

March 31, 2010

Members of the MAG Specifications and Details Committee

Jesse Gonzales, City of Peoria, Chairman

**SUBJECT: MEETING NOTIFICATION AND TRANSMITTAL OF AGENDA**

Wednesday, April 7, 2010 at 1:30 p.m.  
MAG Office, Second Floor, Cholla Room  
302 North First Avenue, Phoenix

A meeting of the MAG Specifications and Details Committee has been scheduled for the time and place noted above. Members of the MAG Specifications and Details Committee may attend the meeting either in person, by videoconference or by telephone conference call. If you have any questions regarding the meeting, please contact Committee Chair Jesse Gonzales at 623-773-7548 or Gordon Tyus, MAG staff at 602-254-6300.

Please park in the garage under the building, bring your ticket, parking will be validated. For those using transit, Valley Metro/RPTA will provide transit tickets for your trip. For those using bicycles, please lock your bicycle in the bike rack in the garage.

In 1996, the Regional Council approved a simple majority quorum for all MAG advisory committees. If the MAG Specifications and Details Committee does not meet the quorum requirement, no action can be taken. Your attendance at the meeting is strongly encouraged.

Pursuant to Title II of the Americans with Disabilities Act (ADA), MAG does not discriminate on the basis of disability in admissions to or participation in its public meetings. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Gordon Tyus at the MAG office. Requests should be made as early as possible to allow time to arrange the accommodation.

It is requested (not required) that written comments on active cases be prepared in advance for distribution at the meeting.

AGENDA

<u>ITEM</u>	<u>COMMITTEE ACTION REQUESTED</u>
1. <u>Call to Order</u>	1. No action required.
2. <u>Approval of March 3, 2010 Meeting Minutes</u>	2. Corrections and approval of March 3, 2010 minutes.
3. <u>2009 &amp; 2010 Cases</u>	3. Review of 2009 & 2010 cases. New cases.
4. <u>General Discussion</u>	4. Presentation by Ann Seiden of Southwest Gas on keyhole pothole repair. Open general discussion.
5. <u>Request for Agenda Items</u>	5. Request desired new agenda items
6. <u>Adjournment</u>	6. No action required.

MEETING MINUTES FROM THE  
MARICOPA ASSOCIATION OF GOVERNMENTS  
STANDARD SPECIFICATIONS AND DETAILS COMMITTEE

March 3, 2010

Maricopa Association of Governments Office, Cholla Room  
302 North First Avenue  
Phoenix, Arizona

AGENCY MEMBERS

Jim Badowich, Avondale	Mike Samer, Mesa
Scott Zipprich, Buckeye	Jesse Gonzales, Peoria, Chairman
Warren White, Chandler	Jeff Van Skike, Phoenix (St. Trans.)
Dennis Teller, El Mirage	Jami Erickson, Phoenix (Water)
* Edgar Medina, Gilbert	Mark Palichuk, Queen Creek
Tom Kaczmarowski, Glendale	Rodney Ramos, Scottsdale
Troy Tobiasson, Goodyear, Vice Chairman	Jason Mahkovtz, Surprise
Bob Herz, MCDOT	Tom Wilhite, Tempe

ADVISORY MEMBERS

John Ashley, ACA	* Jeff Hearne, ARPA
Jeff Benedict, AGC	Peter Kandararis, SRP
* Kwigs Bowen, NUCA	Paul R. Nebeker, Independent
Tony Braun, NUCA	Mike Smith, ARPA
* Brian Gallimore, AGC	

MAG ADMINISTRATIVE STAFF

Gordon Tyus

\* Members not attending or represented by proxy.

GUESTS/VISITORS

Tom Avanbuan, NUCA  
Joe Bacik, American Ductile Iron Pipe  
Phil Cisneros, Southwest Gas  
Jim Easterly, NUCA  
Kenny Pollock, Southwest Gas  
Mike Sanders, NUCA  
Ann Seiden, Southwest Gas

1. Call to Order

Chairman Jesse Gonzales called the meeting to order at 1:33 p.m.

2. Approval of Minutes

The members reviewed the February 3, 2010 meeting minutes. Bob Herz introduced a motion to accept the minutes as written. John Ashley seconded the motion. A voice vote of all ayes and no nays was recorded.

3. 2009 Cases (old cases)

**a. Case 09-13 – ADA-Compliant Dual Sidewalk Ramps:** Develop ADA-compliant details for 35-foot and 20-foot corner radius dual sidewalk ramps. Jesse Gonzales said he has continued to have discussions with the access board on the proposed details. He said they like directional ramps. He is waiting for additional feedback from the access board and committee members.

**b. Case 09-14 – Revise Ramps for ADA Compliance:** Revise Details 231, 232, 233 and 234 to obtain compliance with ADA requirements. Bob Herz provided an updated drawing for Detail 232 that corrected the title. The committee discussed the use of a concrete “sliver” in front of the detectable warning rather than trying to custom design or cut the curved arc in the detectable warning material, which would be difficult due to various radii used and the potential of cutting through a raised dome.

**c. Case 09-15 – Revisions to Section 610.4 for Water Line Handling:** Modify Section 610.4 to clarify water line pipe protection measures at the job site prior to placement (during storage or staging) to help prevent contamination. Joe Bacik of American Ductile Iron Pipe gave a short presentation on the various methods of capping pipe, and the problems they have had keeping ductile iron pipe capped. The complete presentation is available on the MAG web site at: <http://www.mag.maricopa.gov/detail.cms?item=11601>

Discussion during the presentation included reasons for capping end pipes. Mr. Tobiasson added that Goodyear tests for HPC, and keeping the pipe clean was necessary because of the limited water available for flushing. Other problems in our area that increased risk of contamination included watering the job site (and unprotected pipe) with reclaimed water for dust control, and dust storms that can coat the insides of unprotected pipe.

Mr. Bacik described difficulty capping ductile iron pipe due to the exterior texture, which kept tape from adhering properly, the bell shape of the pipe ends, and problems with other capping methods. He showed photos of plastic/foam end caps that came unglued in the heat (near Las Vegas) and popped off the pipe ends, causing a litter problem as well. His recommendation was to tarp the pipe in transit, and tarp it again at the job site. During installation he recommended checking and cleaning out the pipe before laying, and capping ends of unfinished sections.

Mr. Bacik also answered questions from Mr. Gonzeles on the storage of pipe at distributors, and about the rejection of a particular shipment. He said that currently distributors and their own storage yards do not tarp pipe, and that pipe can become discolored after sitting at a distributor for some time, but that would not affect the performance of the pipe, and that most pipe is shipped directly to the project site.

4. 2010 Cases (new cases)

**d. Case 10-01a – Miscellaneous Bloopers:** Correct typographic errors in Section 317 Asphalt Milling. No comments were provided.

**e. Case 10-02 – Utility Pothole Repair:** Revise and add keyhole repair to Detail 212 and add new Sections 355 and 708. Warren White provided copies of an article from the APWA Reporter on “Keyhole coring and replacements: the right solution for right-of-way owners.” Peter Kandaris provided draft Section 355 Keyhole Potholes and Section 708 Keyhole Bonding Materials, as proposed new specifications. These would describe the process and materials used in more detail than previously provided on Detail 212. He also said that Detail 212 would be updated to reference these specifications.

Jeff Van Skike asked if the keyhole process was used only for gas line repair. Kenny Pollock from Southwest Gas said the process could be used for other utilities, and he was aware of its use by a Las Vegas water district.

Other members discussed the possibility of using the keyhole repair technique for standard pothole repair. Jim Badowich asked about the possibility of saw cutting square sections and replacing them using the same technique and bonding agent. Concerns were raised about corner cracking.

Peter Kandaris said these draft specifications were originally developed by the City of Toronto, and suggested that committee members provide their feedback to have them reflect or local conditions other potential uses. He said the draft specifications allowed different sized keyholes and CLSM could be used for backfill.

Ann Sieden of Southwest Gas agreed to give a short presentation on the process to committee members at the April 7, 2010 meeting.

**f. Case 10-03 – Modify Section 336 Pavement Matching and Surfacing Replacement:** Revise Section 336 to be in conformance with changes made last year to Detail 200-1. Peter Kandaris introduced a case to make changes to Section 336 Pavement Matching and Surfacing Replacement to match the new requirements of Detail 200-1 Backfill, Pavement and Surface Replacement. He also plans to fix minor errors on the detail. Due to the large number of supplements and changes needed in this section, it was determined that last year’s case focus on updating the detail drawing. The new case updates the specifications to be consistent with the revised detail. Mr. Kandaris also

reorganized sub-section 336.2.4.1 to be in a more logical order. He also said that a color version would be distributed that made the changes and revisions easier to see. He asked the committee to review the case and offer suggestions and corrections.

**g. Case 10-04 – Revise Section 109.8:** Remove quotations of Arizona Revised Statutes from text located in Section 109.8 PAYMENT FOR DELAY. Due to changes in ARS language, the quote in Section 109.8.1 is no longer accurate. Bob Herz submitted this new case to update the MAG specifications by removing quotations that referred to previous Arizona statutes. In addition to the noted corrections, he supplied the new and old ARS sections for reference.

**h. Case 10-05 – Revise FOREWORD:** The purpose of this change is to clarify use of the MAG Specifications and Details for Public Works document. Jesse Gonzales submitted draft revisions to the Foreword of the MAG Specification book that he and Peter Kandaris had worked on. The sections in red were suggested changes by Mr. Kandaris, who described the rationale to clarify who and what purposes the specifications were designed for. It also emphasized the importance of professional review and engineering in their application. The blue text indicated suggested addition by Mr. Gonzales. He said revising the Foreword was cathartic, but that it was only an initial draft to generate comments from and participation by the committee.

Mr. Gonzales also provided a draft Foreword to a proposed document that supplements the MAG Specifications for “Public Works Construction Not in the Right of Way.”

## 5. General Discussion:

### *American Society for Testing and Materials (ASTM) Access*

Jesse Gonzales said he was investigating with a representative of ASTM the possibility of setting up a region-wide web portal that would allow all agencies access to the latest ASTM standards. Since the MAG Specifications frequently reference ASTM – and many jurisdictions do not have, or cannot afford a subscription – difficulties could arise over disputes that involve references to ASTM standards. Mr. Gonzales thinks that by pooling resources, it may be more affordable for members and provide better access and collaboration. Peter Kandaris said that SRP has a subscription that limits the number of downloads, and Michael Smith said they have access, but only to a few specific books. It was agreed to continue to pursue the issue.

### *MAG Trash Rack Detail 502-2*

Peter Kandaris brought in a copy of a Trash Rack Detail that SRP uses in addition to the MAG details. Jesse Gonzales noticed that the SRP detail avoids the problem of trash going around the sides of the rack. He plans to review and distribute the detail to members as reference material to make possible modifications to MAG Detail 502-2.

*Army Corp of Engineers Research on Pavement Cuts*

Jeff Van Skike asked if any members remembered a study that was being done about 5-6 years ago by the Army Corp of Engineers Cold Weather Research Lab on the effects of utility cuts on pavement durability. He recalled MAG had some initial involvement in the study and was wondering if anyone knew what the outcomes were. Peter Kandarlis said he recalled the topic and said he has a comprehensive file created during the utility cut evaluation process that has more information.

Mr. Van Skike also announced that due to Phoenix cut-backs he may be offered an early retirement package, and if so, it may be his last committee meeting.

