–13 DRAWING

PE–6–96



DIA	A	B	C
	mm		
300	1030	725	330
375	1165	830	370
450	1320	950	380
600	1830	1290	550
750	2285	1815	700
900	2795	2050	885

APPLICABLE SPECIFICATIONS

1. Smooth interior shall conform to the requirements of : AASHTO M 294 (Type S & SP).
2. Welding shall be in accordance with drawings and specifications supplied by the manufacturer and approved by the purchaser.
3. Reducing Branches shall be stubbed first with solid wall HDPE where practical.

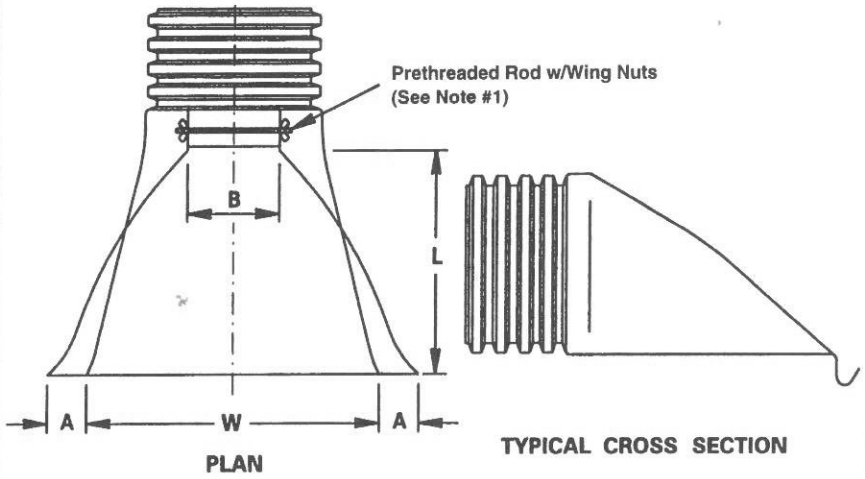
INTENDED USES

1. In culvert, storm sewer, or underdrains for making intersecting lines of pipe.
2. Underdrain and recharge patterns:
   A. Highway
   B. Airport
   C. Railroad
   D. Flood protection
   E. Structures (Abutments, Walls, etc.)

SLCPP LATERAL FITTINGS

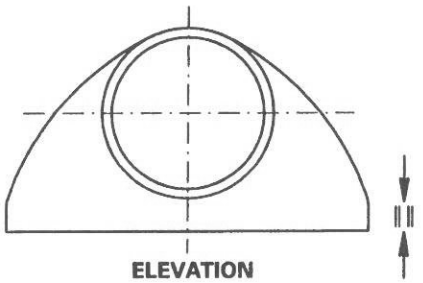
AASHTO-AGC-ARTBA
TF-13 DRAWING

PE-7-96



PLAN

TYPICAL CROSS SECTION



ELEVATION

PIPE DIA	A, +25	B MAX	H, +25	L, +13	W, +50
millimeters					
300	165	254	165	635	735
375	165	254	165	635	735
450	190	380	165	812	890
600	190	450	165	900	1140
750	266	NA	178	1345	1725
900	266	NA	178	1345	1725

APPLICABLE SPECIFICATIONS

1. Prethreaded Rod w/wing nuts provided for End Sections 300 mm, 600 mm, 750 mm & 900 mm. End Sections to be welded to pipe per manufacturer's recommendations.

