

**UNIFORM STANDARD
SPECIFICATIONS
for
PUBLIC WORKS
CONSTRUCTION**

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**1998
ARIZONA
(Includes revisions through 2010)**

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 who could not afford to promulgate such standards for themselves.

A uniform set of specifications and details, updated and embracing the most modern materials and construction techniques will redound to the benefit of the public and the private contracting industry. Uniform specifications and details will eliminate conflicts and confusion, lower construction costs, and encourage more competitive bidding by private contractors.

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*:

www.mag.maricopa.gov

While in the interest of 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.

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SECTION 215

Materials used or work performed by the Contractor, to stabilize the subgrade so it will withstand loads which may be placed upon it by his equipment shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

215.4 FILL AND BACKFILL:

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill provided that all organic material, rubbish, debris, and other objectionable material is first removed. However, stone, broken portland cement concrete and bituminous type pavement obtained from the project excavations will be permitted in the backfill or fill with the limitations as specified in Section 211.

Unless otherwise specified in the special provisions, the density of fills and backfills shall be at least 90 percent.

215.5 GRADING:

Grading of unlined channels, levees and access roads shall conform to the following tolerances:

(A) A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

- (1) Channel bottom
- (2) Channel side slopes in both cut and fill
- (3) Levee and access road side slopes in cut

(B) A vertical tolerance of none below and 3 inches above the specified grade will be allowed on:

- (1) Top surface of levee and access road in both cut and fill
- (2) Levee and access road side slopes in fill

Regardless of the construction tolerances specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface.

Construction tolerances specified above for grading are solely for purposes of field control.

215.6 TESTS:

Density tests shall be made in accordance with Section 211.

215.7 MEASUREMENT:

If compensation for stripping is included in the price paid for other items of work the Contractor shall notify the Engineer sufficiently in advance of excavation or other work so that cross section elevations and measurements of the ground surface may be taken upon completion of stripping.

The Engineer will compute the quantity of excavation by a method which in his opinion is best suited to obtain an accurate determination.

215.8 PAYMENT:

Earthwork for open channels will be paid for on a lump sum basis or at the contract unit price per cubic yard of excavation as stipulated in the proposal. Such price shall include clearing, stripping, excavation, fill, backfill, compaction, grading, hauling, removal and disposal of excess excavated material and debris unless an alternate method of payment is stipulated in the proposal.

End of Section

SECTION 220

RIPRAP CONSTRUCTION

220.1 DESCRIPTION:

Riprap construction shall consist of furnishing and placing stone, with or without grout, and underlain with filter material of granular filter blankets or erosion control geosynthetic fabric. The depth and type of riprap shall be as shown on the plans or in the special provisions.

220.2 MATERIALS

Riprap shall conform to the requirements of Section 703.

Erosion control geosynthetic fabric shall conform to the requirements of Table 796-3 in Section 796.

Waste or sacked concrete shall not be permitted for use as riprap.

The Contractor, at no additional cost, shall provide mechanical equipment, a sorting site, and labor needed to assist in checking riprap gradation.

Granular filter blankets shall consist of processed natural material conforming to the requirements of Section 702.3, with the gradation and thicknesses as specified on the plans or in the special provisions.

220.3 PREPARATION OF GROUND SURFACES

The bed for placement of riprap shall be shaped and trimmed to provide even surfaces.

220.4 PLACEMENT OF EROSION CONTROL GEOSYNTHETIC FABRIC:

Fabric shall be placed at the locations shown on the project plans. The Contractor shall provide a surface free of obstructions, depressions, debris, and soft yielding surfaces prior to the placement of fabric. The fabric shall be loosely laid (not in a stretched condition), aligned and placed with no fold over wrinkles.

The fabric shall be placed to provide a minimum 24-inch of overlap for each joint. On horizontal joints, the uphill fabric shall overlap the downhill fabric. On vertical joints, the upstream fabric shall overlap the downstream fabric.

Bedding material shall be placed uniformly on the fabric to the depth specified on the plans and shall be free of mounds, dips, and windrows. Bedding material shall not be compacted.

220.5 RIPRAP PLACEMENT:

Riprap shall be carefully placed on filter material consisting of a granular filter blanket or the bedding material on erosion control geosynthetic fabric. Placement shall not damage the underlying filter blanket or geosynthetic fabric. If the Engineer determines that the placement of stone has damaged or displaced the filter material to the extent that it cannot function as intended, the Contractor, at his expense, shall remove the placed riprap stone and properly correct the damage to, and/or the displacement of, the filter material. Such correction may include the removal of the filter material, re-grading the affected area, and subsequent replacement of the filter material and riprap stone as required by the Engineer.

Riprap shall be placed in a manner which will produce a dense, reasonably well-graded mass without segregation and with a minimum amount of voids. The larger stone shall be evenly distributed through the riprap mass. The individual placement of larger riprap stones may be required to obtain a uniform distribution of stone size. The riprap placement shall be supplemented by such hand methods as are required to obtain a uniform finished surface. Allowable tolerance from the slope lines and grades shown for the finished riprap surfaces shall not exceed a distance equal to 1/3 of the nominal D_{50} size above or below the design surfaces. The final surface elevations shall be lower than any adjacent apron or pipe invert elevations and shall not obstruct the operation of adjacent structures. The flow line within riprap shall provide positive drainage with minimal ponding. Individual stones shall

SECTION 220

depress below the finished grades no lower than a distance equal to 1/2 of the nominal D_{50} size. Special care shall be exercised in placing riprap within 3 feet of structures to avoid damage to such structures.

220.6 GROUTED RIPRAP:

Place riprap as specified in Section 220.5, excluding the use of filter material, then grout in place with portland cement mortar. Place grout to the depth as shown on the plan but in no case less than 70 percent of the depth of riprap. Consolidate grout into place with suitable spades, trowels or other approved means to provide a dense stone and mortar layer with all voids and interstices filled. After grout has been placed, the rocks shall be thoroughly brushed so that their top surfaces are exposed. If required, use water pressure to clean stone faces after the mortar has achieved sufficient strength. The outer rocks shall project 1/3 to 1/4 their diameter above the grouted surface.

The grout shall consist of 1 part cement and 3 parts by volume of aggregate. The portland cement shall be Type II as specified in Section 725 and the aggregate shall be 2 parts sand and 1 part gravel passing a 3/8 inch square mesh screen. The quality of the sand and gravel shall be as specified in Section 701.

The amount of water shall be such as to permit gravity flow into the interstices with limited spading and brooming. The consistency of the grout shall be as approved by the Engineer.

Except when hand mixing is permitted by the Engineer, grout shall be mixed in an approved machine mixer for not less than 1 1/2 minutes. Should hand mixing be permitted, the cement and aggregate shall be thoroughly mixed in a clean, tight mortar box until the mixture is of uniform color after which clean water shall be added in such quantity as to provide a grout of the required consistency.

220.7 MEASUREMENT:

The completed, in place riprap construction within the limits of the dimensions shown on the plans shall be measured. Measurement will be in cubic yards rounded to the nearest cubic yard.

No separate measurement will be made for erosion control geosynthetic fabric, bedding material, or grout.

220.8 PAYMENT:

Payment for riprap will be made for the accepted complete in-place riprap construction at the contract unit price. Riprap construction shall include excavation, ground surface preparation, erosion control geosynthetic fabric (if used for the project), bedding material, riprap stone, grout (if used for the project) and backfilling.

Payment for riprap shall be full compensation for furnishing all material, labor and equipment for riprap construction.

SECTION 225

WATERING

225.1 DESCRIPTION:

Water for compacting embankments, constructing subgrade, placement of screened gravel and crushed surfacing, and for laying dust caused from grading operations or public travel, shall be applied in the amounts and places as directed by the Engineer.

225.2 WATER SUPPLY:

Water shall consist of providing a water supply sufficient for the needs of the project and the hauling and applying of all water required.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon.

The Contractor shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use.

The Contractor shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use.

225.3 CONSTRUCTION EQUIPMENT:

The tank truck and/or trailer shall meet all safety and licensing regulations and the water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus.

225.4 MEASUREMENT:

No measurement will be made of water, unless otherwise provided for in the special provisions or proposal.

225.5 PAYMENT:

The cost of watering will be included in the price bid for the construction operation to which such watering is incidental or appurtenant, unless otherwise provided for in the special provisions or proposal.

End of Section

SECTION 230

DUST PALLIATIVE APPLICATION

230.1 DESCRIPTION:

This section shall govern the application of dust control palliatives (agents) on unpaved roads, traffic surfaces, vacant lots, construction sites and road shoulders. Dust palliatives may also be used to protect erosion of slopes, embankments, sediment control and re-vegetated areas.

Dust palliatives may be applied as topical treatments to penetrate an undisturbed surface, or may be applied to larger areas using mixing methods that blend the product with surface material and then compact the mixture to provide a stabilized, dust resistant, surface course.

230.2 MATERIALS:

Materials to be used as dust palliatives shall conform to the requirements of Section 792. The specific dust palliative to be used shall be as shown on the plans or as directed by the Engineer.

Water used for diluting dust palliatives and for pre-wetting of treated subgrade shall be either potable or from a source compatible with dust palliative ingredients.

230.2.1 Product Verification:

The Contractor, in the presence of the Engineer or his designee, shall obtain samples of the bulk, undiluted liquid dust palliative/stabilizer product as it is delivered to the job site. Samples shall be taken from each bulk tanker that delivers the liquid dust palliative/stabilizer for product verification testing purposes. If the bulk undiluted liquid dust palliative/stabilizer is delivered in containers, a sample must be taken from each container delivered to the job site. The Engineer will select the exact locations and times of sampling. The obtained liquid dust palliative/stabilizer samples will be split in three equal portions (minimum 2 ounce each), whereby the Contractor may retain one sealed portion for verification testing, and the Engineer will retain two sealed portions. One portion of the Engineer's samples will be provided to an AASHTO accredited test lab chosen by the Contractor. The other sample will be held for backup until the testing is completed. Sample containers will be labeled and sealed under the supervision of the Engineer.

The accredited lab will test the product in accordance with ASTM D2834 to confirm that the liquid dust palliative/stabilizer meets the requirements of Section 792.2 for active solids. Contractor is responsible for the cost of product verification testing.

If the test reports indicate that the minimum acceptable active solids content value as specified in Section 792.2 is not met, the quality of the liquid dust palliative/stabilizer product shall be deemed deficient by the Engineer. The delivery and application of a deficient product shall be stopped. Work shall not resume until all product verification testing is complete or the Contractor replaces the product and initial tests on the new material show compliance.

The Contractor may perform additional verification testing on the split samples. In case of dispute where the verification tests produce different results by the Contractor than the Engineer, the Engineer will hire a different independent AASHTO accredited testing laboratory to perform a third round of testing. Such testing and the results of the testing shall be considered final by both the Engineer and Contractor for verification.

230.3 COMPLIANCE:

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the following Applicator qualifications: (a) Information showing that the Applicator has at least three years of experience within the last five years serving as either a primary contractor or subcontractor in delivering and applying dust palliative/stabilizer product services, (b) A minimum 3 local references (including company/organization name, contact person and telephone number) to demonstrate that the Applicator is familiar with local environmental and permitting requirements associated with soil stabilization and dust palliative, and (c) Copy of the Applicator's State of Arizona Registrar of Contractors License.

SECTION 230

At least two weeks prior to the start of work, the Contractor shall provide the Engineer the proposed application methods and equipment for the project. The information provided shall include: (a) curing time for each application method required for the project, (b) application and dilution rates proposed for the project, and (c) equipment to be used during all phases of application that are in conformance with Section 230.4.

Prior to the commencement of any work, the Contractor shall provide copies of all required environmental/dust control permits, any required notices of intent, and the current Material Safety Data Sheet (MSDS) for the dust palliative/stabilizer product. The MSDS must include all chemical compounds present in concentrations greater than 1% for dust palliative/stabilizer product.

