Guide to the Standard Inlet and Manhole Program

Procedures

Bridge Division

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Chapter 1
About this Guide

Purpose

The Texas Department of Transportation (TxDOT) and the Texas Concrete Pipe Association (TCPA) produced this Guide in conjunction with the Standard Inlet and Manhole Program and development of the precast inlet, junction box, and manhole standards. It is meant to assist the Designer, Contractor, and Inspector in the use of best practices for layout protocols, installation and inspection of precast concrete inlets, junction boxes, and manholes. This Guide is not meant to supersede any portion of the project specifications or local, state, or national regulations.

This guide and the Standard Inlet and Manhole Program are maintained by a joint task force comprised of personnel from TxDOT and TCPA.

Seminars about the Standard Inlet and Manhole Program are available, at no charge, from the TCPA.

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Updates

Updates to this guide are summarized in the following table.

Revision History

Version	Publication Date	Summary of Changes
2013-1	August 2013	New guide published.
2015-1	January 2015	Guide organization; corrections; new material in Ch. 4
2020-1	February 2020	Guide organization; corrections
2020-8	August 2020	Corrected Table 2.

Organization

The information in this guide is organized as follows:

- Chapter 1, “About this Guide,” contains introductory information on the purpose and organization of this guide.
- Chapter 2, “Introduction to the Program,” describes the background and objectives of the Standard Inlet and Manhole Program.
- Chapter 3, Definitions and Abbreviations,” contains definitions of commonly used terms in the Standard Inlet and Manhole Program.
- Chapter 4, “Design,” contains information on the design of the precast inlet, junction box, and manhole standards, as well as information Designers need to consider when planning drainage layouts.
- Chapter 5, “Installation,” contains information for the Contractor and project personnel on delivery and installation of precast products.
- Chapter 6, “Inspection,” contains information for the Inspector and project personnel on important aspects of product and installation inspection.

Feedback

You may direct any questions or comments on the content of this guide to the Bridge Standards Engineer, Design Section, Bridge Division, Texas Department of Transportation.

Chapter 2
Introduction to the Program

Background and Objectives

The Standard Inlet and Manhole Program was initiated to address several common problems within the industry:

- frequent use of one-off designs, which can lead to delays and excessive production costs
- existence of too many standard designs across the state
- absence of precast standards, with only cast-in-place standards available
- inadequate traffic rating of roadway products
- inconsistent structural design of products among Manufacturers and among districts

The objective of the Standard Inlet and Manhole Program is to simplify the layout protocol, selection, manufacture, and installation of drainage structures across the state through the creation of a uniform, flexible system of precast concrete inlets, junction boxes, and manholes. The intended results are reduced costs and improved installation. To those ends, the necessary styles were selected, standard geometries developed, and minimum levels of reinforcement and concrete strength determined.

The benefits of the system, which can be seen by all parties involved from initial planning to complete installation, are summarized below:

- providing the Designer the maximum amount of flexibility
- offering the Manufacturer the ability to standardize production
- allowing the Contractor and Inspector the ability to know and understand a simple and effective method of installation and inspection

The Owner, Designer, Contractor, and Inspector can be assured that—regardless of the Manufacturer providing the drainage structures—the products will essentially be the same size and shape, with a very similar appearance.

Development of Standards

Each component in the Standard Inlet and Manhole Program has been engineered by a qualified Professional Engineer licensed by the State of Texas. All designs have been submitted to and approved by the TxDOT Bridge Division. The standards are designed in accordance with the AASHTO *LRFD Bridge Design Specifications*, except as noted. Where applicable, products fully comply with relevant national standards and specifications.

The system is fundamentally a collection of mix-and-match pieces that are combined to create a complete drainage structure. During development, it was determined that just a few base and riser

sizes, plus a collection of lid and inlet styles, were needed to accommodate 85% of the market that was in use across the state. The resulting combinations of standardized bases, risers, lids, and inlet styles are summarized in Table 1:

Table 1: Summary of Available Combinations

Dimensions (W x L)	Base	Curb Inlet	Flat Slab Lid	Sloped Slab Lid	Grate Inlet Lid	Ring & Cover Lid	Barrier Drain Inlet	Area Drain Inlet	Manhole Cone
3' x 3'	✓		✓	✓	✓	✓		✓	
4' x 4'	✓		✓	✓	✓	✓		✓	
3' x 5'	✓	✓	✓	✓	✓	✓	✓		
4' x 5'	✓	✓	✓			✓	✓		✓
5' x 5'	✓	✓	✓			✓	✓	✓	✓
5' x 6'	✓	✓	✓			✓	✓		✓
6' x 6'	✓		✓			✓			✓
8' x 8'	✓		✓			✓			✓
48" round	✓		✓			✓			✓
60" round	✓		✓			✓			✓
72" round	✓		✓			✓			✓

Standard Drawings

The standard drawings for drainage structures that are part of the Standard Inlet and Manhole Program include:

- PB – Precast Base
- PJB – Precast Junction Box
- PDD – Design Data for Precast Base and Junction Box
- PRM – Precast Round Manhole
- PCO – Precast Curb Inlet Outside Roadway
- PCU – Precast Curb Inlet Under Roadway
- PSL – Precast Slab Lid
- POD – Precast Overpass Drain
- PMBD – Precast Median Barrier Drain
- PAZD - Precast Area Zone Drain
- PAZD-CZ – Precast Area Zone Drain within Clear Zone
- PBGC – Pipe and Box Grouted Connections for Precast Structures

Other standard and reference drawings that accompany the drainage structures include:

- Example of PB Reducing Slab and Reduced Riser Sizes
- Example of PSL Styles and Sizes
- CGT-PCO – Curb and Gutter Transition Details for PCO Inlet
- CGT-PCU – Curb and Gutter Transition Details for PCU Inlet

Also included is the reference document *Approved Cast Iron Product Sheets*. This document provides the details of the cast iron frames, rings, covers, and grates for use with the Standard Inlet and Manhole Program. Cast iron products are supplied with the precast inlet and manholes, and are subsidiary to the corresponding bid item, per Item 465, "Junction Boxes, Manholes, and Inlets" and Item 471, "Frames, Grates, Rings and Covers." The document includes a table of hydraulic design values for the approved grates.

Need for Non-standard Designs

TxDOT and the Standard Inlet and Manhole Program recognize that precast inlet, junction box, and manhole standards cannot satisfy every situation. Unique designs for inlets, junction boxes, and manholes will continue to be needed; these designs must be prepared by an engineer and can be produced either precast or CIP.

Each standard drawing in the Standard Inlet and Manhole Program specifies nominal dimensions, minimum wall thickness, base thickness, slab thickness, minimum concrete strength and minimum reinforcement area. Any precast concrete inlet, junction box or manhole product in conformance with the Standard Inlet and Manhole Program does not require submittal for review. Any product not meeting these minimums is considered non-standard and must comply with current review procedures, specifically submission of sealed design and approval by TxDOT prior to manufacture and sale.

Chapter 3
Definitions and Abbreviations

Definitions

Assembly – a combination of parts forming a whole with a specific function. For example, the lid and throat of a curb inlet top or the grate, frame and concrete slab of a grate inlet top is referred to as an assembly.

Base – the lowest portion of a structure with a bottom but no top, generally with thin wall panels or penetrations. The base serves as a combined foundation and conduit-acceptance device.

Benching – a system of Contractor-fabricated channels built on or above the invert, which serve to direct and facilitate flows of effluent in sewer manhole and inlet bases. Benching is optional in storm sewers, but highly recommended in sanitary sewers or any application where the generation of sewer gases is a concern. Benching is not included in the Standard Inlet and Manhole Program and is best fabricated by the installing Contractor in the field.

Clamshell Base or Structure – a two-part base or structure where the base is cast in upper and lower halves, each of which may fractionally encircle the entering and exiting conduits. A clamshell base or structure may not be used with flexible connectors. The clamshell base or structure is not a part of the Standard Inlet and Manhole Program; however, it is a common solution to relatively large square and rectangular base needs. Because it is not a part of the Standard Inlet and Manhole Program, it is subject to normal submittal and approval procedures.

Concentric Cone - a manhole cone designed and manufactured with the entry to the cone centered over the riser, creating an entry hole above the center of the riser. The manhole entrance location cannot be adjusted without moving the entire structure.