*Reflective Street Markers*

Bob Herz asked Rod Ramos if he would be willing to present Scottsdale Detail 2363 as a case or provide the detail drawing. Mr. Ramos said their details were available on their web site. Mr. Herz said he plans to review the detail as a potential case for inclusion in MAG.

6. Adjournment:

The meeting was adjourned at 3:07 p.m.

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February 2010

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## 2010 PROPOSED REVISIONS TO MAG SPECIFICATIONS AND DETAILS

(Updated information can be found on the website: <http://www.mag.maricopa.gov/detail.cms?item=11284> )

CASE	DESCRIPTION	PROPOSED BY	MEMBER	SUBMITTAL DATE Last Revision	VOTE DATE	VOTE	
09-13	<a href="#">Case 09-13</a> : Dual Curb Ramp Details	Peoria	Jesse Gonzales	07/01/2009 02/03/2010		0 0 0	Yes No Abstain
09-14	<a href="#">Case 09-14</a> : Revise Ramps for ADA Compliance, Details 231, 232, 233 and 234	MCDOT	Bob Herz	07/01/2009 03/03/2010		0 0 0	Yes No Abstain
09-15	<a href="#">Case 09-15</a> : Revisions to Section 610.4: Pipe Protection	Tempe	Tom Wilhite	07/01/2009		0 0 0	Yes No Abstain
10-01	<a href="#">Case 10-01</a> : Miscellaneous Bloopers: A. Section 317 Asphalt Milling	MCDOT	Bob Herz	01/06/2010		0 0 0	Yes No Abstain
10-02	<a href="#">Case 10-02</a> : Utility Pothole Repair: Revise and add keyhole repair to Detail 212. New Sections 355 and 708.	Chandler	Warren White	02/03/2010 03/03/2010		0 0 0	Yes No Abstain
10-03	<a href="#">Case 10-03</a> : Modifications Section 336 Pavement Matching and Surfacing Replacement	SRP	Peter Kandarlis	03/03/2010		0 0 0	Yes No Abstain
10-04	<a href="#">Case 10-04</a> : Revise Section 109.8: Remove quotations of ARS from text located in Section 109.8 PAYMENT FOR DELAY.	MCDOT	Bob Herz	03/03/2010		0 0 0	Yes No Abstain
10-05	<a href="#">Case 10-05</a> : Revise FOREWARD to clarify use of the <i>MAG Specifications and Details for Public Works Construction</i> document	Peoria	Jesse Gonzales	03/03/2010		0 0 0	Yes No Abstain
10-06	Case 10-06: Revise Controlled Low Strength Materials Specifications in Sections 604, 701 and 728.	ARPA Peoria	Jeff Hearne	04/07/2010		0 0 0	Yes No Abstain
10-07						0 0 0	Yes No Abstain

\* Case was approved with verbal modifications at time of voting.



**Chandler • Arizona**  
*Where Values Make The Difference*

**MEMORANDUM**

**Case # 10-02**

**DATE:** February 3, 2010

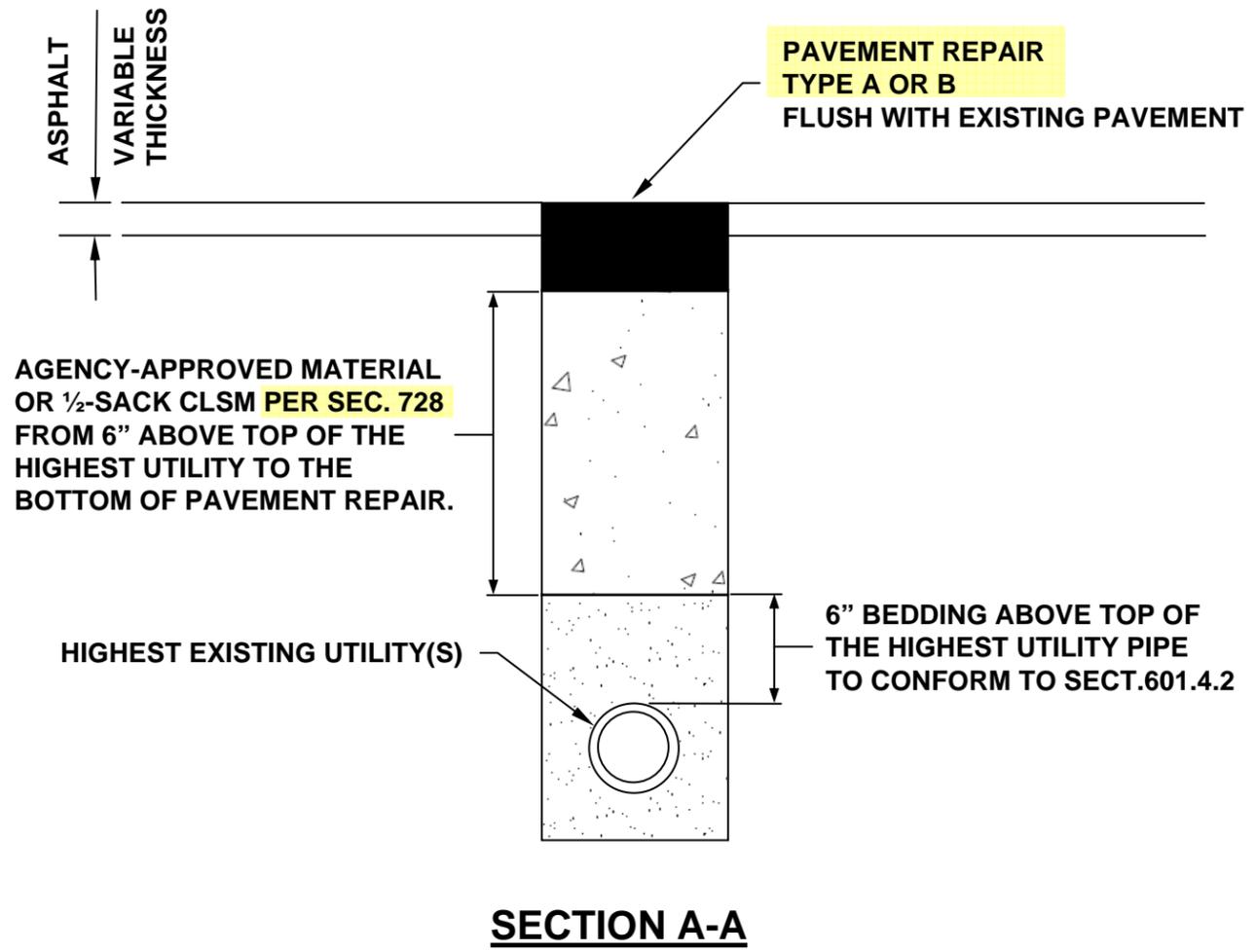
**TO:** MAG Specifications and Details Committee Members

**FROM:** Warren White, City of Chandler Representative

**SUBJECT:** Modifications to Detail 212: Utility Pothole Repair, Keyhole Repair Option

Attached is a revision to Detail 212 reorganizing and adding a Type B - Keyhole Repair option. The changes also include a spelling correction and addition of a MAG section backfill material reference. This repair methodology has been in place for a number of years and has been used within multiple municipalities within the Valley. The City of Chandler is currently accepting this technology on a case-by-case basis and wishes to have a standard in place. Our preference would be to incorporate this option into a MAG detail in lieu of adding supplemental agency standards.

Keyhole pavement cutting technology is a cleaner, quicker way to cut city streets in order to access underground facilities. The process involves cutting an 18-24" core, then backfilling the hole with native soil (or agency specific requirements) and reinstating the original core by bonding it to the cut pavement. The process is complete after a few hours at which time traffic lanes can be re-opened.

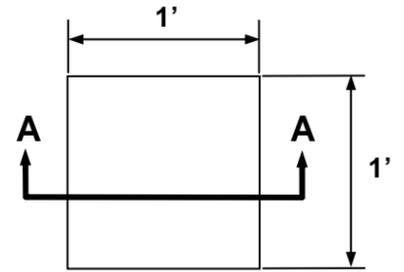


**TYPE B – KEYHOLE REPAIR**

**NOTES:**

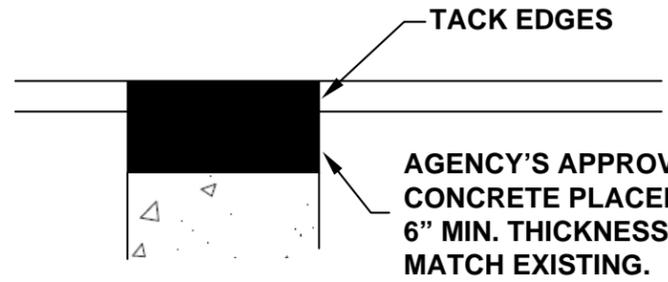
1. CUT AND REMOVE PAVEMENT PLUG WITH AN APPROVED KEYHOLE CORING DEVICE. PAVEMENT TO BE CORED SHALL CONTAIN NO CRACKS AND SHALL BE AT LEAST 4" THICK.
2. BONDING MATERIAL SHALL BE A SINGLE COMPONENT CEMENTITIOUS, RAPID HARDENING, HIGH STRENGTH, WATERPROOF BONDING AGENT THAT ALLOWS THE CORE ABLE TO SUPPORT AT LEAST TWO TIMES AASHTO H-25 LOADING WITHIN 30 MINUTES OF APPLICATION. BOND AGENT MUST SHOW A MINIMUM 20 PSI BOND STRENGTH (ASTM C882) AND A MINIMUM 200 PSI COMPRESSIVE STRENGTH (ASTM C109) IN 30 MINUTES.
3. AGENCY-APPROVED BACKFILL BELOW REPAIR SHALL BE ABC, GRANULAR, OR NATIVE SOIL PER SECTIONS 702 AND 601 PLACED IN MAXIMUM 10-INCH LOOSE LIFTS.
4. FILL KEYHOLE WITH BONDING MATERIAL DURING REPAIR.

**TYPE A – CUT & PATCH REPAIR**

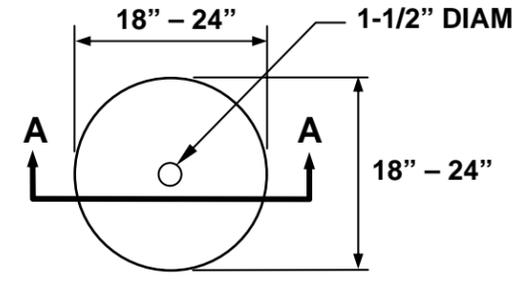


NOTE: EDGES SHALL BE CUT TO A NEAT VERTICAL FACE.

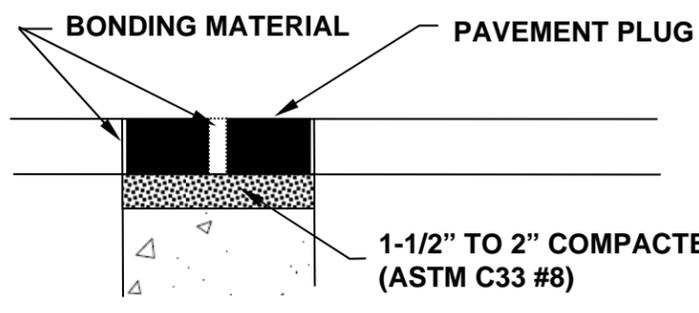
**POT HOLE PLAN VIEW**  
(NOMINAL DIMENSIONS)



**POT HOLE PROFILE**



**POT HOLE PLAN VIEW**  
(NOMINAL DIMENSIONS)



**POT HOLE PROFILE**

## **SECTION 355 KEYHOLE POTHoles**

### **355.1 DESCRIPTION:**

This specification covers the requirements for keyhole coring, vacuum excavation, backfilling, and reinstatement of the keyhole core in asphalt concrete pavements to allow for underground utility repairs.

