

October 1, 2020

TO: MAG Public Works Directors  
CC: Specifications and Details Committee  
FROM: Gordon Tyus, MAG Senior Communications Project Manager

SUBJECT: TRANSMITTAL OF RECOMMENDED REVISIONS TO THE MAG SPECIFICATIONS  
AND DETAILS FOR PUBLIC WORKS CONSTRUCTION 2021 REVISION

Attached is the summary package of the specifications and details revised for the 2021 revision to the 2020 edition of the MAG Specifications and Details for Public Works Construction. This packet is the culmination of a year's work by the MAG Specifications and Details Committee and was recommended for review by all MAG agencies. Member agencies are requested to review this package and forward any comments to Gordon Tyus by November 2, 2020.

This packet is being provided for review by MAG member agency Public Works Directors for a period of 30 days. Members of the MAG Management Committee and Regional Council will also review the summary information at their November 4 and December 2 meetings, respectively. During this time, if any objections or comments are received following these reviews, each will be considered by the Chair of the Specifications and Details Committee as a possible case for consideration during next year's process.

These materials are also available electronically on the MAG website at the following link:  
<https://www.azmag.gov/Event/26773>

Eight cases were considered in 2020, including four cases carried over from 2019. Of these, seven were approved, and one was withdrawn for additional revisions. It is anticipated that the updated 2021 revision will be available online and for purchase in early January, 2021. This packet includes a summary of cases, voting and attendance records, and draft updates with the revised specifications and detail drawings available for review.

The marked up individual case files are also available online here:  
<https://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration>

Please contact Gordon Tyus at (602) 254-6300 or by e-mail at [gtvus@azmag.gov](mailto:gtvus@azmag.gov) if you have questions regarding the attached package or to submit comments.

## MAG Specification & Detail Committee – ATTENDANCE for 2020

Quorum - 8 Agency Representatives		January 8, 2020	February 5, 2020	March 4, 2020	April 1 (canceled)	May 6 (canceled)	June 3, 2020 (virtual)	July 1, 2020 (virtual)	Aug. 5, 2020 (virtual)	Sep. 2, 2020 (virtual)	Total (7 meetings)
Member	Representative										
<b>Agency Members:</b>											
Avondale	Jim Badowich	S		√			√	√	√	√	6
Buckeye	Craig Sharp (Chair)	√	√	√			√	S	√	√	7
Chandler	Warren White	√	√	√			√	√	√	√	7
El Mirage	Jose Denny		√	√							2
Gilbert	A.J. Kerin	√	√	S			√	√	√	√	7
Glendale	Dan Gerhard		√	√							2
Goodyear	Tom Vassalo	A	A	A							3
Maricopa Co.	Karl Rockwell	√	√	√			√	√	√	√	7
Mesa	Ryan Nichols (Vice Chair)	√	√	√			√	√	√	√	7
Peoria	Dan Nissen		√	√			√	√	√	√	6
Phoenix	Jose Rodriguez (Streets)	√		√			√	√	√	√	6
	Jami Erickson/Matthew Bryan (Water)	√	√	√				√	√	√	6
Scottsdale	Roy Herrington	√	√	√			√		√	√	6
Surprise	David Mobley	√					√	√			3
Tempe	Bashir Hassan	√	√								2
Youngtown	Gregory Arrington	√					P				2
AZ Rock Products Association	Greg Groneberg	√	√	S				√	√	√	6
	Jeff Hearne	√	S	√			√	√	√	√	7
Associated General Contractors	Brian Gallimore	√	√	√			√	√	√	√	7
	Vacant										
S.R.P.	Christina Hannoush	√	√				√	√	√	√	6
Independent	Paul Nebeker	√	√	A			√			√	5
	Peter Kandarlis/Ashley Evans	√	√	√			√	√	√	√	7
Arizona Utility Contractors Assoc	Arvid Veidmark	√		A							2
	Vacant										
MAG Admin.	Gordon Tyus	√	√	√			√	√	√	√	7

Attendance: √: Attended meeting; (Blank): Not attended meeting; S: Designated substitute attended  
P: Attended a portion of the meeting; A: Attended via audio conferencing. \*If needed.

## 2020 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

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(web link: <http://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration> )

### RECOMMENDATION SUMMARY OF THE MARICOPA ASSOCIATION OF GOVERNMENTS STANDARD SPECIFICATIONS AND DETAILS COMMITTEE

September 29, 2020

Detailed information about each case is provided on the *2020 Specs and Details Cases Under Consideration* page on the MAG website. <https://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration>

Some case files include a cover memo listing the purpose of each case and proposed changes. The final version of the working cases are posted, which often include the strike-through changes and other discussion points.

Further discussion on the cases is available in the committee meeting minutes, which are posted separately for each meeting. Links to past meetings can be found on the Standard Specifications & Details Committee page.

<http://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee>

Final summary materials for review of the 2020 Edition of the MAG Specifications and Details for Public Works Construction manual including detailed attendance and voting records are posted on the Specifications & Details Public Works Directors Review Deadline page.

<https://www.azmag.gov/Event/26773>



## 2020 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

(web link: <http://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration> )

CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
	<b>CARRY FORWARD CASES FROM 2019</b>						
19-04	Revisions to Section 360 Telecommunications Installation	Chandler	Warren White	04/03/2019 06/09/2020	Approved: 08/05/2020	9 0 0	Yes No Abstain
Summary	<p>Section 360 was rewritten and updated to meet current standards and practices. In 360.1, it now references the National Electric Safety Code (NESC), and a sentence was added to have pothole repairs per Detail 212 or per Detail 200-1, since some agencies use this latter method for larger repairs. In 360.2, (Trenching, Backfill and Restoration) it adds a reference to Section 336. Several changes were made to Section 360.3 (Installation), most notably that the telecom cables are installed within conduits, which is the standard practice. The second paragraph of this section references Section 608 for trenchless technology. The specification places conduits at a minimum depth of 48” below grade on arterial and collector streets and 36” for residential streets. A subsection on Conduit Identification and Detection was added. The case was also sent out to the Arizona Utility Coordinating Committee and utility companies for review and comment.</p>						
19-09	New Section 626 Corrosion Coating of Sanitary Sewer Manholes	Avondale/ Water/Sewer WG	Jim Badowich	07/03/2019 06/18/2020	Approved: 07/01/2020	9 0 0	Yes No Abstain
Summary	<p>This is a new section added to MAG based on the City of Phoenix supplement. The case was developed and reviewed by the Water/Sewer working group. The case modified the Phoenix specifications to make them more general for all MAG members, and removed references to specific manufacturers. It now states that “all new concrete manholes on 15-inch and larger diameter sanitary sewers; plus extending to and including one upstream manhole regardless of lateral size, shall have an internal corrosion coating applied. Drop manholes and force main manholes on 8-inch or larger diameter lines shall also be coated.” The spec has a Quality Assurance specification that requires a certification letter and 5-year warranty. It also has information on the type of products allowed, the execution (including cleaning, installation and testing), as well as measurement and payment. Testing requirement include the Holiday “Spark” tests, film thickness measurement, and adhesion tests on 15% of the manholes coated on any given project.</p>						
19-11	Revisions to Section 611 Add Sanitary Sewer Manhole Vacuum Testing	Avondale/ Water/Sewer WG	Jim Badowich	07/03/2019 06/18/2020	Approved: 07/01/2020	9 0 0	Yes No Abstain
Summary	<p>This is a new subsection of 611 based on a City of Phoenix supplement. Similar to Case 19-09, it was developed and reviewed by the Water/Sewer working group. It adds Section 611.5 Sanitary Sewer Manhole Testing, which includes negative air pressure (vacuum) testing of manholes performed in accordance with ASTM C1244, but modified for the time frames defined in a table. The times are determined by the depth and diameter of the manhole, and were originally based on times in the Phoenix supplement. The case also added to the Payment section that, “there will be no separate measurement or payment for this testing.” The remaining subsections of 611 were renumbered as required.</p>						

## 2020 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

(web link: <http://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration> )

CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
19-12	Revisions to Detail 550 Spillway Inlet and Outlet: Clarify geometry/dimensions	MCDOT	Karl Rockwell	07/03/2019 06/25/2020	Approved: 07/01/2020	9 0 0	Yes No Abstain
Summary	<p>The case sponsor said MCDOT surveyors had difficulty laying out the spillway because the control points were not clear based on the detail geometry. Detail 550 was cleaned up and dimensions were added to be able to more easily locate corner points. The dimensions from the plan view and section view now match.</p> <p>To provide a more stable structure and help counter erosion, 12" x 6" cut-off walls were added on the spillway section. Shading was added to the detail to differentiate the inlet and spillway sections, rather than using horizontal and vertical lines.</p>						
<b>NEW CASES FOR 2020</b>							
20-01	<p><b>Case 20-01: Miscellaneous Corrections</b></p> <p>A. Change "PAYMENT AREA" note on Detail 251 to "PAY ITEM AREA" and shade the area to avoid confusion.</p> <p>B. Change "DRAFT" to "REVISED" on Detail 505 title block.</p> <p>C. Make Section 787 Gray Iron Castings match manhole frame cover details. (Revised to show ASTM 48 Class 35 and AASHTO M306.)</p> <p>D. Delete unneeded tests from Tables 714-2 and 715-2.</p> <p>E. Correct typographic error in Detail 220-1, Note 1, to reference Section 340 instead of 304.</p> <p>F. Update size of weld beads on Detail 393 to match previous detail and manufacturer drawings.</p> <p>G. Change all occurrences of highlighted "storm sewer" to "storm drain" for consistency.</p>	Chandler, Phoenix, Avondale, Mesa, Buckeye, Scottsdale	Warren White, Jose Rodriguez, Jim Badowich, Ryan Nichols, Craig Sharp, Roy Herrington	01/08/2020 09/01/2020	Approved: 09/02/2020	9 0 0	Yes No Abstain
Summary	<p>The miscellaneous corrections case is added each year and compiles minor edits and clarifications as well as typographic, spelling, and drafting corrections.</p> <p>A summary of the changes A-G is shown above.</p>						

## 2020 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

(web link: <http://www.azmag.gov/Committees/Technical-Committees/Standard-Specifications-Details-Committee/2020-Specs-and-Details-Cases-Under-Consideration> )

CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
20-02	Delete Detail 346 Fire Line Detector Check Vault	Chandler	Warren White	03/04/2020 03/04/2020	Withdrawn: 08/05/2020	0 0 0	Yes No Abstain
Summary	Initially this case was brought forward to delete Detail 346 because most agencies do not use it, and it was out-of-date, referencing manufacturers no longer in business. However, before voting on its deletion, the representative from the City of Phoenix said they still use the detail. Rather than deleting the detail, the committee decided it was best to leave it in for now, until either it can be updated, or the City of Phoenix can add it to their supplements. Based on the discussion, the sponsor withdrew the case, and the chair referred it to the Outside Right-of-Way working group for further review.						
20-03	Revisions to Section 725 Portland Cement Concrete	Concrete Working Group	Jeff Hearne	03/04/2020 08/05/2020	Approved: 08/05/2020	9 0 0	Yes No Abstain
Summary	<p>Several subsections of Section 725 Portland Cement Concrete were updated as noted below:</p> <p>725.2 – Revision of the Low Alkali designation ASTM recently eliminated the Low Alkali (LA) designation, so MAG added directly in the specification, “Portland cement shall not contain more than 0.60 percent total equivalent alkalis.”</p> <p>725.6 – Revise mix design submittal process to every two years The City of Phoenix has already changed their requirements to two years, and other types of mix designs in MAG have a two-year submittal process. This updates the Portland cement concrete section to be consistent.</p> <p>725.9 (A) (2) – Increasing the maximum temperature limit to 95 degrees ACI 305, Hot Weather Concrete, had extended the limit to 95 degrees several years ago based on industry data and advances in mix designs. The modern use of admixtures can compensate for the higher temperature limit. This 95 degree limit has been used on Phoenix projects, and ADOT projects such as the Loop 202 South Mountain Freeway.</p> <p>725.9 (A) (4) – Increasing the maximum time limit over 90 minutes with the use of a hydration stabilizer The revised specification adds, “The 1 1/2 hours (90 minute) time limit may also be waived if the mix design incorporates a hydration stabilizing admixture at the sufficient dosage to slow down hydration in order to permit additional transit/placement time. The dosage and associated additional time shall be noted on the delivery ticket. The additional discharge time shall not exceed the maximum additional time based on the dosage noted on the approved mix design or delivery ticket. It is the Contractor’s responsibility to obtain approval for additional discharge time from the Engineer prior to concrete placement.”</p>						

## 2020 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

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CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
20-04	New Section 303 Pervious Concrete Base Coarse, Revisions to Section 323 Pervious Concrete, and a new Pervious Concrete Pavement Detail 228	Scottsdale, Outside ROW Group	Roy Herrington	07/01/2020 08/10/2020	Approved: 09/02/2020	9 0 0	Yes No Abstain
Summary	<p>This case adds a new Section 303 for the base coarse materials and installation specifications for pervious concrete projects as well as a new detail with construction section views. The case also makes minor updates to Section 323 Pervious Concrete including references to the new Section 303. The case was developed and reviewed by the Outside Right-of-Way and Concrete/Materials working groups. Although the base for pervious concrete projects is typically designed based on the drainage/water storage needs of the project, Section 303 provides typical materials used and construction methods based on pervious concrete projects done in the region including several park and ride lots. The specifications were reviewed, and input was provided by local contractors and industry representatives.</p> <p>Specifically, in Section 303, typical aggregate sizes, compaction requirements, and void content requirements were specified, which is important to provide for the drainage these systems require. The aggregates chosen were based on national standards, availability of materials, and those successfully used in local projects. In Section 323, there were some minor changes such as updating the ASTM reference from C140 to C1754. The Pervious Concrete Pavement Detail 228 was created to provide guidance for a generic construction application. The detail provides section views for projects designed for light traffic and pedestrian areas.</p>						