Eccentric Cone – a manhole cone designed and manufactured with the entry to the cone off-set to the side, creating a straight vertical wall on one side. These cones are generally considered to allow safer ingress. These cones allow greatest flexibility in placement of the lid due to the ability of the Contractor to rotate the cone and move the manhole entrance.

Flexible Connector – a flexible, leak-resistant connector or gasket, which is mechanically attached or cast into a structure; also referred to as a *boot*. Due to problems with adhesion and thermal expansion rates, flexible connectors are required when using dissimilar pipe and structure materials.

I.D. Measurements – when describing the inside dimensions of a product, the dimension description is prefaced by "I.D."

Infall – the opening through which storm water enters the structure from the surface and, generally, describing the curb opening in a curb inlet.

Inlet – the assembly which is placed at finished grade and connected to a base. The Standard Inlet and Manhole Program includes curb inlets, flat slab inlets with grates or covers, barrier inlets, and raised area inlets.

Invert – the internal bottom or floor of a structure, usually an integral part of the base and not to be confused with the flow line or with benching.

Junction Box – a structure consisting of a base and below grade slab, which does not have access from finished grade.

Lid – the topmost piece of a structure. For a manhole ring and cover it would be the cover. For a curb inlet, it would be the top slab. For a grate inlet, it would be the grate, frame and concrete slab assembly.

Manhole – a structure that provides access to a drainage system. In the Program, the Precast Round Manhole (PRM) consists of a round base, round risers, and lid; a rectangular base structure can be used when the PRM is not suitable.

Measurements – inlets, junction boxes, and manholes use internal diameter or internal width and length as their descriptors. For example, a 48-in. manhole has a nominal 48 in. internal diameter. A 3x5 inlet would nominally measure 3 ft. by 5 ft. internally. These measurements are described width (shorter) and length (longer). Height is described from inside bottom of structure to outside top of structure (this can be different from top of grade). Therefore, a 3x5x6'-3" (W x L x H) structure would be 6 ft. 3 in. tall from inside bottom to outside top. Designers and Installers must be aware of description conventions and how they vary from overall outside dimensions.

O.D. Measurements – when describing the outside dimensions of a product, the dimension description is prefaced by "O.D.". So, the example from above would then be O.D. 4 x 6 x 6'-9" (assuming wall and slab thicknesses of 6 in.) as these are the external dimensions of the structure.

Reducing Slab – a flat slab designed and manufactured to reduce a structures' size in order to provide a more cost-effective solution for the customer or to accommodate a smaller lid or top assembly.

Riser – a structure with no bottom and no top, generally without penetrations or thin wall sections, which serves to rise from the base of a unit to the top assembly; a spacer. Risers may have holes as long as the standard conventions are followed (6 in. from joints, no penetration of corners). Multiple risers can be used as needed.

Skew – the angle at which a pipe or conduit enters a square or rectangular base when that angle is other than a nominal 90° to the wall; angle of entry.

Structure – the entire set of pieces, parts and assemblies that make up the whole.

Thin Wall Panel – a circular section of a base unit wall that is fabricated with only half of the wall thickness; also called a *knockout (KO)*. The thin wall panel diameter may be no larger than the inside wall width and 6 inches less than the interior base height (12 inches less than the interior riser height.) Any pipe size requiring a penetration less than or equal to the KO diameter can be installed in a base unit by cutting and removing the appropriate portion of the panel. Manufacturers cast stock base units with thin wall panels; stock base units without thin wall panels; or base units with cast-holes on a per-job basis.

Throat – The piece of an assembly through which storm water ingress occurs, when that ingress does not occur through the lid; also, the lowest piece of any two-piece lid assembly. For example, the bottom piece of a two-part curb inlet assembly is the throat.

Abbreviations

AASHTO – American Association of State Highway and Transportation Officials

ACPA – American Concrete Pipe Association

ASTM – American Society for Testing and Materials

CFR – Code of Federal Regulations

CIP – cast-in-place

CMP – corrugated metal pipe

HDPE – high-density polyethylene

LRFD – load and resistance factor design

OSHA – Occupational Safety and Health Administration

RCP – reinforced concrete pipe

TCPA – Texas Concrete Pipe Association

WWR – welded wire reinforcement

Chapter 4
Design

Overview

The Standard Inlet and Manhole Program was conceived as a system of mix-and-match pieces that are combined to create a complete drainage structure. Products are designed with tongue and groove joints, allowing most any base to be stacked with a reducing slab, risers, and top assembly to create a uniform, standardized structure.

All "SIZE" dimensions given on the precast standard drawings are internal product dimensions. Internal measurements are nominal; manufacturing tolerance variations which do not substantially affect hydraulic capacity of the structure are acceptable. Each standard drawing specifies a minimum wall thickness, base thickness, slab thickness, minimum concrete strength and minimum reinforcement area. Reinforcement designs are based on grade 60 reinforcing steel, but direct area-to-area conversion to WWR is acceptable.

Bases

There are three base types in the Standard Inlet and Manhole Program: precast base (PB), precast junction box (PJB), and precast round manhole (PRM).

The PB and PJB utilize the same design for the base slab and base unit. They differ in that the PJB terminates below ground with a below grade slab, such that there is no access to the PJB from the surface, or it is connected to the POD inlet with a vertical 18 in. RCP. The PB continues from the base unit to finished grade with risers or optional reducing slab and reduced risers, and is capped with one of the PCO, PCU, PSL, PMBD, PAZD, or PAZD-CZ inlets.

The PRM is a unique structure, with a round base unit and round risers. The PRM may also be placed on a PB. The PRM is always capped with a manhole cone or round Style RC lid. The inlets PCO, PCU, PMBD, PAZD, and PAZD-CZ are not placed on a PRM. Round manhole products must comply with ASTM C478.

When using box culverts, it may not be feasible to use a PB or PJB. If this is the case, consider attaching the riser, if needed, and inlet directly to the top of the box culvert. The box culvert fabricator for precast or designer for cast-in-place will need to design the top slab of the box for this attachment and load. For this type of connection for precast, the Designer should clearly show and call for it in the plans and request shop plans for review.

Depth

Standard depths for PB and PJB bases are 15 or 25 ft. from finished grade to inside floor of structure. For the sake of economy this was broken into two divisions: from 0 to 15 ft. and 15 to 25 ft. Standard depths for PRM bases are up to 25 ft. from finished grade to inside floor of structure. Deeper installations may require non-standard designs.

The minimum height of base units is provided in Table 2. These minimums are specifically for bases that are manufactured with a thin wall panel and kept in stock by the Manufacturer. Bases are available in 3-in. increments beyond the minimum base height, up to the capacity of the Manufacturer. Beyond that risers will be provided, which also come in 3-in. increments. The minimum height of a base unit without thin wall panel is 2 ft. 6 in. Base units without thin wall panels are manufactured on a per-job basis.

When a 3-in. increment does not meet the flow line, the bottom of the structure is buried deeper to bring the flow line up inside the structure. A CIP invert must then be placed in the base to form the flow line at the desired elevation.

Table 2: Summary of Heights for Bases and Risers

Base Dimensions (W X L)	Minimum Inside Base Unit Height	Minimum Riser Height	Base Unit/Riser Increment	Base Slab Thickness	Reducing Slab Thickness
3’ x 3’	3'-6"	6”	3”	6”	N/A
4’ x 4’	4'-6"	6”	3”	6”	N/A
3’ x 5’	3'-6"	6”	3”	6”	9”
4’ x 5’	4'-6"	9”	3”	6”	9”
5’ x 5’	5'-6"	9”	3”	6”	9”
5’ x 6’	5'-6"	9”	3”	9”	9”
6’ x 6’	6'-6"	12”	3”	9”	9”
8’ x 8’	8'-6"	12”	3”	9”	9”
48” round	1’-0”	12”	3”	9”	N/A
60” round	3’-0”	12”	3”	9”	9”
72” round	3’-0”	12”	3”	9”	12”

Refer to section Minimum Cover for Inlet Assembly and Pipe for further explanation on determining structure depth.

Size

The size of the base is determined by the pipe that must connect into it. For the precast bases, the connecting pipe will always frame into the base unit wall, meaning the entire pipe sits in the wall. As such, it is imperative to take into consideration the O.D. of the pipe, not just the I.D., when sizing the base.