230.4 EQUIPMENT:

The Contractor shall provide all equipment necessary to complete the work. The equipment may include but not be limited to motorized graders, distribution trucks, mixing and pulverizing equipment, pneumatic-tired rollers, sprinkler systems, etc. All equipment used for this work is subject to approval by the Engineer. Equipment which fails to provide an acceptable application of properly diluted dust palliative/stabilizer product or does not perform satisfactorily shall be removed from the job and replaced with acceptable equipment meeting the requirement of this specification.

Distributor trucks shall be designed, equipped, maintained and operated so that dust palliative/stabilizer product may be applied uniformly on variable widths of surface up to 16 feet at readily determined and controlled rates from 0.03 to 1.0 gallons per square yard, with uniform pressure, and with an allowable transverse variation from any specified rate not to exceed 10% or 0.02 gallon per square yard, whichever is less. The maintenance and calibration of this vehicle shall be checked periodically. The record of maintenance and calibration shall be submitted to the Engineer for review upon request.

Distributor trucks proposed for use shall have been tested within 6 months from the date of spreading to determine the rate of the transverse spread. If requested, the Contractor shall furnish the Engineer with evidence that the transverse spread of the distributor truck, when the trucks were approved for use, was as uniform as practicable and under no condition was there a variance on any of the test pads greater than the allowable transverse variation; however, the Engineer may require that each distributor truck be tested to determine the rate of the transverse spread. The rate of the transverse spread shall be determined in accordance with the requirements of Arizona Test Method 411.

230.5 PREPARATION OF SURFACE:

All surface preparation shall be in conformance with Maricopa County Rule 310 and 310.01 as applicable.

230.5.1 Topical Preparation: Prior to the application of the dust palliative, the surface shall be graded to provide drainage.

Dust palliatives shall not be applied when the surface is excessively wet or saturated. Surfaces shall be pre-moistened only if required by the product manufacturer.

230.5.2 Surface Course Preparation: Areas to receive dust palliative shall be graded and scarified to at least the minimum depth and width shown on the plans. The soil shall be scarified/loosened by tilling, disking, ripping, or by other soil preparation methods, which achieves uniform results to the minimum depth shown on the plans. The material shall be damp at time of scarification to reduce dust and aid in pulverization. Soil clods shall be pulverized until all material, exclusive of gravel or stone, will pass a 2-inch sieve.

All debris, weeds, organic material, stone larger than 4 inches, etc., shall be removed from the site. Surface gravel or stones shall be removed or thoroughly mixed with the surrounding soils to obtain a homogeneous mixture.

If pre-wetting is required, ample amount of water shall be added and mixed with the in-place material to obtain a moisture content near optimum. This moisture content shall be established prior to and maintained until the application of the dust palliative. The methods to establish and maintain the moisture shall be done in accordance with manufacturer's recommendations. The moisture must be uniformly distributed throughout the surface course and over the underlying undisturbed soil. Dust palliatives shall not be applied when the soil is excessively wet or saturated. Moisture content shall be determined in accordance with either ASTM D6938 or ASTM D4944.

SECTION 230

230.6 APPLICATION:

230.6.1 General: The dust palliative shall be applied by a pressure type distributor vehicle equipped with a power unit for the pump, full circulation spray bars adjustable laterally and vertically, and computer controls. The distribution vehicle shall be calibrated to ensure a controlled application method. Spray bars and extensions shall be of the full circulating type. Valves which control the flow from nozzles shall be of a positive active design so as to provide a uniform, unbroken spread of dust palliative on the surface.

Corners or surface that cannot be accessed by the distributor truck shall be hand sprayed by means of hoses or bars pressurized by a gear pump or air tanks.

Distributor equipment shall be equipped with a tachometer and pressure gauge. To provide for accurate, rapid determination and control of the amount of dust palliative being applied, distributor equipment shall include one or more of the following: accurate volume measuring devices, a calibrated tank, and/or a certified meter or weight tickets and calibration charts relating to the specific gravity of the concentrate and/or dilution.

The dust palliative shall be applied at the dilution ratio and application rate specified in accordance with Section 792, unless otherwise directed by the Engineer. The Contractor shall dilute the dust palliative product as needed, with the dilution ratio adjusted within the ranges specified in Section 792, to bring the mixture to the desired moisture content. Products may be applied in multiple passes at reduced application rates to meet the total application rate specified and/or assure uniform coverage.

The Contractor shall notify the Engineer a minimum of 5 working days prior to any application of dust palliative.

230.6.2 Topical Application: Topical applications shall be rolled only when recommended by the manufacturer. Complete penetration of palliative will be required prior to the surface rolling. Complete penetration occurs when the compaction equipment will not track or pick up the dust palliative and/or the top layer of the surface material.

230.6.3 Surface Course Application: The stabilization product shall be applied, incorporated and thoroughly blended into the soil until the homogeneous mixture is obtained to the full depth of treatment. Mixing shall be done in-place using mixing equipment or by motorized grader (blade mixing). The blending methods utilized shall result in a uniformly treated mixture of soil and dust palliative at or near optimum moisture content (minus any post-compaction dust palliative top coat application quantity). The dilution ratio may be adjusted to bring the mixture to the desired moisture content. The amount of area treated each day shall be limited to that which the Contractor can thoroughly mix and compact within that work day.

Complete penetration of palliative will be required prior to compaction. Complete penetration occurs when the compaction equipment will not track or pick up the blended material.

The blended material shall be shaped to the required grade line and cross section shown on the plans and be compacted at least 95% of maximum density in accordance with ASTM D 698, unless otherwise directed by the Engineer. The final surface shall be rolled to a smooth and even grade. Sufficient grading shall be done to provide reasonable drainage within the limits of existing drainage patterns. Immediately after the compaction, a top coat of dust palliative shall be applied.

230.7 CURING:

No equipment or traffic will be permitted on the treated surface for 24 hours unless otherwise approved by the Engineer. Once cured, the dust palliative final coat shall form a skin at the surface or a crusted surface. For purpose of this work, a "skin" on the surface will be a formation of any palliative on the surface of the soil that cannot be dislodged from the soil by winds. Any formation of the palliative on the soil surface must adhere to the underlying soil to a depth of 1/8th inch when applied topically.

230.8 WEATHER CONDITIONS:

Dust palliative/stabilizer product shall be applied only when the ambient temperature is above 50°F. Application should be avoided during high wind or when there is the chance of rain within the next 8 hours. The Contractor shall be responsible to retreat at no additional cost if the application is degraded by weather within the first 24-hours of placement.

SECTION 230

230.9 QUALITY CONTROL

The Contractor must provide manufacture-trained personnel for on-site technical assistance during initial delivery and application. This technical assistance is to assure that the dust palliative/stabilizer product is applied at proper dilution ratios and application rates on various soil, and subgrade types for optimum results.

At the start of each work day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product brought to the job site. At the end of the day, the bulk tanker will be measured to verify the gallons of liquid dust palliative/stabilizer product remaining at the job site. The distributor truck shall be inspected to insure it is empty at the end of the day. The total gallons of liquid dust palliative/stabilizer product used for the day will be established by the start and end of day measurements of the bulk tanker.

A daily "Gallon Use Report" will be filled out by the distributor truck driver. The report will also identify the size of area treated for the day. It will be verified and signed by the Engineer or his designee. This report will be used to verify application rate and total product used. If the report indicates that the minimum application rate was not achieved, the work shall be deemed deficient by the Engineer.

230.10 DEFICIENCIES AND WARRANTY

If applied product active solids content is found deficient per Section 230.2.1, the Engineer may allow the Contractor to apply to any surfaces already treated by the deficient product additional topical coats of the dust palliative/stabilizer product to remedy the deficiency. Otherwise, the Contractor shall be required to repeat all work as directed by the Engineer with a different approved liquid dust palliative/stabilizer product that is compatible with the original product and will not result in adverse effects. The Contractor shall bear the cost of all remediation work for deficient product.

If the application rate as determined by the methods described in Section 230.9 or as agreed to in the contract documents is found to be deficient, the Contractor shall apply additional product within 24-hours of the original application to bring the total application rate to at least the minimum specified amount. If liquid dust palliative/stabilizer product was used as a soil stabilizer per Section 230.6.3, as directed by the Engineer, the Contractor shall re-scarify the stabilized section to its full depth and re-apply product at the original application rate. The Contractor shall bear the cost of all remediation work for deficient application rate.

For non-traffic areas (less than 150 vehicle trips per day), application of the dust palliative/stabilizer product placed in accordance with this Section shall provide a surface meeting the stabilization requirements of Maricopa County Rule 310 Section 302 and Maricopa County Rule 310.01 Section 302 for a minimum of 12 months from acceptance by the Engineer.

During the warranty period, the Contractor shall provide and install the product free of charge if the finished product fails to meet the performance requirement and specification/criteria outlined under this technical specification. The Contractor shall provide additional applications when within five working days of notification from the Engineer of performance failure.

230.11 MEASUREMENT:

Dust palliative surface course application shall be measured by the square yard, in place, treated, compacted, to the proper depth and accepted.

Dust palliative materials will be measured by the ton of undiluted material. Any conversion from volumetric quantities shall be done with Contractor-supplied calibration charts relating to the specific gravity of the concentrate and/or dilution.

230.12 PAYMENT:

Payment will be made for the applicable items at the Contract unit price and shall constitute full compensation for the item complete in place.

PART 300

STREETS AND RELATED WORK

Section Title

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SECTION 306

MECHANICALLY STABILIZED SUBGRADE - GEOGRID REINFORCEMENT

306.1 DESCRIPTION:

Mechanically stabilized subgrade shall consist of furnishing and placing a geogrid material within or below untreated base to provide a stabilized platform on which paving materials are placed. Geogrid type, fill thickness, pavement cross-section and associated details, shall be as shown on the contract drawings.

306.2 MATERIALS:

The geogrid material shall be supplied in accordance with and conform to the material requirements of Section 796 and Table 796-4.

306.3 SUBGRADE PREPARATION:

The geogrid shall not be placed when weather or surface conditions do not meet the manufacturer's recommendations for installation.

306.3.1 Placing Geogrid on Soft Subgrade: Prior to placement of geogrid material, soft subgrade shall be lightly proof rolled to provide a firm surface, brought to grade and shaped to conform to the typical sections, lines and grades as shown on the plans. The surface on which the geogrid will be placed shall be free of rock and other material that could damage the geogrid. The placement of the geogrid shall be approved by the Engineer before placement of overlaying materials.

Subgrade tolerances shall be in accordance with MAG Section 301.4.

306.3.2 Placing Geogrid Within Untreated Base: Subgrade shall be prepared in accordance with MAG Section 301.

306.4 EQUIPMENT:

Mechanical or manual laydown equipment shall be capable of laying the geogrid properly and smoothly, in compliance with the manufacturer's recommendations.

306.5 GEOGRID PLACEMENT:

The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.

The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or acceptable fill material as required by fill placement procedures, weather conditions, or as directed by the Engineer. A 12-inch minimum secured overlap is required at all joints (both transverse and longitudinal). At transverse joints, the preceding roll shall overlap the following roll in the direction that the aggregate base will be placed. The geogrid shall be rolled out along the alignment in the direction of advancing construction. All wrinkles and folds shall be removed.

The geogrid shall be tensioned by hand and anchored to the ground at the edges, including overlaps, and in the center of the roll at 30-foot intervals along the roll length, at the corners if applicable, or as directed by the Engineer. Securing locations may be reduced or eliminated if it can be shown to the satisfaction of the Engineer that an alternative installation process will provide satisfactory results.

Geogrid shall be placed to obtain full coverage of the indicated area. Placement of geogrid on irregular shaped areas and radii may require cutting of the geogrid material and the use of diagonal overlapping joints. Buckling of geogrid material will not be allowed.

306.6 PLACING AND COMPACTING AGGREGATE FILL:

The aggregate shall be back dumped and spread in a uniform lift maintaining the design aggregate thickness at all times. The aggregate material shall be bladed on the geogrid in such a manner that the aggregate rolls forward onto the grid ahead.