# MAG Specification & Detail Committee

## VOTING SUMMARY for 2020

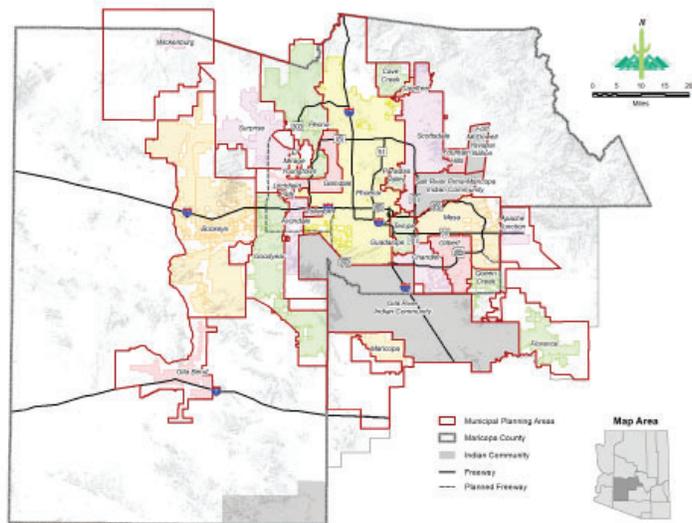
Case No.	Title – Section/Detail	Vote Date	Avondale	Buckeye	Chandler	El Mirage	Gilbert	Glendale	Goodyear	Maricopa County	Mesa	Peoria	Phoenix	Scottsdale	Surprise	Tempe	Youngtown	Voting Summary Y-N-A-NP
19-04	Case 19-04: Revisions to Section 360 Telecommunications Installation.	08/05/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	Y	—	—	—	9-0-0-6
19-09	Case 19-09: New Section 626 Corrosion Coating of Sanitary Sewer Manholes	07/01/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	—	Y	—	—	9-0-0-6
19-11	Case 19-11: Revisions to Section 611: Add Sanitary Sewer Manhole Vacuum Testing	07/01/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	—	Y	—	—	9-0-0-6
19-12	Case 19-12: Revisions to Detail 550 Spillway Inlet and Outlet: Clarify geometry/dimensions	07/01/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	—	Y	—	—	9-0-0-6
20-01	Case 20-01: Miscellaneous Corrections (A-G)	09/02/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	Y	—	—	—	9-0-0-6
20-02	Case 20-02: Delete Detail 346 Fire Line Detector Check Vault	Withdrawn																0-0-0-0
20-03	Case 20-03: Revisions to Section 725 Portland Cement Concrete	08/05/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	Y	—	—	—	9-0-0-6
20-04	Case 20-04: New Section 303 Previous Concrete Base Coarse, Revisions to Section 323, and a new Pervious Concrete Pavement Detail 228	09/02/20	Y	Y	Y	—	Y	—	—	Y	Y	Y	Y	Y	—	—	—	9-0-0-6

Voting Abbreviations: Y: Yes N: No A: Abstain — : Not Present (NP)

\*: Indicates changes made to proposal prior to vote.

2021 Revision to the  
**2020 Edition**

# Uniform Standard Specifications and Details for Public Works Construction



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January 2021

## NEW IN THE 2021 REVISION

### *Uniform Standard Specifications and Details for Public Works Construction—2021 Revision to the 2020 Edition*

The MAG Standard Specifications and Details Committee, with assistance from specialized working groups, considered 8 cases during the 2020 session. Of these, 1 was withdrawn and 7 were approved and included in this revision.

#### **New Specifications:**

- Section 303: Pervious Concrete Base Coarse
- Section 626: Corrosion Coating of Sanitary Sewer Manholes

#### **Specifications rewritten, or with major updates:**

- Section 360: Telecommunications Installation
- Section 611: Water, Sewer and Storm Drain Testing

#### **Specifications with minor updates:**

- Section 323: Placement of Pervious Concrete
- Section 345: Adjusting Frames, Covers And Valve Boxes
- Section 620: Cast-In-Place Concrete Pipe
- Section 621: Corrugated Metal Pipe And Arches
- Section 714: Microsurfacing Materials
- Section 715: Slurry Seal Materials
- Section 725: Portland Cement Concrete
- Section 787: Gray Iron Castings

#### **Other updates:**

- Updated Table of Contents, Index, and Hyperlinks

#### **New detail drawings:**

- Detail 228: PERVIOUS CONCRETE PAVEMENT

#### **Details that have been updated:**

- Detail 100-1: INDEX (Page 1 of 2)
- Detail 100-2: INDEX (Page 2 of 2)
- Detail 220-1: CURB AND GUTTER TYPES A, B, C, AND D
- Detail 251: RETURN TYPE DRIVEWAYS
- Detail 393: WATER VALVE EXTENSION
- Detail 505: CONCRETE COLLAR FOR PIPE
- Detail 550: SPILLWAY INLET AND OUTLET

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## Changes made in the 2020 Edition

### *Uniform Standard Specifications and Details for Public Works Construction—2020 Edition*

The MAG Standard Specifications and Details Committee, with assistance from specialized working groups, considered 15 cases during the 2019 session. Of these, 11 were approved and included in this revision. These changes are summarized in the list below. This edition also includes all the updates since the 2015 Edition as listed on the following pages. Finally, the 2020 Edition includes numerous non-content related corrections throughout including: typographic, spelling, hyperlinking, and formatting.

#### **New Specifications:**

- Section 627: Painting Sanitary Sewer Manholes with Insecticide
- Section 744: Precast Polymer Concrete Manhole

#### **Specifications rewritten, or with major updates:**

- Section 331: Placement and Construction of Asphalt Emulsion Micro-Surfacing Treatments
- Section 332: Placement and Construction of Asphalt Emulsion Slurry Seal Treatments
- Section 713: Emulsified Asphalts Materials
- Section 714: Microsurfacing Materials
- Section 715: Slurry Seal Materials

#### **Specifications with minor updates:**

- Section 206: Structure Excavation and Backfill
- Section 321: Placement and Construction of Asphalt Concrete Pavement
- Section 525: Pneumatically Placed Mortar
- Section 618: Storm Drain Construction
- Section 625: Manhole Construction and Drop Sewer Connections
- Section 631: Water Taps and Meter Service Connections
- Section 719: Polymer Modified Asphalt Concrete

#### **Other updates:**

- Updated Table of Contents, Index, and Hyperlinks

#### **New detail drawings:**

- Detail 238-4: SINGLE CURB RAMP MID-BLOCK RESIDENTIAL STREET W/4" ROLL CURB
- Detail 419-1: POLYMER CONCRETE SANITARY SEWER MANHOLE
- Detail 419-2: PRE-CAST POLYMER CONCRETE MANHOLE BASE
- Detail 419-3: POLYMER CONCRETE MANHOLE BASE

#### **Details that have been updated:**

- Detail 100-1: INDEX (PAGE 1 OF 2)
- Detail 100-2: INDEX (PAGE 2 OF 2)
- Detail 145: SAFETY RAIL
- Detail 200-1: TRENCH BACKFILL AND SURFACE REPLACEMENT
- Detail 200-2: TRENCH BACKFILL AND SURFACE REPLACEMENT
- Detail 262: WING TYPE ALLEY ENTRANCE (W/ COMBINED CURB & GUTTER)
- Detail 404-1: WATER AND SANITARY SEWER SEPARATION/PROTECTION
- Detail 404-3: WATER AND SANITARY SEWER SEPARATION/PROTECTION
- Detail 423-1: 24" CAST IRON MANHOLE FRAME AND COVER
- Detail 423-2: 30" CAST IRON MANHOLE FRAME AND COVER
- Detail 424-1: 24" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
- Detail 424-2: 30" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
- Detail 501-1: HEADWALL
- Detail 501-2: HEADWALL
- Detail 501-3: HEADWALL 42" TO 84" PIPE
- Detail 501-4: HEADWALL IRRIGATION 18" TO 60" PIPE
- Detail 501-5: HEADWALL DROP INLET
- Detail 502-1: TRASH RACK

**STANDARD  
SPECIFICATIONS  
for  
PUBLIC WORKS  
CONSTRUCTION**

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**2021 Revision to the  
2020 Edition**

**ARIZONA**

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**SECTION 303**

**PLACEMENT AND CONSTRUCTION OF COARSE AGGREGATE BASE COURSE FOR PERVIOUS CONCRETE PAVEMENT**

**303.1 DESCRIPTION:**

Coarse aggregate base course shall be open graded and shall be constructed to the thickness indicated on the contract documents above a subgrade as approved by the Engineer. Coarse aggregate base course thickness depends on vehicle loads, soil type, and stormwater storage requirements.

The contractor performing this work shall meet the qualifications of Section [323](#).

**303.2 MATERIALS:**

**303.2.1 Coarse Aggregate:** Coarse aggregate shall conform to the criteria in Table 303-1 or as defined in the contract documents.

<b>Table 303-1</b>		
<b>Coarse Aggregate Design Criteria</b>		
<b>Gradations for Coarse Aggregate:</b>		
ASTM <a href="#">C33</a> , Table 3, Test Method ASTM <a href="#">C136</a>		
Sieve Size	Accumulative Percent Passing Sieve, by Weight	
	No. 4	No. 57
3 inch	-	-
2 1/2 inch	-	-
2 inch	100	-
1 1/2 inch	90 to 100	100
1 inch	20 to 55	95 to 100
3/4 inch	0 to 15	-
1/2 inch	-	25 to 60
3/8 inch	0 to 5	-
No. 4	-	0 to 10
No. 8	-	0 to 5
No. 16	-	-
<b>voids in Aggregate:</b>		
Test Method ASTM <a href="#">C29</a>		
Percent Minimum by Weight	30	30
<b>Resistance to Degradation and Abrasion by the Los Angeles Abrasion Machine:</b>		
Test Method ASTM <a href="#">C131</a> , Percent Loss by Weight		
Maximum allowable value at 100 revolutions	10	10
Maximum allowable value at 500 revolutions	40	40

The coarse aggregate shall be uniformly washed to remove dust, oil and other deleterious substances. The percent by weight of material passing the No. 200 sieve tested in accordance with ASTM [C117](#) shall not exceed 2 percent.

The Contractor may substitute materials meeting the gradation and other criteria specified herein for coarse aggregate when approved by the Engineer. The Contractor shall provide the Engineer laboratory testing documentation on the source of the coarse aggregate material showing compliance to this section at least 10 business days prior to placement except where the materials are being obtained from a currently approved source from a list maintained by the appropriate Agency or as determined by the Engineer.

**303.2.2 Filtration and Separation Fabric:** When specified, the filtration and separation fabric shall be nonwoven and per Table [796-2](#), Class A.

## SECTION 303

### 303.3 PLACEMENT AND CONSTRUCTION:

**303.3.1 Subgrade Preparation:** The subgrade shall be constructed and compacted true to grades and lines indicated on plans and as specified in Section 301 except as modified in this section. Unless otherwise noted in the contract documents, the subgrade shall be uniformly compacted between 90 to 95 percent, measured as a percentage of maximum dry density when tested in accordance with Section 301. Unless otherwise noted in the project plans or project specifications, compaction shall be performed within 2 percentage points of the optimum moisture content. The Contractor shall exercise extreme caution to prevent the subgrade from being over compacted. Over-compaction can affect the overall permeability of the subgrade.

All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer.

Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed and replaced with material satisfactory to the Engineer prior to the placement of coarse aggregate base course.

Coarse aggregate base course or geosynthetic fabric construction shall not commence until placement of the subgrade material has been inspected and approved by the Engineer.

**303.3.2 Filtration and Separation Geosynthetic Fabric:** Filtration and separation fabric shall only be used when specified in the contract documents. The Contractor shall provide a surface free of obstructions, depressions, debris, and soft yielding surfaces prior to the placement of fabric. The fabric shall be loosely laid (not in a stretched condition), aligned and placed with no fold over wrinkles.

The fabric shall be placed to provide a minimum 24-inch of overlap for each joint. On horizontal joints, the uphill fabric shall overlap the downhill fabric. On vertical joints, the upstream fabric shall overlap the downstream fabric. Securely attach the fabric to the vertical sides of the excavation in accordance with manufacturer's recommendations.

**303.3.3 Coarse Aggregate Base Course:** Coarse aggregate shall be placed in lifts not more than 6 inches in depth before leveling.

After distributing, the coarse aggregate base course material shall be graded to a uniform layer that will net the required thickness. The grading operation shall be continued to such extent as may be necessary to minimize segregation.

After placement, the coarse aggregate base course surface shall be true, even, and uniform, conforming to the grade and cross-section specified. In no case shall the coarse aggregate base course vary by more than ½ inch above or below required grade. No concrete shall be placed until the coarse aggregate base course has been inspected and approved by the Engineer.

Any ruts in the coarse aggregate, which develop during spreading or construction operations, shall be removed and re-leveled prior to the placement of pervious concrete.

### 303.4 MEASUREMENT:

Measurement for coarse aggregate base course will be by the square yard. No separate measurement will be made for geosynthetic fabric.

### 303.5 PAYMENT:

Payment for coarse aggregate base course shall be made at the contract unit price per square yard for each thickness shown on the plans.

- End of Section -

## SECTION 323

### PLACEMENT OF PERVIOUS CONCRETE

#### 323.1 DESCRIPTION:

Pervious concrete describes a near-zero-slump, open graded material with sufficient continuous voids to allow water to pass from the surface to underlying layers. It does not look or behave like typical asphalt or concrete. The finished surface is not tight and uniform, but is open and varied to allow permeability. Minor surface irregularities and minimal amounts of surface raveling, and color variations are normal. Pervious concrete is usually part of a water management system used to reduce runoff rates and volumes from on-grade surfaces such as patios, walkways, driveways, fire lanes, and parking spaces. Sections without sub-surface storage bed systems can achieve reductions in runoff rates and volumes by providing less surface runoff than conventional hardscape surfaces. Sections with sub-surface storage bed systems designed to meet specific groundwater recharge requirements will require additional engineering and supplemental specifications. The work covered by this specification is intended for light traffic areas and pedestrian surfaces, and consists of furnishing all materials, labor and equipment for the placement of pervious concrete.