Multiple pipes can frame into a single side of the PB and PJB bases. A distance equal to the base wall thickness must be provided between the penetrations for each pipe. Multiple pipes can also frame into the circumference of PRM bases, with the same requirement of a distance equal to the base wall thickness provided between the penetrations for each pipe.

Table 3 is provided as an aide in base selection for the PB and PJB standards with a single pipe framing into one side. The table shows the minimum wall width needed per size of pipe, taking into account the O.D. and 2 in. of clearance around the circumference of the pipe (4 in. total) to allow for placement. Note that the table is for straight walled pipe and not for belled pipe. Furthermore, the table is for standard "B" and "C" wall RCP. For alternate pipe materials, such as HDPE and CMP, consult the alternate pipe material Manufacturer for O.D.

Table 3: Minimum Rectangular Base Wall Size per RCP I.D.
(for use with PB and PJB)

Pipe I.D.	"B" Wall RCP			"C" Wall RCP		
	Pipe O.D.	Minimum Base Wall Width		Pipe O.D.	Minimum Base Wall Width	
		0° skew	Max 7° skew		0° skew	Max 7° skew
12"	16"	3'	3'	17 ½"	3'	3'
15"	19 ½"	3'	3'	21"	3'	3'
18"	23"	3'	3'	24 ½"	3'	3'
24"	30"	3'	3'	31 ½"	3'	3'
30"	37"	4'	4'	38 ½"	4'	4'
36"	44"	4'	5'	45 ½"	5'	5'
42"	51"	5'	5'	52 ½"	5'	5'
48"	58"	6'	6'	59 ½"	6'	6'
54"	65"	6'	6'	66 ½"	6'	6'
60"	72"	7'	7'	73 ½"	7'	7'
66"	79"	7'	7'	80 ½"	7'	7'
72"	86"	8'	8'	87 ½"	8'	8'

Table 4 is provided as an aide in base selection for the PRM standard. The table shows the base diameter needed per size of pipe, taking into account the O.D. and 2 in. of clearance around the

circumference of the pipe (4 in. total) to allow for placement. Note that the table is for straight walled pipe and not for belled pipe. Furthermore, the table is for standard "B" and "C" wall RCP. As can be seen in Table 4, the largest RCP that can be used with the PRM bases is 36 in. For alternate pipe materials, such as HDPE and CMP, consult the alternate pipe material Manufacturer for O.D.

Table 4: Minimum Round Base Diameter per RCP I.D.
(for use with PRM)

Pipe I.D.	"B" Wall RCP			"C" Wall RCP		
	Pipe O.D.	Minimum Base Diameter		Pipe O.D.	Minimum Base Diameter	
		0° skew	Max 7° skew		0° skew	Max 7° skew
12"	16"	48"	48"	17 ½"	48"	48"
15"	19 ½"	48"	48"	21"	48"	48"
18"	23"	48"	48"	24 ½"	48"	48"
24"	30"	60"	60"	31 ½"	60"	60"
30"	37"	72"	72"	38 ½"	72"	72"
36"	44"	72"	72"	45 ½"	72"	72"
42"	51"	use PB	use PB	52 ½"	use PB	use PB
48"	58"	use PB	use PB	59 ½"	use PB	use PB
54"	65"	use PB	use PB	66 ½"	use PB	use PB
60"	72"	use PB	use PB	73 ½"	use PB	use PB
66"	79"	use PB	use PB	80 ½"	use PB	use PB
72"	86"	use PB	use PB	87 ½"	use PB	use PB

Penetrations

All PB and PJB bases and risers are designed with thin wall panels on all four walls. All thin wall panels are round and do not extend into floor, into walls, or within 6 in. of the joint above or below. The Standard Inlet and Manhole Program does not preclude the use of cut or cast holes in PB and PJB bases and risers as long as they follow the design criteria of the thin wall panels.

Manufacturers recommend that conduit be brought into rectangular bases as close to 90° to the wall as possible (normal to the wall). Skew (a.k.a. angle of entry), measured from normal, is limited to 7°; the limit is based on maximum tolerance when using a flexible connector. When the angle of entry of the conduit is greater than 7°, use a pre-manufactured bend (elbow) or field-constructed collar to align the conduit prior to reaching the base. Refer to Figure 1.

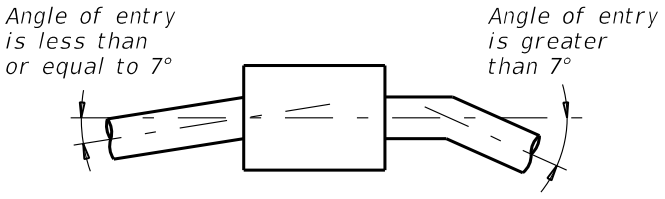

Figure 1 Conduit Angle of Entry

It is also recommended that conduit enter rectangular structures as close to horizontally-centered on the base wall as possible; this will reduce the size of base required. Conduit can enter the base laterally-offset from center when needed, such as when pipes on opposite walls are not co-linear; the base needs to be properly sized for the offset. Penetration of a rectangular base corner is prohibited.

All PRM bases and risers may have cast or cut holes that do not extend into floor or less than the wall thickness of the product from an adjacent hole or the joints above and below. Thin wall panels are not feasible in round bases from a manufacturing perspective. Maximum hole diameters (as opposed to pipe diameter) for PRM bases and risers are provided in Table 5. When these hole diameters are insufficient it is generally most economical to move to square or rectangular structures. If a larger pipe is needed, show and call for a PB base on the plan sheets.

Table 5: Maximum Hole Diameter for PRM

PRM Base or Riser Size	Maximum Hole Diameter
48”	32”
60”	40”
72”	54”

The diameter of hole cut into either the thin wall panel or wall must take into account the O.D. of pipe and a placement clearance. For RCP, the placement clearance ranges from 1 in. minimum to 2 in. maximum around the circumference of the pipe (2 in. to 4 in. total). When using an alternate pipe material with flexible connector, allow for placement clearance as per alternate pipe material and flexible connector Manufacturer’s recommendations.

Pipe and conduit must enter a round base at the centerline of structure. If it does not, the size of the penetration increases and can cause constructability issues. Penetration of a round base wall is prohibited.

Reducing Slabs and Reduced Risers

While the base size is determined by connecting pipes, the size of inlet installed on the base is determined by drainage demands at finished grade. It is not necessary for the base unit and inlet assembly to be the same size, although the base cannot be smaller than the inlet. To accomplish this, a reducing slab and reduced risers are used. Reducing slabs are available for all sizes other than 3’x3’, 4’x4’, and 48 in. round bases. These three components do not have reducing slabs available as there are no sizes to which they can be economically reduced.

It is generally in the customer’s best economic interest to reduce the base size, where possible, to the minimum needed for the inlet assembly required. For example, a 3’x5’ PCU inlet structure

designed to accept a 54 in. RCP entering and exiting the base unit, where both pipes are parallel to the roadway, would require a 5'x6' PB. Assuming the cover over the outside of the pipe is greater than 3 ft., a reducing slab could be installed and then 3'x5' reduced risers could be fitted to allow the use of a 3'x5' PCU inlet.

Similarly, there is rarely a need to bring a 72-in. manhole to the surface with a 72-in. manhole cone. It is usually more economical to reduce the manhole to 48 in. with a reducing slab, install 48 in. reduced risers, and use a 48-in. manhole cone or flat slab top.

Generally, economic pressure on the Manufacturer will ensure the most economical structure configuration and the Designers, aside from ensuring minimum cover over the O.D. of the pipe and specifying type of the lid assembly, need not concern themselves with the specific assembly components except for bid estimation purposes. Regardless, it is in the Designer's best interest to be prepared for requests from the Manufacturer to reduce riser and base sizes when appropriate.

Base and Reduced Riser Orientation

When planning for a size reduction, keep in mind that the reduced riser will not be centered over the base unit. The location of the reduced riser with respect to the base unit varies for the PB and PRM bases, as described below.