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When underlying substrate is trafficable with minimal rutting, rubber-tired equipment may pass over geogrid reinforcement at slow speeds (less than 10 mph). Sudden stops and turning by trucks shall be avoided on the geogrid. Traffic shall not be allowed onto coated geogrid materials. A minimum loose fill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid. Turning of tracked vehicles shall be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

Any ruts which develop during spreading or compacting aggregate fill shall have additional aggregate added rather than bladed from surrounding areas. Placing additional aggregate into the rutted areas limits disturbance to the underlying geogrid keeping it intact.

Untreated base shall be compacted as specified in Section 310. Untreated base material shall not be mixed or processed on the geogrid. Base materials will be uniformly blended and sampled for acceptance prior to placement on the geogrid material. Contamination and segregation of base materials during placement shall be minimized.

306.7 REPAIR:

Any geogrid material damaged before, during or after installation shall be replaced by the contractor at no additional cost to the Agency.

Replacement of geogrid reinforcement shall consist of removal and replacement of the geogrid and aggregate fill from the defective area. The aggregate fill shall be removed at least 3 feet beyond the limits of the defective area. The replacement geogrid shall be installed with proper overlaps. Aggregate fill replacement shall not commence until placement of the geogrid material has been inspection and approved.

306.8 PAYMENT:

The surface area of accepted in-place geogrid reinforcement will be measured to the nearest square yard.

Payment for geogrid reinforcement at the contract unit price shall be full compensation for furnishing all labor, material, equipment, and installing complete in place the geogrid as shown on the project plans.

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321.7 TRANSPORTATION:

Petroleum distillates or other substances that will have a detrimental effect on the asphalt concrete shall not be used as a release agent.

The beds of all transportation units shall be clean and smooth to allow the free flow of material into the paving machine's hopper.

Tarpaulins shall be furnished on all trucks and used when weather condition warrant, or if directed by the Engineer.

321.8 PLACEMENT:

321.8.1 Placing: All courses of asphalt concrete shall be placed and finished by means of a self-propelled paving machine equipped with an automatically actuated control system, except under certain conditions or at locations where the Engineer deems the use of a self-propelled paving machine impracticable.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternatively when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with one of the following devices:

- (A) Ski or non-contact device of not less than 30 feet in length, supported throughout its entire length
- (B) Taut stringline or wire set to grade
- (C) Short ski or sonar sensing units from curb control
- (D) Joint matching shoe

Failure of the control system to function properly shall be cause for the suspension of asphalt concrete production. In order to achieve a continuous operation, the speed of the paving machine shall be coordinated with the hot mix plant and transport units.

If the asphalt concrete is dumped from the hauling vehicles directly into the paving machine, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machine by the truck.

If asphalt concrete is dumped upon the surface being paved and subsequently loaded in the paving machine, the loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine. Substantially all of the asphalt concrete shall be picked up and loaded into the paving machine.

Self-propelled paving machines shall spread the mixture without segregation or tearing, true to line, grade and crown indicated on the Project plans. Pavers shall be equipped with hoppers and augers that will distribute the mixture uniformly in front of an adjustable floating screed. The raising of the hopper wings must be minimized and the paving machine will not be operated when in an empty condition.

Screeds shall include any strike-off device operated by tamping or vibrating action which is effective, without tearing, shoving or gouging the mixture and which produces a course with a uniform texture and density for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required. In the case of the screed, auger extensions and vibrators shall be installed wherever the screed is extended more than one (1) foot beyond the end of the base auger or auger extension. However, when placing material against an extremely uneven curb or edge over a short distance, the Engineer may waive the auger extensions and vibrators.

At any place not accessible to the roller, the mixture shall be thoroughly compacted with tampers to provide a uniform and smooth layer over the entire area compacted in this manner.

321.8.2 Joints: Transverse joints, before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth and exposing a fresh face. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in

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the area of the joint shall not deviate more than ¼ inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline.

Longitudinal Joints of each course shall be staggered a minimum of 6 inches with relation to the longitudinal joint of the immediate underlying course cold transverse construction joint, the cold existing asphalt concrete shall be trimmed to a vertical face for its full depth and exposing a fresh face. The fresh face shall be tacked prior to placement of the adjacent course. After placement and finishing the new asphalt concrete, both sides of the joint shall be dense and the joint shall be smooth and tight. The surface in the area of the joint shall not deviate more than ¼ inch from a 12-foot straightedge, when tested with the straightedge placed across the joint, parallel to the centerline. The joint will be tack coated if required by the Engineer.

321.8.3 Leveling Course: A leveling course shall be used when specified, or as directed in writing by the Engineer, to bring existing pavement to a uniform grade prior to placing an overlay or other course. If a leveling course is being applied on an Asphalt surface, a tack coat shall be applied. The compaction requirements contained in Section 321.10 do not apply to leveling courses.

321.8.4 Compaction Base and Surface: It is the contractor's responsibility to perform any desired Quality Control monitoring and/or testing during compaction operations to achieve the required compaction. Asphalt concrete immediately behind the laydown machine shall be referenced to Table 321.3. The probe type thermocouple thermometer shall have a current calibration sticker attached. When measuring the temperature of the mat, the probe shall be inserted at mid-depth and as horizontal as possible to the mat.

Asphalt compaction equipment shall be of sufficient size and weight to accomplish the required compaction. All compaction equipment shall be operated and maintained in accordance with the manufacturer's recommendations and the project requirements. During the rolling operation, the speed of the roller shall not exceed 3 miles per hour, unless otherwise approved by the Engineer.

Pneumatic tired compactors shall be equipped with skirt-type devices mounted around the tires so that the temperature of the tires will be maintained during the compaction process.

The Engineer will determine the acceptability of the pavement compaction in accordance with Section 321.10.

321.8.5 Smoothness: The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than one-fourth (¼) inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway.

321.8.6 Asphalt Concrete Overlay: Asphalt concrete overlay consists of the placing and compacting plant mix asphalt concrete over existing asphalt concrete paving. The thickness of the overlay shall be as shown on the plans or as specified in the special provisions. Preliminary preparation of existing surfaces will be required except when accomplished by the Contracting Agency, and it is so stipulated in the special provisions. With the exception of those which have been preheated and remixed only, existing surfaces shall receive a tack coat.

Asphalt concrete mix aggregate gradation and percentage of asphalt binder shall be in accordance with Section 710 using a 1/2-inch Marshall-Low Traffic asphalt concrete mix designation for overlay more than one and one-half inch in thickness and a 3/8-inch Marshall-Low Traffic asphalt concrete mix designation for overlay one and one-half inch or less in thickness, unless otherwise shown or specified in the special provisions.

Except when they have been preheated and remixed, pavement surfaces shall be prepared as follows:

- (a) Before placing asphalt concrete overlay, severely raveled areas or cracked areas that are depressed more than 3/4-inch from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted areas or rough high spots shall be either milled or cut out and patched. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the Engineer. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above are incidental, and the cost thereof shall be included in the bid items.
- (b) Before placing asphalt concrete overlay, milling shall be done as shown on the plans or specified in the special provisions and shall be in accordance with Section 317.

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(c) After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat per Section 321.4. Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto the concrete gutter, the gutter shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

Asphalt concrete overlay shall be placed as specified in Section 321.8.1 and compacted as specified in Section 321.8.4. The surface smoothness shall meet the tolerances specified in Section 321.8.5.

Manholes shall be built up and the frames set flush with the finished surface of the new paving, and tops of valve boxes, clean-outs and other existing structures shall be adjusted to finish grade. In the event the base course and original paving have been removed or disturbed in order to build up the manhole, they shall be replaced with approved materials which shall be thoroughly compacted. The asphalt concrete around the manhole frame shall be completed and made flush with the adjacent overlay.

321.8.7 Pavement Fabric Interlayer: Pavement fabric interlayer shall be used only when specified on the plans or in the specifications.

Pavement fabric interlayer shall be in accordance with Table 796-1 and be the class designated on the plans or in the specifications.

Asphalt binder coat used to bond the fabric to the pavement shall be paving asphalt PG 70-10 asphalt cement conforming to the requirements of Section 711. The application and distributing equipment for the asphalt binder shall conform to the requirements of Section 330. The asphalt binder coat shall be uniformly spray applied to the prepared pavement surface at the rate of 0.20 gallons per square yard for Class B fabric or at the rate of 0.25 gallons per square yard for Class A fabric. Some underlying surfaces may require a higher or lower application rate. A test strip may be necessary to determine the proper application rate. The width of liquid asphalt cement application shall be the fabric width, plus six inches.

Neither the asphalt binder coat or fabric interlayer shall be placed when weather conditions, in the opinion of the Engineer, are not suitable. The asphalt binder and fabric interlayer shall only be placed when the pavement is dry, the ambient air temperature is 50 degrees F and rising, and pavement temperature is 40 degrees F and rising.

Equipment for placing the fabric shall be mechanized and capable of handling full rolls of fabric. The equipment shall be able to lay the fabric smoothly to maximize pavement contact and remove air bubbles. Stiff bristle brooms shall be used to smooth the fabric. The equipment used to place the fabric shall be in good working order and is subject to approval by the Engineer.

Pavement fabric interlayer shall not be placed if the in-place binder is hotter than 325 degrees F or has cooled to 180 degrees F or below (as determined by non-contact thermometer).

Pavement fabric interlayer shall be placed onto the asphaltic binder with the heat bonded side up with a minimum amount of wrinkling or folding. Remaining wrinkles or folds 1-inch and larger shall be removed or slit and shingle-lapped in the direction of paving. Burning or torching of wrinkles is not allowed. Fabric shall overlap three to six inches to insure full closure of the joint. Transverse joints shall be shingle-lapped in the direction of paving to prevent edge pickup by the paver. A second application of hand-placed asphalt binder may be required at laps and repairs as determined by the Engineer to ensure proper binding of the narrow double fabric layer.

All areas where fabric has been placed shall be paved with asphaltic concrete during the same workshift. Placement of the asphaltic concrete shall closely follow fabric lay down. The temperature of the asphaltic concrete immediately behind the laydown machine shall not exceed 325 degrees F. In the event that the asphalt binder coat bleeds through the fabric causing construction problems before the overlay is placed, the affected areas shall be sanded with a sand blotter in compliance with Section 333. Excess sand shall be removed before beginning the paving operation. In the event of rainfall prior to the placement of the asphaltic concrete, the fabric shall be allowed to dry before the asphalt concrete is placed.

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Turning of the paving machine or of other vehicles on the fabric shall be gradual and kept to a minimum to avoid damage to the fabric. Should equipment tires stick to the fabric during pavement operations, small quantities of paving asphalt concrete shall be broadcast on the fabric to prevent pick-up. Decrease of binder rate in order to minimize pick-up on tires is not allowed.

TABLE 321.2

MINIMUM ASPHALT CONCRETE PLACEMENT TEMPERATURE

Base ⁽¹⁾ Temp (°F)	Mat Thickness (inches)					
	½	¾	1	1 ½	2	3 and greater
40 – 50	---	---	310	300	285	275
50 – 60	---	310	300	295	280	270
60 – 70	310	300	290	285	275	265
70 – 80	300	290	285	280	270	265
80 – 90	290	280	270	270	265	260
+90	280	275	265	265	260	255

(1) Base on which mix is to be placed

321.9 QUALITY CONTROL:

It is the contractor's responsibility to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required compaction and to perform Quality Control monitoring and/or testing during asphalt concrete production to achieve the required mix properties. The Engineer may obtain samples of any portion of any material at any point of the operations for his own use. Also, the Engineer may order the use of any drying, proportioning and mixing equipment or the handling of any material discontinued which, in his/her opinion, fails to produce a satisfactory mixture.

The asphalt concrete produced shall conform to the properties of the mix design. When the asphalt concrete does not conform to the approved mix design properties, it shall be reported to the Engineer, and corrective quality control measures shall be implemented, or production shall cease immediately at no additional cost to the contracting Agency or Engineer.