#### 323.2 MATERIALS:

Materials utilized in pervious concrete shall conform to the requirements of Section [723](#).

#### 323.3 GENERAL:

The Pervious Concrete Contractor shall be experienced in the installation of pervious concrete and shall employ no less than one National Ready Mixed Concrete Association (NRMCA) certified Pervious Concrete Craftsman who must be on site overseeing each placement crew during all pervious concrete placements or employ no less than three NRMCA Certified Pervious Concrete Installers on each pervious concrete placement crew during all pervious concrete placements. The minimum number of certified individuals (1 Craftsman or 3 Installers) is to be present at each pervious concrete placement, and a certified individual is to be in charge of the placement crew and the construction procedures.

Field test(s) of pervious concrete shall be performed by an individual certified as both an NRMCA Certified Pervious Concrete Technician or equivalent, and ACI Concrete Field Technician Grade 1 or equivalent as approved by the Engineer.

#### 323.4 CONSTRUCTION OF TEST SECTION(S):

If required by the Engineer or contract documents, the Contractor shall construct a test section(s) using the same equipment, and placement crew as proposed to be used for the remainder of the pervious concrete work and may be placed non-contiguously. Test section(s) shall be a minimum of 225 square feet and shall include a construction joint and a control joint. Test section(s) may be placed at any of the final pervious concrete placement locations and may be incorporated into the work if approved by the Engineer.

**323.4.1:** Sample fresh pervious concrete in accordance with ASTM [C172](#). The size of the sample shall be at least 1 ft<sup>3</sup>. The temperature of the pervious concrete shall be tested in accordance with ASTM [C1064](#) and shall be 95 degrees or less, unless a higher temperature is approved by the Engineer. Complete at least one density test on a sample of freshly mixed pervious concrete and void content in accordance with ASTM [C1688](#). The acceptable fresh density shall be within  $\pm 5$  lbs./ft<sup>3</sup> of the approved mix design density.

**323.4.2:** Remove cores not less than 7 days after placement in accordance with ASTM [C42](#) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete. Test thickness in accordance with ASTM [C174](#) and test void content and hardened density in accordance with ASTM [C1754](#).

Tolerance for thickness, and density, reported as the average of three cores of each test panel, shall be as follows:

- A. The average compacted thickness shall not be greater than 1/2 in. less than the specified thickness, with no single core exceeding 1 in. less than the specified thickness; nor shall the average compacted thickness be 1-1/2 in. more than the specified thickness.
- B. The acceptable hardened density shall be within  $\pm 5$  lbs./ft<sup>3</sup> of the approved mix design density.

## SECTION 323

When a test panel is outside any of the limits of A and B above, the test panel shall be rejected, removed, and replaced at the Contractor's expense, unless accepted by the Engineer. When the test panel complies with A and B, the panel may be left in place and included in the completed work.

### 323.5 PERVIOUS CONCRETE BASE PREPARATION:

The surface below pervious concrete shall be prepared in accordance with the contract documents and Section 303 or as directed by the Engineer. The surface of the coarse aggregate base course shall be moistened immediately prior to placement of concrete to provide a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing pervious concrete. Failure to provide a moist coarse aggregate base course will result in a reduction in strength of the pavement.

### 323.6 PLACEMENT:

Pervious concrete shall be constructed a minimum of 6 inches in depth, unless otherwise specified in the plans or special provisions.

When hot weather is anticipated, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information to help the Contractor prepare and submit detailed procedures for the production, transportation, placement, protection, and curing of pervious concrete for approval by the Engineer. Evaporation retarders shall be available during placement and applied as needed in accordance with the manufacturer's recommendations to protect the pervious concrete from rapid evaporation. In cold weather, follow the requirements of Section [725.9\(A\)\(2\)](#).

Pervious concrete shall be uniformly deposited over the entire formed area. A self-propelled roller screed shall be used for strike-off, spreading, and compaction. Hand-rodding or other placement methods may be used if approved by the Engineer. Adjacent to the edge of each form, hand tampers shall be used for compaction. Placement operations shall not result in the voids becoming sealed in order to maintain an adequate continuous voids structure for water passage through the pervious concrete. Surface depressions shall be corrected immediately after compaction by placing fresh pervious concrete in the depressions and compacting using a hand tamper or roller screed. The final surface shall not deviate more than 3/8 inch from a 10 foot straightedge laid on the surface.

#### 323.6.1 JOINTS:

Joints shall be constructed in accordance with an approved jointing plan. Contraction joints shall be constructed at regular intervals not to exceed two times the placement width or 15 feet on center, whichever is less. Joints shall be constructed to a depth of 1/4 of the pavement thickness, or a minimum of 1-1/2 inches whichever is greater. Unless otherwise approved, contraction joints shall be constructed by one of the following methods:

- A. Rolling with a small roller to which a beveled fin has been attached around the circumference immediately after compaction and prior to curing.
- B. Saw cutting as soon as the pervious concrete can be saw cut without causing raveling along the joint edges. Only the area occupied by the concrete saw shall be uncovered and exposed with all other curing materials remaining in place. Immediately after sawing each joint, the exposed area shall be fogged with water and re-covered in accordance with Section [323.7](#).

Use isolation joints only where pavement abuts fixed objects, such as buildings, foundations, and manholes or at 75 feet on sidewalks. Extend isolation joints through the full depth of the pavement. Fill the entire isolation joint with expansion joint material that complies with Section [729](#).

### 323.7 CURING:

The Contractor shall submit a curing plan to the Engineer for review and approval. Curing shall begin immediately or in any case within 20 minutes of finishing. The surface and edges shall be securely covered with polyethylene sheeting/film having a minimum thickness of 6 mils and meeting the requirements of Section [726.2\(A\)](#). The cover shall be checked daily to verify

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that it has not been displaced or damaged, and that condensation is evident underneath the sheeting. Damaged sheeting shall be repaired immediately. Displaced sheeting shall be replaced immediately. When there is no observable condensation, 1.5 gallons of water per square yard shall be applied to the surface. Curing methods shall remain in place for a minimum of 7 days or as directed by the Engineer. Pavement sections shall not be opened to light vehicular traffic until the concrete has cured for at least 14 days (28 days for heavy traffic), and until approved by the Engineer for opening to traffic.

### 323.8 QUALITY CONTROL FIELD TESTING:

Complete at least one density test on a sample of freshly mixed pervious concrete for each 5000 square feet or each day of concrete placement, whichever is greater, in accordance with ASTM [C1688](#). Sample fresh pervious concrete in accordance with ASTM [C172](#). The size of the sample shall be at least 1 ft<sup>3</sup>. The temperature of the pervious concrete shall be tested in accordance with ASTM [C1064](#) and shall be 95 degrees or less, unless a higher temperature is approved by the Engineer. Discharge of the previous concrete shall be completed in accordance with Section [725.9](#) (A)(4).

Remove three cores from each lot of 5,000 square feet or each day's production, whichever is less, in accordance with ASTM [C42](#) not less than 7 days after placement of the pervious concrete. Cores shall be a minimum nominal 4 in. diameter. Select three locations in accordance with ASTM [D3665](#). Upon approval of the Engineer, small test sections may be cast for sample extraction along with each placement to avoid removing cores from in-place work. Measure the cores for thickness in accordance with ASTM [C174](#). After thickness determination, trim and measure the cores for void content and hardened density in accordance with ASTM [C1754](#). Core holes in the in-place work shall be filled with pervious concrete or other acceptable material in a manner satisfactory to the Engineer.

### 323.9 TOLERANCES:

Mechanically sweep or vacuum pavement with clean equipment or flush with water before testing for compliance with tolerances.

Tolerance for hardened thickness and density, reported as the average of three cores for each test panel, shall be as follows:

- A. Average hardened thickness from a lot shall not be more than 1/2 in. less than the specified thickness, with no single core exceeding 1 in. less than the specified thickness; nor shall the average hardened thickness be 1-1/2 in. more than the specified thickness.
- B. Average hardened density from a lot shall be within  $\pm 5$  lbs./ft<sup>3</sup> of the average hardened density of the test section(s) from Section [323.4](#).
- C. Unless otherwise specified in the Special Provisions, Pervious Concrete shall have a minimum infiltration rate of 50 inches per hour when tested in accordance with ASTM [C1701](#).

### 323.10 ACCEPTANCE:

Pervious concrete does not look or behave like typical concrete or asphalt. The finished surface shall be open and varied to permit permeability. Minor surface irregularities and moderate amounts of surface raveling and color variations are normal and acceptable. Pervious concrete shall have no visible excess cement paste, tears, or gouges. Roller constructed joints shall have smooth, rounded, and uniformly compacted edges. Saw cut joints shall not contain cement paste or dust nor exhibit evidence of spalling.

Acceptance will be based on conformance to the specifications. When a lot is outside one of more of the tolerances in Section [323.9](#), the lot shall be subject to rejection, removal, and replacement at the Contractor's expense, unless accepted by the Engineer.

### 323.11 PAYMENT:

Payment for pervious concrete shall be made at the contract unit price per square yard for each thickness shown on the plans.

- End of Section -

## SECTION 345

### ADJUSTING FRAMES, COVERS AND VALVE BOXES

#### 345.1 DESCRIPTION:

The Contractor shall furnish all labor, materials, and equipment necessary to adjust all frames, covers and valve boxes as indicated on the plans or as designated by the Engineer. The frames shall be set to grades established by the Engineer.

The Contractor may elect to remove old frames, covers, and valve boxes and then install new frames and/or boxes in accordance with standard detail drawings at no additional cost to the Contracting Agency.

The Contractor shall be responsible for maintaining an accurate description and location of all items to be adjusted. The locations shall be referenced with map documentation by the use of swing ties or GPS locations. This information shall be supplied to the Engineer and utility owner(s) prior to taking any action that would hide or restrict access to the items to be adjusted.

Any missing or defective frames, covers, valve boxes or related hardware shall be reported to the Engineer in writing during the initial location process to allow for timely replacement. The Engineer shall be responsible for providing replacement items to the contractor. The contractor is responsible for providing items required to accomplish the required adjustments such as additional adjusting rings, valve box extensions, meter box extensions, and pull box extensions.

#### 345.2 LOWERING PROCEDURE:

If required, manholes, valve boxes, or survey monuments located within the paved areas to be milled or reconstructed shall be lowered to an elevation that will allow required work to be accomplished without damaging the facilities. Care shall be taken to prevent entrance of any material into the lowered facilities. Lowering shall be to a depth that will prevent damage to the utility during the construction activities.

All manhole frames, valves boxes, survey hand hole frames and related items removed by the contractor during the lowering process shall be maintained in a secure area, and the contractor shall bear full responsibility for the material. Any hardware items lost or damaged by the contractor shall be replaced in kind, at no additional cost to the Contracting Agency.

**Preparation for Milling:** Temporary asphalt concrete shall be placed over the steel plate filling the excavated area. The temporary pavement shall be maintained until removed during the adjustment to final grade. For manholes located on major streets that are to be kept opened to vehicular traffic, hot mix asphalt shall be used to backfill the excavated areas and compacted flush with the existing pavement prior to opening up to traffic. In residential or low volume streets with minimal traffic, cold mix or other approved product may be used for temporary pavement. No measurement or payment shall be made for temporary pavement placement or removal.

#### 345.3 ADJUSTING FRAMES:

The Contractor shall loosen frames in such a manner that existing monuments, cleanouts, manholes, and valve boxes will not be disturbed or damaged. Debris shields shall be used to prevent debris from entering sanitary sewers or storm drains. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames. If dirt or debris enters the sewer system, the contractor shall be responsible for cleaning the sewer system for a minimum of one reach (the next downstream structure from the contamination point.)

Frames shall be set to match finished grade or the elevations and slopes established by the Engineer. Manhole frames shall be firmly blocked in place with masonry or metal supports. Spaces between the frame and the facility shall be sealed on the inside to prevent any concrete from entering the hand hole or manhole. A Class AA concrete collar shall be placed around and under the frames to provide a seal and properly seat the frame at the required elevation and slope. Concrete shall be struck off flush with the top of the existing pavement.

Adjustments of utilities, if located within the asphalt pavement, shall be made after placing the final surface course when there is only a single lift of pavement required. When there are multiple lifts of pavement required, adjustments may be made before the final surfacing or as directed by the Engineer.

## SECTION 360

### TELECOMMUNICATIONS INSTALLATION

#### 360.1 DESCRIPTION:

This work shall consist of the individual installation of underground telecommunications facilities within the public right-of-way. This specification is not intended for joint trench installations.

Other than as described within this manual or by Agency supplements, all work shall conform to the latest version of the National Electrical Safety Code (NESC).

The contractor shall follow all local and state laws pertaining to locating and protecting existing underground utilities and call AZ811 two working days prior to starting any onsite work. All potholes shall be repaired per Detail 200-1 or Detail 212 as required by the Agency.

#### 360.2 TRENCHING, BACKFILL AND RESTORATION:

All work shall be done in accordance with Section [336](#) and [601](#).

#### 360.3 FACILITY INSTALLATION:

All cables shall be installed within a PVC Schedule 40 or better conduit unless otherwise authorized by the Agency. Conduits shall be placed in the diameter and quantity as specified on the plans.

Facility crossings under existing, paved streets shall be accomplished by trenchless technology in accordance with Section [608](#) unless open trenching is authorized by the Agency.

Minimum conduit depths shall comply with the following requirements unless otherwise approved by the Agency:

- 1) Arterial and collector streets: All new conduits shall be placed at a minimum depth of 48-inches below the finished grade.
- 2) All other streets and alleys: All new conduits shall be placed at a minimum depth of 36-inches below the finished grade.