To satisfy structural design, the penetration for the reduced riser on the PB reducing slab will always be in a corner. The guide sheet *Example of PB Reducing Slab and Reduced Riser Sizes* is provided with the standard drawings to illustrate the location of the reduced riser in each size of PB reducing slab. All square reducing slabs can be rotated on the structure such that the reduced riser can be located in any of the four corners. The rectangular reducing slab can be rotated 180° to locate the reduced riser in the two opposing corners.

Similarly, the penetration for the reduced riser on the PRM reducing slab will always be on a side. Because this reducing slab is round, it can be rotated 360° to help locate the infall or access point at any ordinate of the base. The variability is further enhanced with a round top slab (which will also have the riser opening to one side) or an eccentric cone.

Joints

All products have tongue and groove or gasketed joints, except for the PCO and PCU lids which may have a pinned throat and top slab in order to provide as much lateral adjustment as possible. Minimum joint depth is 3/4 in.

The structural design of the components assumes joints will be fully closed on both shoulders, which requires having products with matching joint geometry. The Standard Inlet and Manhole Program does not specify a standard joint design; therefore, products from different Manufacturers may not fit together because the joints cannot be guaranteed to match.

Inlets

Types and Styles

The Standard Inlet and Manhole Program includes six inlet types, with several types having multiple styles of lid, as summarized in Table 6.

Table 6: Inlet Types and Styles

Type (Standard)	Style
Curb inlet with the base outside of street (PCO)	N/A
Curb inlet with the base under of street (PCU)	N/A
Slab lid (PSL)	Solid lid—no hole (SL) Ring and cover/grate (RH, RC and RG) Frame and grate (FG and SH) Sloped frame and grate (SFG) Stage one with exposed rebar (S1)
Slab lid on a shallow box (POD)	Frame and grate (FG) Sloped frame and grate (SFG)
Median barrier drain (PMBD)	N/A
Area zone drain- slab lid on a raised box outside of clear zone (PAZD)	Solid lid (SL) Ring and cover/grate (RC and RG) Frame and grate (FG)
Area zone drain- slab lid on a raised box within the clear zone (PAZD-CZ)	Frame and grate (FG)
Manhole cone (see explanation below)	N/A

All inlets, except the PAZD, are traffic-rated and can be placed in or adjacent to the roadway. The PAZD (a.k.a four way, wye or table top drain) is elevated 1 ft. above finished grade and must be located outside the clear zone. The PAZD-CZ (a.k.a four way, wye or table top drain) is elevated 4 inches above finished grade, can be located within the clear zone, and must be located outside the roadway.

On all types of inlets, the lid can only have one penetration for a ring/cover or frame/grate, per structural design. On the PSL, that penetration will always be located in a corner, as illustrated on

the *Precast Slab Lid* (*PSL)* standard sheet and *Examples of PSL Styles and Sizes* guide sheet. On the other inlets, the penetration is located as shown on the standard drawing.

The frame and grate for Styles FG, SH, and SFG is only available in rectangular 3x3, 4x4 and 3x5 sizes. Styles FG and SH can be cast into larger slabs; the SFG is only available in 3x3, 4x4 and 3x5 slab lids. The Style SFG is a sloped frame and grate lid that can accommodate roadway cross-slope.

Styles RH and SH are lids with the ring/cover or frame/grate shipped loose. "*Ship loose"* means that the cast iron is shipped to the jobsite with the inlet or manhole, but not cast into the lid. The cast iron is placed on the lid after the lid is installed, and adjusted to meet finished grade using grade adjustment rings. "*Ship loose"* is recommended if future grade adjustments are expected, for example a ring and cover in an asphalt roadway. Metal adapters are available where grade rings may not be a suitable option. Contact your cast iron Manufacturer for more information.

Style SL is a solid slab lid that does not have any hole or cast iron. The SL is intended to be placed at finished grade, not buried; for structures with a buried top lid, see the PJB standard. The SL style is useful for cases where a grate inlet is not presently needed, but may be needed in the future, i.e.. a widening that will place the inlet in the roadway. At the later time, the Style SL lid can be removed and replaced with a Style RH, RG, FG, etc.

Style S1 is intended for 2-stage construction or where a special inlet—usually CIP— is used. In the latter case, the PB with risers is placed, the S1 lid is placed, and then the special inlet is cast onto the projecting reinforcing bars.

Manhole Cone

The PRM base is fitted with either a manhole cone or a round Style RC lid, both having a ring and cover. Cones are used when sufficient cover exists to make placement of the cone possible. Contact your Manufacturer for more information. When cover is limited, the flat lid must be used.

Manhole ring and covers are provided "*loose",* with grade rings if required. Metal adapters are available where grade rings may not be a suitable option. Contact your cast iron Manufacturer for more information.

Minimum Cover for Inlet Assembly and Pipe

Section 12.6 of the AASHTO *LRFD Bridge Design Specifications* defines minimum cover over different types of pipe. This cover is from top, outside of pipe to top of soil or to top or bottom of pavement as per the specification.

Precast inlets also require minimum cover above the exterior crown of the pipe, as shown in Table 7. For most inlet and lid assemblies the minimum cover is equal to:

$$height\ of\ assembly + 6" + 2"\ grout$$

The POD inlet requires an 18 in. RCP riser to connect it to a PJB below grade slab. For proper placement of the RCP riser, 2 ft. of backfill is needed between bottom of POD and top of PJB. Therefore, minimum cover for the POD is equal to:

$$height\ of\ assembly + 2'min.\ backfill + PJB\ below\ grade\ slab + 6" + 2"\ grout$$

If the minimum cover for POD is not available, a PSL inlet should be considered.

Manhole cones are not detailed in the Standard Inlet and Manhole Program; the height of cones varies by Manufacturer. If minimum cover needed for a cone is not available, the Manufacturer will provide a flat slab top with the PRM.

Both the minimum cover required for the assembly and for the pipe design must be checked to determine which governs at the installation location.

Table 7: Minimum Cover for Inlet and Lid Assemblies

Inlet or Lid Assembly Type	Height of Assembly	Minimum Cover
Curb inlet with the base outside of street (PCO)	21" [1]	29"
Curb inlet with the base under street (PCU)	27" [1]	35"
Slab lid (PSL)	9" 6" sloped	17" 14"
Slab lid on a shallow box (POD)	27" 24" sloped	68" or 71" [2] 65" or 68" [2]
Median barrier drain (PMBD)	21"	29"
Area zone drain- slab lid on a raised box (PAZD)	6" [3]	14"
Area zone drain- slab lid on a raised box within clear zone (PAZD-CZ)	19" [3]	27"
Manhole flat slab	9"	17"
Manhole cone	varies by Manufacturer	height + 8"

[1] measured from top of assembly to bottom of assembly; top of assembly is 9" above infall
[2] includes additional height of min. backfill and PJB below grade slab; below grade slab varies by PJB size
[3] measured from infall to bottom of assembly; does not include portion of assembly above finished grade

Cast Iron Frames, Grates, Rings, and Covers

All frames, grates, rings, and covers used with the Standard Inlet and Manhole Program are cast iron, traffic-rated and capable of being secured. Refer to the Approved Cast Iron Product Sheets for details of the cast iron products and hydraulic design values.

Round covers come in both solid and grate options. The rings can accept either the solid or grate covers, such that the cover can be swapped at a later date, if needed. The PRM, PCO, PCU, PMBD all come with a default *solid cover*; if the Designer wants a *grate cover* for any of these structures, this must be specified in the plans.

A modified grate with more open area than the standard grate—called the *extra open area grate*—is available for the 3x3 and 4x4 frames. All inlets with grate lids come with the default *standard grate*; if the Designer wants an *extra open area grate* for any of these structures, this must be specified in the plans.

Slab Lid Orientation

While only three sizes of frame and grate—3'x3', 4'x4', and 3'x5'—and one size of ring and cover—32" diameter—are available, all of these can be cast into a larger slab lid shown on the PSL. To satisfy structural design, only one penetration for the frame/grate or ring/cover is allowed and is always located in a corner of the slab lid. The guide sheet *Example of PSL Styles and Sizes* is provided with the standard drawings to illustrate the location of penetrations in each size of PSL.

All square slab lids (3'x3', 4'x4', 5'x5', 6'x6', and 8'x8') can be rotated on the structure such that the penetration can be located in any of the four corners. The rectangular slab lids (3'x5', 4'x5', and 5'x6') can be rotated 180° to locate the penetration in the two opposing corners.