321.10 ACCEPTANCE:

321.10.1 Acceptance Criteria: Unless otherwise specified, asphalt concrete will be divided into lots for the purpose of acceptance. A lot shall be considered to be one day's production. When the quantity of asphalt concrete placed in a day exceeds 500 tons but is less than 2000 tons, the lot shall be divided into 500 ton sublots or fraction thereof. Where the quantity of asphalt concrete placed in a day exceeds 2000 tons, the day's production will be divided into four (4) approximately equal sublots. A minimum of one sample will be obtained from each lot. Tests used to determine acceptance will be performed by the Engineer or a laboratory employed by the Engineer. In either case the laboratory shall be accredited by the AASHTO Accreditation Program (AAP), for the tests being performed. The acceptance laboratory will take representative samples of the asphalt concrete from each sublot to allow for gradation, binder content, air voids, pavement thickness and compaction of base and surface course. Each sublot will be accepted based upon the test data from the sample(s) from that sublot. All acceptance samples shall be taken using random locations or times designated by the Engineer in accordance with ASTM D 3665.

321.10.2 Gradation, Binder Content and Air Voids: The acceptance laboratory will take a sample of the asphalt concrete in accordance with the requirements of Section 2 or 4 of Arizona Test Methods 104 or AASHTO T168 from each sublot. The minimum weight of the sample shall be 45 pounds. Asphalt binder content and gradation shall be determined in accordance with AASHTO T308 using the ignition furnace for each sublot. The acceptance laboratory is responsible for obtaining the necessary materials and performing an ignition furnace calibration as outlined in AASHTO T308 for each asphalt concrete mixture utilized on the project. The correction factor used for each test shall be clearly indicated on the report. The bulk density for Marshall Mix designs shall be tested in accordance with AASHTO T245. The bulk density for Gyrotory mix designs shall be tested in

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accordance with AASHTO T312. The maximum theoretical density shall be tested in accordance with the requirements of AASHTO T209. Effective voids determined on the laboratory compacted specimens will be determined at a minimum of once per lot in accordance with the requirements of AASHTO T269. Should the testing for effective air voids not meet the “Full Payment” or “No Corrective Action” requirements of Table 321-6, additional testing for laboratory air voids on the remaining sublots will be performed as necessary to determine the extent of the deficiency. Acceptance testing results will be furnished to the contractor within five working days of receipt of samples by the acceptance laboratory.

The allowable deviations for acceptable production of each measured characteristic from the values established in the JMF for each subplot are as follows:

TABLE 321-3	
ACCEPTANCE LIMITS FOR ASPHALT CONCRETE	
Maximum Aggregate Size	100% passing
Nominal Maximum Aggregate Size	±7%
No. 8 Sieve to the Nominal Maximum Aggregate Size	±6%
No. 100 and No. 30 Sieves	±4%
No. 200 Sieve	±2%

If the results from a single acceptance sample fall outside of the acceptance limits in Table 321-3 a second sample shall be taken and if the second acceptance sample is also outside of the acceptance limits in Table 321-3 the Contractor shall cease production of asphalt concrete. Production shall not begin again until calibration test results verify that adjustments made to materials or proportions yield a gradation that falls within acceptance limits in Table 321-3.

The asphalt binder content shall be considered acceptable if it is within ± 0.40% of the mix design target value.

TABLE 321-4		
ASPHALT BINDER CONTENT CORRECTIVE ACTION FOR DEVIATIONS		
Deviation from that permitted	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
0.0 to 0.1% points	\$2.00	EA (see 321.10.6)
Over 0.1 to 0.2% points	\$6.00	EA (see 321.10.6)
Over 0.2% points	Removal*	Removal*

Note: Removal* refers to Section 321-10.6

TABLE 321-5		
LABORATORY VOIDS ACCEPTANCE AND PENALTIES		
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
Less than 1.5%	Removal*	Removal*
1.5-2.0%	\$2.50	EA (see 321.10.6)
2.1-2.7%	\$1.00	EA (see 321.10.6)
2.8-6.2%	Full Payment	No corrective action
6.3-6.9%	\$1.00	EA (see 321.10.6)
7.0-8.0%	\$2.50	EA (see 321.10.6)
Greater than 8.0%	Removal*	Removal*

Note: Removal* refers to Section 321-10.6

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If an agency or Engineer is purchasing asphalt concrete directly from a commercial material supplier, the agency or Engineer will use Section 321.10 and specifically Tables 321-3, 321-4 and 321-5 from Section 321.10 when determining the acceptance of the asphalt concrete with the material supplier.

321.10.3 Surface Testing: If directed by the Engineer surface drainage test shall be performed. The completed surfacing shall be thoroughly compacted, smooth and true to grade and cross-section and free from ruts, humps, depressions or irregularities. An acceptable surface shall not vary more than 1/4 inch from the lower edge of a 12-foot straightedge when the straightedge is placed parallel to the centerline of the roadway. The straightedge shall be furnished by the contractor and shall be acceptable to the Engineer.

All streets shall be water tested for drainage in the presence of the Engineer or designated representative before final acceptance. Any areas not draining properly shall be corrected to the Engineer's satisfaction at the Contractor's expense. Water for this testing shall be provided and paid for by the Contractor.

When deviations in excess of the above tolerance are found, humps or depressions shall be corrected to meet the specified tolerance, or shall be cut out along neat straight lines and replaced with fresh hot mixture and thoroughly compacted to conform with and bond to the surrounding area. Materials and work necessary to correct such deviations shall be at no additional cost to the Contracting Agency.

321.10.4 Asphalt Pavement Thickness: Asphalt Pavement thickness will be determined from cores secured from each subplot for this purpose. Such cores will be taken and measured by the Asphalt Concrete Coring Method. This method can be found at in Section 321.14. Each core location will be patched by the party responsible for the testing.

If the pavement thickness is deficient from the target thickness by 0.25 inches or less, it will be paid for at the contract unit price. If the pavement thickness deficiency is greater than 0.25 inches and the contracting agency is not the owner (i.e. permits) the following steps will apply:

- (1) If the thickness deficiency of the pavement exceeds 0.25 inch, the limits of the deficient area will be isolated by coring at maximum intervals of 100 feet from the deficient core. The thicknesses of the original deficient core will be averaged with the thicknesses of the cores taken from 100 feet on each side of it to determine compliance with the acceptance requirements.
- (2) If the pavement thickness from step one above deviates from the target thickness by more than 0.25 inch but not more than 0.50 inch, corrective action will be required. This corrective action will consist of application of a Type II slurry seal coat in accordance to Section 715. The Contractor may present an engineering analysis outlining other proposed remedial measures for the consideration of the Engineer. The Engineer will review the engineering analysis and decide within 30 working days whether to accept the proposed remedial measures.
- (3) If the pavement thickness from step one above deviates from the target thickness by more than 0.50 inch, corrective action will be required. The deficient area will be overlaid with no less than 1 inch thick lift, for the full width of the pavement to meet or exceed the designed thickness, with the appropriate end and edge milling, with a mixture approved by the Engineer. The Contractor may present an engineering analysis outlining other proposed remedial measures for the Engineer's consideration. The Engineer will review the engineering analysis and decide within 10 working days whether to accept the proposed remedial measures. If the Engineer chooses to reject the engineering analysis, the indicated overlay will be constructed by the Contractor at no additional cost to the Owner.

If the pavement thickness deficiency is greater than 0.25 inches and the contracting agency is the owner, Table 321-6 will apply.

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TABLE 321-6	
ASPHALT PAVEMENT THICKNESS PAYMENT REDUCTION For Thickness Deficiency of More Than 0.25 inches and less than 0.50 inches	
Specified Mat Thickness	Reduction in Payment or Corrective Action
Less than 1.5 inches	50%
1.50 inches to 1.99 inches	33%
2.00 inches to 2.49 inches	25%
2.50 inches to 2.99 inches	20%
3.00 inches and over	17%

321.10.5 Density: Achieving the required compaction is the responsibility of the contractor. The number and types of rollers is the contractor's responsibility and shall be sufficient to meet these requirements.

In-place air voids shall be determined in accordance with AASHTO T269 utilizing cores taken from the finished pavement. The maximum theoretical density used in the determination of in-place air voids will be the average value from the acceptance samples determined for the Lot as outlined in 321.10.1.

The Engineer will designate two random test locations for each subplot and the acceptance laboratory will obtain two cores from each location. The two cores will be averaged for acceptance. The outside one foot of each pass of the pavement course or any unconfined edge will be excluded from testing. The Engineer may exclude areas from the compaction lot that are not accessible by normal compaction equipment.

The Contractor will provide the traffic control to facilitate any coring operations necessary for compaction acceptance.

Cores will be taken per the Asphalt Concrete Coring Method. This method can be found in Section 321.14. The acceptance laboratory will furnish test results within three working days of receipt of the cores.

If the pavement density has in-place voids of 8.0% or less, the asphalt concrete will be paid for at the contract unit price. If the pavement density has in-place voids greater than 8.0%, the limits of the deficient area will be isolated within the subplot by coring at maximum intervals of 100 feet from the deficient core. The in-place voids of the original deficient core will be averaged with the in-place voids of the cores taken from 100 feet on each side of it to determine compliance with the acceptance requirements. If the average of the in-place voids is greater than 8.0% then Table 321-6 shall apply to the subplot.

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TABLE 321-7		
PAVEMENT DENSITY PENALTIES		
Limits of In-place Air Voids Less than 1.5 inches	When the contracting agency is the owner: Payment Reduction (\$ per ton of asphalt concrete)	When the contracting agency is not the owner (i.e. permits): Corrective Action
8.1% to 9.0%	\$4.00	EA
9.1% to 10.0%	\$6.00	EA and Type II Surry Seal
10.1% to 11.0%	Removal*	Removal*
Greater than 11.0%	Removal	Removal

Notes: Removal refers to Section 321-10.6. The Contractor shall remove and replace the entire subplot that is deficient. Removal for In-place Air Voids greater than 11.0% is not eligible for Section 321.10.6.

321.10.6 Engineering Analysis (EA): Within 10 working days after receiving notice that a subplot of asphalt concrete is deficient for “Removal” by the Engineer, the contractor may submit a written proposal (Engineering Analysis) to accept the material in place at the applicable penalties listed in the “Removal” category. Engineering Analysis can also be proposed for non-removal categories of “Corrective actions” when the contracting agency is not the owner (i.e. permits).

The Engineering Analysis shall contain an analysis of the anticipated performance of the asphalt concrete if left in place. The Engineering Analysis shall also detail the effect of any proposed corrective action on the performance. The Engineering Analysis shall be performed by a professional engineer experienced in asphalt concrete testing and mix designs. If the subplot is submitted for referee testing by the contractor, the ten working days allowed to prepare an engineering analysis will begin upon notification of referee test results.

When an Engineering Analysis recommends that a specific lot or subplot not be removed, the Engineering Analysis will recommend that the following penalties (Table 321-8) be paid when the contracting agency is the owner, for the specific criteria being reviewed by the EA.

TABLE 321-8		
ENGINEERING ANALYSIS PENALTIES for REMOVAL* LOTS/SUBLOTS LEFT IN-PLACE		
Acceptance Criteria	Acceptance Limits	Penalty When Contracting Agency is the Owner (\$/Ton)
Asphalt Binder Content	Over 0.2% points from that Permitted	\$9.00
Laboratory Air Voids (Measured at N_{des} or 75 blows as applicable)	Less than 1.5% or Greater Than 8.0%	\$3.75
Limits of In-place Air Voids	10.1% to 11.0%	\$9.00

Within 15 working days, the Engineer will determine whether or not to accept the contractor’s proposed Engineering Analysis.

321.11 REFEREE:

In the event the contractor elects to question the acceptance test results for a subplot, the Contractor may make a written request for additional testing of that subplot. The Contractor will engage an independent laboratory (at the Contractors own expense) who

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Is accredited by AAP in all of the acceptance tests. The independent laboratory shall be acceptable to the Engineer and shall perform a complete new set of acceptance tests (as required by Section 321.10 representing the area or set of tests in question).