#### 360.4 CONDUIT IDENTIFICATION AND DETECTION:

All subsurface installations shall be detectable by a locate service by way of a locate wire or other means, such as markers or detection tape, specified by the facility owner and agency, to be installed at the time of installation or by wire integrated into the conduit itself during manufacture.

#### 360.5 PAYMENT:

Payment will be made at the contract unit price bid per lineal foot.

- End of Section -

**PART 600**

**WATER, SEWER, STORM DRAIN AND IRRIGATION**

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## SECTION 611

- (5) The allowable water loss for sanitary sewers shall not exceed 0.158 gallons per hour per 100 feet of pipe per inch of diameter of pipe under a minimum test head of 4 feet above the top of the pipe at the upper end.

### (C) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation that shows deflection in excess of 5% of the nominal inside diameter per Section [738](#) for HDPE pipe or in excess of 5% of the average inside diameter per ASTM [D3034](#) for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long-term deflection of the sewer. If the Contracting Agency determines that the deflection has exceeded 7 ½% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

### (D) Closed Circuit T.V. Inspection:

The Contracting Agency reserves the right to visually inspect the interior of the sewer line using a television camera. Any defects in the pipe or construction methods revealed shall be corrected by the Contractor at no additional cost to the Contracting Agency.

### 611.5 SANITARY SEWER MANHOLE TESTING:

Unless otherwise approved by the Engineer, all new sanitary sewer manholes installed on 27" dia. pipe and less shall be tested for exfiltration either by a watertightness test or by a negative air pressure (vacuum) test modified for the timeframes listed in Table 611-2. Exfiltration testing shall be performed in accordance with Subsection 611.3(B) and Arizona Department of Environmental Quality (ADEQ) Engineering Bulletin No. 11, Chapter 4, Section B.

When using the watertightness test method, exfiltration loss shall not exceed 0.1 gallons per vertical foot of manhole in a 24-hour period.

Negative air pressure (vacuum) testing shall be performed in accordance with ASTM [C1244](#), modified for the timeframes in Table 611-2. Testing shall be performed at the top of the manhole cone for manholes located in paved areas. Manholes outside paved areas shall be vacuum tested at the ring and cover.

Testing shall be performed after all backfill and compaction operations are complete and prior to any interior protective coating applications. A negative air pressure of ten (10) inches of mercury shall be drawn on the manhole. The time shall be measured for the vacuum to drop from ten (10) inches to nine (9) inches of mercury. The manhole shall pass this test if the time to drop in mercury meets or exceeds the values in Table 611-2.

TABLE 611-2

MANHOLE DEPTH	MINIMUM TEST DURATION (SECONDS) 48-INCH DIAMETER MANHOLE	MINIMUM TEST DURATION (SECONDS) 60-INCH DIAMETER MANHOLE
10 feet or less	60	75
Greater than 10 feet to 15 feet	75	90
Greater than 15 feet	90	105

If manhole joint compound is pulled out during the vacuum test, the manhole shall be disassembled and the joint repaired or replaced as necessary. The vacuum testing shall then be repeated until the manhole passes.

## SECTION 611

### 611.6 POST INSTALLATION INSPECTION OF NEW MAINLINE STORM DRAINS:

#### (A) Video Inspection:

The Contractor shall provide the Engineer with an annotated video inspection record (either VHS or DVD format) of the new mainline storm drain pipeline. The video shall clearly show all joints, seals, connecting pipes, and manholes. This video shall be provided to the Engineer, and reviewed and approved by the Engineer prior to the Contractor being allowed to place the final pavement over the storm drain line.

#### (B) Deflection Test for HDPE and PVC Pipe:

In addition to the tests prescribed above, the Contractor shall perform a deflection test on the system as directed by the Engineer. Any part of the installation, which shows deflection in excess of 5% of the nominal inside diameter per Section [738](#) for HDPE pipe, or in excess of 5% of the average inside diameter per ASTM [D3034](#) for PVC pipe, shall be evaluated and appropriate remedy, if any, shall be performed.

After acceptance but prior to the termination of the warranty period, the Contracting Agency may test the long-term deflection of the storm drain. If the Contracting Agency determines that the deflection has exceeded 7 1/2% of the average inside diameter, that portion of the installation shall be corrected by the Contractor at no cost to the Contracting Agency.

### 611.7 PAYMENT:

No separate pay item shall be contained in the proposal for disinfecting water mains. This operation shall be included in the price bid for the water mains, installed complete in place, as specified in the proposal

The Contracting Agency will pay for the initial Sewer C.C.T.V. inspection. Any additional inspection(s) required, due to the failure of the initial inspection, shall be paid for by the Contractor.

No separate payment will be made for this Storm Drain Video or Deflection Testing; the cost of the video and deflection testing shall be included in the cost of the pipe.

Exfiltration testing of sanitary sewer manholes is considered incidental to the cost of furnishing and installing the manhole. There will be no separate measurement or payment for this testing.

*- End of Section -*

## SECTION 620

### CAST-IN-PLACE CONCRETE PIPE

#### 620.1 GENERAL:

This specification covers cast-in-place non-reinforced concrete pipe intended for use as storm drains or irrigation lines. The abbreviated title is CIPP. CIPP is conduit made of Portland cement concrete cast monolithically in a properly prepared trench, using equipment specifically designed for this purpose. The type of equipment to be used by the Contractor must be approved by the Engineer and the Contractor may be required to furnish evidence of the successful use of this equipment on prior work. CIPP will be placed only:

- (A) By experienced operators. The Engineer will be the sole judge as to experience level.
- (B) In the presence of the Engineer.
- (C) In ground capable of standing unsupported from the bottom of the trench to the top of the pipe without sloughing.
- (D) In fill when it can be demonstrated to the satisfaction of the Engineer that the fill will adequately support the pipe.

#### 620.2 MATERIALS:

**620.2.1** Cement shall be ASTM [C150](#), Type II, and low alkali as per Section [725](#).

**620.2.2** Sand aggregate used for concrete and mortar shall conform to Section [725.3](#). Maximum size of the aggregate shall not be greater than  $\frac{1}{3}$  of the minimum wall thickness up to and including a wall thickness of 4  $\frac{1}{2}$  inches. The maximum aggregate size is 1  $\frac{1}{2}$  inches.

**620.2.3** Water used for concrete and for curing the pipe shall be as per Section [725](#).

**620.2.4** Concrete shall be Class A in accordance with Section [725](#). Slump shall be the minimum required for satisfactory placement of the concrete by the equipment used by the Contractor. The slump shall not exceed 3 inches.

**620.2.5** Bonding mortar shall consist of two (2) or more parts of cement to three (3) parts of sand by volume.

#### 620.3 CONSTRUCTION METHODS:

**620.3.1 Excavation:** The trench will be neatly excavated with vertical sides and semi-circular bottom. The trench shall be shaped to form the bottom outside of the pipe on the alignment and to the grades specified in the plans. Departure from and return to established grade shall not exceed 1 inch per 10 linear feet with a maximum allowable departure of 1  $\frac{1}{2}$  inches. Departure from and return to specified alignment shall not exceed 2 inches per 10 linear feet with a maximum allowable alignment departure of 4 inches. The bottom of the trench, hereinafter known as the trench form, will be shaped to provide full, firm, and uniform support by undisturbed earth or compacted fill for at least the bottom 210 degrees of the pipe. Density of the fill shall be at least five percent (5%) greater than the natural in-place soil, but in no case less than 85 percent (85%) when tested in accordance with AASHTO T-99, Method A and T-191 or ASTM [D6938](#).

When it is necessary to install the pipe in rocky areas, the rock will be removed and replaced with suitable fill material compacted to proper density. The rock will be over-excavated to leave 6 inches minimum compacted soil cushion between the rock and the pipe. For construction accuracy, areas left void by rock removal will be completely filled with compacted material, then trenched for the pipe as though natural ground. If the rock below the pipe subgrade is fractured or fragmented or if it consists of large cobblestones or boulders, the replacement fill material will be carefully selected to insure that it is of such gradation that it will not be removed downward by fluctuation of the water table. In no case will expansive soils be used for fill. A similar procedure of over-excavation, backfill, compaction, and retrenching will be used where sloughing sand or where soft or spongy soil conditions are encountered. When expansive clays are encountered, they will be thoroughly moistened by ponding, to completely expand the soil, and the moisture maintained until the concrete is placed.

Where the pipe is to be constructed through fill materials, such fill shall have stability in the zone of the trench form equal to firm undisturbed earth, in the area adjacent to the fill.

## SECTION 621

### CORRUGATED METAL PIPE AND ARCHES

#### 621.1 DESCRIPTION:

These specifications cover plain galvanized, bituminous coated, and bituminous coated and paved galvanized corrugated metal pipe for use in storm drains. The pipe shall be of the types, constructed as specified, and shall be manufactured in accordance with the requirements of the stated specifications. Except as otherwise required, corrugated metal pipe shall conform to AASHTO M-36 for Type I, Type IA, II and Type IIA. The external coating and internal lining shall be in accordance with AASHTO M-190 and Section [760](#).

#### 621.2 MATERIALS:

The types of pipe and fabrication shall be in accordance with Section [760](#).

All helically-wound corrugated metal pipe shall have a marking system, which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

#### 621.3 INSTALLATION:

Excavation, bedding and backfill shall be in accordance with Section [601](#), except as modified by standard details.

No pipe shall be laid except in the presence of an inspector. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipe lines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes, elliptical or round, as well as pipe arches requiring external coating or internal lining shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

All field repairs to the bituminous coating or paving shall be made with approved fiber reinforced bituminous mastic.

Corrugated metal pipe and/or pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. Any metal in the joints, which is not thoroughly protected, shall be coated with bituminous mastic. During the installation, the pipe shall be handled with care so as not to damage the external coating or internal lining. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous mastic as specified above prior to placing the backfill. As determined by the Engineer, pipe that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

**621.3.1 Joints:** Before the connecting band is placed around the pipe, the ends of the pipe that will be beneath the band shall be coated with bituminous mastic or, if of suitable design, fitted with circular rubber gaskets to provide a watertight joint. The band shall be tightened evenly, keeping equal tension on the bolts. If mastic is used, tension shall be maintained over an interval of time until the flow of mastic terminates. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint the nuts shall be tested for tightness. If the nut has a tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained. Prior to backfilling around the joint, the bolts, lugs, and nuts shall be given a coating of bituminous mastic. The annular space between abutting pipe sections shall be filled with bituminous mastic after jointing.

**621.3.2 Pipe Elongation:** Except as otherwise specified, the standard details shall control as to conditions under which pipe must be elongated. Pipe shall be elongated  $5 \pm \frac{1}{2}$  percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical diameter of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than

## SECTION 626

### CORROSION PROTECTIVE COATING OF SANITARY SEWER MANHOLES AND STRUCTURES

#### 626.1 GENERAL:

##### 626.1.1 Description:

(A) Scope: Unless otherwise approved by the Engineer or as called for on the plans, all new concrete manholes and access structures constructed on 15-inch and larger diameter sanitary sewers, plus those extending to and including one upstream manhole regardless of lateral size, shall have an internal corrosion coating applied as specified herein. Drop manholes and force main manholes on 8-inch or larger diameter lines shall also be coated. When specified, existing sanitary sewer manholes shall be similarly coated.

##### (B) Requirements:

- (1) Contractor shall furnish all labor, materials, and equipment required to clean and coat the manholes.
- (2) Contractor shall comply with the local authority and all occupation safety and health administration (OSHA) requirements for confined space entry.
- (3) All materials specified by name brand or manufacturer shall be delivered unopened to the job in original containers.
- (4) All safety precautions recommended by the manufacturer in printed instructions or special bulletins shall be obtained and followed.
- (5) For existing manholes, application of coating shall be carried out after all planned cleaning, prep and repairs to cone, walls, pipe penetrations, bench, and invert are completed.
- (6) Contractor's applicator shall be certified by the coating and underlayment material manufacturers as properly trained for applying the manufacturer's coating and underlayment products. Underlayment products include repair materials, fillers, primers, etc.

##### 626.1.2 Quality Assurance:

(A) Standardization: Materials and supplies provided shall be the standard products of manufacturers. The standard products of manufacturers other than those specified shall be reviewed and approved by the Engineer. Submittal info requirements shall include directions for the application, descriptive literature, safe storage, handling, and disposal of the product.

##### (B) Warranty:

- (1) A written warranty against coating failure shall be provided for the entire coating system, including all repair material, defect fillers, primers, intermediate, and finish coats. The minimum duration of the warranty shall be five (5) years. The product and the installation may be both covered by the manufacturer's warranty, or separate warranties may be issued by the manufacturer and installer.
- (2) This warranty shall state that the coating will not fail for a minimum period of five years. Coating failure is defined as blistering, cracking, embrittlement, or softening, or failure to adhere to the substrate. The warranty shall also apply to any underlayment materials used in the application. If any repair or replacement is necessary within the warranty period, a new five (5) year warranty period shall start at the date that the manhole is placed back into service.
- (3) Contractor shall be required to submit a certification letter to the Engineer documenting the effective warranty date, which should typically be after all manhole testing has passed and after any manhole adjustments are complete for the specific project. The effective warranty date may also be a mutually agreed upon date or some other established acceptance date if otherwise directed by the Engineer.

##### 626.1.3 Submittals Info Requirements:

##### (A) Contractor Shall Submit:

- (1) Manufacturer's data:
  - (a) Manufacturer's technical literature on coating material.
  - (b) Description of installation method including:
    - (I) Product material safety data sheets (MSDSI).
    - (II) Maximum storage life and storage requirements.
    - (III) Mixing and proportioning requirements (as applicable).

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(IV) Environmental requirements for application and worker safety, including ventilation, humidity, and temperature ranges.

(V) Application film thickness PM coat of primer and finish coat.

(VI) Curing time required.

(2) Sample of finished product showing final color: Coating shall be light in color.