### **355.2 KEYHOLE EXCAVATION**

Keyhole excavation shall be the operation of coring a circular hole through the roadway pavement using diamond drilling/coring equipment to remove the asphalt concrete courses of flexible pavement. The vertical alignment of the keyhole-coring saw shall be perpendicular to the horizon and the cutting shall be extended to the full depth of the existing pavement section.

Unless otherwise approved by the Engineer, keyhole cores shall not be greater than 24 inches in diameter, shall not be closer than 3 feet from each other (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8-inch wide, and shall not be performed in pavements where the asphalt concrete section is less than 4 inches thick.

Cuts shall be performed with an approved keyhole-coring saw.

Contractor shall place a temporary mark (paint or chalk) on the keyhole core prior to cutting to insure that the keyhole core is replaced in the same orientation as originally found in the pavement.

Pavement cores shall be either removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for restoring the keyhole.

Soils within potholes shall be removed by air/vacuum extraction methods to expose utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the core hole.

The Contractor shall remove all materials excavated by keyhole excavation off site at their expense.

### **355.3 BACKFILL AND COMPACTION**

**355.3.1 Backfill Using Mechanical Compaction:** Agency-approved backfill below repair shall be ABC, granular, or native soil per Sections 702 and 601 placed in maximum 10-inch loose lifts.

Backfill compaction quality shall be determined by use of a compression wave amplitude monitoring device manufactured specifically for the purpose of measuring soil compaction. This device shall measure the compression wave amplitude as compaction progresses using below-

grade disposable piezoelectric transducer wave sensors and an above-grade electronic monitor. The device shall signal the operator of successful compaction when the compaction wave amplitude becomes asymptotic to continued compaction effort for each lift.

Backfill soil shall be compacted to within 3 percent of optimum moisture content. Moisture content shall be determined in accordance with AASHTO T-217.

Place a disposable compaction sensor at the bottom of the first loose lift. A new sensor shall be placed for every 48 inches of compacted fill depth. Remove backfill soil and sensor if the disposable sensor fails during compaction and repeat repairs with a new sensor.

Mechanical compaction on each lift shall be continued until the electronic monitor signals that compaction is complete. A new lift shall not be placed until a positive signal has been received. Remove backfill soil and sensor if the monitor does not give a positive compaction signal after repeated compaction work.

**335.3.2 Slurry Backfill:** In lieu of backfill using mechanical compaction, the Contractor shall use ½-sack CLSM in accordance with MAG Section 728.

**335.3.3 Leveling Course:** A 1-1/2-inch to 2-inch thick leveling course of compacted crushed gravel meeting the requirements of ASTM C33, No. 8 coarse aggregate shall be placed above the backfill and directly below the asphalt concrete pavement section.

#### **355.4 PAVEMENT RESTORATION**

The surface cut by keyhole coring shall be restored to its original condition with the reinstated core flush with and in the original orientation as the existing surface, matching existing asphalt concrete surface appearance.

Bonding agent meeting the requirements of MAG 708 shall be used for keyhole core reinstatement. Excess bonding material shall be removed from the restored surface. A "patched" appearance shall be avoided in surface restoration wherever possible.

Unless otherwise approved, the contractor shall reinstate the bonded keyhole core within 24 hours of cutting the pavement. Keyhole openings allowed to be left open greater than 24 hours of cutting shall be covered with an approved steel road plate capable of supporting traffic loads. The steel plate must be rounded with a fitted collar that, when inserted into the keyhole, will prevent the hole cover from tipping, tilting, bouncing or spinning out of the hole under traffic conditions. An asphalt mix shall be used to ramp pavement up to the steel plate along all edges.

#### **355.5 SURFACE TOLERANCES**

The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16-inch between the bottom of a minimum 3-foot long straightedge and the surface of the pavement in any direction on the surface of the keyhole core, except across the crown or drainage gutters.

### **3.5.6 DEFICIENCIES**

Where the keyhole core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstating the keyhole cuts, the defective or damaged core shall not be used to reinstate the pavement. Pavement at damaged keyhole core locations shall be cut and patch repaired in accordance with MAG Detail 211, Type A.

A keyhole core is considered unacceptable when one of the following conditions exist:

- a) The keyhole core contains any vertical cracks wider than 1/8-inch extending full depth or partial depth through the core; or
- b) Any deteriorated piece of the keyhole core is larger than 10 percent of the overall area of the keyhole core.
- c) Two or more successive layers of asphalt concrete in the keyhole core become horizontally delaminated and cannot be rebounded to each other with the bonding compound.

All keyhole cores that are damaged or do not meet the surface tolerances shall be removed from the job site at the Contractor's expense. All repair work shall be at the Contractor's expense.

### **355.6 MEASUREMENT**

Measurement will be made for each reinstated keyhole core up to 24 inches in diameter.

### **355.7 PAYMENT**

Payment at the contract price for the above item shall be full compensation for all labor, equipment and material required to do the work including traffic control, coring, sawcutting, vacuum excavation, backfill material, bonding material and asphalt concrete.

**SECTION 708  
KEYHOLE BONDING MATERIALS**

**708.1 GENERAL:**

This specification covers the materials required to bond undamaged keyhole cores to the asphalt concrete pavement from which it was originally removed as shown in MAG Detail 211, Type B.

**708.2 MATERIALS:**

Bonding material shall be a single component cementitious, rapid hardening, high strength, waterproof bonding agent conforming to the physical properties shown in Table 708-1.

<b>Table 708-1</b>		
<b>Bond Material Properties</b>		
<b>Property</b>	<b>ASTM Test Method</b>	<b>Requirements</b>
Bond Strength, psi	C882	20 min.
Compressive Strength, psi, (70 degrees F., 30 minute cure)	C109	200 min.

Bonding material shall be impervious to water penetration at the joint after application. The bonding material is required to securely bond the undamaged keyhole core to the pavement or sidewalk and to fill the annular space at the joint.

**708.3 FIELD TESTING OF BONDING MATERIAL**

Bonding material shall, within 30 minutes at minimum ambient temperature of 70 degrees F., allow the core to support an equivalent traffic load condition of at least three (3) times the AASHTO H-25 standard.

**708.4 TEST REPORT AND CERTIFICATION**

Specifications for the bonding material shall be submitted to the Agency for review and approval before use.



P.O. Box 52025  
Phoenix, AZ 85072-2025  
(602) 236-5900

Case # 10-\_\_\_\_\_

DATE: March 3, 2010

TO: MAG Specifications and Details Committee Members

FROM: Peter Kandarlis, SRP Representative

RE: **Modifications Section 336 Pavement Matching and Surfacing Replacement**

The attached specification section revisions are proposed to bring Section 336 in conformance with changes made last year to Detail 200. The case is proposed at the request of the Committee. Minor additions and typographical corrections are also included and are detailed below:

- Section 336.1 is modified to note trench repair types shown in Detail 200 as it was revised last year and provide a reference to Detail 200.
- A new sentence is added to 336.2.2 which limits the time between temporary and permanent trench patch repair.
- Section 336.2.4 is completely re-organized to more simply describe pavement section repair, be consistent with language in Detail 200, be consistent with asphalt concrete mix type designations in Section 710, reference Section 321 for placement and compaction methods, correct typos, include surface tolerance requirements, and change surface seal repair from chip seal to slurry seal.
- Sections 336.3 and 336.4 are revised to be consistent with Detail 200.

## SECTION 336

## PAVEMENT MATCHING AND SURFACING REPLACEMENT

## 336.1 DESCRIPTION:

Street and alley pavement and surfacing within the Contracting Agency's rights-of-way, removed by construction activities or to be widened or matched in connection with the improvement of Public Works, shall be placed as shown on the plans and applicable standard details, in accordance with this specification and/or the special provisions.

Asphalt concrete pavement replacement shall be constructed in accordance with Type A, B, ~~D or E~~ <sup>or T-Top</sup> of standard details, as indicated in the Contracting Agency Special Provisions or on the plans, ~~and as required by Sections 321 and 710.~~ <sup>Standard Detail 200 and</sup>

Portland cement concrete pavement replacement shall be in accordance with Type C of the Standard Details, <sup>200</sup> and as required by Sections ~~505 and 725,~~ 324.

~~ABC or decomposed granite~~ <sup>All other</sup> surface replacement shall be constructed in accordance with Type ~~F~~ <sup>E</sup> of standard details, as indicated in the Contracting Agency Special Provisions or on the plans ~~and in Section 702.~~ <sup>in the right-of-way but not in paved roadways</sup> ~~D~~ of Standard Detail 200 and

Temporary pavement replacement shall be constructed as required ~~below.~~ <sup>herein</sup>

Pavements to be matched by construction of new pavements adjacent to or at the ends of a project shall be saw cut in accordance with these specifications and where shown on the plans.

Pavement and surfacing replacement within ADOT rights-of-way shall be constructed in accordance with their permits and/or specification requirements.

## 336.2 MATERIALS AND CONSTRUCTION METHODS:

Materials and construction methods used in the replacement of pavement and surfacing shall conform to the requirements of all applicable standard details and specifications, latest revisions.

**336.2.1 Pavement Widening or Extensions:** Existing pavements which are to be matched by pavement widening or pavement extension shall be trimmed to a neat true line with straight vertical edges free from irregularities with a saw specifically designed for this purpose. The minimum depth of cut shall be 1 1/2 inches or D/4, whichever is greater.

The existing pavement shall be cut and trimmed after placement of required ABC and just prior to placement of asphalt concrete for pavement widening or extension, and the trimmed edges shall be painted with a light coating of asphalt cement or emulsified asphalt immediately prior to constructing the new abutting asphalt concrete pavements. No extra payment shall be provided for these items and all costs incurred in performing this work shall be incidental to the widening or pavement extension.

The exact point of matching, termination, and overlay may be adjusted in the field, if necessary, by the Engineer or designated representative.

**336.2.2 Pavement to be Removed:** Existing asphalt pavement to be removed for trenches or for other underground construction or repairs shall be cut by a device capable of making a neat, straight and smooth cut without damaging adjacent pavement that is not to be removed. The Engineer's decision as to the acceptability of the cutting device and manner of operation shall be final. If saw cutting, only, is to be utilized, it will be so specified in the plans or special provisions.

In lieu of cutting trenches across driveways, curbs and gutters, sidewalks, alley entrances, and other types of pavements, the Contractor may, when approved by the Engineer, elect to tunnel or bore under such structures and pavements.

When installations are within the street pavement and essentially parallel to the center line of the street, the Contractor, with approval of the Engineer, may elect to bore or tunnel all or a portion of the installation. In such installations, the seal coat requirements, as discussed in Section 336.2.4, will be modified as follows:

## SECTION 336

(A) If the pavement cuts (bore pits, recovery pits, etc.) are 300 feet or more apart, the bore or tunneled distance will not be considered as part of the open trench and the seal coat may not be required.

(B) If the pavement cuts (bore pits, recovery pits, etc.) are less than 300 feet apart, the distance between the cuts will be considered the same as a trench cut and the distance will be added to any trench cut distances.

**336.2.3 Temporary Pavement Replacement:** Temporary pavement replacement, as required in Section 601, may be with cold-mix asphalt concrete, with a minimum thickness of 2 inches, using aggregate grading in accordance with Section 710.