These tests shall include asphalt binder content, aggregate gradation, Marshall or Gyratory unit weight, and maximum theoretical unit weight. Samples for referee testing shall come from representative samples obtained from the completed pavement, as directed by the Engineer.

The number of samples taken will be the same as specified in Section 321.10. The independent laboratory shall compile the test results and transmit them to both the Engineer and the Contractor. The independent laboratory shall include a letter signed by an Engineer registered in the State of Arizona, who is experienced in asphalt concrete testing and mix designs. The signed letter shall give an opinion that the material evaluated either does or does not comply with project specifications, and shall clearly describe any deficiencies, and the results will be binding between all parties.

321.12 MEASUREMENT:

Asphalt concrete pavement will be measured by the ton, or by the square yard, for the mixture actually used as allowed above, which shall include the required quantities of mineral aggregates, asphalt binder, and mineral admixture. Measurement shall include any tonnage used to construct intersections, roadways, streets, or other miscellaneous surfaces indicated on the plans or as directed by the Engineer.

321.13 PAYMENT:

The asphalt concrete measured as provided above will be paid for at the contract price per ton or square yard, as adjusted per Section 321.10, which price shall be full compensation for the item complete, as herein described and specified.

Payment for tack coat will be by the ton diluted, based on the rate of application, as directed by the Engineer.

No payment will be made for any overrun in quantity of asphalt concrete in excess of 10 percent based on actual field measurement of area covered, design thickness, and the mix design unit weight. The calculations and payment for overrun will be by individual pay item. To compensate or adjust for a thickness deficiency in an underlying asphalt concrete course, the Engineer may authorize a quantity increase in excess of 10 percent for a subsequent asphalt concrete course. In such cases, the quantity in excess of 10 percent will be paid for at the lowest unit price.

Except as otherwise specified in the special provisions, no separate payment will be made for work necessary to construct miscellaneous items or surfaces of asphalt concrete.

321.14 ASPHALT CORE METHOD: Core Drilling of Hot Mix Asphalt (HMA) for Specimens of 4" or 6" diameter

321.14.1 Scope: This method is to establish a consistent method of the use of a diamond bit core to recover specimens of 4 or 6 inch diameter for laboratory analysis and testing. The method will require the use of: water, ice (bagged or other suitable type), dry ice, and a water-soap solution to be utilized when coring asphalt rubber concrete. Individuals doing the specimen recovery should be observing all safety regulations from the equipment manufacturer as well as the required job site safety requirements for actions, and required personal protective equipment.

321.14.2 Core Drilling Device: The core drilling device will be powered by an electrical motor, or by an acceptable gasoline engine. Either device used shall be capable of applying enough effective rotational velocity to secure a drilled specimen. The specimen shall be cored perpendicularly to the surface of pavement, and that the sides of the core are cut in a manner to minimize sample distortion or damage. The machinery utilized for the procedure shall be on a mounted base, have a geared column and carriage that will permit the application of variable pressure to the core head and carriage throughout the entire drilling operation. The carriage and column apparatus shall be securely attached to the base of the apparatus; and the base will be secured with a mechanical fastener or held in place by the body weight of the operator. The core drilling apparatus shall be equipped with a water spindle to allow water to be introduced inside of the drill stem while operating. The cutting edge of the core drill bit shall be of

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hardened steel or other suitable material with embedded diamond chips in the cutting surface. The core barrel shall be of sufficient diameter to secure a specimen that is a minimum of four or six inches or whichever is prescribed for necessary testing. The core barrel shall not be missing more than one of the teeth used for cutting; if so it shall be discarded and another barrel shall be used. The core barrel shall also be a minimum of two inches longer than the anticipated depth of pavement in accordance with project paving plans.

321.14.3 Accessory Equipment: A sufficient supply of ice and dry ice shall be provided to sufficiently cool the pavement prior to securing the samples from the designated areas in the pavement. The ice should also be used to adjust the temperature of the water used to cool the core bit. A water supply (usually a plastic 35 – 55 gal drum) with sufficient hose to introduce the water into and through the spindle of the coring device by gravity feed. The drum should be white or light in color to minimize excessive thermal heating of the water (*for coring of asphalt rubber cores see Note 1*). At no time shall the water utilized in the coring operation exceed 65° F during the coring operation. Ice shall be utilized to ensure the temperature control of the water being introduced during the cutting operation. An ice chest or other suitably insulated container that can maintain a temperature of less than 70° F shall be used to secure the specimens during transport. The container will be equipped with flat shelving that will support the drilled cores throughout the entire specimen dimension during transport back to the testing facility.

Miscellaneous hand tools to remove the drilled specimen from the drill hole or the core barrel taking great care in not disturbing the specimen more than necessary (refer to fig. 1 in ASTM D 5361-05).

321.14.4 Process: The pavement surface at the time of coring shall not exceed a temperature of 90° F, the pavement shall be conditioned with ice or dry ice to ensure that this requirement is met. Immediately after it has been ensured that the pavement has dropped to the required temperature, core drilling shall begin. The operator will then apply an even and continuous pressure (Note 2) to penetrate through the full depth of the pavement. The operator will concurrently ensure that enough water is moving over the core surface as to adequately remove any and all cuttings that could damage the drilled core. After the pavement thickness has been penetrated the core shall be carefully removed from either the drill hole or the core barrel and be immediately transferred to an ice chest or other suitable container. Each individual core shall be placed on a shelf in the cooler with the exposed side of the specimen facing down, or the “top side” down. If the specimen is a two lift core, the only acceptable means of separating lifts is with a power or other acceptable wet saw type of equipment (conforming to ASTM D 5361-05); however, at no time shall cores be split using a mallet and screwdriver or metal straight edge when being tested for bulk density. Perpendicularity of the specimen shall be checked in the field after the specimen has been extracted from the surface. The core operator shall hold the core up to eye level and place the core top side down in a “speed square” or small carpenters square. The specimen placed in the square shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). If the specimen is outside of this distance from square it shall be discarded in the field and another sample cored that falls within tolerance. The cores upon arriving at the laboratory for testing shall be carefully cleaned and measured for thickness in accordance with ASTM D 3549. A speed square shall be utilized to measure squareness as compared to a 90° degree angle and shall not depart from perpendicular to the axis more than 0.5° (approximately equivalent to 1/16 of an inch in 6 inches). All remaining testing shall be done within the parameters of the current project and / or agency required specification.

End of Section

• **Note 1** – It should be noted that when the material to be cored is a rubberized asphalt mixture a wetting agent such as liquid dish soap shall be added to the water barrel to hinder the material from sticking or allowing the binder to spread during coring.

• **Note 2** – This refers to pressure exerted on the core barrel and machine during the coring process. Too much pressure can cause damage to the core barrel and the motor; and too little pressure can cause a glazing of the diamonds, reducing cutting efficiency and premature wear of the barrel.

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Moved to Section 321.8.6 and revised.



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SECTION 323

HEATER REMIX RESURFACING

323.1 DESCRIPTION:

Heater remix resurfacing consists of heating, scarifying and remixing existing asphalt concrete paved surfaces, and unless otherwise specified in the special provisions, followed by the application of a rejuvenating agent and an asphalt concrete overlay.

323.2 COORDINATION:

There shall be close coordination between those performing the heating and remixing operation and those placing the asphalt concrete overlay.

323.3 WEATHER CONDITIONS:

Heater remix resurfacing shall not be done when it is raining or there is a threat of rain. The ambient temperature shall be at least 50°F. and rising and the application shall cease when the temperature is 55°F. and falling.

323.4 SURFACE PREPARATION:

The pavement to be treated shall be cleaned of trash, debris, earth or other deleterious substances present in sufficient quantity to interfere with the work to be performed.

323.5 HEATER SCARIFY REMIX EQUIPMENT:

The heater remixer shall consist of an insulated 8-12 foot minimum adjustable width heating furnace chamber with ports to inject fuel and air for satisfactory combustion without excessive smoke. The use of highly volatile fuels for heating, such as gasoline, will not be permitted within the boundaries of any incorporated City. Use of said highly volatile fuels for heating may be permitted in unincorporated areas only if authorized in writing by the Engineer prior to such use. The burners shall be rated at 10,000,000 BTU per hour minimum. The hourly production shall be not less than 1100 square yards of heated and remixed surface. Movable exhaust ducts shall be provided and equipped with shields to protect trees and adjacent shrubbery. The heating chamber and scarifier shall be positively controlled by side shifting and rear wheel steering to heat areas divergent from the central axis of the machine at intersections and along existing structures. The scarifier shall be sectioned and spring tensioned to insure continuous and undiminished pavement contact. It shall be equipped with automatic release mechanism to protect manholes and valve boxes from damage.

323.6 HEATING AND REMIXING:

Prior to heating and remixing, all manholes in the path of the heater shall be checked for presence of explosive gases and ventilated, if necessary. The existing surface shall be evenly heated and remixed to a depth of from 0.05 to 0.08 foot by a continuously moving surface heater remixer machine. The remixed surface shall be left in an evenly spread condition and aggregate shall not be pulverized, spalled or broken. At least 80 percent of the aggregate shall be remixed by spinning or tumbling and heated to a minimum temperature of not less than 250°F. measured within 3 minutes following heating. The asphalt binder shall not be charred in excess of 0.10 of 1 percent. No uncontrolled heating causing differential softening of the upper surfaces without affecting the underlying structure will be permitted. The remixed layer shall be uniformly and evenly heated throughout.

323.7 ASPHALT REJUVENATING AGENTS:

Following the mixing operation, an asphalt rejuvenating agent, or emulsion, if required, of the type designated in the contract, shall be applied at the rate hereinafter specified, by a pressure distributor while the remixed material is still hot. The pressure distributor shall be as specified in Section 330.

Where the contract requires the use of an asphalt rejuvenating agent, or emulsion, it will designate one of the following types:
(A) Type I asphalt rejuvenating agent, a cationic oil and resin emulsion, shall comply with Section 718 and shall be applied at the rate of 0.07 to 0.15 gallons of undiluted concentrate per square yard. However, the exact quantity shall be as directed by the Engineer.

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The Contractor shall furnish the Engineer with the brand name and name of the manufacturer of the Type I asphalt rejuvenating agent he proposes to use and the material shall be approved by the Engineer before it is used. The Contractor shall also furnish the Engineer with a manufacturer's certificate of compliance indicating quality and specification control.

(B) Type II asphalt emulsion shall be SS-1 or SS-1h emulsified asphalt as specified in Section 713 and shall be applied at the rate of 0.10 to 0.20 gallons per square yard undiluted. However, the exact quantity shall be as directed by the Engineer.

323.8 ASPHALT CONCRETE OVERLAY:

- Asphalt concrete overlay shall be in accordance with applicable requirements specified in Section 321.8.6.

The asphalt concrete overlay shall be placed within 48 hours after the heating and remixing operation, unless otherwise specified in the special provisions.

The overlay shall also cover existing pavement over areas not accessible to the heater remixer. Such areas including edges of adjoining concrete, shall receive a tack coat and joints shall be finished as specified in Section 321.

323.9 PAYMENT:

Payment for heater remix surfacing will be made on the basis shown below:

- | | |
|---------------------------------------|--------------------|
| (A) Heater Remix Only | Square Yard |
| (B) Type I Asphalt Rejuvenating Agent | Ton (Undiluted) |
| (C) Type II Asphalt Emulsion | Ton (Undiluted) |
| (D) Asphalt Concrete Overlay | Ton or Square Yard |
| (E) Tack Coat | Ton (Diluted) |

End of Section

SECTION 324

PORTLAND CEMENT CONCRETE STREET PAVEMENT

324.1 DESCRIPTION:

This item shall consist of construction of a pavement composed of plain jointed portland cement concrete on a prepared subgrade. The Contractor shall furnish all labor, materials and equipment necessary for the construction of the pavement in accordance with these specifications and in reasonably close conformity to the lines, grades, thicknesses and details indicated by the plans or as established by the Engineer. All tests shall be performed by a laboratory approved by the Engineer.