(3) Contractor (or subcontractor) applying coating shall be an Arizona licensed contractor. Each of the Contractor's employees applying coatings and underlayments shall be certified by the manufacturer as having sufficient training and knowledge to properly apply their products. Contractor shall submit certification documents. Such certification shall be no more than two (2) years old for any applicator.

### 626.2 PRODUCTS:

#### 626.2.1 Coating Material:

(A) Approved Materials: The coating material shall be an Engineer approved product.

(B) Dry film thickness of epoxy/polymer coatings shall be a minimum 1/8-inch (125 Mils) thick, or per the manufacturer's recommendation, whichever is greater.

(C) Cured underlayment thickness shall equal or exceed minimum thickness recommended by manufacturer, but shall provide uniform finished surface for application of epoxy/polymer.

(D) An underlayment process and material recommended by the manufacturer shall be used to repair and reprofile corroded areas of manhole surfaces. Manhole surfaces shall be cleaned and prepared in accordance with the manufacturer's recommendations and requirements herein prior to application of any underlayment and coating. A separate adhesion pull test to verify the integrity of any underlayment repairs may be required by the Engineer.

### 626.3 EXECUTION:

#### 626.3.1 Manhole Cleaning:

(A) Cleaning shall remove all sediment, rocks, debris, roots, grease accumulations, and obstructions from the manholes. Cleaning of the manhole walls, bench, and channel shall remove all grease, scale encrustation, and loose mortar so that no foreign intrusion shall cause imperfections in the coating. Cleaning methods shall include washing with high-pressure water, mechanical removal, or other as approved by the Engineer.

(B) The Contractor shall use water blasting with a minimum water pressure of 3,000 psi to clean the manhole prior to applying the coating. Contractor shall also be responsible for any additional surface preparation beyond water blasting as required by the coating system manufacturer. Where additional preparation is required, the Contractor shall provide all labor materials and equipment as necessary at no additional cost to the Agency.

(C) Before installation of the coating system, the surface must be clean. Excess water shall be blown from the surface using compressed air equipment with oil-trapping filters. Suitable heaters shall be used as needed to produce a surface-dry condition. The surface shall be vacuumed to make sure that loose particles are not present.

(D) No sediment or debris from the cleaning operations is allowed in the sewer. Any sedimentation deposited into the sewer system, as determined by the Engineer, shall be removed at no cost to the Agency.

#### 626.3.2 Coating Installation and Repair:

(A) With Engineer's approval, new manholes may have corrosion coating applied at manhole manufacturer's facility, but all final acceptance testing shall be performed in the field following installation of the manhole.

(B) If new manhole is coated at the manufacturer's facility, then all joints will require sealing and coating in the field after manhole assembly. After the joint is assembled in the field, the Contractor shall prepare the coated surface above and below

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the joint to receive the protective coating in accordance with the manufacturer's recommendations. Typically, a light abrasion blast to 2-inches above and below the joint will clean the surface and give the coating a good surface to adhere.

(C) If the new manhole is coated at manufacturer's facility, coating of joints, concrete adjustment rings, bench and invert, and any necessary repairs to barrel or cone shall be performed in the field after successful leakage testing per Section 611.

(D) New manholes that do not have corrosion coating applied at manhole factory shall be fully coated in the field including barrels, cones, joints, concrete adjustment rings, and bench and invert after successful leakage testing per Section 611.

(E) Where specified for corrosion coating, existing manholes shall be prepared in accordance with these specifications and the manufacturer's recommendations. Weak and deleterious material shall be removed down to sound substrate. Repairs shall be made with coating manufacturer's recommended underlayment. Coating shall be applied to barrels, cones, joints, concrete adjustment rings, and bench and invert. If flows cannot be bypassed or diverted with a flow through plug, the Engineer may waive coating of invert.

(F) If the frame and cover of an existing coated manhole is adjusted in the field, the existing or added concrete adjustment rings shall be coated or have coating repaired as necessary in accordance with the manufacturer's recommendations.

### 626.3.3 Inspection and Testing:

(A) Contractor shall give the Engineer a minimum of two (2) business days advance notice before start of any surface preparation work, underlayment application work, coating application work, or testing.

(B) All work and testing shall be performed in presence of the Engineer or a designated representative of the Engineer, unless the Engineer has granted prior approval to perform portions of the work in their absence.

(C) Acceptance for holidays testing and adhesion testing may be witnessed by an independent testing agency or laboratory approved by the Engineer. Documentation shall be in accordance with Engineer's requirements. Cost of this inspection and testing shall be the responsibility of the Contractor.

(D) Additional illumination, scaffolding, and confined space entry equipment and support shall be provided by Contractor as necessary to facilitate inspection by Engineer or Engineer's representative, and/or testing agency when requested at no additional cost to the Agency.

(E) Contractor shall furnish appropriate equipment and supplies for holiday testing, dry and wet film thickness testing, and coating adhesion testing. Contractor shall provide trained personnel for performing required acceptance testing including operation of holiday detection devices.

(F) Holiday testing equipment and procedures shall be performed in strict accordance with latest edition of NACE "Standard Recommended Practice-Discontinuity (Holiday) Testing of Protective Coatings." Areas containing holidays shall be marked repaired or re-coated and re-tested in accordance with coating manufacturer's printed instructions. High voltage pulse-type holiday detectors shall be adjusted to operate at voltage required to cause sparks jump across air gap equal to twice the specified coating thickness. Minimum applied voltage for 125 Mil coating shall be 12,500 volts.

(G) Wet film thickness measurement shall be provided by report submitted by Contractor to the Engineer. The report shall be presented after completion of underlayment, top coating operations, and shall state number of manufacturer's product units used and total square footage of surface area covered. The Engineer shall have option of requiring Contractor to document number of units (coating materials) on hand before and after coating operations to verify actual minimum dry film thickness applied. All film thicknesses not meeting required minimums will be re-coated per manufacturer's recommendations to required minimum 125 mil thickness.

(H) Contractor shall perform adhesion tests on 15% of the manholes coated on any given project (at least one manhole if 15% is less 1.0). Adhesion tests shall conform to ASTM D7234, minimum pull off strength shall be 200 PSI on concrete and 100 PSI on brick and some portion of substrate shall be adhered to coating and dolly. A minimum pull off strength of 150 PSI on concrete will be acceptable if substrate is adhered to coating and dolly on more than ½ the area of the dolly. 50 mm dollies

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shall be used for adhesion testing. In the event of a failure, the Engineer and Contractor shall determine limits of failure through additional investigation, sounding and pull tests. Failed areas shall be removed and repaired in accordance with these specifications and manufacturer's recommendations. Repaired area shall be re-tested per these requirements. Engineer shall be allowed to increase the testing frequency depending on number or percent of failed test results.

### **626.3.4 Warranty Period Inspection:**

The Engineer may conduct inspection any time prior to five (5) years following completion of new coating work and/or repaired coating work. Contractor and representative of coating manufacturer shall be notified of any apparent coating failures. Defective work or coating failures shall be repaired in accordance with specifications and to satisfaction of the Engineer. If warranty inspections are not held, Contractor is not relieved of responsibilities under the contract documents.

### **626.4 MEASUREMENT:**

Measurement shall be per the square foot of manhole wall coated or per each treated manhole as required by the contract documents.

### **626.5 PAYMENT:**

If required, payment shall be made at the agreed upon unit price, and shall be considered full compensation for cleaning, surface preparation materials, application, testing, and any incidentals, thereto, in conformance with the plans and specifications.

*-End of Section-*

**PART 700**  
**MATERIALS**

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**SECTION 714**

<b>TABLE 714-2</b>			
<b>MICRO-SURFACING JOB MIX FORMULA</b>			
<b>ASTM TEST METHOD</b>	<b>ISSA TECHNICAL BULLETIN</b>	<b>TEST</b>	<b>REQUIREMENTS</b>
		Residual Asphalt, % by dry weight of aggregate	6.0 – 11.5
<a href="#">D242</a>		Mineral Filler, % by dry weight of aggregate.	0.1 – 2.0
		Modifier Content, % (see Section <a href="#">714.6</a> )	4, minimum.
		Additive	As required for mix properties
		Water	As required for mix properties
<a href="#">C136/ C117</a>		Aggregate Grading	Meets requirements of Table <a href="#">714-1</a>
	TB-106	Consistency, cm.	2.5-3.0
	TB-100	Abrasion Loss (Wet Track Abrasion Test) One Hour Soak, g/ft <sup>2</sup> Six Day Soak, g/ft <sup>2</sup>	50, maximum 75, maximum
	TB-114	Wet Stripping, %	90, minimum
	TB-139	Wet Cohesion Test, at 77° F Set Time Test: (30 minutes), kg-cm Early Rolling Traffic Time: (60 minutes), kg-cm	12, minimum 20, minimum
	TB-102	Quick Set Emulsion Mix Properties Micro-Surfacing Setting Test, 70-85 ° F. (1-hour cure) Micro-Surfacing Water Resistance Test, 70-85 ° F. (30-minute cure)	No Brown Stain No More Than Slight Discoloration
	TB-115	Split Consistency Test	Uniform
	TB-113	Mix Time Micro-Surfacing Mixing, 70-85 ° F., Sec.	120, minimum
	TB-147	Measurement of Stability and Resistance to Compaction, Vertical and Lateral Displacement of Multi-layered Fine Aggregate Cold Mixes	Lateral Displacement 5%, maximum Specific Gravity 2.10, maximum
	TB-109	Loaded Wheel Sand Adhesion	50 g/ft <sup>2</sup> , maximum

**714.7.2.1 Bulking Effect (ASTM [C29](#) Modified):** The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect).

**714.8 TEST CERTIFICATES AND REPORTS:**

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

**714.9 CONVERSION OF QUANTITIES:**

Volumetric conversions shall be accomplished in accordance with Section [713](#).

- End of Section -

**SECTION 715**

<b>TABLE 715-2</b>			
<b>SLURRY SEAL JOB MIX FORMULA</b>			
<b>ASTM TEST METHOD</b>	<b>ISSA TECHNICAL BULLETIN</b>	<b>TEST</b>	<b>REQUIREMENTS</b>
		Residual Asphalt, % by dry weight of aggregate: Type I Type II Type III	10.0 – 16.0 7.5 – 13.0 6.5 – 12.0
<a href="#">D242</a>		Mineral Filler, % by dry weight of aggregate.	0.1 – 2.0
		Modifier Content, % (see Section <a href="#">715.4</a> ), if applicable	3, minimum.
		Additive	As required for mix properties
		Water	As required for mix properties
<a href="#">C136/ C117</a>		Aggregate Grading	Meets requirements of Table <a href="#">715-1</a>
	TB-106	Consistency, cm.	2.0-3.0
	TB-100	Abrasion Loss (Wet Track Abrasion Test) One Hour Soak, g/ft <sup>2</sup> Six Day Soak, g/ft <sup>2</sup>	75, maximum 75, maximum
	TB-114	Wet Stripping, %	90, minimum
	TB-139	Modified Cohesion Test, at 77° F Set Time Test: (30 minutes), kg-cm Early Rolling Traffic Time: (60 minutes), kg-cm	12, minimum 20, minimum
	TB-102	Quick Set Emulsion Mix Properties Slurry Seal Setting Test, 70-85 ° F (1-hour cure) Slurry Seal Water Resistance Test, 70-85 ° F (30-minute cure)	No Brown Stain No More Than Slight Discoloration
	TB-115	Split Consistency Test	Uniform
	TB-113	Mix Time Slurry Seal Mixing, 70-85 ° F, Sec.	120, minimum
	TB-109	Loaded Wheel Sand Adhesion	50 g/ft <sup>2</sup> , maximum

**715.7.2.1 Bulking Effect (ASTM [C29](#)):** The laboratory shall further report the quantitative effects of moisture content in the unit weight of the aggregate (bulking effect).

**715.8 TEST CERTIFICATES & REPORTS:**

Test certificates and reports for the bituminous material shall be furnished in accordance with Section [711](#).

**715.9 CONVERSION OF QUANTITIES:**

Volumetric conversions shall be accomplished in accordance with Section [713](#).

*- End of Section -*

## SECTION 725

### PORTLAND CEMENT CONCRETE

#### 725.1 GENERAL:

Portland cement concrete shall be composed of cementitious materials, fine and coarse aggregates, water, and, if specified or allowed, certain chemical admixtures and additives.

Class of Concrete	Minimum Cementitious Materials Content (lbs. per cubic yard)	Minimum Compressive Strength * at 28 Days (psi)
AA	600	4000
A	520	3000
B	470	2500
C	420	2000

\* In accordance with Section [725.8](#)

#### 725.2 CEMENTITIOUS MATERIALS:

Hydraulic cement shall consist of either Portland cement or Portland pozzolan cement.

Portland cement shall conform to the requirements of ASTM [C150](#) for Type II, III, or V, and shall not contain more than 0.60 percent total equivalent alkalis.

Portland Pozzolan Cement shall conform to the requirements of ASTM [C595](#) for blended hydraulic cement with moderate sulfate resistance, Type IP (MS), when no other specific type is specified.

Supplementary Cementitious Materials (SCM) shall not be used as an additional cementitious materials replacement in concrete in combination with Portland Pozzolan Cement without prior approval by the Engineer.

Cementitious materials shall be sampled and tested as prescribed in the applicable ASTM specifications. Upon request, the Contractor shall obtain and deliver to the Engineer a Certification of Analysis or Certificate of Compliance conforming to the requirements of Section [106.2](#) signed by the material manufacturer, identifying the cementitious material and stating that the cementitious material delivered to the batching site has been tested in accordance with the cited specifications and complies with the cited specifications. The cost of furnishing tested cementitious materials shall be considered as included in the contract price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cementitious materials, such facilities shall be used. Otherwise, the cementitious material shall be delivered in original unopened sacks that bear the name or brand of the manufacturer. The type of cementitious material, and the weight contained in each sack shall be plainly marked thereon.