Also note that the two square grates (3'x3' and 4'x4') are rotatable by 90°, 180° and 270° in the frame.

The combination of lid orientation and grate orientation allows for numerous installation options.

Extensions for Curb Inlets

The PCO and PCU inlets have a maximum of two optional extensions, with one placed on the right and the other placed on the left of the main throat of inlet. The designations of *right* and *left* are determined while facing the infall of the inlet. For example, Figure 2 shows a PCO inlet with a right extension.

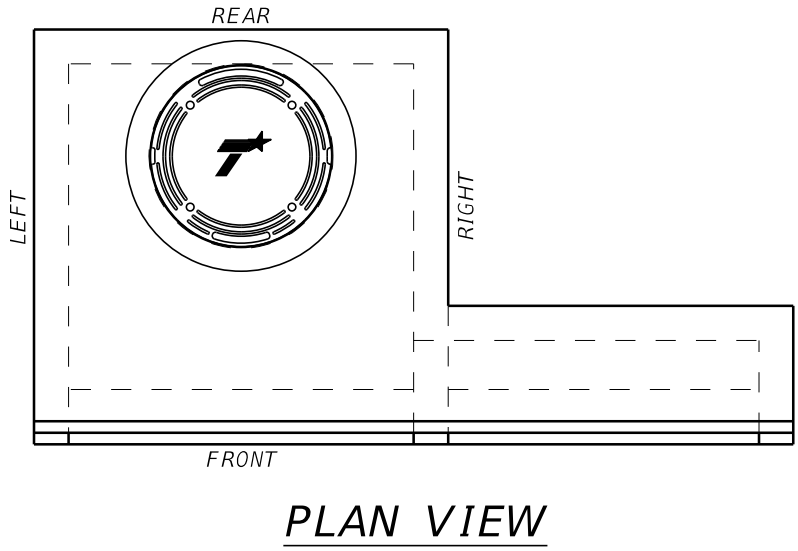

Figure 2: Extension Placement on PCO Inlet

When only one extension is used, that extension should be located upstream of the main throat. When additional hydraulic capacity is required, it is recommended that additional curb inlets be included in the design.

When extensions are specified in the plans, they are fabricated monolithically with the main throat of the inlet. As such, the extensions do not have a bid code separate from the main throat, as was done in the past. The inlets can be designed and bid with the following extension options: right, left, both, or none.

Curb and Gutter Transition Details

The PCO and PCU inlets have been designed to approximately match the Types II and IV curbs on the *Concrete Curb and Curb and Gutter (CCCG-12)* standard, with a 6-in. rise from normal gutter line to top of inlet (top of curb) and a 3 in.3-in. inlet depression.

Curb and gutter transition details are provided for both the PCO and PCU inlets. A 10–ft. transition length is provided on both sides of the inlet to transition the gutter from normal to depressed. The

details accommodate all the curb types shown on the CCCG-12 roadway standard. Note that for the Types I, IIa, and III curbs, the top of inlet will be higher than the curb, in order to maintain the 3-in. inlet depression.

Structure Placement

Designers should consider inlet, junction box, and manhole placement during the design process. Granted, limiting factors sometimes restrict the placement of a structure to one location, but it is advisable that structures be placed so as to restrict or limit a vehicle's ability to run into or over them. This holds true for any structure but it is of particular importance for drains, where water may tend to pond. Standing water is never a traffic advantage. Multiple inlets can be placed next to each other in order to reduce standing water. Refer to Section Minimum Structure Separation for explanation on how to place inlets beside each other.

Structure Orientation

The Standard Inlet and Manhole Program accommodates many possibilities for orienting a structure in a drainage system. Refer to the sections Base and Reduced Riser Orientation and Slab Lid Orientation for explanation of how these pieces can be rotated. The Designer can take advantage of this rotation to adjust where the inlet or drain is located with respect to the roadway or pipe line. This flexibility can also be useful in the field, if lines or stations need adjusting because of field conditions.

Curb Inlet Location

Infall location is a critical concern for curb inlets because exact placement of the inlet curb face can be important; where the base is located determines where the infall is located. It is important that the Designer consider infall placement when laying out pipe line and grade, in order to ensure that the curb inlet matches the curb. Of particular importance is top exterior surface of the pipe and minimum cover requirements of the inlet.

Many options are available. For example, the Designer can select a PCU inlet and place the outside back of the box 22 in. behind the curb line. Also, if a reducing slab is used it can change the inlet assembly location as described above. Finally, the curb inlet can be set back behind the curb line, as shown in Figure 3, making matching the curb far easier.

If due to physical restrictions or pipeline right-of-way issues the Designer finds it difficult to locate an inlet structure contact a Manufacturer for assistance. A one-off design can be developed for any unique application, bearing in mind that it will not be as economical.

Additionally, it is best to avoid placing curb inlets at or near corners or on either radius of a curve, as those locations may expose them to excessive traffic hits. It is better to place them away from a corner, away from curb breaks or driveways, and far enough away from curves that they are more protected from traffic. Where it is not possible to place the curb inlet in a protected area, consideration should be given to setting the curb inlet behind the curb line, as shown in Figure 3.

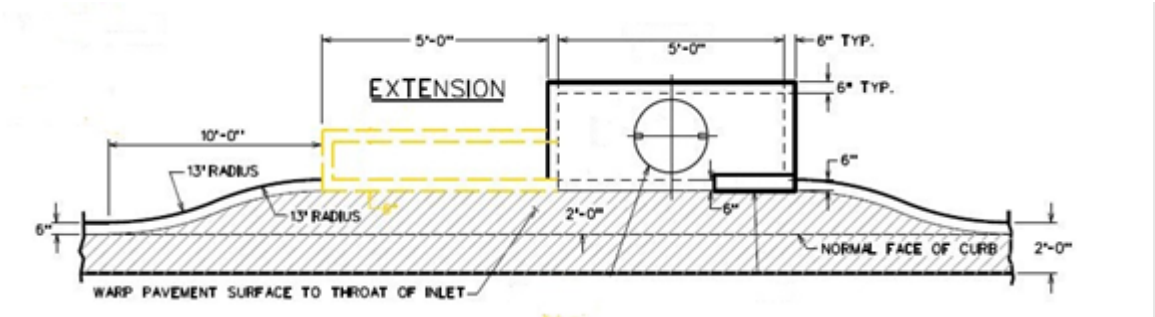

Figure 3: Curb Inlet Setback

If the Designer determines that it is not effective to move the pipeline to accommodate an inlet setback, using a PCU inlet rather than a PCO inlet in Figure 3 would allow the inlet setback without too much adjustment to the pipeline.

Curb inlets work best—they will accept the greatest amount of infall—when installed level. The slope of the road should be leveled at the point of curb inlet installation rather than attempting to match the curb inlet to the slope of the road. If eliminating roadway slope at the inlet location is not possible, a grate inlet may be a better choice than a curb inlet for that particular location.

Minimum Structure Separation

Often multiple structures are needed in an area to provide adequate drainage. While it may be tempting to place inlets side-to-side in areas of high demand, long-term integrity of the structures will be compromised if placed too closely together. Side-to-side inlets will suffer structural distress, spalling, separation of joints, and infiltration as the natural settlement of the system happens over its lifespan.

To allow adequate working space for the proper placement and compaction of backfill, locate structures with minimum 2 ft. separation. Separation must be measured at the largest portion of the structures—typically the base units— or at extensions.

Preventing Infiltration and Exfiltration at Joints

Historically, connections between conduit and structure have been grouted. Infiltration and exfiltration at these joints is a significant concern. Damage to adjacent structures due to soil

infiltration into the structure and capacity issues due to water infiltration are problems that may occur. Steps can be taken in the design and construction stages that will minimize these problems as follows:

a) The foundation under the structure should be designed to support the combined load of the structure and effluent. At a minimum, it should be constructed in similar manner to the foundation under the pipe and compacted to a minimum of the same proctor density.

b) The foundation under the pipe near the structure must be constructed just as the foundation under the balance of the pipe.

c) Grouted connections are acceptable only on RCP. Grouted connections should be made with a pre-packaged non-shrink or expansive grout, properly placed and cured prior to backfill as per grout Manufacturer's recommendations.

d) Dissimilar materials have different thermal expansion rates, can deflect over time and have issues bonding to grout. Therefore, alternate pipe materials require flexible connectors.