324.2 MATERIALS:

324.2.1 Portland Cement Concrete: Portland cement concrete shall conform to the applicable requirements of MAG Standard Specifications Section 725 and the additional requirements of this section.

Concrete shall develop a modulus of rupture of not less than 520 psi within 14 days after placement, and not less than 650 psi at 28 days' age as determined by tests of specimens fabricated in accordance with ASTM C-31 and tested in accordance with ASTM C-78 procedures. The Contractor shall submit data acceptable to the Engineer at least 30 days in advance of the start of concrete paving operations which demonstrate that concrete produced with materials and proportions as proposed for use in the construction will conform to the modulus of rupture requirements of these specifications. The data shall include results of compressive strength tests conducted at the same age as modulus of rupture tests to establish the correlation which can be expected between the flexural and compressive strength properties of the concrete. The Engineer may, at his option, use compressive strength tests of specimens fabricated in accordance with ASTM C-31 and tested in accordance with ASTM C-39 to verify conformance to the modulus of rupture requirements of these specifications.

The maximum concrete slump shall be as determined by the approved mix design.

324.2.2 Concrete Materials: Portland cement conforming to the requirements of ASTM C-150 for Type III, low-alkali, may be used at the Contractor's option. Aggregates shall be crushed rock or gravel conforming to the requirements of ASTM C-33. Coarse aggregate gradation shall conform to requirements for Size No. 57. Fine aggregates shall have an average sand equivalent of not less than 75 when tested in accordance with the requirements of AASHTO T-176 or ASTM D-2419.

324.2.3 Reinforcement: Tie bars shall be deformed billet steel reinforcing bars conforming to the requirements of ASTM A-615, Grade 40.

Dowel bars shall be plain round bars conforming to the requirements of ASTM A-615, Grade 40. One-half the length of each dowel bar shall be painted with one coat of tar paint.

Metal sleeves of an approved design shall be provided for use with dowel bars. Sleeves shall cover 2 inches, plus or minus 1/4 inch, of the dowel, shall have a closed end with a suitable stop to hold the end at least 1 inch from the end of the bar, and shall be designed to prevent collapse during construction. An approved basket support shall be used to hold bars parallel to pavement surface.

324.2.4 Curing Materials: Materials for curing concrete shall conform to the requirements of Section 726.

324.2.5 Joint Materials: Joint sealant shall be a one component, hot-poured type, conforming to the requirements of ASTM D-3406.

Back-up rod or tape and bond breakers provided to control the depth of sealant, achieve the desired shape factor, support sealant against indentation and sag, or to prevent bond of the sealant to the bottom concrete surface shall be compatible with the joint sealant material.

Other pour-type joint sealants conforming to the requirements of Subsection 729.2 may be used if approved by the Engineer.

Preformed expansion joint filler shall conform to the requirements of ASTM D-1751.

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324.3 CONSTRUCTION METHODS:

324.3.1 General: Pavement shall be constructed with mechanical equipment utilizing stationary side forms or by the use of slipform paving equipment without stationary side forms. Manual methods of placing and finishing concrete with stationary side forms may be permitted by the Engineer for areas inaccessible for mechanical equipment.

Curbs, or combined curb and gutter, shall be constructed along the edges of all pavement where shown in the plans and shall be formed to the cross-section in accordance with the plans. Curbs may be constructed integrally with the pavement using a slipform or extrusion equipment or placed immediately after finishing operations by hand forming or using face forms. They may also be constructed as a separate operation after pavement construction using forms, slipform, or extrusion equipment. The edge of each gutter of the curb and gutter section built first may be used as a form in lieu of the setting of stationary side forms. Curbs, or curb and gutter, constructed as a separate operation shall otherwise conform to the requirements of Section 340. All curbs and gutters shall have the same thickness as the main roadway section. All joints shall be aligned with roadway joints.

324.3.2 Equipment: Design, capacity, and mechanical condition of equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer. Equipment shall be at the jobsite sufficiently ahead of the start of concrete paving operations to permit thorough examination and approval by the Engineer prior to start of concrete paving.

Equipment used to place concrete may consist of one or more machines, shall be capable of uniformly distributing and consolidating the concrete as it is placed without segregation and shall be capable of producing concrete pavement which will conform to the required cross-section with a minimum of hand work. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to the concrete delivery rate.

Vibrators shall be used to consolidate concrete; the rate of vibration shall be not less than 3,500 cycles per minute for surface vibrators and not less than 8,000 cycles per minute for internal vibrators. Power to vibrators mounted on mechanical equipment shall be so connected that vibration ceases when forward or backward motion of the machine is stopped. Contractor shall furnish a tachometer or other suitable device for measuring and indicating the frequency of vibration.

Slipform pavers shall be equipped with high frequency internal vibrators mounted with axes either parallel or normal to pavement alignment for the full paving width. Vibrators mounted with axes parallel with pavement alignment shall be spaced at intervals not to exceed 24 inches, measured center-to-center. Vibrators mounted with axes normal to pavement alignment shall be spaced so that lateral clearance between individual vibrating units does not exceed 6 inches.

Slipform paving equipment which will be wholly or partially supported on subgrade shall be equipped with traveling side forms of sufficient dimensions, shape and strength to support the concrete at free edges laterally for a sufficient length of time during placement to produce pavement of the required cross-section, and shall be equipped and operate with automatic sensing and control devices such that the machine automatically senses deviations from the established guideline and performs the necessary corrective maneuvers to overcome variations from correct grade and alignment.

When concrete will be placed adjacent to existing pavement or curb and gutter, that part of the equipment supported on the existing pavement or curb and gutter shall be equipped with protective pads on crawler tracks or rubber-tired wheels with bearing surfaces offset a sufficient distance from the edge of the pavement or curb and gutter to avoid edge damage, or the surface of the existing pavement or curb and gutter shall be otherwise protected against such damage in a manner approved by the Engineer.

324.3.3 Subgrade Preparation: Subgrade shall conform to the compaction and elevation tolerances specified for the material involved, shall be kept smooth and compacted, and shall be free of all loose and extraneous material when concrete is placed.

The surface of the subgrade shall be uniformly moist when concrete is placed. The surface of the subgrade shall be moistened immediately prior to placement of concrete if necessary to produce a uniformly moist condition. Any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

Construction equipment shall not operate on the subgrade in the paving lane when conditions of the job will permit operation from outside the lane. When job conditions make it necessary to operate equipment on the subgrade in the paving lane, suitable runways or other precautions shall be taken to prevent rutting or displacement of subgrade material. The grade shall be checked and corrected immediately ahead of concrete placement and all disturbed grade shall be properly recompacted.

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When concrete pavement will be placed with slipform paving equipment which will be supported and operate on the subgrade, the subgrade and slipform paver track area shall be brought to proper grade and cross-section by means of a properly designed and operated machine.

324.3.4 Stationary Side Forms and Setting of Forms: Side form sections shall be straight, free from warps, bends, indentations or other defects. Side forms shall be of metal, have a base width of at least four inches and a minimum depth equal to the thickness of the pavement. No section shall show a variation from a true plane greater than 1/8 inch in ten feet on the top of the form or more than 1/4 inch in ten feet on the inside face. Flexible or curved forms of proper radius shall be used for curves of 100 feet radius or less. Suitable materials other than metal may be used to form end closures or at other locations where use of metal forms is not practical when approved by the Engineer. Forms shall be thoroughly cleaned and oiled each time they are used.

Forms shall be of such cross-section and strength and so secured and supported on the subgrade as to resist the pressure of the concrete when placed and the impact and vibration of any equipment they are to support without springing or settlement. The method of connection between sections shall be such that the joints shall not move in any direction.

Subgrade under forms shall be compacted and cut to grade so that the form when set will be uniformly supported for its entire length at the specified elevation. Forms shall be so supported and secured during the entire operation of placing and finishing that they will not deviate vertically at any point more than 1/8 inch from the proper elevation. Forms shall be set to the required lines and grades well in advance and for a distance sufficient to prevent delay in placing concrete, and shall be approved by the Engineer prior to placing concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

Side forms shall remain in place until the day after placing concrete, and in all cases until the edge of the pavement no longer requires the protection of the forms. Forms shall be carefully removed in such a manner as to avoid damage to the pavement. Use of pry bars between the pavement and the forms will not be permitted.

324.3.5 Placing, Spreading and Compacting: Except when otherwise approved by the Engineer, concrete shall be deposited on the subgrade and spread full width using mechanical methods that result in a minimum of handling and segregation. Necessary hand spreading shall be done with shovels, not rakes. Placement shall be continuous between transverse joints without the use of intermediate bulkheads.

The Contractor shall make adequate advance arrangements for preventing delay in delivery and placing of concrete. An interval of more than 15 minutes between placing of any two consecutive batches shall constitute cause for stopping operations, and Contractor shall install a construction joint in the concrete already placed at the location and of the type directed by the Engineer.

Concrete shall be deposited as near to expansion and construction joints as possible without disturbing them but shall not be dumped onto a joint assembly. Concrete shall be thoroughly consolidated against and along the faces of all forms, adjacent pavement or curb and gutter, and on both sides of all joint assemblies. Vibrators shall not be permitted to come in contact with joint assemblies, the grade, or side forms, and shall not be operated longer than 15 seconds in any one location.

Manual methods of placing, spreading, and compacting may be used in the construction of pavement lanes of irregular width or widths less than 10 feet, and sections of intersections or other locations with complex variable surface configurations when permitted by the Engineer. Workmen shall not be allowed to walk in the freshly placed concrete with boots or shoes coated with earth or other foreign substances.

324.3.6 Shaping and Initial Finishing: Concrete shall be struck off, consolidated, and float-finished with a slipform paver, mechanical finishing machine, vibrating screed, or by hand finishing methods when approved by the Engineer so that the complete pavement will conform to the thickness and cross-section requirements of the plans and specifications. When the pavement being constructed is contiguous to existing parallel concrete pavement or curb and gutter, the elevation of the new pavement surface shall conform as closely as possible to the elevation of the existing pavement or gutter surface and in a manner which will prevent ponding.

Water shall not be applied to the pavement surface during screeding and finishing operations in excess of the amount lost by evaporation. Adding water to the surface of the concrete to assist in finishing operations shall not be permitted. When applications of water to the surface are required to prevent rapid evaporation of water from the surface during finishing operations, it shall be applied as a fog spray and with approved spray equipment.

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324.3.6 (a) Slipform Supported on Subgrade Method: The equipment shall spread, consolidate, screed and float-finish the concrete in one complete pass of the machine. The machine shall be operated with as nearly a continuous forward movement as possible and all paving operations shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. Sliding side forms shall be rigidly held together to prevent spreading. Any edge slump of the pavement, exclusive of edge rounding, in excess of 1/4 inch shall be corrected.

No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed 1 inch from the alignment established by the Engineer.

While concrete is being spread, compacted and shaped, vibrating units shall be operated within fresh concrete so that the longitudinal axis, at the center of each unit, is not more than 6 inches above the top of the subgrade. Amplitude of vibration shall be sufficient to be perceptible on the surface of concrete along the entire length of vibrating units and for a distance of at least one foot therefrom.

324.3.6 (b) Mechanical Equipment Supported on Fixed Form Method: When concrete is spread without the use of internal vibration, the finishing machine shall be equipped with vibrating equipment that will internally vibrate the concrete for the full paving width and with not less than two oscillating or reciprocating screeds. Concrete shall be struck off and consolidated so that the surface will conform to the finished grade and cross-section shown on the project plans and with sufficient material on the surface for floating operations.

After the concrete has been struck off and consolidated, it shall be floated with a longitudinal float of a type approved by the Engineer.

A slipform paver or a single machine which will effectively spread, consolidate, screed, and float in one operation may be used in lieu of separate finishing and floating equipment.