Cementitious materials shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cementitious material be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

**725.2.1 Supplementary Cementitious Materials (Pozzolans):** Supplementary Cementitious Materials to be used in concrete or furnished under this specification shall conform to the appropriate ASTM requirements as follows:

Fly ash or natural pozzolan	ASTM <a href="#">C618</a> and <a href="#">C311</a>
Silica Fume	ASTM <a href="#">C1240</a>

## SECTION 725

### 725.6 MIX DESIGN PROPORTIONING:

A concrete mix design carrying the producer's designated mix number for each type of concrete being furnished under these specifications shall be submitted to the Engineer every two years for approval. Each design shall utilize the proper proportioning of ingredients to produce a concrete mix that is homogeneous and sufficiently workable to provide a consistent and durable concrete product that meets the specified compressive strength and other properties as required by the application.

A concrete mix design submittal shall include the mix identification number and the applicable proportions, weights, and quantities of individual materials incorporated into the mix including the size and source of concrete aggregates, the type and source of cement and fly ash or SCM, and the brand and designation of chemical admixtures or other additives.

In the event there is a modification to the mix design proportions:

(A) Modifications that do not require a new mix design submittal/approval:

- (1) Modifications, which do not result in batch, target weights for the fine aggregate or combined coarse aggregates changing by more than 5 percent from the original approved mix design.
- (2) Modifications to the percentage of coarse aggregate fractions that do not change the total coarse aggregate volume.
- (3) Modifications to dosages of chemical or air-entraining admixtures, within the manufacturer's recommendations.
- (4) The incorporation or elimination of chemical admixtures, which are listed on the mix design to effect a change in the time-of-set (retarders or accelerators).

(B) Modifications that require a new mix design submittal/approval and may require performance verification:

- (1) Modification to the class of concrete per Table [725-1](#).
- (2) Modification to the type/class/source of cement, fly ash, natural pozzolan, or silica fume.
- (3) Modification to the percentage of fly ash, natural pozzolan, or silica fume.
- (4) Modification to a coarse aggregate size designation.
- (5) Modification of the type of chemical admixture, or the incorporation or elimination, of an air-entraining admixture.
- (6) Modification of coarse or fine aggregate source.

### 725.7 MIXING:

All proportioning/batching/mixing equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or National Ready Mixed Concrete Association. The proportioning shall consist of combining the specified sizes of aggregates with cementitious materials, admixtures/additives, and water as herein provided. No method which may cause the segregation or degradation of materials, shall be used.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

Any admixture/additive shall be measured accurately by mechanical means into each batch by equipment or in a method pre-approved by the Engineer.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight. The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate. Machine mixing will be required in all cases unless pre-approved by the Engineer. Regardless of the method employed, mixing shall be commenced as soon as possible after the cementitious material is placed in contact with the aggregates or water. All concrete

## SECTION 725

### 725.9 ACCEPTANCE:

#### (A) Plastic Concrete Properties:

(1) The slump of the concrete shall meet the requirements of ASTM [C94](#) Tolerances in Slump section. When the approved mix design or project specification requirements for slump are a “maximum” or “not to exceed”, the following tolerances apply:

Specified slump:	If 3” or less	If more than 3”
Plus tolerance	0 inch	0 inch
Minus tolerance	1 1/2 inch	2 1/2 inch

When the approved mix design or project specification requirements for slump are not written as a “maximum” or “not to exceed,” the following tolerances apply:

For design slump of:	Tolerance
2 inch and less	+/- 1/2 inch
More than 2 through 4 inch	+/- 1 inch
More than 4 inch	+/- 1 1/2 inch

(2) Limit the maximum allowable temperature of the concrete mixture immediately before placement to 95°F unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer. At the discretion of the Engineer, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information and may be used to modify maximum allowable concrete temperature and acceptance.

Per ACI 306, Specification for Cold Weather Concreting, when the atmospheric temperature at the time of placing concrete is above 30°F the temperature of the concrete, as placed, shall not be less than 60°F. When the atmospheric temperature at the time of placing concrete is between 0°F and 30°F the temperature of the concrete, as placed, shall not be less than 65°F.

(3) Air entrained concrete shall meet the requirements of ASTM [C94](#) Air-Entrained Concrete section. The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within the approved mix design tolerance or +/- 1.5 % of the specified value. When a representative sample taken prior to discharge shows an air content below the specified level by more than the allowable tolerance, additional air entraining admixture shall be added to the concrete mix to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

(4) Per ASTM [C94](#) Mixing and Delivery section, discharge of the concrete shall be completed within 1 1/2 hours (90 minutes) after the introduction of the mixing water to the cementitious materials or the introduction of the cementitious materials to the aggregates. The Engineer may allow the continuation of concrete placement after the 1 1/2 hours (90 minutes) time limit has been reached if the concrete is of such slump or workability that it can be placed without the addition of water to the batch. The 1 1/2 hours (90 minutes) time limit may also be waived if the mix design incorporates a hydration stabilizing admixture at the sufficient dosage to slow down hydration in order to permit additional transit/placement time. The dosage and associated additional time shall be noted on the delivery ticket. The additional discharge time shall not exceed the maximum additional time based on the dosage noted on the approved mix design or delivery ticket. It is the Contractor’s responsibility to obtain approval for additional discharge time from the Engineer prior to concrete placement.

Any concrete failing to meet the tolerances for plastic concrete properties in 725.9 (A) (1) through (4) shall be reviewed by the Engineer and is subject to rejection.

#### (B) Hardened Concrete Properties – Compressive Strength:

Compressive strength of concrete shall be determined on the basis of cylinder strength tests obtained in accordance with Section [725.8.2](#) and shall be acceptable if the tests meet or exceed the minimum specified strength. When the validity of cylinder strength tests are suspect, the strength of concrete in question shall be determined in accordance with Section [725.8.3](#).

## SECTION 787

### GRAY IRON CASTINGS

#### 787.1 GENERAL:

The castings shall be true to pattern in form and dimension and free from pouring faults, spongings, cracks, blowholes, or other defects in locations affecting their strength and value for the service intended. Castings shall be filleted boldly at angles, and the arises shall be sharp and true.

Before the castings are removed from the foundry, they shall be thoroughly cleaned and the parting lines, gates, and risers ground flush.

#### 787.2 TEST SPECIMENS:

Test coupons shall be cast separately of the castings, using a mold as described in ASTM [A48](#). A representative of the Engineer may be present at the time a melt is poured to identify both coupons and castings.

Two test coupons are required for each melt poured. Additional coupons shall be cast for use as replacements or in case a retest is required.

A representative of the Engineer may discard and replace specimens which show obvious lack of continuity of metal or if the machining is defective.

The manufacturer shall machine the tension specimens to the dimension specified for specimen B of ASTM [A48](#), at no additional cost to the Contracting Agency.

When approved by the Engineer transverse tests may be made in lieu of tensile tests, in which case the castings shall meet the requirements of ASTM [A48](#).

#### 787.3 MANHOLE FRAME AND COVER SETS:

Castings shall conform to ASTM [A48](#), Class 35 and AASHTO M306. The bearing surfaces of the frames and covers shall be machined and the cover shall seat firmly onto the frame without rocking.

Covers shall be the types and shall be imprinted as shown on the plans or standard details.

#### 787.4 RAILINGS, RAILING POSTS, AND WHEEL GUARDS:

Castings shall conform to ASTM [A48](#), Class 40.

#### 787.5 ROCKERS, ROCKER PLATE BEARINGS, AND BEARING PLATES FOR BRIDGES:

Castings shall conform to ASTM [A48](#), Class 50.

Castings shall be machined and finished as specified on the plans provided that tool marks on sliding contact surfaces shall run in the direction of plate movement, or in the case of rocker plate bearings, perpendicular to the rocker movement. Tool marks shall be not more than 1/32 inch apart.

#### 787.6 UNCLASSIFIED CASTINGS:

All castings not specifically classified, shall conform to the requirements of ASTM [A48](#), Class 30.

- End of Section -

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302-1	1998	JOINT RESTRAINT WITH TIE RODS (DRAWING)
302-2	1998	JOINT RESTRAINT WITH TIE RODS (NOTES)
303-1	2019	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON AND PVC WATER PIPES (DRAWING)
303-2	2019	JOINT RESTRAINT FOR DUCTILE IRON AND POLYETHYLENE WRAPPED DUCTILE IRON AND PVC WATER PIPES (TABLES)
310	2017	STEEL WATER METER BOX COVER
315	2017	POLYMER CONCRETE WATER METER BOX COVER
319	2017	TRAFFIC RATED BOX AND COVER
320	2017	NON TRAFFIC RATED WATER METER BOXES
321	1998	STANDARD WATER METER VAULT
340	2002	INSTALLING TAPPING SLEEVES AND VALVES
342	1998	CONCRETE PRESSURE PIPE TAPPING SLEEVE
345-1	1998	3", 4", 6" WATER METER
345-2	1998	4", 6" WATER METER WITH ON-SITE HYDRANTS
346	1998	FIRE LINE DETECTOR CHECK VAULT
360-1	2019	DRY BARREL FIRE HYDRANT INSTALLATION
360-2	2019	WET BARREL FIRE HYDRANT INSTALLATION
360-3	2013	FIRE HYDRANT INSTALLATION DETAILS
362	1999	LOCATIONS FOR NEW FIRE HYDRANTS
370	1998	VERTICAL REALIGNMENT OF WATER MAINS
380	1998	THRUST BLOCKS FOR WATER LINES
381	1998	ANCHOR BLOCKS FOR VERTICAL BENDS
389	2001	CURB STOP WITH VALVE BOX AND COVER
390	2018	CURB STOP WITH FLUSHING PIPE
391-1	2018	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
391-2	2017	VALVE BOX INSTALLATION AND GRADE ADJUSTMENT
392	2015	DEBRIS CAP INSTALLATION
393 *	2021	WATER VALVE EXTENSION

DETAIL NO.

**100-1**STANDARD DETAIL  
ENGLISH**INDEX (PAGE 1 OF 2)**\* NEWLY  
REVISED.

REVISED

01-01-2021

DETAIL NO.

**100-1**

**400 SERIES: SEWER INFORMATION**

Detail	Revised	Title
403-1	1998	PIPE SUPPORT ACROSS TRENCHES
403-2	1998	PIPE SUPPORT ACROSS TRENCHES
403-3	1998	ALTERNATIVE TO PIPE SUPPORT
404-1	2020	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-2	2006	WATER AND SANITARY SEWER SEPARATION/PROTECTION
404-3	2020	WATER AND SANITARY SEWER SEPARATION/PROTECTION
405	1998	BROKEN SEWER LINE REPLACEMENT
419-1	2020	POLYMER CONCRETE SANITARY SEWER MANHOLE
419-2	2020	PRE-CAST POLYMER CONCRETE MANHOLE BASE
419-3	2020	POLYMER CONCRETE MANHOLE BASE
420-1	2015	CONCRETE SANITARY SEWER MANHOLE
420-2	2015	PRE-CAST CONCRETE MANHOLE BASE
420-3	2015	CONCRETE MANHOLE BASE
421	2015	OFFSET MANHOLE 8" TO 30" PIPE
422	2018	MANHOLE FRAME AND COVER ADJUSTMENT
423-1	2020	24" CAST IRON MANHOLE FRAME AND COVER
423-2	2020	30" CAST IRON MANHOLE FRAME AND COVER
424-1	2020	24" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
424-2	2020	30" CAST IRON WATERTIGHT MANHOLE FRAME AND COVER
425	1998	24" ALUMINUM MANHOLE FRAME AND COVER
426	2007	DROP SEWER CONNECTIONS
427	1998	STUB OUT AND PLUGS
429	2015	INDUSTRIAL WASTE CONTROL VAULT WITH MANHOLE
440-1	2007	TYPE 'A' SEWER BUILDING CONNECTION - ELECTRONIC BALL MARKERS (STANDARD)
440-2	2007	TYPE 'B' SEWER BUILDING CONNECTION - TWO-WAY CLEANOUT AND METER BOX AT R/W
440-3	2007	TYPE 'C' SEWER BUILDING CONNECTION - ONE-WAY CLEANOUT AND METER BOX
440-4	2006	SEWER SERVICE CURB CROSSING STAMP DETAIL
441	2001	SEWER CLEANOUT

**500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION**

Detail	Revised	Title
501-1	2020	HEADWALL
501-2	2020	HEADWALL
501-3	2020	HEADWALL 42" TO 84" PIPE
501-4	2020	HEADWALL IRRIGATION 18" TO 60" PIPE
501-5	2020	HEADWALL DROP INLET
502-1	2020	TRASH RACK
502-2	2004	TRASH RACK
503	2018	IRRIGATION STANDPIPE
504	1998	CONCRETE BLOCK JUNCTION BOX
505 *	2021	CONCRETE COLLAR FOR PIPE
506	1998	IRRIGATION VALVE INSTALLATION
507	2017	ENCASED CONCRETE PIPE (FOR SHALLOW INSTALLATION)
510	1998	CORRUGATED METAL PIPE AND INSTALLATION

**500 SERIES: IRRIGATION AND STORM DRAIN INFORMATION (CONT.)**

Detail	Revised	Title
520	1998	STORM DRAIN MANHOLE BASE (48" AND SMALLER)
521	1998	STORM DRAIN MANHOLE BASE (51" OR LARGER)
522	2015	STORM DRAIN MANHOLE SHAFT
523-1	1998	PRESSURE MANHOLE
523-2	1998	PRESSURE MANHOLE
524	1998	STORM DRAIN LATERAL PIPE CONNECTIONS
530	1998	3'-6" CURB OPENING CATCH BASIN - TYPE 'A'
531	1998	5'-6" CURB OPENING CATCH BASIN - TYPE 'B'
532	1998	8'-0" CURB OPENING CATCH BASIN - TYPE 'C'
533-1	1998	CATCH BASIN TYPE 'D'
533-2	1999	APRON FOR TYPE 'D' CATCH BASIN
533-3	2007	FRAME AND GRATE FOR TYPE 'D' CATCH BASIN
533-4	2007	7'-0" CURB OPENING CATCH BASIN TYPE 'D' - GRATE DETAILS
534-1	1998	CATCH BASIN TYPE 'E'
534-2	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-3	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-4	1998	CATCH BASIN TYPE 'E' (DETAILS)
534-5	1998	ALTERNATE GRATE STYLES, SUMP LOCATION
535	2009	CATCH BASIN TYPE 'F' (FOR USE WITHOUT CURB)
536-1	1999	COMMON DETAILS AND SECTIONS FOR CURB OPENING CATCH BASINS
536-2	1998	ALTERNATIVE COVER FOR CURB OPENING CATCH BASINS
537	2002	CATCH BASIN TYPE 'G'
538	1998	CATCH BASIN TYPE 'H'
539	1998	GRATES FOR CATCH BASINS, TYPE G AND H
540-1	1998	CATCH BASIN GRATES
540-2	1998	CATCH BASIN GRATES
541	2005	CATCH BASIN SUBGRADE DRAIN
545	1998	END SECTION - REINFORCED CONCRETE PIPE
550 *	2021	SPILLWAY INLET AND OUTLET
552	2015	FORD CROSSING WITH CUT-OFF WALLS
555	2010	EROSION PROTECTION/GABIONS

DETAIL NO.