← Permanent pavement replacement shall replace temporary repairs within 5 working days after completion of temporary work.

Temporary pavement replacement shall be used in lieu of immediate placement of single course permanent replacement or the first course of two course pavement replacement only on transverse lines such as spur connections to inlets, driveways, road crossings, etc., when required by the Engineer, by utilities or others who subcontract their permanent pavement replacement, under special prior arrangement; or for emergency conditions where it may be required by the Engineer. Temporary pavement replacement shall be placed during the same shift in which the backfill to be covered is completed.

Rolling of the temporary pavement replacement shall conform to the following:

(A) Initial or breakdown rolling shall be followed by rolling with a pneumatic-tired roller. Final compaction and finish rolling shall be done by means of a tandem power roller.

(B) On small areas or where equipment specified above is not available or is impractical, the Engineer will approve the use of small vibrating rollers or vibrating plate type compactors provided comparable compaction is obtained.

The surface of the temporary pavement shall be finished off flush with the adjacent pavement.

#### 336.2.4 Permanent Pavement Replacement and Adjustments:

(336.2.4.1: rearranged existing text in red – proposed new text in green)

~~**336.2.4.1 Permanent Pavement Replacement:** Pavement replacement for cuts essentially parallel to the street centerline and greater than 50 feet in length shall be two course pavement replacement as hereinafter specified. For cuts greater than 600 feet in length the entire area shall then be seal coated in accordance with Section 330 (coated chips) or as otherwise specified. This seal coat shall extend from the edge of pavement or lip of gutter to the street centerline except that on residential streets less than 36 feet face to face of curb or where the pavement patch straddles the centerline, the entire width of street shall be seal coated.~~

**336.2.4.1 Permanent Pavement Replacement:** Pavement replacement for longitudinal trenches cuts (essentially parallel to traffic the street centerline) greater than 50 feet in length and transverse cuts of any length shall be at least a two-course pavement replacement as specified herein. Pavement replacement for longitudinal trenches cuts parallel to the street centerline less than 50 feet in length, transverse cuts, bell holes and similar small areas may be a single course provided the layer thickness complies with requirements of Section 321.5.4. All pavement replacement shall match gradation and thickness of the existing pavement. These one course Pavement patches replacement shall be compacted with a vibratory roller to the same density specified for asphalt concrete pavements in Section 321.

~~In lieu of placing the seal coat as required previously, and with approval of the Contracting Agency, the Contractor may deposit with the Contracting Agency for credit to the Street Maintenance Department, a negotiated agreed upon amount. The Street Maintenance Department will incorporate this work into their street maintenance program.~~

Unless otherwise noted, pavement replacement shall comply with the following:

~~Pavement replacement for cuts parallel to the street centerline less than 50 feet in length, transverse cuts, bell holes and similar small areas shall match gradation and thickness of the existing pavement. These one course pavement patches shall be compacted with a vibratory roller to the same density specified for asphalt concrete pavements.~~

(A) Single course pavement replacement shall consist of a 1/2" or 3/4" mix 12.5 mm or 19 mm mix placed and finished as directed by the Engineer in accordance with Section 710.

~~Laying of single course or the base course of the asphalt concrete pavement replacement where a two course replacement is applicable shall never be more than 600 feet behind the ABC placed for the pavement replacement.~~

(B) The base course(s) of two a multi-course pavement replacement shall consist of a 3/4" 19 mm mix in accordance with Section 710.

~~The trench must be compacted to its required density, and required ABC must be in place prior to the placement of the asphalt concrete.~~

(C) The surface course of a multi-course pavement replacement shall consist of a 9.5 mm 3/8" or 1/2" mix in accordance with Section 710 as specified by the Engineer to match the existing surface. The surface course shall not be placed sooner than 2 weeks after the base course, except where the trench crosses a signalized intersection. In this case the surface course shall be placed within 48 hours, or the crossing pavement replacement shall be a single course as specified above.

~~Single course replacement shall consist of a 12.5 mm or 19 mm mix placed and finished as directed by the Engineer.~~

(D) Where the base course is to be placed with non-compactive equipment, it shall be not less than 2 inches in thickness and the material shall be immediately rolled with a pneumatic-tired roller. The surface course shall be of sufficient depth to provide the total required compaction thickness of the two courses, but not more than 1 inch.

~~The base course of two course pavement replacement shall consist of a 19 mm mix in accordance with Section 710.~~

SECTION 336

(336.2.4.1 continued: Rearranged existing text in red – proposed new text in green)

~~Where the base course is to be placed with non-compactive equipment, it shall be not less than 2 inches in thickness and the material shall be immediately rolled with a pneumatic-tired roller. The surface course shall be of sufficient depth to provide the total required compacted thickness of the two courses, but not more than 1 inch.~~

~~Where the trench is 6 feet or more in width, all courses, single or both courses of the two course pavement replacement, shall be laid with a self-propelled compacting, spreading equipment. When the trench is from 6 to 8 feet in width, the self-propelled compacting, spreading equipment shall not be wider than 8 feet. All courses, except the surface course, shall be of a compacted thickness of not less than 1 1/2 inches.~~

~~The surface course shall consist of a 9.5 mm mix in accordance with Section 710 as specified by the Engineer to match the existing surface. The surface course shall not be placed sooner than 2 weeks after the base course, except where the trench crosses a signalized intersection. In this case the surface course shall be placed within 48 hours, or the crossing pavement replacement shall be single course as specified above.~~

~~Placement of the surface course is to be by means which will result in a surface texture satisfactory to the Engineer, and flush with the existing pavement.~~

~~Where deep lift asphalt concrete (asphalt concrete base and asphalt concrete wearing course) exists, the base course replacement shall be made in lifts not exceeding 6 inches in compacted thickness to within 1/2 inch of the finish grade.~~

**336.2.4.2 Adjustments:** When new or existing manholes, valves, survey monuments, clean outs, etc. fall within the limits of the permanent pavement replacement as discussed in this Section, the Contractor shall be responsible for adjusting the various items to the new pavement surface or as directed by the Engineer. This will include but not be limited to slurry and chip seals.

The Contractor will coordinate with the Engineer and with representatives of the various utilities regarding the adjustment and inspection of the work. The Contractor shall be responsible for obtaining and complying with all specifications, special requirements, details, etc. of the Utility Company regarding the adjustments. When adjusting the Agency's utilities, survey monuments, etc., the adjustment will comply with these Specifications and Details.

The work will be done in compliance with OSHA standards and regulations regarding confined space entry.

The Contractor shall remove all material attached to the lids and/or covers including that of prior work. The method of removal shall be approved by the Engineer and/or the Utility Representative.

**336.3 TYPES AND LOCATIONS OF PAVEMENT AND SURFACING REPLACEMENT:**

Normally, the type of pavement replacement and backfill required will be noted on the plans or specified in other portions of the contract documents and construction will be in accordance with Detail 200. ~~This detail requires that a 12 inches "T" Top be utilized when normal traffic flow is perpendicular to any one of the four sides of the trench excavation. Therefore, Type A pavement replacement will require a "T" Top whenever the trench crosses a street or goes through an intersection and at the end(s) if they terminate in the street. Type B pavement replacement will require the "T" Top on the sides that are perpendicular to normal traffic flow.~~

Details 200-1 and 200-2.

Placed as Notes 6, 7 and 8 in Detail 200-1 in 2009

If a type is not noted on the plans or specified in the special provisions, the following criteria will govern:

Type A ~~pavement replacement, including the "T" Top,~~ <sup>trench repair</sup> will be utilized on all streets where the excavation is ~~parallel to the centerline of the street.~~ <sup>essentially longitudinal or parallel to traffic.</sup>

Type B ~~pavement replacement, including the "T" Top,~~ <sup>T-top trench repair</sup> will be utilized on all streets where the excavation is ~~transverse to the centerline of the street.~~ <sup>essentially transverse or not parallel to traffic, including trenches that go through an intersection.</sup> Type B trench repair may be used to repair transverse trenches if specified by the Agency.

Type C ~~pavement replacement~~ <sup>trench repair</sup> will be used to match existing portland cement concrete pavement.

Type D ~~pavement replacement~~ <sup>trench repair</sup> will be utilized to repair asphalt concrete, portland concrete and aggregate surfaces in the right-of-way, but not in paved roadways. It may also ~~A or B.~~ Prior written approval of the Engineer is required. <sup>for this condition.</sup>

## SECTION 336

~~Type F pavement replacement will be utilized to match existing ABC or decomposed granite roadways.~~

Where a longitudinal trench is partly in pavement, the pavement shall be replaced to the outside edge of the existing pavement, on a straight line, as indicated on the plans. Measurements for payment shall be from the inner limit of pay width allowed below, to the outside edge of the existing pavement as defined herein.

Where no part of a trench is in pavement, surfacing replacement will only be specified where existing surfacing materials have been removed.

When a trench cut is in aggregate surfaced area, the surfacing replacement shall be of a like type and depth as the existing material, compacted to the densities required in Section 601.

**336.4 MEASUREMENT:**

Measurement for payment and surfacing replacement shall be by the square yard, based upon actual field measurement of the area covered except as noted below.

(A) In computing pay quantities for replacement Types ~~A, B, and F~~ <sup>B and E</sup>, pay widths will be based on the actual field measured width, however the boundaries of the measurement will not extend further than 1/2 the distance, either side, from the centerline of the pipe as depicted on Table 601-1, Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel.

(B) In computing pay quantities for replacement Types ~~C, D, E, and T~~ <sup>T-Top, A, C and D</sup>, pay widths will be based on the actual field measured width, however the boundaries of the measurement will not extend further than 1/2 the distance plus 12 inches, either side, from the centerline of the pipe as depicted on Table 601-1, Maximum Width At Top Of Pipe Greater Than O.D. Of Barrel.

(C) Where a longitudinal trench is partly in pavement, computations of pay quantities shall be based on the limitations specified above.

(D) The length of pavement and surfacing replacement shall be measured through any manhole, valve box, or other structure constructed in the pipe line, and any pavement or surface replacement and/or seal treatment in excess of the above pay widths shall be considered and included in the bid item for such structure.

(E) Any pavement replacement in excess of the specified pay widths necessitated by the installation of valves, tapping sleeves and valves, valve by-passes, and concrete thrust blocks shall be included in the bid price for these items.

(F) When special provisions allow deviations from the trench widths specified in Section 601, the above allowed pay widths for pavement replacement may be altered where so specified.

(G) Measurement of pavement and surfacing replacement shall be made along the finished surface of the ground to the nearest foot, and shall be computed to the nearest square yard.

**336.5 PAYMENT:**

Direct payment for pavement or surfacing replacement will be made for replacement over all pipe trench cuts except as otherwise allowed in the special provisions. Payment for replacements over other work shall be included in the cost of constructing that work, in accordance with the applicable standard details and specifications.

Payment for temporary pavement replacement shall be included in the cost of the pipe.

When a Contractor has the option of either jacking and/or boring or opencut construction, and elects to construct a pipeline by the jacking and/or boring method, he will be paid for the replacement of such items of work as pavement, curb and gutter, sidewalk, driveway, and alley entrances, as allowed for opencut construction.