324.3.6 (C) Manual Methods with Fixed Forms: Concrete shall be deposited, spread and struck off to such an elevation that, when properly consolidated, the surface will conform to the required lines and grades. Concrete shall be consolidated by internal vibration as it is struck off with a screed. A slight excess of concrete shall be kept in front of the screed at all times during the strike-off operation.

After consolidation and screeding, concrete shall be tamped to the proper surface elevation and cross-section using either a heavy plank with a length in excess of the width of pavement being placed by one foot or more, or with a mechanical vibrating unit spanning the full width between forms. The tamping plank, if used, shall be stiffened as necessary to prevent sag and shall have the lower tamping edge shod with metal. The tamping plank shall be moved forward with a combined vertical tamping and longitudinal screeding motion so that the concrete will be thoroughly consolidated and the surface screeded to the required elevation. A small surplus of concrete shall be kept in front of the tamper or vibrating unit. Tamping or vibrating shall continue until the specified cross-section is obtained and the mortar flushed slightly to the surface. On grades in excess of 5 percent a second strike board shall follow from 25 to 50 feet behind the tamper or vibrating unit and shall be used in the same manner to remove waves caused by the flow of concrete behind the first strike board.

Other methods than the tamping plank may be utilized for screeding when approved by the Engineer.

Pavement shall be finished smooth and true to grade with suitable manually operated floats or powered finishing equipment.

324.3.7 Final Finishing: After the pavement has been float finished, it shall be scraped with a 10-foot long straightedge equipped with a handle to permit operations from the edge of the pavement, and excess water and laitance shall be removed from the surface. The straightedge shall be operated parallel to the centerline of the pavement and shall be moved forward one-half length after each pass. Irregularities shall be corrected by adding or removing concrete, and disturbed places shall be again straight-edged.

Long-handled wood floats shall be used only in areas not accessible to finishing equipment and in emergencies, and use of such floats shall be confined to a minimum.

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The addition of water to the surface of the concrete to assist in finishing operations shall not be permitted unless approved by the Engineer. When addition of water to the surface is permitted to prevent rapid evaporation of water from the surface during finish, it shall be applied as a fog spray with approved spray equipment.

Pavement edges and joints shall be edged in accordance with details shown on the project plans or as directed by the Engineer.

In advance of curing operations, pavement shall be given a texturing. Texturing shall be performed with an artificial turf drag with a board added to assure the weight needed to obtain an approved surface. Artificial turf shall be a molded composite structure with polyethylene face, nylon and polyester backing, a pile height of 0.85 inches, and total weight of 75 oz./sq. yd. The approved surface will be made by the Engineer on the initial construction and shall not be changed without approval. Each time the construction is stopped or cause the texturing to stop, the artificial turf must be shaken clean before continuing.

324.3.8 Curing: Curing shall begin immediately following surface texturing and edging. Contractor shall have at hand and ready to install before concrete placement begins the materials and equipment needed for adequate curing.

After finishing operations have been completed, the newly placed concrete shall be cured by moist curing methods, by application of a white liquid membrane compound, or by a combination of these methods. All surfaces not covered by reasonably waterproof forms shall be kept damp by applying water with a nozzle that so atomizes the flow of water that a fog mist and not a spray is formed until the surface is covered with liquid membrane compound, the surface has hardened sufficiently to permit sprinkling of the surface, or moist curing by covering with wet burlap or other approved materials can be initiated. Moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow and erode the surface. Moist curing shall be continued until liquid membrane curing compound or other type of curing membrane is applied.

Membrane curing compound shall be applied to all pavement by automatic mechanical method from a construction bridge.

The edges of concrete slabs exposed by the removal of forms shall be protected immediately to provide these exposed surfaces with continuous curing treatment equal to the method selected for curing the pavement surface.

The membrane method of curing may be applied behind the final finishing operation after all free water has disappeared from the surface. Complete and uniform coverage at the rate of one gallon per 100 square feet, or as otherwise recommended by the manufacturer, shall be required. Compound shall be kept agitated to prevent pigment from settling.

324.3.9 Joints:

324.3.9.1 General: Joints shall be provided in the pavement of the type, dimensions and at the locations as indicated in the plans or as specified herein.

Joints in concrete pavement will be designated as transverse expansion joints, longitudinal or transverse construction joints, longitudinal or transverse weakened plane joints, or isolation joints. The faces of all joints shall be perpendicular to the pavement surface. Joints shall be constructed in accordance with the details shown in the plans and in accordance with the following provisions.

At all times prior to acceptance of the construction, joints shall be maintained clean and free of all soil, gravel, and other foreign material except approved types of joint filler materials.

324.3.9.2 Longitudinal Joints: Longitudinal joints shall be weakened plane or construction joints. Longitudinal weakened plane joints shall be constructed by sawing or by insertion of a parting strip in the plastic concrete to be left in place. Longitudinal construction joints shall be constructed with tie bars or keyways as indicated in the plans.

324.3.9.3 Transverse Joints: Transverse joints shall be weakened plane, construction or expansion joints. All transverse weakened plane joints will be constructed by sawing and in accordance with the details shown in the project plans. Transverse construction joints shall be constructed with dowels or with sawed keyways and in accordance with the details shown in the project plans. Transverse expansion joints shall be constructed as butt joints with vertical expansion joint filler and with or without dowel bars in accordance with the details shown in the project plans. Dowel bars shall be supported on a basket-type system with a base plate on subgrade and up the side form to prevent material from entering dowel openings.

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324.3.9.4 Joint Location: Longitudinal joints shall be constructed between traffic lanes and at other locations as indicated in the project plans.

Transverse construction joints shall be constructed at the end of a day's production or when placing of concrete is discontinued for more than 45 minutes. Transverse construction joints will not be allowed within 500 feet of a structure unless otherwise approved by the Engineer.

Transverse weakened plane joints in concrete placed in lanes adjacent to previously placed concrete shall be located to align with weakened plane joints in the adjacent lanes. No transverse weakened plane joint shall be constructed within 6 feet of another transverse joint. When the planned spacing of transverse weakened plane joints results in location of a weakened plane joint within 6 feet of another transverse joint, the transverse weakened plane joint shall be relocated so it is not within 6 feet of said transverse joint.

Transverse expansion joints shall be located at the junction of the normal roadway pavement slab with bridge approach slabs and at other locations as shown on the plans.

Isolation joints shall be provided around manholes, catch basins, or other elements which extend into or project through the pavement and act as point of restraint to horizontal or vertical movement of the pavement.

324.3.9.5 Construction of Joints:

324.3.9.5.1 Sawed Joints: Sawed joints shall be constructed by cutting a groove in the pavement using a single or multiple-blade power saw. The groove shall be cut to the dimensions shown on the project plans. Suitable guidelines or devices shall be used to assure joints are cut true to the lines as shown on the project plans.

If joints are sawed in stages, the initial saw cut shall be of the minimum width specified and sawed to the required depth shown on the project plans. The depth of the initial saw cut in the construction of weakened plane joints shall be a minimum of 1/4 of slab thickness.

Sawing of weakened plane joints shall be done before uncontrolled cracking takes place, and after the concrete has hardened to the extent that tearing or raveling of the edges of the saw cut is not excessive. The exact time for all sawing shall be determined by the Contractor when not otherwise specified herein.

Any procedure for sawing joints that results in premature, uncontrolled cracking shall be revised immediately. The Contractor shall be responsible for replacing or repairing areas containing uncontrolled cracking and for repairing spalled or chipped concrete along the edges of sawed joints as directed and to the satisfaction of the Engineer.

After saw cutting of the joint and just prior to sealing the joint, the internal joint surfaces shall be cleaned of all dirt, curing and compound residue, laitance and other foreign materials. The internal joint surface shall be defined as the sawed portion of the joint and the resultant crack for the full depth of the pavement.

324.3.9.5.2 Construction Joints: Longitudinal and transverse construction joints shall be of the type and formed in accordance with the details shown on Detail 224 or as directed by the Engineer.

324.3.9.5.3 Expansion and Isolation Joints: Transverse expansion and isolation joints shall be formed in accordance with the details shown on Detail 224 or as directed by the Engineer.

324.3.9.5.4 Sealing of Joints: Sealing of sawed joints where required shall be completed prior to the opening of the pavement to traffic unless otherwise approved by the Engineer. When delayed sealing of sawed joints is permitted, saw cuts and formed recess to be filled with sealant shall be protected to ensure thorough curing of the concrete along the edges of the joint recesses and to prevent entry of foreign materials into the joint. At the Contractor's option, inert compressible joint filler material such as plastic backer rod or upholstery cord may be inserted into joints immediately after sawing or forming of the joint recess to provide curing protection and prevent entry of foreign material. If absorptive filler material is used, it shall be thoroughly moistened either before or immediately after installation in the sawed groove. When filler material is rope, or similar material which does not fill the entire depth of sawed groove, it shall be depressed not less than 1/2 inch below the pavement surface before the pavement is opened to traffic.

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Sealant shall be applied in accordance with the sealant manufacturer's recommendations. A primer shall be furnished and applied after the joint has been cleaned and prepared to receive sealant if so indicated in the manufacturer's recommendations.

Prior to the application of the sealant, an approved type of inert, compressible joint filler material such as plastic backer rod or upholstery cord, or an approved type of bond breaker, shall be inserted along the joint in accordance with the details shown on the project plans. The joint shall then be filled with sealant to a level not less than 1/8 inch or more than 1/4 inch below the elevation of the pavement surface adjacent to the joint edge.

The equipment used to apply sealant shall be as recommended by the sealant manufacturer. Sealant shall not be spilled on the surface of the concrete pavement, and Contractor shall remove any sealant inadvertently spilled on the pavement surface.

324.3.9.5.5 Repair of Cracks, Spalls, Raveling and Tearing: Contractor shall be responsible for replacing or repairing all areas of pavement containing uncontrolled cracking, surface spalls, or other types of surface defects as directed by the Engineer. Repairs shall be made by methods acceptable to the Engineer and the repair shall be completed to the satisfaction of the Engineer.

324.4 Tests of Finished Pavement:

324.4.1 Smoothness: The pavement Surface Profile Index shall not exceed seven inches per mile in any 0.1 of a mile section or any remaining portion thereof as measured along any line parallel to the edge of the pavement except at and through intersections, and at and through railroad crossings. The surface profiles will be evaluated in accordance with the requirements of Arizona Department of Transportation Test Method 801.

After completion of all paving, the Contractor shall clean the pavement by brooming or any other method to allow the Engineer to obtain accurate profilograph readings. Profilograph readings will be taken one time in each wheel path of each lane.

Grinding will be required if necessary to produce a surface smoothness conforming to the requirements of this section. In addition, all high areas having deviations in excess of 0.3 of an inch shall be ground. After grinding, the finished surface of the ground area shall be provided with a uniform texture acceptable to the Engineer. The method of texturing shall be approved by the Engineer.

In addition to the Surface Profile Index requirement, the pavement surface including pavement in intersections will be tested with a ten-foot straight-edge placed parallel to the centerline of the pavement in each lane. Ordinates measured from the face of the straight-edge to pavement surface shall at no place exceed one-quarter inch. Areas that do not meet the required surface accuracy as determined by straight-edge testing shall be marked, and Contractor shall at his own expense and as required by the Engineer either:

- (1) Grind down areas higher than 1/4 inch but not more than 1/2 inch above the correct surface.
- (2) Correct areas lower than 1/4 inch but not lower than 1/2 inch below the correct surface by grinding down the adjacent areas.
- (3) Break out and replace pavement when the deviation exceeds 1/2 inch from the correct surface. Area replaced shall be of a length, width and depth as required to allow formation of a new slab of the required quality.

324.4.2 Pavement Thickness: Concrete pavement shall be constructed in accordance with the thickness requirements of the plans and specifications. Tolerances for base and subgrade construction and other provisions of these specifications which may affect thickness shall not be construed to modify such thickness requirements.