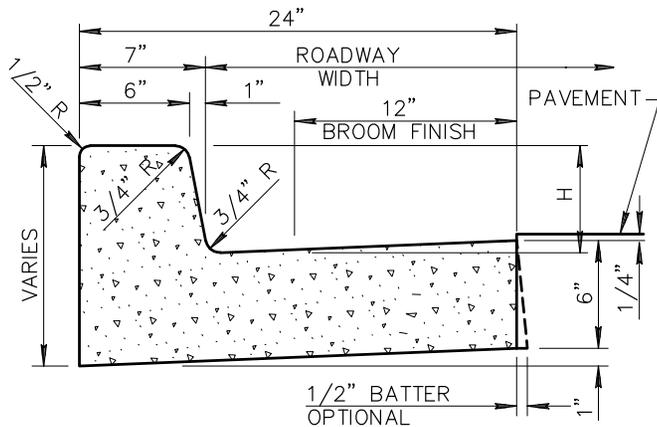
**100-2**STANDARD DETAIL  
ENGLISH**INDEX (PAGE 2 OF 2)**\* NEWLY  
REVISED.

REVISED

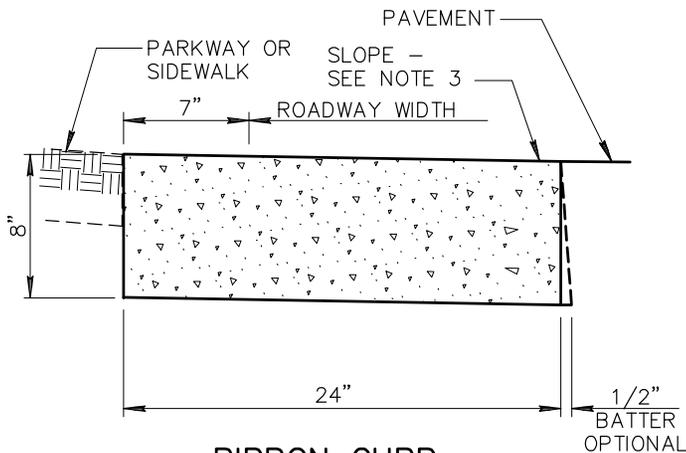
01-01-2021

DETAIL NO.

**100-2**



**VERTICAL CURB AND GUTTER  
(TYPE A)**



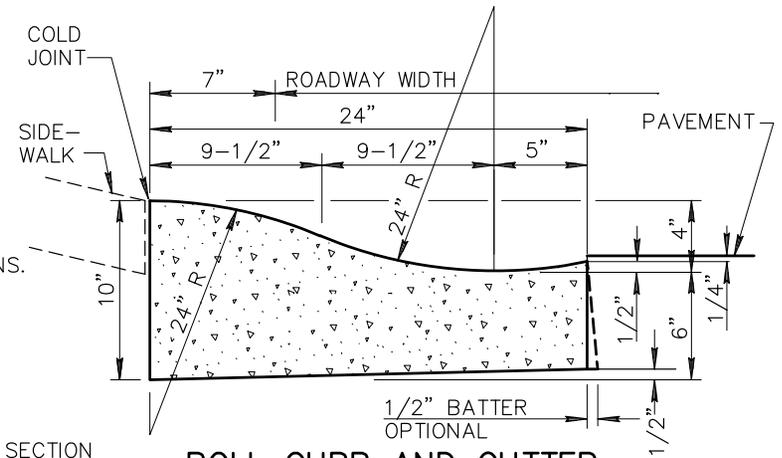
**RIBBON CURB  
(TYPE B)**

**NOTES: (TYPE A)**

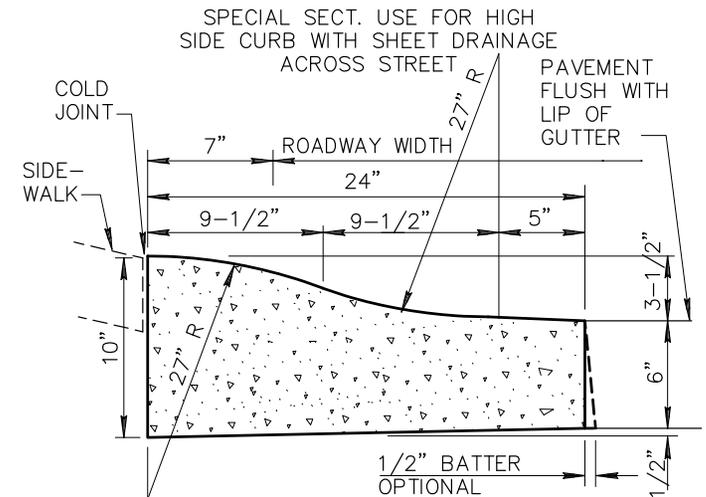
1. ALL EXPOSED SURFACES TO BE TROWEL FINISHED EXCEPT AS SHOWN. SEE SECT. 340.
2. H=6" OR AS SPECIFIED ON PLANS.
3. CONTRACTION JOINT SPACING 10' MAXIMUM.
4. EXPANSION JOINTS AS PER SECT. 340.
5. CLASS 'B' CONCRETE PER 725.
6. WHEN THE ADJACENT PAVEMENT SECTION SLOPES AWAY FROM THE GUTTER, THE SLOPE OF THE GUTTER PAN SHALL MATCH PAVEMENT CROSS SLOPE.

**NOTES: (TYPE B)**

1. CONSTRUCT CURB AND INSTALL 1/2" MASTIC EXPANSION JOINTS, A.S.T.M. D-1751. SECT. 340.
2. BROOM FINISH ALL SURFACES.
3. RIBBON CURB MAY SLOPE TOWARDS PAVEMENT OR PARKWAY AS INDICATED ON PLANS.
4. CONTRACTION JOINT SPACING 10' MAXIMUM.
5. CONCRETE SHALL BE CLASS 'B' PER SECT. 725 AND INSTALLED PER SECT. 505.



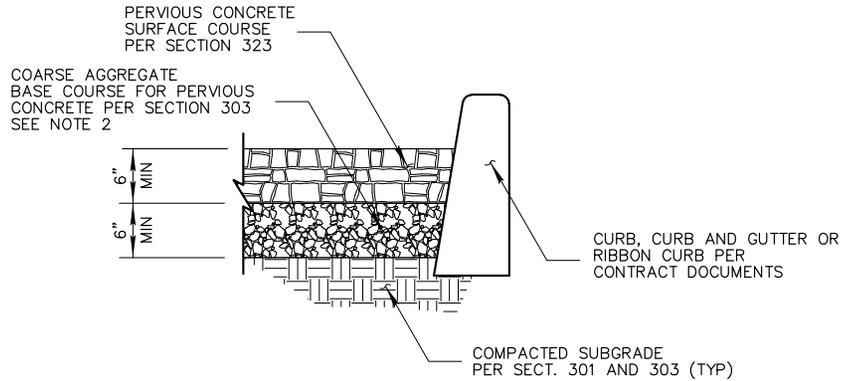
**ROLL CURB AND GUTTER  
(TYPE C)**



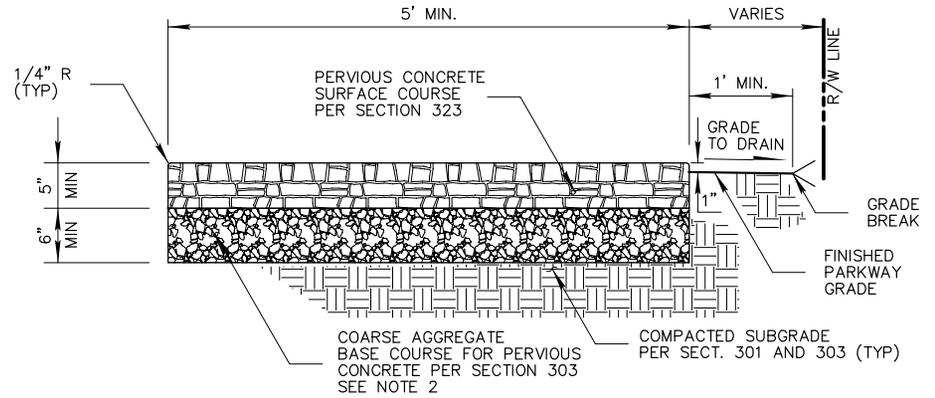
**(TYPE D)**

**NOTES: (C & D)**

1. ALL WORK AND MATERIALS SHALL CONFORM TO SECT. 340, 505 AND 725. BROOM FINISH TO EXPOSED SURFACE.
2. CONTRACTION JOINT SPACING 10' MAXIMUM.
3. EXPANSION JOINTS AS PER SECT. 340.
4. CLASS 'B' CONCRETE PER 725.



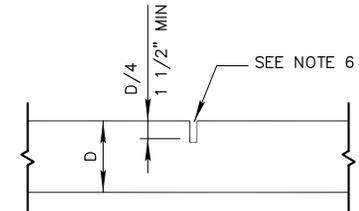
**PERVIOUS CONCRETE PAVEMENT**  
(FOR LIGHT TRAFFIC AREAS ONLY)



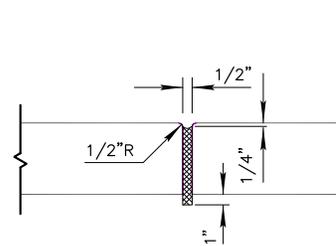
**PERVIOUS CONCRETE PAVEMENT**  
(SIDEWALK)

**NOTES:**

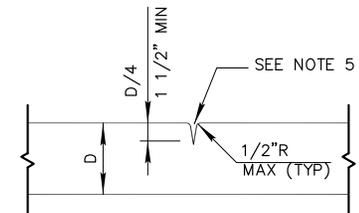
1. THIS USE OF PERVIOUS CONCRETE PAVEMENT IS INTENDED FOR LIGHT TRAFFIC AREAS AND PEDESTRIAN SURFACES ABOVE A SUBGRADE AS APPROVED BY THE ENGINEER.
2. PERVIOUS CONCRETE PAVEMENT AND COARSE AGGREGATE BASE COURSE SHALL BE CONSTRUCTED TO THE THICKNESS INDICATED IN THE CONTRACT DOCUMENTS.
3. FILTRATION AND SEPARATION GEOSYNTHETIC FABRIC SHALL ONLY BE USED WHEN SPECIFIED IN THE CONTRACT DOCUMENTS.
4. CONTRACTION JOINTS SHALL BE CONSTRUCTED AT REGULAR INTERVALS NOT TO EXCEED TWO TIMES THE PLACEMENT WIDTH OR 15 FEET ON CENTER, WHICHEVER IS LESS. CONTRACTION JOINTS SHALL BE CONSTRUCTED WITH A PERVIOUS CONCRETE JOINT CUTTER OR BY SAW CUTTING.
5. WHEN JOINTING A CONTRACTION JOINT USING A PERVIOUS JOINT ROLLER, THE JOINT SHALL BE PLACED IMMEDIATELY AFTER COMPACTION AND PRIOR TO CURING. DEPTH OF JOINT SHALL BE AT LEAST 1/4 THE PAVEMENT THICKNESS OR A MINIMUM OF 1-1/2" WHICHEVER IS GREATER.
6. SAW CUTTING SHALL CONFORM TO SECTION 323. DEPTH OF SAWCUT SHALL BE AT LEAST 1/4 THE PAVEMENT THICKNESS OR A MINIMUM OF 1-1/2" WHICHEVER IS GREATER.
7. EXPANSION JOINTS SHALL CONFORM TO SECTION 729, BE INSTALLED PRIOR TO CONCRETE PLACEMENT AND AT A MAXIMUM SPACING OF 75 FEET.



**CONTRACTION JOINT**  
(SAWCUT JOINT)



**EXPANSION JOINT**



**CONTRACTION JOINT**  
(USING PERVIOUS CONCRETE JOINT CUTTER)

DETAIL NO.

**228**



STANDARD DETAIL  
ENGLISH

**PERVIOUS CONCRETE PAVEMENT**

REVISED

01-01-2021

DETAIL NO.