INTENDED USE

End Sections attached to inlet and outlet of pipe:

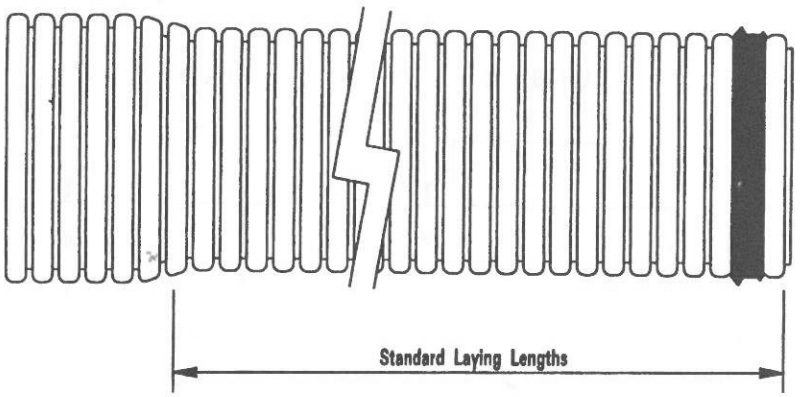
1. Prevent scour and undermining
2. Prevent piping and burrowing
3. Facilitates slope maintenance
4. Esthetically finishes ends of conduit

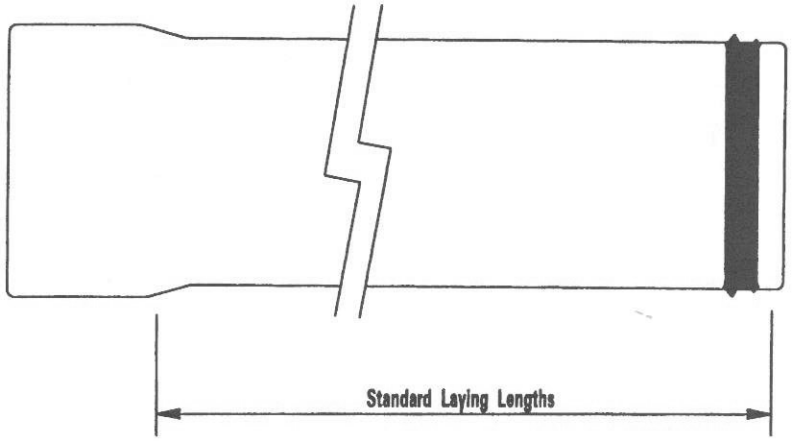
PE END SECTIONS

AASHTO-AGC-ARTBA
TF-13 DRAWING

PE-8-96

SECTION PVC—POLYVINYL CHLORIDE PIPE





APPLICABLE SPECIFICATIONS

Polyvinyl Cloride (PVC) pipe (solid or profile wall) shall meet the requirements of one of the following specifications:

AASHTO M 278
AASHTO M 304M
ASTM D 3034
ASTM F 679
ASTM F 794
ASTM F 949

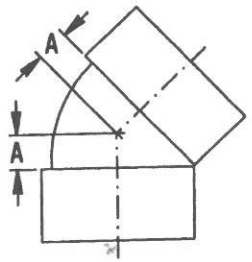
INTENDED USE

Pipe for culverts underdrains, storm and sanitary sewers.

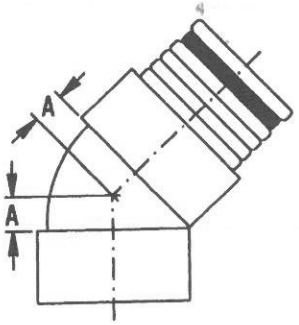
SMOOTH INTERIOR POLYVINYL CHLORIDE (PVC) PIPE