————— End of Section —————



**MARICOPA COUNTY**  
*Department of Transportation*

MEMORANDUM

**Date:** March 3, 2010

**To:** MAG Specifications and Details Committee

**From:** Robert Herz, MCDOT Representative

**Subject:** Obsolete quotations of Arizona Revised Statutes in Section **Case 10-04**  
109.8 PAYMENT FOR DELAY

**PURPOSE:** Remove quotations of Arizona Revised Statutes from text located in Section 109.8 PAYMENT FOR DELAY.

**REVISION:** Revise wording in section 109.8 as indicated below:

**109.8 PAYMENT FOR DELAY:**

The procedures contained in this Section shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

**109.8.1 Failure to Locate or Incorrect Location of Utilities:** Arizona Revised Statutes 40-360.28 states ~~“indicates~~ that if ~~a person~~~~the~~ (owner, ~~or~~ operator, ~~or agent~~) fails to locate or incorrectly ~~marks the location of~~~~locates~~ the underground facility ~~in a timely manner, pursuant to this article~~, the ~~person~~ (owner, ~~or~~ operator, ~~or agent~~) becomes liable for resulting damages, costs and expense to the injured party.” The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

**109.8.2 Contracting Agency Delays:** Arizona Revised Statutes 34-221 states “A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract.” In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Arizona Revised Statute:

**40-360.28. Civil penalty; liability**

A. Except as provided in section 40-360.22, subsection M, a person who violates any provision of this article is subject to a civil penalty in an amount not to exceed five thousand dollars to be imposed by the court in favor of the state. Any penalties received by the state shall be deposited in the state general fund.

B. If a violation of this article results in damage to an underground facility, the violator is liable to all affected underground facilities operators and excavators for all resulting damages proximately caused by the violations, including economic loss.

**C. If a person violates this article by failing to provide timely notice as required by this article, by failing to respond in the time and manner provided by this article or by failing to locate and mark an underground facility in the manner provided by this article, the person is liable to all affected underground facilities operators and excavators for all damages proximately caused by the violation, including economic loss.**

D. Notwithstanding any other law, a violation of section 40-360.22, subsection D or subsection I, paragraph 3 is a superseding event that breaks the chain of causation for any damages that could result from an underground facilities operator's failure to accurately locate or mark an underground facility.

E. If a landlord or an excavator complies with the duties set forth in sections 40-360.22, 40-360.30 and 40-360.32 for all facilities operated by a landlord as provided in section 40-360.22, subsection P, paragraph 1, the person is not liable for any death or injury to persons or property or for any economic loss to any person to the extent the conduct is regulated by this article. This section does not excuse any landlord or excavator from liability for any death or injury to persons or property or for any economic loss to any person to the extent the injury or loss does not arise from the conduct regulated by this article.

F. This section is not applicable to an excavation made:

1. During an emergency which involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.
2. In agricultural operations or for the purpose of finding or extracting natural resources.
3. With hand tools on property owned or occupied by the person performing the excavation while gardening or tilling such property.

## § 40-360.28. Civil penalty; liability

A. Except as provided in § 40-360.22, subsection M, a person who violates any provision of this article is subject to a civil penalty in an amount not to exceed five thousand dollars to be imposed by the court in favor of the state. Any penalties received by the state shall be deposited in the state general fund.

B. If a violation of this article results in damage to an underground facility, the violator is liable to all affected underground facilities operators and excavators for all resulting damages proximately caused by the violations, including economic loss.

C. If a person violates this article by failing to provide timely notice as required by this article, by failing to respond in the time and manner provided by this article or by failing to locate and mark an underground facility in the manner provided by this article, the person is liable to all affected underground facilities operators and excavators for all damages proximately caused by the violation, including economic loss.

D. Notwithstanding any other law, a violation of § 40-360.22, subsection D or subsection L, paragraph 3 is a superseding event that breaks the chain of causation for any damages that could result from an underground facilities operator's failure to accurately locate or mark an underground facility.

E. If a landlord or an excavator complies with the duties set forth in §§ 40-360.22, 40-360.30 and 40-360.32 for all facilities operated by a landlord as provided in § 40-360.22, subsection P, paragraph 1, the person is not liable for any death or injury to persons or property or for any economic loss to any person to the extent the conduct is regulated by this article. This section does not excuse any landlord or excavator from liability for any death or injury to persons or property or for any economic loss to any person to the extent the injury or loss does not arise from the conduct regulated by this article.

F. This section is not applicable to an excavation made:

1. During an emergency which involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.

2. In agricultural operations or for the purpose of finding or extracting natural resources.

3. With hand tools on property owned or occupied by the person performing the excavation while gardening or tilling such property.

Added by Laws 1981, Ch. 153, § 6. Amended by Laws 1985, Ch. 106, § 2; Laws 1999, Ch. 169, § 1; Laws 2005, Ch. 222, § 6; Laws 2006, Ch. 258, § 11, eff. Jan. 1, 2007.

## Historical and Statutory Notes

The 2005 amendment by Ch. 222 rewrote the section, which had read:

"A. A person who violates any provision of this article is subject to a civil penalty in an amount not to exceed five thousand dollars to be imposed by the court in favor of the state. Any penalties received by the state shall be deposited in the general fund.

"B. If a violation of this article results in physical contact with an underground facility, the violator is liable to the owner of the facility for all damages to the facilities and costs, expenses and damages to third parties incurred by the owner of the facility as a result of the contact.

"C. If the owner or operator fails to locate or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expenses to the injured party.

"D. This section is not applicable to an excavation made:

"1. During an emergency which involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.

"2. In agricultural operations or for the purpose of finding or extracting natural resources.

"3. With hand tools on property owned or occupied by the person performing the excavation while gardening or tilling such property."

The 2006 amendment by Ch. 258 rewrote the section, which had read:

"A. Except as provided in § 40-360.22, subsection J, a person who violates any provision of this article is subject to a civil penalty in an amount not to exceed five thousand dollars to be imposed by the court in favor of the state. Any penalties received by the state shall be deposited in the state general fund.

"B. If a violation of this article results in damage to an underground facility, the violator is liable to the owner of the facility for all damages to the facilities and all costs and expenses, including dam-

## FOREWORD

Publication of these Uniform Standard Specifications and Details for Public Works Construction fulfills the goal of a group of agencies who joined forces in 1966 to produce such a set of documents. Subsequently, in the interest of promoting county-wide acceptance and use of these standards and details, the Maricopa Association of Governments accepted their sponsorship and the responsibility of keeping them current and viable.

These specifications and details, representing the best professional thinking of representatives of several Public Works Departments, reviewed and refined by members of the construction industry, were written to fulfill the need for uniform rules governing public works construction performed for Maricopa County and the various cities and public agencies in the county. It further fulfills the need for adequate standards by the smaller communities and agencies [within Maricopa County](#) who could not afford to promulgate such standards for themselves. [Agencies in other regions or climes within the state of Arizona wishing to apply these specifications may need to make adjustments for local conditions.](#)

[These uniform specifications and details are intended to aid the private construction industry in providing modern materials and construction techniques, eliminate conflicts and confusion, lower construction costs and encourage more competitive bidding by private contractors for the benefit of public works construction in the right-of-way. Use of these standards for projects outside of the right-of-way should be reviewed by professional engineers and architects and applied with care to insure relevance to the planned work.](#)

[Specifications and details contained herein should be incorporated into project plans and specifications after careful review by the design engineer or architect of specific project needs. Not all specifications will apply to all projects as these standards are developed to meet a variety of public works needs. Prepared plans and specifications should clearly call out specific uniform specifications and details required for the project.](#)

[Uniform specifications and details are not a substitute for good engineering judgment. Unique conditions will arise that are outside the scope of these standards. When this happens, professional engineers and architects are required to use their judgment to amend these standards to best meet site-specific project needs in accordance with rules set forth by the State of Arizona and policy statements made by the Arizona State Board of Technical Registration.](#)

The Uniform Standard Specifications and Details for Public Works Construction will be revised periodically and reprinted to reflect advanced thinking and the changing technology of the construction industry. To this end a Specifications and Details Committee has been established as a permanent organization to continually study and

recommend changes to the Specifications and Details. Interested parties may address suggested changes and questions to:

Standard Specifications & Details Committee  
c/o Maricopa Association of Governments  
302 North First Avenue, Suite 300  
Phoenix, Arizona, 85003.

These suggestions will be reviewed by the committee and appropriate segments of the industry and cumulative annual revisions will be published the first of each year. A copy of this publication is available for review on the internet at the website listed below.

Please follow the links to the publications page and look for *Uniform Standard Specifications for Public Works Construction and/or Uniform Standard Details for Public Works Construction Within Public Rights of Way*:

[www.mag.maricopa.gov](http://www.mag.maricopa.gov)

While in the interest of **regional** uniformity, it is hoped that all using agencies will adopt these standards with as few changes as possible, it is recognized that because of charter requirements and for other reasons, some agencies will find it necessary to modify or supplement certain requirements. **In the interest of reducing a proliferation of agency specific modifications it is strongly recommended that the agency representatives to MAG bring their modifications for consideration by the committee for inclusion into these standards.**

## Forward

### Public Works Construction Not in Right of Way

This document has been prepared as a supplement to the Uniform Standard Specifications for Public Works Construction as adopted by MAG and is to be used for onsite development that is not associated with public right of way. While these standards are intended to apply to all agency public works projects within Maricopa County, they are intended to be utilized in applicable agency developments such as libraries, equipment yards, service centers or other public agency building sites. They may also serve as a guide for non-agency private development should the design professional find they are useful.

We attempt to achieve maximum uniformity of planning, engineering, and construction practices outside the public right of way and as applicable as outlined above. These are minimum standards and are intended to assist, but not to substitute for competent work by engineering and design professionals. Special conditions or environmental constraints may require a more stringent design than would normally be required under these Standards. It is not the intent to unreasonably limit any innovative effort which could result in a superior project design. A proposed design which is different than these Development Guidelines will be evaluated on the basis that the proposed design will produce a comparable or superior result, and in every way adequate for the user, and the public.

SECTION 604 – Revision 3-29-10

PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

The following is a brief description of the types of controlled low strength material (CLSM) and their intended uses:

**1/2 SACK:** ~~One half sack CLSM can be used as a g~~General trench backfill in areas where future excavation into the backfill with conventional hand tools is anticipated or in areas of low loading such as streets, parking areas, behind retaining walls, etc.

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**1 SACK:** ~~One sack CLSM can be used as a g~~General trench backfill and backfill behind retaining walls where additional strength is required above that of 1/2 sack CLSM.

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**1-1/2 SACK:** ~~One and one half sack CLSM can be used as a s~~Structural backfill under foundations and as thermal fill and/or mechanical protection of duct banks and conduits.

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The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

604.2 MATERIALS:

~~Controlled low strength material CLSM~~ shall conform to the requirements of Section 728. Ready-mixed concrete not meeting the requirements of table 728-1 shall not be used in lieu of 1/2 sack or 1 sack CLSM.

604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required. The total elapsed time between the initial addition of water to the CLSM and the completed placement shall not exceed 90 minutes.

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## SECTION 604 – Revision 3-29-10

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

Where CLSM is used for backfill around pipes or conduits with a depth less than 20 feet, the width of the excavation shown on the plans or in Section 601 may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches for pipes or conduits 42 inches and larger, 6 inches for pipes or conduits between 4 inches and 42 inches and 3 inches for pipes or conduits 4 inches and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation of the backfilling.

CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Section 610.5. Pipes smaller than 4 inches can be completely wrapped with tape as per Section 610.5 or approved equal.