**228**

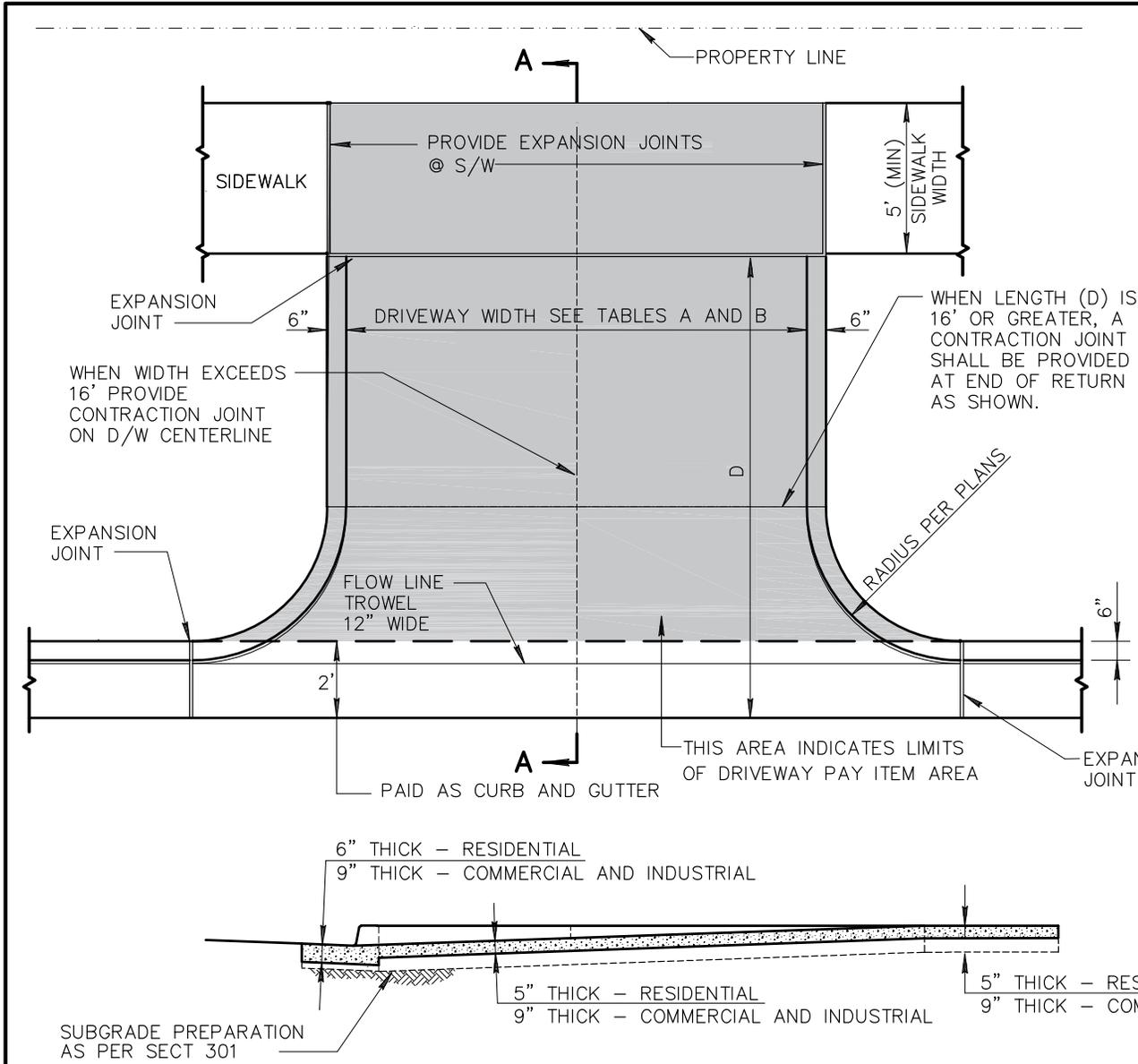


TABLE A		
ZONING	DRIVEWAY WIDTH	
	MIN*	MAX
COMMERCIAL AND INDUSTRIAL		
COMMERCIAL	16'	40'
INDUSTRIAL	16'	40'
* 24' WHERE 2-WAY TRAFFIC IS ANTICIPATED		

TABLE B		
ZONING	DRIVEWAY WIDTH	
	MIN*	MAX
RESIDENTIAL		
MAJOR STREET	16'	30'
COLLECTOR STREET	12'	30'
LOCAL STREET	12'	30'
* 16' WIDTH IS DESIRABLE		

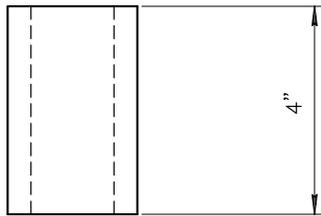
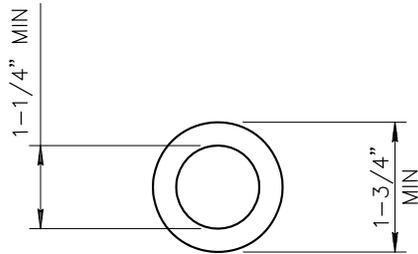
**NOTES:**

1. EXPANSION JOINT SHALL COMPLY TO SECTION 340.
2. THIS TYPE D/W TO BE USED ONLY UPON APPROVAL OF ENGINEER.
3. CONCRETE:  
RESIDENTIAL CLASS B  
COMMERCIAL AND INDUSTRIAL CLASS A

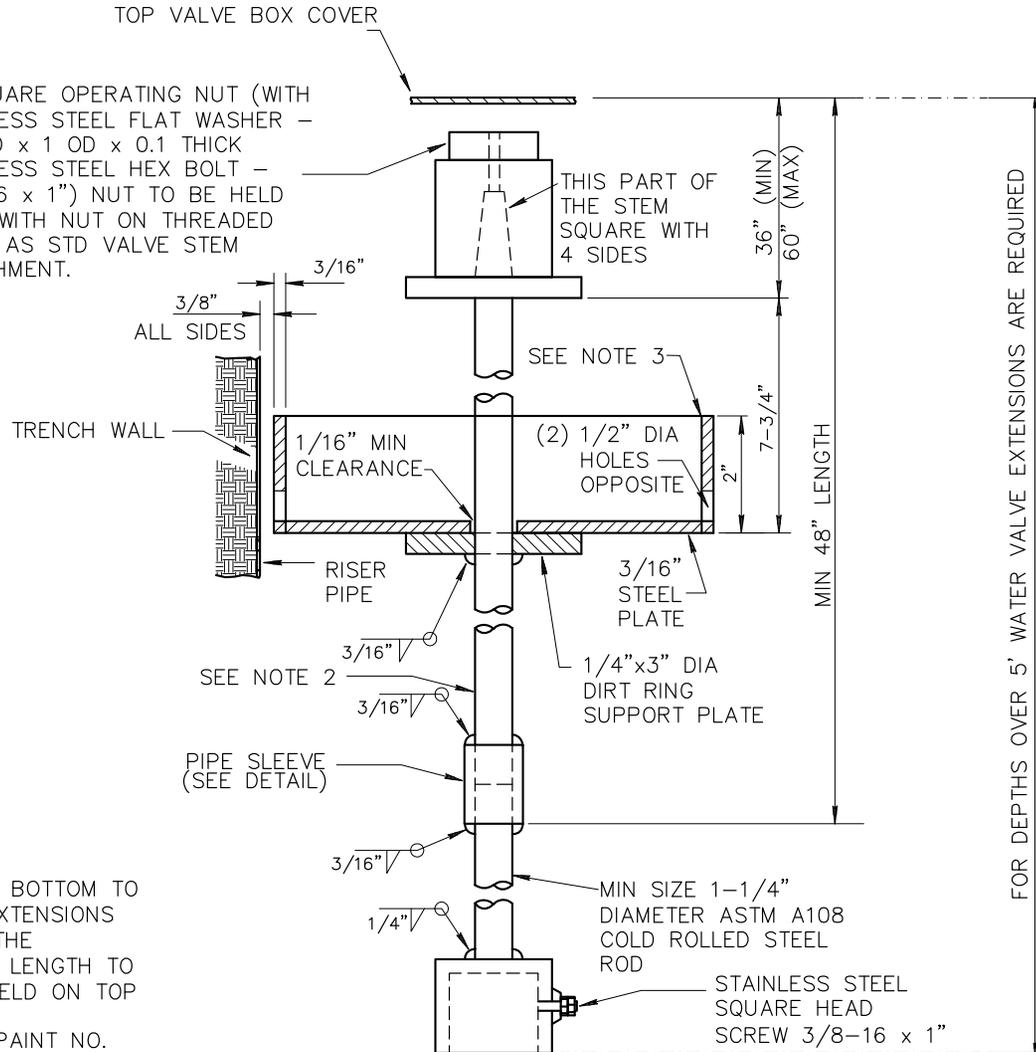
**SECTION A-A**

# PIPE SLEEVE DETAIL

MATERIAL: STEEL PER ASTM A513



2" SQUARE OPERATING NUT (WITH STAINLESS STEEL FLAT WASHER - 0.43 ID x 1 OD x 0.1 THICK STAINLESS STEEL HEX BOLT - 3/8-16 x 1") NUT TO BE HELD DOWN WITH NUT ON THREADED SHAFT AS STD VALVE STEM ATTACHMENT.



## NOTES:

1. EXTENSION STEM: WITH A SQUARE SOCKET ON THE BOTTOM TO FIT A 2" SQUARE VALVE OPERATING NUT. VALVE EXTENSIONS ARE REQUIRED ON ALL VALVES INSTALLED WHERE THE OPERATING NUT IS OVER 5' BELOW THE SURFACE. LENGTH TO FIT EACH INSTALLATION. OPERATING NUT TO BE HELD ON TOP OF EXTENSION WITH STOP NUT.
2. PAINTING: ALL STEEL TO HAVE A PRIME COAT OF PAINT NO. 1-D AND ONE HEAVY APPLICATION (FINISH COAT) OF PAINT NO. 9 AS PER SECTION 790.
3. DIRT RING TO FLOAT FREELY ON THE TOP OF THE SUPPORT PLATE.
4. PIPE SLEEVE SHALL BE SECURELY WELDED TO THE UPPER AND LOWER PORTION OF THE 1-1/4" EXTENSION ROD.

FOR DEPTHS OVER 5' WATER VALVE EXTENSIONS ARE REQUIRED

**NOTES:**

1. A CONCRETE COLLAR IS REQUIRED WHERE PIPES OF DIFFERENT DIAMETERS OR MATERIALS ARE JOINED, OR WHERE THE CHANGE IN ALIGNMENT OR GRADE EXCEEDS THAT ALLOWED FOR ON ORDINARY JOINTS.
2. WHERE PIPES OF DIFFERENT DIAMETERS ARE JOINED WITH A CONCRETE COLLAR, L AND T SHOULD BE THOSE OF THE LARGER PIPE.  $D=D-1$ , OR  $D-2$  WHICHEVER IS GREATER.
3. OMIT REINFORCING ON PIPE 24" OR LESS IN DIAMETER.
4. WHERE REINFORCING IS REQUIRED, THE DIAMETER OF THE CIRCULAR TIES SHALL BE THE OUTSIDE DIAMETER OF PIPE+T.
5. FIELD CLOSURES OF PIPE OF THE SAME DIAMETER AND WITHOUT CHANGE IN GRADE OR ALIGNMENT SHALL BE MADE WITH A CONCRETE COLLAR.
6. CONCRETE SHALL BE CLASS B PER SECT. 725.
7. ALL REBAR SHALL HAVE 3" MINIMUM CLEAR COVER.
8. PIPE ENDS TO BE TRIMMED SUCH THAT THE MAXIMUM DISTANCE BETWEEN PIPES AT ANY POINT IS 2".
9. AN ENGINEER APPROVED WATER STOP IS REQUIRED ON ALL PIPES EXCEPT CONCRETE PIPE.

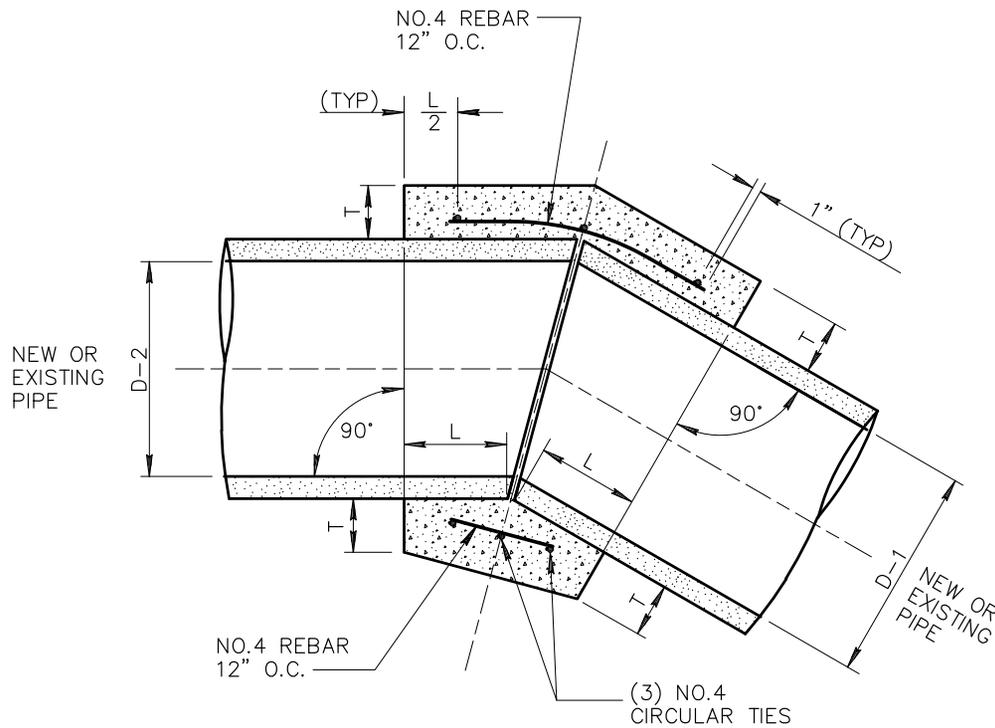


TABLE		
D	L	T
18"	1.0'	5"
24"	1.0'	6"
36"	1.5'	8"
57"	1.5'	10"
66"	1.75'	11"

FOR PIPE SIZES NOT LISTED AND LESS THAN 66" USE THE NEXT SIZE LARGER.

DETAIL NO.

505



STANDARD DETAIL  
ENGLISH

CONCRETE COLLAR FOR PIPE

REVISED

01-01-2018

DETAIL NO.

505