Where infiltration or exfiltration are a concern to the Owner or the Designer, special attention to connections, joints and seals in the plans and specifications are recommended. Flexible connectors are available for many pipe materials. Those connectors, or more properly adaptors for those connectors, can be pipe material specific. Ensure that connectors or adaptors are available for any allowed alternative pipe material.

Additionally, structure joints (as opposed to connections) may be externally wrapped. While external wrap will help resist infiltration through the joint, it may not resist exfiltration.

If surface water ingress is considered a problem with manhole ring and covers, chimney seals may be specified. In order for such seals to function the manhole cone must have a *chimney*. Some manhole cone designs will not accept a chimney seal. Refer to the Manufacturer's specifications for more detail.

Miscellaneous Details

Inverts and Benching

Slight variations in line and grade of pipelines can make precast inverts on rigid pipe lines extremely difficult to meet. Those same variations lend to irregularities in line and grade of flexible pipelines at or near structures leading to ponding of storm water in, at or near the structures. Therefore, inverts and benching, if desired, must be constructed by the installation Contractor in the field.

Curb Armor

Cast iron curb armor may be specified on curb inlets if the curb inlet cannot be located away from significant traffic impacts. However, the Standard Inlet and Manhole Program does not consider curb armor to be a significant structural addition to the product. Rather, the armor helps to contain concrete spalls, should they occur.

Steps

Cast-in-place steps, which provide permanent access into the inlet or manhole, are not part of the precast standards. These steps are a safety hazard for two reasons: they are difficult to adequately maintain, which leads to ultimate deterioration and failure; and they can become an attractive nuisance. A better alternative is to have inspection and maintenance personnel carry a ladder.

Chapter 5
Installation

Information in this guide is general in nature. Refer to ASTM C891, *Standard Practice for Installation of Underground Precast Concrete Utility Structures* for additional information.

The use of these procedures for the installation of precast concrete manholes and inlets will afford the Contractor, Inspector, Designer, and Owner the best possible product. Should you have questions or concerns about these procedures please contact the Manufacturer, TCPA, or the ACPA.

This guide does not address all safety concerns related to the use and handling of these precast concrete structures. It is the responsibility of the Installer to adhere to or to surpass the rules and regulations of the OSHA *29 CFR 1926-Safety and Health Regulations for Construction* and to establish appropriate health and safety practices.

Lifting, Handling, and Storage

The delivery area must be acceptable to the Manufacturer's driver or representative and be free of overhead wires or other obstructions that would inhibit access of the delivery trucks. Trucks should be able to pull alongside of or back up to within 8 ft. of the excavation area on a suitably firm, stable and level surface. Traffic control is the responsibility of the customer. Manufacturers may refuse delivery if site conditions do not meet the requirements of this guide.

Always rig and handle the products using the lifting points and hardware installed by the Manufacturer. Weights of components are marked on each component. Ensure the use of adequate lifting equipment as per, at a minimum, OSHA guidelines. Ensure that chain falls or straps do not exceed 30° from the vertical (sling angle) while lifting, as per Figure 4. Ensure chains or straps do not contact joints. Use the full complement of lift points and hardware. When using more than two legs on a sling a spreader bar is recommended to ensure adequate distribution of the load.

Never lift precast components through preformed holes other than those specifically provided for lifting. Ensure adequate weight distribution behind the lift hole when using lift holes specifically provided for lifting. Never lift precast components from hardware designed and installed for pulling electrical cables. All lifting devices such as slings, chains wire ropes, hooks, shackles, rolling blocks, closed links, lifting plates and spreader bars should be inspected for wear or damage prior to lifting and handling. **Never allow personnel under a load**. All lifting hardware should be certified to meet the requirements of OSHA *29 CFR 1926* and be sized appropriately for the weights to be handled.

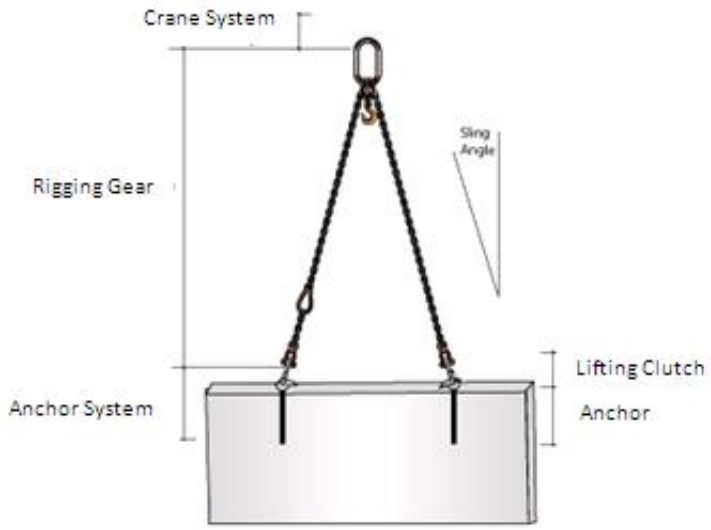

Figure 4: Lifting Diagram

Selection of appropriate lifting equipment is, by necessity, at the determination of the Contractor. Inappropriate lifting equipment and techniques can be very dangerous. Excavators are specifically exempted from OSHA lifting regulations. For this reason, the use of excavators for unloading, moving and placing of precast concrete structures is not recommended. The use of qualified riggers is strongly advised. If unsure about proper handling procedures contact your Manufacturer.

Do not push or drag components across the ground. Do not wrap chain, cable or strap around or through product to lift or handle the components. Failure to properly use the designed and installed lifting hardware is a significant cause of damage to precast concrete components. In order to more easily comply with these recommendations, it is strongly recommended that inlet, junction box, and manhole products be unloaded at their designated station upon arrival at the jobsite in order to keep handling to a minimum.

It is our recommendation that the Contractor always stockpile the components for a station adjacent to the station where they will be installed. While it can sometimes appear expedient to centrally stockpile components it is generally not an economical option for several reasons. First, a central stockpile means that the Contractor must move the product to the correct station. Second, the central stockpile means that the Contractor must select all of the correct components to move to the station. This is an error prone procedure. Lastly, the handling damage incurred when moving precast components across the uneven jobsite may result in a component or structure being rejected.

The manufacturing company can determine if the damage is from handling and if it is, then the liability for that damage may well rest solely on the Contractor.

Excavation and Bedding

The excavation should have sufficient width and length to allow for safe installation, sealing of the joints, and compaction of the backfill. The depth of the excavation should allow for the overall dimensions of the assembled structure plus the required foundation. The Installer should ensure that the bedding thickness, slab thicknesses, wall heights, grade rings, access covers, and dimensional manufacturing tolerances and joint tolerances are accommodated by the excavation.

If standing water is encountered, additional excavation may be required to allow for the use of pumps to prevent water from collecting at the bottom of the excavation during installation.

A firm and uniform foundation is essential to provide a uniform bearing surface and to prevent adverse settlement. The foundation must be compacted to the same minimum density as the foundation below penetrating pipes. When the foundation material is either unsuitable or unstable, the foundation should either be stabilized or removed and replaced with a suitable foundation material. The base of the excavation should be free of any large stones or other similar objects.

Unless otherwise specified by the owner, a leveling course should be constructed above the foundation, of moderately firm to hard in situ soil. An example of this is shown in Figure 5. In installations where native soils do not provide a suitable leveling course, the leveling course should be constructed of sand, crushed stone, pea gravel, or other approved select fine granular bedding materials, where the maximum particle size is 1/2 in. If the leveling course is placed over rock or other incompressible material, the leveling course should not be less than 6 in. thick. The leveling course should extend slightly beyond all sides of the base of the structure and should be firmly compacted in even lifts.