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. CLSM mixes must be modified where long term freeze-thaw durability is indicated as a concern. The mix design shall have an air content of no less than six percent by volume, when tested in accordance with ASTM C-6023.  
~~Further testing may be required prior to placing the material in a freeze-thaw condition.~~

### 604.4 ~~PROTECTION:~~ PERFORMANCE TESTING:

~~When~~ CLSM ~~is~~ placed within the traveled way or otherwise to be covered by paving or embankment materials, shall not be covered until one of the following performance criteria have been met:

- A) When a person of average weight and shoe size can walk on the surface of the CLSM without creating greater than 1/8-inch indents in the material, or
- B) When the in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM D-4832, or
- C) When a ball drop indentation of 3-inches or less is obtained, when tested in accordance with ASTM D-6024, or
- D) When a penetration resistance reading of 650 is achieved, when tested in accordance with ASTM C-403.

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## SECTION 604 – Revision 3-29-10

~~Additionally, CLSM shall not be covered if proof rolling by pneumatic-tired or steel-wheel vibratory roller results in the bringing of free water to the surface or results in surface undulation (pumping). the material shall achieve a penetration resistance of 3 inches (indentation diameter) or less with 5 drops at a drop distance of 5 inches prior to covering and opening to traffic or the installation of the surface be delayed for 12 hours, whichever occurs first. Penetration resistance shall be as measured by ASTM Test Method D-6024, "Standard Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application."~~

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When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM C-403, or allowed to set in place for 24 hours, whichever occurs first.

~~Where the Engineer has identified soils as being moisture sensitive, a drainage notch or drain wick shall be placed longitudinally along the centerline of the trench or CLSM placement. The notch or wick shall be constructed within the first hour following placement. Drainage water shall be collected and removed at the end of notch or wick.~~

### 604.5 ACCEPTANCE:

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer if:

(A) The CLSM is outside of the limits specified in Table 728-1 and/or

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(B) The aggregate gradation is outside the limits specified in Section 701.3.5.

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Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

### 604.6 PAYMENT:

No pay item will be included in the proposal nor direct payment made for CLSM unless specifically included in the Project Specifications and Fee Proposal. The cost for placing the material shall be included in the unit price ~~bid~~ for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

## SECTION 701 - Revision 3-29-10

**701.3.2 Sand for Mortar and Plaster:** It shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70. No individual sample shall have a sand equivalent less than 65.

The size and grading of sand to be used in mortar, and plaster shall be such as to conform with the requirements specified as follows:

Mortar:               ASTM C-144

Plaster:               ASTM C-35

**701.3.3 Aggregate for Portland Cement Concrete:** Coarse and fine aggregate shall conform to the applicable requirements of ASTM C-33.

Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate Table. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

The average value of 3 successive sand equivalent samples shall not be less than 70 when tested in accordance with AASHTO T-176. No individual sample shall have a sand equivalent less than 65.

The loss by abrasion in the Los Angeles abrasion machine, determined as prescribed in ASTM C-131, Grading A, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

**701.3.4 Aggregate for Masonry Grout:** The size and grading of the fine or coarse aggregate to be used in masonry grout shall conform to ASTM C-404.

**701.3.5 Aggregate for Controlled Low Strength Material:** Coarse and fine aggregate shall conform to the applicable requirements of ASTM C-33.

Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate Table. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section. aggregate shall conform to ASTM C-33 grading size No. 57. The size and gradation of fine aggregates (sand) shall conform to ASTM C-33.

### 701.4 QUARRY STONE:

**701.4.1 General:** Quarry stone shall be angular, sound, durable, hard, resistant to abrasion; free from laminations, weak cleavages, and undesirable weathering, leaching, exfoliation tendencies, and slaking; and of such character that it will not disintegrate

**SECTION 728 - Revision 3-29-10**

**CONTROLLED LOW STRENGTH MATERIAL**

**728.1 GENERAL:**

Controlled Low Strength Material (CLSM) is a mixture of portland cementitious materials, aggregates, admixtures/additives, and water that, as the cementitious materials hydrates, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious based material that is primarily used as a backfill or structural fill in lieu of compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section 604.

**728.2 MATERIALS:**

Portland Cementitious materials shall conform to Section 725.2.  
Coarse and fine aggregates shall conform to Section 701.3.5  
Water shall conform to Section 725.45.

**728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:**

Proportioning of the mixture shall comply ~~with Section 701.3.5,~~ Section 725.67 and Table 728-1. The CLSM shall have consistency, workability, plasticity, and flow characteristics such that the material when placed is self-compacting. A minimum of 40% coarse aggregate shall be used. A mix design shall be submitted with test data for the Engineer's approval prior to the excavation for which the material is intended for use. Sampling shall be in accordance with ASTM D-5971. The flow consistency shall be tested in accordance with ASTM D-6103. Unit weight (when applicable) shall be obtained by ASTM D-6023. Compressive strength shall be tested in accordance with ASTM D-4832.

<b>CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS</b>			
<b>Description of CLSM</b>	<b>Portland Cement Content, Sacks/cu yd</b>	<b>Flow, Slump, inches</b>	<b>Compressive Strength at 28 days, psi</b>
1/2 Sack CLSM	<u>1/2 Sack</u> 47±5%	79±24	150 maximum 70±30
1 Sack CLSM	<u>1 Sack</u> 94±5%	79±24	500 maximum 450±50
1 1/2 Sack CLSM	<u>1 1/2 Sack</u> 141±5%	79±24	400 minimum 425±75

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**Notes for Table 728-1:**

1. CLSM mixes meeting the table requirements for Portland Cement Content generally will not be placeable by means of a concrete pump or may not provide the needed workability for certain conditions. When pumpable mixes or increased workability are required, the addition of fly ash or a natural pozzolan in excess of the required Portland

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## SECTION 728 - Revision 3-29-10

Cement Content may be used.

- ~~1. The values specified in the table are for both mix design requirements and field production. The deviations are for production, testing and sampling tolerances.~~
- ~~2. Slump shall be tested in accordance with ASTM C-143. Flow consistency test can be substituted for the slump test. When used, the CLSM shall have a flow consistency of 8 inches as tested in accordance with ASTM D-6103.~~
- ~~3. Compressive strength shall be tested in accordance with ASTM D-4832. The supplier shall provide laboratory and/or field test data to verify the design strength.~~
- ~~4. Sampling shall be in accordance with ASTM D-4832.~~
- ~~5. Unit weight shall be obtained by ASTM D-6023.~~
- ~~6. Temperature shall be taken in accordance with ASTM C-1064.~~
- ~~7. Cement content shall be tested in accordance with ASTM D-5982.~~

~~Where CLSM is to be used as backfill around gas pipelines (totally encapsulating the gas pipeline), the material shall meet a minimum permeability coefficient (k) of  $1 \times 10^{-5}$  cm/sec or more, based on ASTM D-5048.~~

### **728.4 MIXING:**

~~CLSM mixing shall comply with Section 725.7. Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable. The total elapsed time between the addition of the water and placement of the complete mix shall not exceed 90 minutes. The Engineer may waive this limitation if the slump is such that the material can be placed without addition of water.~~

~~Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable. Proportioning of ingredients shall produce consistency, durability, workability and other required properties appropriate for the intended usage. When the CLSM is mixed other than at the project site, the mixing shall comply with Section 725.8. When the CLSM is mixed at the job site, the Contractor will submit for the Engineer's approval, the methods, equipment and procedures for proportioning and mixing of the material.~~

## PLACEMENT OF CONTROLLED LOW STRENGTH MATERIAL

### 604.1 DESCRIPTION:

The work covered by this specification consists of furnishing all materials, labor and equipment for the placement of controlled low strength material (CLSM).

The following is a brief description of the types of controlled low strength material (CLSM) and their intended uses:

**1/2 SACK:** General trench backfill in areas where future excavation into the backfill with conventional hand tools is anticipated or in areas of low loading such as streets, parking areas, behind retaining walls, etc.

**1 SACK:** General trench backfill and backfill behind retaining walls where additional strength is required above that of 1/2 sack CLSM.

**1-1/2 SACK:** Structural backfill under foundations and as thermal fill and/or mechanical protection of duct banks and conduits.

The type of backfill to be used shall be as specified in the special provisions, plans or by the Engineer.

### 604.2 MATERIALS:

CLSM shall conform to the requirements of Section 728. Ready-mixed concrete not meeting the requirements of table 728-1 shall not be used in lieu of 1/2 sack or 1 sack CLSM.

### 604.3 PLACEMENT:

The controlled low strength material shall be placed directly into the excavation. The CLSM shall be placed in a uniform manner that will prevent voids in or segregation of the material. Foreign material which falls into the trench prior to and during placing of the CLSM shall be immediately removed. The CLSM shall have consistency, workability, plasticity, flow characteristics and pumpability (when required) such that the material when placed is self-compacting. Mechanical compaction or vibration may be used to consolidate around structures, pipes, multiple conduits, etc., otherwise no mechanical compaction or vibration shall be required. The total elapsed time between the initial addition of water to the CLSM and the completed placement shall not exceed 90 minutes.

When CLSM is used for backfill around pipes or conduits, the CLSM shall be placed equally on both sides of pipe or conduit to prevent lateral displacement. Also, the CLSM shall be placed in lifts. The height of each lift shall not exceed the depth that will cause floating of the pipe or conduit. When placing the CLSM in greater lift depths, sufficient anchorage shall be provided so the pipe or conduit will not float.

## SECTION 604 – Revision 3-29-10

Where CLSM is used for backfill around pipes or conduits with a depth less than 20 feet, the width of the excavation shown on the plans or in Section 601 may be reduced so that the minimum clear distance between the outside of the pipe or conduit and the side of the excavation (each side) shall be 12 inches for pipes or conduits 42 inches and larger, 6 inches for pipes or conduits between 4 inches and 42 inches and 3 inches for pipes or conduits 4 inches and smaller.

When CLSM is used behind retaining walls, the depth of each lift shall be limited so it will not induce hydraulic loads greater than the design loads.

For long trenches or installations which require a large amount of CLSM, bulkheads of wood, dirt, sand bags, etc. can be used to control the material's flowability. The bulkhead shall be removed prior to the continuation of the backfilling.

CLSM shall NOT be permitted to come in contact with any aluminum, copper or brass materials, e.g., aluminum pipes or culverts, copper water pipe, saddles, fittings, etc. Protection shall be any combination of the following: place a layer of noncorrosive material around the pipe e.g., native material, import material, etc. or provide a protective covering or wrapping such as polyethylene wrap per Section 610.5. Pipes smaller than 4 inches can be completely wrapped with tape as per Section 610.5 or approved equal.

Generally, CLSM does not resist freezing and thawing and in some cases may propagate the condition. CLSM mixes must be modified where long term freeze-thaw durability is indicated as a concern. The mix design shall have an air content of no less than six percent by volume, when tested in accordance with ASTM C-6023.

### **604.4 PERFORMANCE TESTING:**

CLSM placed within the traveled way or otherwise to be covered by paving or embankment materials, shall not be covered until one of the following performance criteria have been met:

- A) When a person of average weight and shoe size can walk on the surface of the CLSM without creating greater than 1/8-inch indents in the material, or
- B) When the in-place CLSM has reached a strength of 30 psi, when tested in accordance with ASTM D-4832, or
- C) When a ball drop indentation of 3-inches or less is obtained, when tested in accordance with ASTM D-6024, or
- D) When a penetration resistance reading of 650 is achieved, when tested in accordance with ASTM C-403.

Additionally, CLSM shall not be covered if proof rolling by pneumatic-tired or steel wheel vibratory roller results in the bringing of free water to the surface or results in surface undulation (pumping).

When CLSM is placed in foundation excavations, the material shall be protected from foundation loading and placement of foundation concrete prior to having reached initial set per ASTM C-403, or allowed to set in place for 24 hours, whichever occurs first.