AASHTO–AGC–ARTBA TF–13 DRAWING

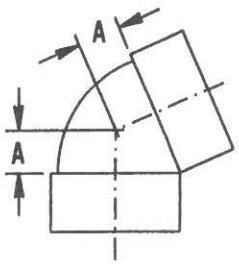
PVC–1–96



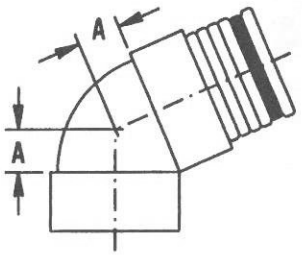
22.5° BEND



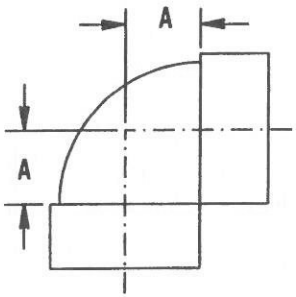
22.5° BEND



45° BEND

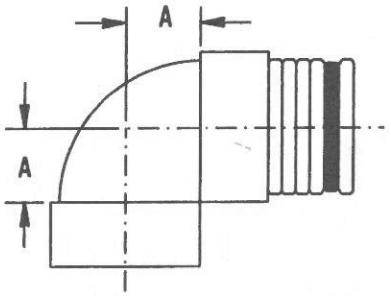


45° BEND



90° BEND

(BELL-BELL)



90° BEND

(BELL-SPIGOT)

APPLICABLE SPECIFICATIONS

Only fittings meeting the pipe specification and recommended by the manufacturer can be used. Outside diameters vary and fittings may not be compatible.

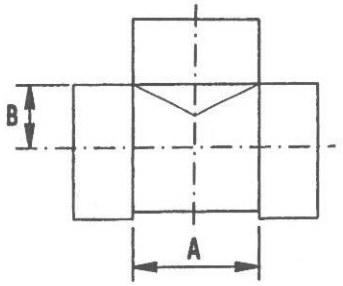
INTENDED USE

Culvert, storm or sanitary sewer where change in alignment or grade occur or for intersecting lines of pipe.

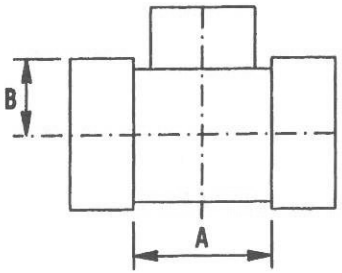
POLYVINYL CHLORIDE (PVC) BENDS

AASHTO–AGC–ARTBA
TF–13 DRAWING

PVC–2–96



NON-REDUCING
INLINE TEE



REDUCING
INLINE TEE

APPLICABLE SPECIFICATIONS

Only fittings meeting the pipe specification and recommended by the manufacturer can be used. Outside diameters vary and fittings may not be compatible.

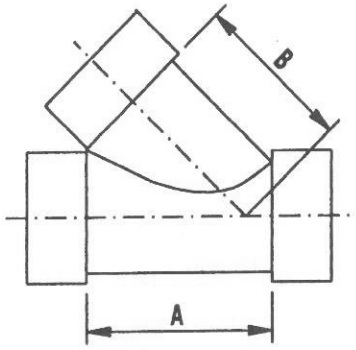
INTENDED USE

Culvert, storm or sanitary sewer where change in alignment or grade occur or for intersecting lines of pipe.

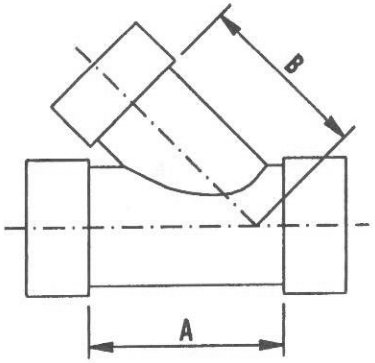
POLYVINYL CHLORIDE (PVC) TEES

AASHTO–AGC–ARTBA
TF–13 DRAWING

PVC–3–96



NON-REDUCING
INLINE WYE



REDUCING
INLINE WYE

APPLICABLE SPECIFICATIONS

Only fittings meeting the pipe specification and recommended by the manufacturer can be used. Outside diameters vary and fittings may not be compatible.

INTENDED USE

Culvert, storm or sanitary sewer where change in alignment or grade occur or for intersecting lines of pipe.

POLYVINYL CHLORIDE (PVC) WYES

AASHTO–AGC–ARTBA TF–13 DRAWING

PVC–4–96