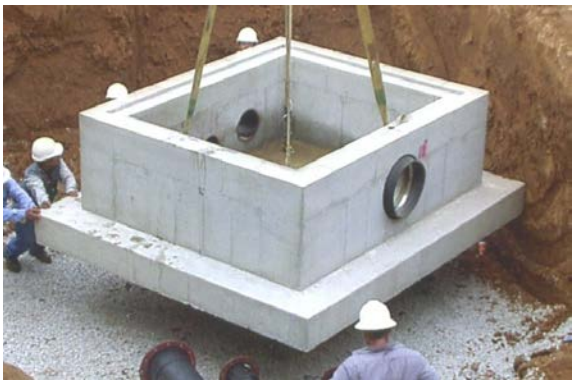

Figure 5: Leveling Course of Select Granular Material

Connections

For mortar connections on rigid storm drain pipe, position the pipe in the center of the opening and set it at proper grade, making the end of the pipe as close to flush with the inside surface of the structure wall as possible. Completely fill the voids between the precast structure and the connecting pipe with non-shrink or expansive, quick setting grout. Finish in a neat, workmanlike manner and cure using an approved method. Bricks, masonry blocks, native stone or similar materials may not be used in conjunction with mortar or grout to fill voids. Allow for proper curing time prior to backfilling. Contact your Manufacturer when filling voids larger than 1-ft. in width, depth, or height.

Flexible connectors are required when using alternate pipe materials such as HDPE or CMP; they may be used on RCP. Flexible connectors have tolerances such that they may only be used on cored or precisely cast holes within tolerances dictated by the flexible connector Manufacturer's recommendations. When using flexible connectors, clean the inside surface of the flexible connector and insert the pipe through the center of the connector, making the end of the pipe flush with the inside surface of the structure wall. Install and tighten clamps to recommended torque per Manufacturer's recommendations. Do not grout the opening, as that will inhibit the designed flexibility of the connector.

Use only the provided knockout areas or openings for conduit and pipe penetrations. Cuts made in any other area of the structure will compromise the integrity of the structure. Contact your Manufacturer for written instructions should penetrations in other areas of the structure be necessary.

Thoroughly compact the bedding and backfill under incoming pipes and utilities to prevent differential settlement or shearing at the connection, which could induce unintended and uncalculated stresses in both the pipe and the precast structure. Do this only after mortar connections have been made and properly cured.

Joints

Joint sealing material is provided for the main structure only. The Installer is responsible for sealing grade rings and access hardware not cast into the structure.

Normally, joining of tongue and groove sections will be made with preformed butyl gasket strips, coils, or bulk mastic and not with mortar or grout. Non-shrink grout may be used to seal joints when grade adjustment is needed. Refer to precast standards for further information.

Clean and inspect all joint surfaces prior to installation. Rocks, soil, dust, and water in the joints may prevent the section from setting and sealing properly. Immediately prior to installation carefully remove all protective paper from gasket material. Install gasket material on the edges of the joint, as required. Splices may be made by kneading ends of each strip together to form a unified splice of the same volume as the remainder of the strip(s). Splices may not be made by placing the ends together in a side-by-side fashion. Splices may not be made by overlapping gasket strips on top of one another. Gasket material should be continuous around corners. Use the specified quantity of gasket material as per precast Manufacturer's recommendations. Ensure adequate, even distribution of bulk mastic. Preformed mastic materials are sized by volume for their application, so do not *stretch* strip or rope material.

Should it be necessary, refer to ASTM C1227 or C1613 for proper vacuum and water testing procedures for concrete structures. Vacuum testing should always be performed prior to backfilling while, conversely, hydrostatic or water testing may require full or partial backfilling prior to testing.

Where mastic or grout is involved a minimum 24–hr. curing period is required before testing. Contact your Manufacturer if water testing above the operational level of any structure is required by the Owner.

Backfill

Once all sections are assembled add backfill material evenly on all sides of the structure in lifts not more than 8 in. each. Acceptable backfill materials are sand, pea gravel, crushed stone, approved native soil, or other approved select fine granular material that is free of large rocks or other debris as approved by owner. Maximum particle size for backfill material is one inch. Backfill material may not be saturated with water. Compact each lift to prevent voids and reduce settlement.

Do not backfill only one side at a time as this may cause structural damage or leakage from joints or connecting pipes due to shifting of the structure induced by uneven loading of the structure.

Installation Guidelines

The following guidelines, when observed, will ensure a speedy and accurate installation of a precast inlet or manhole.

1. Ensure that pipe is accurate to line and grade in the approach to and the exit from the structure. If obstructions have been encountered resulting in a shift of line or grade consultation with the Manufacturer is recommended. The Standard Inlet and Manhole Program is based around *stock* components. Chances are good that the Manufacturer has a precast solution to variations in line and grade in stock. It is usually far cheaper and faster to trade out stock items rather than attempting to *make it fit* and then finding and dealing with problems with final elevation, alignment, and/or with other structures such as the curb or roadway.
2. Verify final grade prior to excavation for the structure. If variations from plan are found consult the design engineer and the Manufacturer.
3. Establish the locations of at least two corners of square or rectangular structures. Establish the center point of round structures. If there have been changes from the plan, contact your Manufacturer. This will save time and money.
4. Verify that the correct components have been brought to the station.
5. Ensure that proper handling procedures are used during jobsite movement of precast components. These components are designed to be handled from specific lifting and handling embedment points. Damage to the product may result from improper handling techniques.

6. Confirm outside dimensions of the structure as it will be assembled; from outside top of structure to outside bottom of structure.

7. Over excavate to such depth as to construct the foundation and leveling course as required by the plans. If no structural foundation and leveling course are specified in the plans the same foundation required for the pipe and a suitable leveling course must be constructed beneath the structure. A properly constructed foundation and leveling course is mandatory to ensure that the structure does not settle.

8. Confirm that top of foundation is at the correct depth for the bottom outside of the structure. Do not confuse bottom outside of the structure with bottom inside. While this sounds obvious, it is a common error.

9. Verify corners or center of structure in the pit. It is recommended that two corners of square or rectangular structures or two outside edges of round structures be marked on the pit bottom prior to installation.

10. Knock out or core the appropriate thin wall sections to accept pipe as required. Take care to avoid damage to the structure during the process. It is recommended that this be done prior to installation.

11. Set the base using correct handling procedures. Ensure the base is level, square, and even with curb when necessary. Failure to properly locate the base of the structure is the single most common error in precast inlet construction and a mis-located base will result in a mis-located top. Not much of a problem with a manhole but a significant concern with a curb inlet.

12. Insert pipe into structure and seal the penetration as required by plans and specifications. Ensure compliance with plans and specifications for the foundation under and the backfill compaction around the pipe.

13. Stack components as per design. Verify elevation, level, and square of structure components as they are installed.

14. Where necessary to adjust grade, joints may be mortared open one half of the joint depth or 1 in., whichever is greater.

15. When using mastic, ensure placement as per Figure 6 and Figure 7. The use of more mastic than recommended by the Manufacturer can result in excess elevation of the structure. The use of less mastic than recommended can result in infiltration of fines. The Standard Precast Joint Detail is for vertical installations and is not the same as that for horizontal installations.

16. When installing curb inlets do not install slab pins, if provided, until curb line and elevation have been finalized. Install pins and grout as per Manufacturer's recommendations.

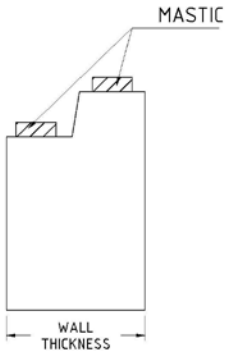

Figure 6: Standard Precast Joint Detail

Figure 7: Gasket Material Installed on Top and Bottom of Joint Shoulders

Chapter 6
Inspection

Products conforming to the Standard Inlet and Manhole Program have been designed for simpler and better inspection by standardizing the product range; the Inspector will no longer be required to understand the peculiarities of various Manufacturers' product lines as the Manufacturers will be producing similar products whose variations will be kept to a minimum.

Products conforming to the Standard Inlet and Manhole Program must be manufactured in a facility that conforms to DMS-7340. A list of approved Manufacturers can be found on the TxDOT website at http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/manin.pdf. The reader is advised that the list is fluid and should be referenced immediately prior to placing an order for the product and prior to construction of the project in order to ensure that there are no problems with the Manufacturer's qualifications.

Table 8 provides the ASTM specifications for manholes, junction boxes, and inlets.