**604.5 ACCEPTANCE:**

CLSM shall be considered deficient and may be rejected at the discretion of the Engineer if:

- A) The CLSM is outside of the limits specified in Table 728-1 and/or
- B) The aggregate gradation is outside the limits specified in Section 701.3.5.

Rejected material not placed shall be immediately removed from the job site. Rejected material placed shall be removed and replaced with acceptable material. Removing and disposing of the rejected material shall be at no additional cost to the Contracting Agency.

**604.6 PAYMENT:**

No pay item will be included in the proposal nor direct payment made for CLSM unless specifically included in the Project Specifications and Fee Proposal. The cost for placing the material shall be included in the unit price for the specific work function (laying pipe, placing structure foundation, construction retaining wall, etc.).

## SECTION 701 - Revision 3-29-10

### ROCK, GRAVEL, AND SAND

#### 701.1 GENERAL:

The following specifications set forth the requirements for crushed rock, gravel, sand, and quarry stone. Samplings and sieve analysis shall be performed in accordance with ASTM D-75 and ASTM C-136. Sand equivalents shall be determined in accordance with AASHTO T-176. The liquid limit and plasticity index shall be determined in accordance with AASHTO T-89 and T-90.

#### 701.2 CRUSHED ROCK AND GRAVEL:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

The loss by abrasion in the Los Angeles abrasion machine, determined as prescribed in ASTM C-131, Grading A, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

**701.2.1 Crushed Rock:** Crushed rock shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50 percent by weight of aggregate retained on the No. 4 sieve for 3/4 inch or larger maximum sizes, and 50 percent retained on the No. 8 sieve for maximum sizes less than 3/4 inch shall consist of particles which have at least one rough, angular surface produced by crushing. All material that will pass a grizzly with bars spaced 15 inches apart, clear opening, shall be crushed when producing from the Contracting Agency's source.

The gradation of crushed rock shall comply with ASTM D-448.

**701.2.2 Gravel:** Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn. Crushed rock obtained by crushing rock which exceeds ASTM D-448 maximum gradation sizes may be combined provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this specification.

#### 701.3 AGGREGATE:

Sand shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended.

**701.3.1 Sand for Asphalt Concrete Pavement:** Sand for asphalt concrete pavement shall comply with AASHTO M-29 except that grading requirements shall be deleted and have a minimum sand equivalent of not less than 50 and shall be non-plastic when tested in accordance with AASHTO T-89 and T-90.

## **SECTION 701 - Revision 3-29-10**

**701.3.2 Sand for Mortar and Plaster:** It shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70. No individual sample shall have a sand equivalent less than 65.

The size and grading of sand to be used in mortar, and plaster shall be such as to conform with the requirements specified as follows:

Mortar:                 ASTM C-144

Plaster:                 ASTM C-35

**701.3.3 Aggregate for Portland Cement Concrete:** Coarse and fine aggregate shall conform to the applicable requirements of ASTM C-33.

Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate Table. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

The average value of 3 successive sand equivalent samples shall not be less than 70 when tested in accordance with AASHTO T-176. No individual sample shall have a sand equivalent less than 65.

The loss by abrasion in the Los Angeles abrasion machine, determined as prescribed in ASTM C-131, Grading A, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

**701.3.4 Aggregate for Masonry Grout:** The size and grading of the fine or coarse aggregate to be used in masonry grout shall conform to ASTM C-404.

**701.3.5 Aggregate for Controlled Low Strength Material:** Coarse and fine aggregate shall conform to the applicable requirements of ASTM C-33.

Coarse aggregate grading requirements shall conform to the appropriate rock size designation in the Grading Requirements for Coarse Aggregate Table. Fine aggregate grading requirements shall conform to the Fine Aggregate Grading section.

### **701.4 QUARRY STONE:**

**701.4.1 General:** Quarry stone shall be angular, sound, durable, hard, resistant to abrasion; free from laminations, weak cleavages, and undesirable weathering, leaching, exfoliation tendencies, and slaking; and of such character that it will not disintegrate from the action of air, water, or the conditions to be met in handling and placing. Stone shall be clean and free from deleterious impurities, including alkali, earth, clay, refuse,

## SECTION 701 - Revision 3-29-10

and adherent coatings. Suitable tests and/or service records will be used to determine the acceptability of the stone. Tests to which the material may be subjected include petrographic analysis, X-ray diffraction, specific gravity, absorption, abrasion, rock drop, soundness, wetting and drying, and such other tests as may be considered necessary to demonstrate to the Engineer that the materials are acceptable for use in the work. In connection therewith, the Contractor shall notify the Engineer in writing at least 60 days prior to use of the intended sources of quarry stone.

**701.4.2 Test Requirements:** Quarry stone shall meet the following requirements except as may be otherwise provided on the plans and in the special provisions:

(A) Apparent specific gravity: 2.65 minimum.

(B) Breakdown:

Rock drop breakdown:	5 percent maximum
Abrasion breakdown at 1000 revolutions:	40 percent maximum
Breakdown after 10 cycles of wetting and drying:	5 percent maximum
Solubility in water, breakdown, or softening:	None

**701.4.3 Test Methods:** Unless otherwise specified in the special provisions or indicated on the plans, test methods for quarry stone shall be as follows:

Apparent specific gravity per ASTM C-127.

(B) Abrasion characteristics to be determined by either Rock Drop Test or Los Angeles Rattler, ASTM C-131, as required on the plans or the special provisions.

(1) Standard Rock Drop Test. Tests shall be made on groups of 5 accurately weighed sizes of rocks: No. 1, ranging from 75 to 100 lbs.; No. 2, 100 to 125 lbs.; No. 3, 125 to 150 lbs.; No. 4, 150 to 175 lbs.; No. 5, 175 to 225 lbs.

Each rock of the 5 sizes shall be dropped 3 times on the group of the other 4, in an enclosure, from successive heights of 10, 15, and 18 feet. The enclosure shall have a flexible medium weight galvanized iron floor or equivalent, set on a solid foundation. Order of dropping shall be Nos. 3, 2, 4, 1, 5. All rock passing a 3 inch square mesh screen after test shall be weighed and recorded as a percentage of the total initial weight of the 5 rocks.

(2) Los Angeles abrasion machine, per ASTM C-131, Grading B.

C) Wetting and drying. The stone shall be crushed, screened, and 1000 or 1500 grams of the 3/4 inch to 3/8 inch fraction taken for the test.

## SECTION 701 - Revision 3-29-10

The crushed and graded stone shall be submerged in water for 18 hours at room temperature, after which the sample shall be drained and oven-dried at 140°F. When dry, the sample shall be cooled to room temperature. This would complete one cycle.

The percent loss shall be determined by screening the tested sample on a No. 4 sieve and shall be computed as follows:

$$\frac{100 \times \text{Weight of Materials Passing No. 4 Sieve}}{\text{Total Weight of Sample}} = \% \text{ Loss}$$

(D) Accelerated water breakdown and solubility test. Air-dry samples of representative stone weighing approximately 1 lb. each shall be immersed for 8 hours at 140°F., in distilled water, local tap water, or 3.5 percent sodium chloride solution.

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**SECTION 728 - Revision 3-29-10**

**CONTROLLED LOW STRENGTH MATERIAL**

**728.1 GENERAL:**

Controlled Low Strength Material (CLSM) is a mixture of cementitious materials, aggregates, admixtures\additives, and water that, as the cementitious materials hydrate, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious based material that is primarily used as a backfill or structural fill in lieu of compacted fill or unsuitable native material. Placement and usage of each type of CLSM is described in Section 604,

**728.2 MATERIALS:**

Cementitious materials shall conform to Section 725.2.  
Coarse and fine aggregates shall conform to Section 701.3.5  
Water shall conform to Section 725.4.

**728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:**

Proportioning of the mixture shall comply with Section 725.6 and Table 728-1. The CLSM shall have consistency, workability, plasticity, and flow characteristics such that the material when placed is self-compacting. A minimum of 40% coarse aggregate shall be used. A mix design shall be submitted with test data for the Engineer's approval prior to the excavation for which the material is intended for use. Sampling shall be in accordance with ASTM D-5971. The flow consistency shall be tested in accordance with ASTM D-6103. Unit weight (when applicable) shall be obtained by ASTM D-6023. Compressive strength shall be tested in accordance with ASTM D-4832.

<b>CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS</b>			
	Portland Cement Content, Sack/cu yd	Flow, inches	Compressive Strength at 28 days, psi
	1/2 Sack	9±2	150 maximum
	1 Sack	9±2	500 maximum
	1 1/2 Sack	9±2	400 minimum

Note for Table 728-1:

1. CLSM mixes meeting the table requirements for Portland Cement Content generally will not be placeable by means of a concrete pump or may not provide the needed workability for certain conditions. When pumpable mixes or increased workability are required, the addition of fly ash or a natural pozzolan in excess of the required Portland Cement Content may be used.

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**SECTION 728 - Revision 3-29-10**

**728.4 MIXING:**

CLSM mixing shall comply with Section 725.7. Mixing shall continue until the cementitious material and water are thoroughly dispersed throughout the material. Mixes shall be homogenous, readily placeable and uniformly workable.

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**ASTM References in the MAG Specifications** (\*Specification has been **withdrawn from ASTM** and **should be updated in MAG**)

A6 / A6M - 08 Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling  
A27 / A27M - 08 Standard Specification for Steel Castings, Carbon, for General Application  
A29 / A29M - 05 Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for  
A36 / A36M - 08 Standard Specification for Carbon Structural Steel  
A48 / A48M - 03(2008) Standard Specification for Gray Iron Castings  
A53 / A53M - 07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless  
A82 / A82M - 07 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement  
A116 - 05 Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric  
A121 - 07 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire  
A123 / A123M - 09 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products  
A148 / A148M - 08 Standard Specification for Steel Castings, High Strength, for Structural Purposes  
A153 / A153M - 09 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware  
A185 / A185M - 07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete  
A242 / A242M - 04(2009) Standard Specification for High-Strength Low-Alloy Structural Steel  
A307 - 07b Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength  
A325 - 09a Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength  
A392 - 07 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric  
A416 / A416M - 06 Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete  
A421 / A421M - 05 Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete  
A436 - 84(2006) Standard Specification for Austenitic Gray Iron Castings  
A496 / A496M - 07 Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement  
A500 / A500M - 09 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes  
A502 - 03(2009) Standard Specification for Rivets, Steel, Structural

\*A569/A569M-98 Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial  
**(Withdrawn 2000) REPLACED BY A1011/A1011M – pg 772-1 (792.2 TYPE B)**

\*A570/A570M-98 Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled  
**(Withdrawn 2000) REPLACED BY A1011/A1011M – pg 770-1 (770.2 Copper Bearing Structural Steel)**

A572 / A572M - 07 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel  
A588 / A588M - 05 Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance  
A606 / A606M - 09a Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance

\*A607-98 Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled **(Withdrawn 2000) REPLACED BY A1008/A1008M\_and\_A1011/A1011M – pg 770-1 (770.2)**

\*A611-97 Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled **(Withdrawn 2000) Now A1008/A1008M – pg 770-1 (770.2)**

A615 / A615M - 09b Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement  
A653 / A653M - 09a Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process  
A668 / A668M - 04 Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use  
A924 / A924M - 09a Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process  
A929 / A929M - 01(2007) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe

B22 - 09e1 Standard Specification for Bronze Castings for Bridges and Turntables  
B62 - 09 Standard Specification for Composition Bronze or Ounce Metal Castings  
B88 - 09 Standard Specification for Seamless Copper Water Tube  
B208 - 06 Standard Practice for Preparing Tension Test Specimens for Copper Alloy Sand, Permanent Mold, Centrifugal, and Continuous Castings  
B584 - 09a Standard Specification for Copper Alloy Sand Castings for General Applications

B670 - 07 Standard Specification for Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service  
B766 - 86(2008) Standard Specification for Electrodeposited Coatings of Cadmium

C14 - 07 Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe  
C31 / C31M - 09 Standard Practice for Making and Curing Concrete Test Specimens in the Field  
C32 - 09 Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)  
C33 / C33M - 08 Standard Specification for Concrete Aggregates  
C35 - 01(2009) Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster  
C39 / C39M - 09a Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens  
C42 / C42M - 04 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete  
C76 - 10 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe  
C78 - 09 Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)  
C90 - 09 Standard Specification for Loadbearing Concrete Masonry Units  
C91 - 05 Standard Specification for Masonry Cement  
C94 / C94M - 09a Standard Specification for Ready-Mixed Concrete  
C114 - 09b Standard Test Methods for Chemical Analysis of Hydraulic Cement  
C117 - 04 Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing  
C125 - 09a Standard Terminology Relating to Concrete and Concrete Aggregates  
C127 - 07 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate  
C131 - 06 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine  
C136 - 06 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates  
C138 / C138M - 09 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete  
C140 - 09a Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units  
C143 / C143M - 09 Standard Test Method for Slump of Hydraulic-Cement Concrete  
C144 - 04 Standard Specification for Aggregate for Masonry Mortar  
C150 / C150M - 09 Standard Specification for Portland Cement  
C171 - 07 Standard Specification for Sheet Materials for Curing Concrete  
C172 - 08 Standard Practice for Sampling Freshly Mixed Concrete  
C173 / C173M - 09 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method  
C203 - 05a Standard Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation  
C207 - 06 Standard Specification for Hydrated Lime for Masonry Purposes  
C216 - 07a Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)  
C231 / C231M - 09b Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method  
C260 - 06 Standard Specification for Air-Entraining Admixtures for Concrete  
C301 - 04(2009) Standard Test Methods for Vitrified Clay Pipe  
C309 - 07 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete  
C311 - 07 Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete  
C361 - 08 Standard Specification for Reinforced Concrete Low-Head Pressure Pipe  
C403 / C403M - 08 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance  
C404 - 07 Standard Specification for Aggregates for Masonry Grout  
C425 - 04(2009) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings  
C426 - 07 Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units  
C428 - 05(2006) Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe  
C494 / C494M - 08a Standard Specification for Chemical Admixtures for Concrete  
C497 - 05 Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile  
C541 - 98(2006) Standard Specification for Linings for Asbestos-Cement Pipe  
C595 / C595M - 09 Standard Specification for Blended Hydraulic Cements  
C618 - 08a Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete  
C663 - 98(2008) Standard Specification for Asbestos-Cement Storm Drain Pipe  
C685 / C685M - 07 Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing  
C700 - 09 Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated  
C780 - 09 Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry  
C828 - 06 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines  
C920 - 08 Standard Specification for Elastomeric Joint Sealants

C923 - 08 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals  
C936 / C936M - 09 Standard Specification for Solid Concrete Interlocking Paving Units  
C977 - 03 Standard Specification for Quicklime and Hydrated Lime for Soil Stabilization  
C979 - 05 Standard Specification for Pigments for Integrally Colored Concrete  
C1064 / C1064M - 08 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete  
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C1116 / C1116M - 09 Standard Specification for Fiber-Reinforced Concrete  
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D25 - 99(2005) Standard Specification for Round Timber Piles  
D70 - 09e1 Standard Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)  
D75 / D75M - 09 Standard Practice for Sampling Aggregates  
D81 - 87(2008)e1 Standard Specification for Basic Carbonate White Lead Pigment  
D83 - 84(2008)e1 Standard Specification for Red Lead Pigment  
D88 - 07 Standard Test Method for Saybolt Viscosity  
D79 - 86(2009) Standard Specification for Zinc Oxide Pigments  
D92 - 05a Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester  
D209 - 81(2007) Standard Specification for Lampblack Pigment  
D217 - 02(2007) Standard Test Methods for Cone Penetration of Lubricating Grease

\*D234-82(1998) Standard Specification for Raw Linseed Oil (**Withdrawn 2007**) – pg 790-1 (790.4 (A))

D235 - 02(2007) Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)  
D244 - 09 Standard Test Methods and Practices for Emulsified Asphalts

\*D260-86(1995)e1 Standard Specification for Boiled Linseed Oil – **SUPERSEDED** – pg 790-1 (790.4 (A))

D276 - 00a(2008) Standard Test Methods for Identification of Fibers in Textiles  
D297 - 93(2006) Standard Test Methods for Rubber Products-Chemical Analysis  
D395 - 03(2008) Standard Test Methods for Rubber Property—Compression Set  
D412 - 06ae2 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension  
D448 - 08 Standard Classification for Sizes of Aggregate for Road and Bridge Construction  
D476 - 00(2005) Standard Classification for Dry Pigmentary Titanium Dioxide Products  
D478 - 02(2006) Standard Specification for Zinc Yellow (Zinc Chromate) Pigments  
D558 - 04 Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures  
D572 - 04 Standard Test Method for Rubber-Deterioration by Heat and Oxygen  
D600 - 07 Standard Specification for Liquid Paint Driers

\*D604-81(1996)e1 Standard Specification for Diatomaceous Silica Pigment (**Withdrawn 2003**) **NO REPLACEMENT** – pg 790-2 (790.4 C)

D605 - 82(2007) Standard Specification for Magnesium Silicate Pigment (Talc)  
D633 - 97(2005) Standard Volume Correction Table for Road Tar  
D638 - 08 Standard Test Method for Tensile Properties of Plastics  
D648 - 07 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position  
D698 - 07e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort  
D850 - 03(2008)e1 Standard Test Method for Distillation of Industrial Aromatic Hydrocarbons and Related Materials

\*D1190-97 Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type (**Withdrawn 2002**) **REPLACED BY D6690** –  
pg 729-1 (729.2)

D1238 - 04c Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer  
D1248 - 05 Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable  
D1250 - 08 Standard Guide for Use of the Petroleum Measurement Tables  
D1298 - 99(2005) Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method  
D1388 - 08 Standard Test Method for Stiffness of Fabrics

D1556 - 07 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

\*D1559-89 Test Method for Resistance of Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (**Withdrawn 1998**)  
**NO REPLACEMENT – pg 325-3 (325.4 – 3<sup>rd</sup> paragraph)**

D1598 - 02(2009) Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1599 - 99(2005) Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D1633 - 00(2007) Standard Test Methods for Compressive Strength of Molded Soil-Cement Cylinders

D1751 - 04(2008) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction  
(Nonextruding and Resilient Bituminous Types)

D1752 - 04a(2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

D1784 - 08 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) Compounds

D1785 - 06 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

\*D1788-81 Specification for Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics (**Withdrawn 1988**) **NO REPLACEMENT – pg 744-1 (744.3.2)**

\*D1850-74(1979) Specification for Concrete Joint Sealer Cold-Application Type (**Withdrawn 1989**) **NO REPLACEMENT—pg 729-1 (729.2)**

\*D1854-02 Standard Specification for Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Applied Elastic Type (**Withdrawn 2006**) **NOW D7116 pg 729-1 (729.2)**

D1856 - 09 Standard Test Method for Recovery of Asphalt From Solution by Absorb Method

D1869 - 95(2005)e1 Standard Specification for Rubber Rings for Asbestos-Cement Pipe

D1883 - 07e2 Standard Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils

D2000 - 08 Standard Classification System for Rubber Products in Automotive Applications

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D2122 - 98(2010) Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

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D2170 - 07 Standard Test Method for Kinematic Viscosity of Asphalts (Bitumens)

D2171 - 07 Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer

D2172 - 05 Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures

D2219 - 02(2007)e1 Standard Specification for Poly(Vinyl Chloride) Insulation for Wire and Cable, 60 °C Operation

D2220 - 02(2007)e1 Standard Specification for Poly(Vinyl Chloride) Insulation for Wire and Cable, 75 °C Operation

D2239 - 03 Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D2240 - 05 Standard Test Method for Rubber Property—Durometer Hardness

D2321 - 09 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

D2412 - 02(2008) Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D2419 - 09 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate

D2564 - 04(2009)e1 Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

D2628 - 91(2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

D2680 - 01(2009) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) Composite Sewer Piping

D2834 - 95(2008) Standard Test Method for Nonvolatile Matter (Total Solids) in Water-Emulsion Floor Polishes, Solvent-Based Floor Polishes, and Polymer-Emulsion Floor Polishes

D2837 - 08 Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

D2855 - 96(2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

\*D2922-05 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)  
**(Withdrawn 2007) REPLACED BY D6938 – pg 211-2 (211.4), pg 301-1 (301.3), pg 309-3 (309.4.6), pg 311-2 (311.4.4) , pg 312-1 (312.3), pg 313-2 (313.8), pg 601-2 (601.2.5), pg 601-5 (601.4.4), pg 620-1 (620.3.1)**

\*D2994-98 Standard Test Methods for Rubberized Tar (**Withdrawn 2000**) **NO REPLACEMENT – pg 335-1 (335.4)**

\*D3017-05 Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) (**Withdrawn 2007**)  
**REPLACED BY D6938 – pg 211-2 (211.4), pg 301-1 (301.3), pg 311-2 (311.4.4), pg 312-1 (312.3), pg 313-2 (313.8),  
Pg 601-2 (601.2.5), pg 601-5 (601.4.4), pg 620-1 (620.3.1)**

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D3155 - 98(2006) Standard Test Method for Lime Content of Uncured Soil-Lime Mixtures  
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D3350 - 10 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials  
D3549 - 03 Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens  
D3721 - 05 Standard Specification for Synthetic Red Iron Oxide Pigment  
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D3906 - 03(2008) Standard Test Method for Determination of Relative X-ray Diffraction Intensities of Faujasite-Type Zeolite-Containing Materials  
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D4318 - 10 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils  
D4354 - 99(2009) Standard Practice for Sampling of Geosynthetics for Testing  
D4402 - 06 Standard Test Method for Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer  
D4533 - 04(2009) Standard Test Method for Trapezoid Tearing Strength of Geotextiles  
D4632 - 08 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles  
D4751 - 04 Standard Test Method for Determining Apparent Opening Size of a Geotextile  
D4791 - 05e1 Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate  
D4799 - 08 Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Fluorescent UV, Water Spray, and Condensation Method)  
D4832 - 10 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders  
D4833 - 07 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products  
D4873 - 02(2009) Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples  
D4944 - 04 Standard Test Method for Field Determination of Water (Moisture) Content of Soil by the Calcium Carbide Gas Pressure Tester  
D4945 - 08 Standard Test Method for High-Strain Dynamic Testing of Piles

D5048 - 09 Standard Test Method for Measuring the Comparative Burning Characteristics and Resistance to Burn-Through of Solid Plastics Using 125-mm Flame  
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D5361 - 06 Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing  
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D6024 - 07 Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application  
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\*E54 - **Homeland Security Applications?** – pg 786-1 (786.1)

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F477 - 08 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F894 - 07 Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe

F1043 - 08 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework

F1083 - 08 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

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**Pg 505-8 (505.6.3.3) #5**