Table 8: ASTM Specifications

Designation	Subject
C443	Rubber gasketed joints
C478	Manufacture of manholes
C877	External sealing bands
C891	Installation of inlets and junction boxes
C913	Manufacture of inlets and junction boxes
C920	Elastomeric joint sealants (mastic)
C923	Resilient connectors (flexible connectors)

A working knowledge of these specifications is strongly recommended. Contact the Manufacturer for specific product tolerances.

Handling, and Storage

It is best that the Inspector check product as it is delivered to the project site. There may be times when this is not possible; therefore, inspect the delivered product as early as can be accomplished, in order to evaluate possible delivery damage or the lack thereof. Furthermore, every effort should be made by the Contractor to stockpile manhole and inlet product adjacent to the station at which it will be installed in order to avoid future handling damage.

Poor handling procedures on the part of the delivery service and the field Contractor are one of the biggest problems encountered in precast installations. The necessity to move precast product across the uneven ground of a construction site can cause damage, especially when inadequate or

inappropriate equipment is used for the task. For example, moving a 48-in. manhole riser a quarter of a mile across a plowed field at twenty miles an hour in the bucket of a frontend loader will guarantee damage to the riser. The damage done by that 1/4-mile ride very well may provide a finished manhole that can be rejected. Every effort should be made by the Contractor, and enforced by the Inspector, to stockpile manhole and inlet product adjacent to the station at which it will be installed in order to avoid potential handling damage.

Excavation and Bedding

The excavation depth of the structure pit must be sufficient for the Contractor to construct the foundation and leveling course for the structure as detailed in the plans and specifications. If no foundation is specified, the foundation for the structure must be the same as specified for the pipe. The Inspector should verify the foundation and its depth. When installing on solid rock the minimum leveling course depth is 6-in.

The depth of the excavation should be measured from final finished grade to top of finished leveling course and should be the same as the outside dimension of the assembled structure from outside top of structure to outside bottom of structure. Keep in mind that this dimension will differ from the flowline to finished grade and it may differ from inside bottom of structure to finished grade.

Pipelines into and out of the inlet, junction box, or manhole must be properly supported by the constructed foundation. Failure to adequately support the pipe can result in failure of the joint between the pipeline and the structure. This can lead, in turn, to infiltration or exfiltration through this joint and subsequent damage to structures around the structure (i.e. pavement settlement). It is not acceptable to connect unsupported pipe to a precast structure and simply backfill around the pipe. The foundation of the pipeline must continue to the wall of the structure. Generally speaking this portion of the pipeline foundation must be constructed after placement of the base and pipeline.

The base of the structure must be accurately placed in relation to other structures at or near the station. This is of particular importance when the structure is to closely interact with other structures such as the curb or the pavement. Failure to accurately locate the base of the structure for line, grade, level and square will result in difficulty matching other surrounding structures. Tolerances on precast concrete manholes and inlets are tight and adjustment of some products, such as curb inlets, is very limited. Correct placement of the base then, is critical to the resulting location of the top.

Correct placement and alignment of each subsequent section is also critical. Alignment and elevation should be checked after the installation of each individual section. Should misalignment or elevation problems occur during installation of a section, that section should be removed, the jointing material removed and reapplied, and then the section reset in correct alignment. It is far

better to make these checks as the installation progresses rather than wait until the stack-up is complete and find that several sections need to be removed in order to correct the problem.

Joints

Several jointing materials are approved for use with precast manholes and inlets, including cementitious grout, mastic, and rubber gaskets. It is critical that Manufacturers' recommendations be followed when jointing precast manholes and inlets. Incorrect use of jointing materials can result in infiltration or exfiltration through joints.

All joints in precast manholes and inlets are positive joints (i.e. a spigot or tongue enters a bell or groove) with the single possible exception of the throat and topmost slab on a curb inlet assembly. The throat and topmost slab of the curb inlet assembly may be pinned connections in order to afford the Contractor the most latitude in its placement. The Contractor may be required to drill into the section below the slab in order to fit the pins. Pins should be grouted or epoxied into place. Follow the Manufacturer's recommendations for the use of grout or epoxy. Remember that cementitious grout must be moist cured using a department approved method.

Grouts

Proprietary cementitious grout should be mixed to the Manufacturers' recommendations. Jobsite manufactured grout should conform to the grout specification found on the PBGC standard. Surfaces to which the grout is applied should be clean and thoroughly saturated with potable water. Thoroughly saturated means saturated surface dry (SSD). Joints may be grouted to one inch open but in no case more than one half of the joint depth unless in accordance with precast Manufacturer's recommendations. Do not allow movement of the joint after installation of the grout. Grouted joints must be adequately cured immediately after installation and for a minimum of 24 hr. thereafter. Moisture must be maintained within the grout or grout failure is unavoidable. A moist curing method approved by the department is required on all exposed surfaces of the grout.

Mastic Sealants

Mastic sealants should be applied as detailed in the standard precast joint detail above for vertical joints. Precisely follow the precast Manufacturer's recommendations for mastic size. There should be no more, or no less, mastic than recommended. Apply mastic to clean dry concrete surfaces. Do not allow excessive movement of the joint after installation of the mastic. Mastic should be cured for a minimum of 24 hours prior to testing if testing is required.

Gaskets

Gasketed joints are available from some Manufacturers. Follow the Manufacturer's recommendations precisely for gasketed joints. There is no *one-size-fits-all* procedure for gasketed joint installation. However, the following general guidelines may help.

Gasketed joints must be homed to within the Manufacturer's recommendations and may not be grouted open without the Manufacturer's approval. If rubber gasket joints are grouted open they are no longer gasketed joints but only tongue and groove joints with some extraneous rubber. Consult the Manufacturer if it should be necessary to have gasketed joints open.

Confined O-ring gaskets must be lubricated before they are installed into the confined groove on the spigot. The spigot and the bell of the product must be free of dirt, grease, oil, and debris and the bell and spigot, including the spigot groove must be lubricated prior to installation of the gasket. The tension on the gasket must be relieved by inserting a smooth round object, such as the shaft of a screwdriver under the gasket and running it around the perimeter of the spigot three times. Do not force the joints together; gravity is sufficient to properly home the joints. If the joint does not close to the Manufacturer's specification; remove the section, remove and reinstall the gasket, relieve its tension, and try again. Any indication of creep by the joint (the joint gap opening after installation) is an indication of a rolled gasket. In the case of a rolled gasket, remove the section and reinstall.

Profile gaskets must be lubricated after they are installed onto a clean non-lubricated spigot. Then the tension of the gasket should be relieved as detailed in the paragraph above. After installation of the gasket the bell and spigot should be lubricated. Correct orientation of the gasket is critical; consult the Manufacturer if you are unsure as to the orientation of the gasket. A backwards or upside-down profile gasket will fail. Do not force the joints together; gravity is sufficient to properly home the joints. If the joint does not close to the Manufacturer's specification; remove the section, remove and reinstall the gasket, relieve its tension, and try again. Any indication of creep by the joint (the joint gap opening after installation) is an indication of a rolled gasket. In the case of a rolled gasket remove the section and reinstall.

Pre-lubricated profile gaskets should not be lubricated at all. The tension on the gasket should be relieved as detailed in the paragraphs above. Correct orientation of the gasket is critical; consult the Manufacturer if you are unsure as to the orientation of the gasket. A backwards or upside down self-lubricated gasket will fail. Do not lubricate bell or spigot. Do not force the joints together; gravity is sufficient to properly home the joints. If the joint does not close to the Manufacturer's specification; remove the section, remove and reinstall the gasket, relieve the tension, and try again. Any indication of creep by the joint (the joint gap opening after installation) is an indication of a rolled gasket. In the case of a rolled gasket remove the section and reinstall.

Remember that the guidelines above are non-specific. Consult with the Manufacturer for specific gasket installation guidelines.

Backfill

Final grade elevations should be checked prior to backfill. If elevation problems are found the reasons should be identified and corrected. Normally this will require disassembly and reassembly of the structure. If each section has been checked and approved as it was installed only the last section will require removal and reassembly.

Backfill of the structure should be accomplished as soon as practical after installation of the structure. Construct the backfill as per plans and specifications. If no specification for backfill of structures exists use the same specification as per the pipeline. Mechanical compaction should be limited to as little vibration as possible to accomplish the task. Excessive vibration from mechanical compaction equipment can damage precast concrete structures.