For the purpose of determining acceptability for thickness, cores shall be drilled by the Contractor at the locations specified by the Engineer. Cores shall have a minimum diameter of four inches. Length of cores will be determined in accordance with the requirements of AASHTO T-148 by measurements read to the nearest thousandth of an inch. The average of the measurements will be reported to the nearest hundredth of an inch.

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In calculating average length, cores which have a length in excess of the thickness specified by more than 0.25 of an inch will be deemed to have a length of the specified thickness plus 0.25 of an inch. Field length measurements will be acceptable in lieu of average length measurement in accordance with the requirements of AASHTO T-148, provided the original core in any secondary unit meets or exceeds the specified thickness. Measurements in accordance with the requirements of AASHTO T-148 will be required on any questionable thickness measurements and on the three cores used to determine the average length for payment, regardless of length.

A primary unit of pavement shall be the area of pavement placed in each day's paving operation. Each intersection or special section shall be considered as a primary unit.

A secondary unit of pavement shall consist of 1,000 linear feet, or fraction thereof, of each traffic lane. Each 1,300 square yards of pavement in intersections, etc., shall be considered a secondary unit regardless of when the concrete was placed.

One core shall be drilled in each secondary unit. If the length of that core is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the length of that core is deficient by more than 0.25 of an inch but less than 1.0 inch, two additional cores shall be drilled within that secondary unit and the length of the three cores averaged. If the average length is not deficient by more than 0.25 of an inch, that secondary unit will be measured for payment at 100 percent. If the average length of the three cores is deficient by more than 0.25 of an inch, that secondary unit will be measured for payment in accordance with the requirements of Table 324-1.

If the core in the secondary unit is deficient by more than 1.00 inch, that core will not be used in determining the average thickness of that secondary unit. Additional cores shall be drilled at intervals not to exceed ten feet in each direction from the deficient core, parallel to the main-line centerline, until one core is obtained in each direction which is not deficient by more than 1.00 inch. The pavement between these two cores will be evaluated separately from the balance of the pavement in that secondary unit. The limits for evaluation shall be between the longitudinal weakened plane or construction joint on each side of the core and between the next transverse weakened plane, construction, or expansion joint beyond each of the last two cores. Unless the Engineer allows the pavement to remain, it shall be removed and replaced with pavement of the specified thickness and no payment will be made for the removal pavement. One additional core shall be drilled in the secondary unit to represent the quality of the concrete in that unit after deducting the limits of the deficient area if that pavement represented by the deficient area is allowed to remain. The core shall be measured for payment as hereinbefore specified.

If the pavement in the deficient area is removed, either by the order of the Engineer or at the option of the Contractor, it shall be removed between the limits of the evaluation. After the pavement has been replaced, one core shall be drilled at random in that secondary unit after deducting the area of the replaced pavement and one core shall be drilled in the new pavement. Pavement represented by the core drilled in the secondary unit, less the replaced pavement, will be measured for payment as hereinbefore specified. The core drilled in the replaced pavement shall be not less than the specified thickness, otherwise that pavement will not be measured or paid for.

At all locations where cores have been drilled, the resulting holes shall be filled with concrete in a manner satisfactory to the Engineer.

324.5 PROTECTION OF PAVEMENT:

The Contractor shall be responsible for taking adequate steps to protect concrete placed during rain, hot or cold weather as defined in ACI Standards. Any concrete damaged by rain or extreme temperatures shall be removed and replaced at the Contractor's expense.

When ordered by the Engineer, pavement crossings shall be constructed for the convenience of public traffic. Where motor vehicles are encountered, a temporary bridge to span the newly placed concrete will be provided.

No traffic or Contractor's equipment, except as hereinafter provided, will be permitted on the pavement until the concrete has developed a compressive strength of 3500 psi.

Equipment for sawing joints will be permitted on the pavement when, in the Contractor's judgment, the concrete has developed sufficient strength to support the equipment without damage to the concrete. In case of visible cracking or other damage to the pavement, operation of the equipment on the pavement shall be immediately discontinued.

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Any damage to the pavement resulting from early use of pavement by the Contractor's equipment shall be repaired by the Contractor at his expense.

324.6 METHOD OF MEASUREMENT:

Portland cement concrete pavement will be measured by the square yard. Any opening in excess of one square yard will not be measured for payment.

324.7 BASIS OF PAYMENT:

The accepted quantities of portland cement concrete pavement, measured as provided for herein, will be paid for at the contract unit price complete in place, except that where the average length of cores indicates pavement deficient in thickness by more than 0.25 of an inch but not more than 1.00 inch, payment will be made as specified in Table 324-1. Payment will be made to the nearest cent.

No additional payment will be allowed for pavement constructed in excess of the thickness specified on the project plans.

TABLE 324-1	
PAVEMENT THICKNESS PAYMENT REDUCTION (AC)	
Core Thickness, Less Than Specified Thickness, Inches	Percent of Contract Unit Price Allowed
0.00 to 0.25	100
0.26 to 0.35	93
0.36 to 0.45	85
0.46 to 0.55	75
0.56 to 0.75	63
0.76 to 1.00	50

End of Section

SECTION 325

ASPHALT-RUBBER CONCRETE OVERLAY, GAP GRADED

325.1 DESCRIPTION:

Asphalt-rubber concrete consists of supplying, placing and compaction of plant mixed gap graded asphalt-rubber concrete over asphalt surfaces. The thickness of the finished asphalt-rubber concrete overlay shall be within the range of one to two inches as shown on the plans or as specified in the special provisions.

325.2 MATERIALS:

Asphalt-rubber concrete shall consist of a mixture of aggregate and asphalt-rubber binder. Tack coat, asphalt-rubber concrete mix and transportation thereof shall be as specified in Sections 710 and 321, except as modified below:

325.2.1 AGGREGATE:

The aggregate shall meet the following gradation:

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2 inch	100
3/8 inch	78-92
#4	28-42
#8	15-25
#30	5-15
#200	3-7
*Type II portland cement Or	1.5%
*Hydrated Lime	1.0%

*By total weight of the mineral aggregate.

The aggregate shall conform to the requirements of Sections 701 and 710 for asphalt concrete, except as modified below:

Sand Equivalent	65% minimum
Crushed Aggregate retained on #8 sieve (at least one crushed face, produced by crushing)	85% minimum

325.2.2 Asphalt-Rubber Binder: The asphalt-rubber binder shall conform to Section 717.

325.2.3 Mix Designs: At the Pre-Construction Meeting, the Contractor shall submit the name of the asphalt-rubber concrete supplier, a description of the materials, and the job mix design(s). The design method used shall be in accordance with the Marshall Mix procedure, 75 blows, as described in "Design Methods for Hot-Mixed Asphalt-Rubber Concrete Paving Materials" by James G. Chehovits, October 1989. The job mix designs are subject to approval by the Engineer.

Asphalt Rubber Binder Content:

The percent of asphalt-rubber binder in the mix(es) shall be within the following range:

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Traffic Condition	Asphalt Rubber Binder
Low Traffic	8.4% to 8.8%
High Traffic	8.0% to 8.4%

The amount of asphalt-rubber binder in each mix shall be provided in the design subject to approval by the Engineer. Low traffic areas include residential streets. High traffic areas include arterial streets.

Air Voids:

The percent of air voids in the mix(es) shall be within the following range:

Traffic Condition	Air Voids
Low Traffic	3.0% to 5.0%
High Traffic	4.0% to 6.0%

The amount of air voids in each mix shall be provided in the design subject to approval by the Engineer.

Mix designs shall include the following information as a minimum:

- (1) Aggregate
 - Source and identification (for each material used)
 - Gradation (for each material used)
 - Blend percentage
 - Mixture gradation
- (2) Asphalt - Rubber Binder (No extender oil allowed)
 - Source and PG grade of asphalt cement
 - Source and identification of ground rubber
 - Ground rubber gradation
 - Ground rubber percentage of the asphalt - rubber binder
 - Type and amount of additive(s), if required
 - Temperature when added to aggregate
- (3) Recommended asphalt - rubber binder content by both weight of total mix and by weight of dry aggregate.
- (4) Recommendations for maximum / minimum temperatures during material production and lay down; and the allowable ambient air and existing pavement surface temperatures during lay down.

The mix design shall include sufficient test results and documentation to assure that all requirements for rubber, aggregate and the asphalt-rubber binder are fulfilled.

325.2.4 Calibration Factors: A minimum of one week prior to the production of asphalt rubber hot mix, the Contractor shall submit to the Engineer samples of all hot mix materials that will be used on the project. The materials shall be used to determine the calibration factors using the acceptance laboratory and the Contractor supplied ignition furnaces and related quality control test equipment. Calibration factors shall be recalculated whenever a change in the asphalt rubber hot mix materials occurs and when requested by the Engineer.

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325.3 SURFACE PREPARATION:

Before placing asphalt-rubber concrete on existing pavements, severely raveled areas or cracked areas that are depressed more than 3/4" from the adjoining pavement shall be cut out and patched at least 48 hours prior to the resurfacing operation. Over-asphalted (bleeding or flushing) areas or rough high spots shall be removed by burning or blading. Large shrinkage cracks shall be filled with asphalt sealing compound acceptable to the Engineer. The entire surface shall be cleaned with a power broom. Raveled areas that do not require removing shall be cleaned by hand brooming. The above surface cleaning requirements are included as part of the Asphalt-Rubber Concrete paving operations, and the cost thereof shall be included in the Asphalt-Rubber Concrete pay item. Pavement repairs and crack sealing when required are to be compensated for by other appropriate contract pay items.

Prior to placing the asphalt-rubber concrete on milled surfaces, pot-holes left by the milling operation shall be repaired by the Contractor, as a related non-pay item and as required by the Engineer. The milled area shall be swept.

After surfaces have been prepared to the satisfaction of the Engineer, they shall receive a tack coat as specified in Section 321.

Traffic will not be permitted over surfaces which have received a tack coat. When the overlay is to extend onto a concrete surface, the concrete surface shall be thoroughly cleaned of loose dust and cement particles and shall be tack coated.

325.4 CONSTRUCTION METHODS:

Asphalt-rubber concrete shall be placed only when the surface is dry, and when the atmospheric temperature in the shade is 55°F or above. No asphalt-rubber concrete shall be placed when the weather is foggy or rainy. Asphalt-rubber concrete shall be placed only when the Engineer determines that weather conditions are suitable.

Except as otherwise noted, placing and rolling of the asphalt-rubber concrete and the smoothness of the surface shall be as specified in Section 321 for asphalt concrete. The spreading equipment shall be equipped with a mat reference ski-type control device of not less than 30 feet in length, or other method of control approved by the Engineer.

The density of the compacted mixture shall not be less than 95% of the laboratory unit weight composed of the same mixture compacted by the 75 blow method of ASTM D-1559 at 290° F ± 5° F, or at the job mix design specified compaction temperature. Pneumatic rollers shall not be used.

Placement and compaction temperature shall be specified with the submitted mix design data but in no case less than 275° F at the point of placement. The temperature of the material in the truck shall be measured by inserting a thermometer, or other approved measuring device, to a point at least 6" below the surface of material.

If asphalt-rubber concrete is placed in a windrow during paving, the windrow shall not exceed a distance greater than 150 feet in front of the paving machine.

325.4.1 Lime Water: An application of lime water shall be applied by the Contractor to the compacted asphalt rubber concrete surface after final compaction, prior to opening the roadway to traffic, or when requested by the Engineer to cool the pavement to prevent tracking and pick-up. The lime water solution shall be applied at the rate of approximately 1/2 gallon/square yard. The lime shall be mixed using a minimum of (1) one 50-pound bag per 3,000 gallons of water.

325.4.2 Quality Control and Acceptance: Production requirements for asphalt-rubber concrete shall be as specified in Section 321.9 Quality Control and Section 321.10 Acceptance. The production tolerances and corrective action will be enforced for asphalt-rubber concrete.

325.4.3 Adjustments: After installation of an overlay course all necessary frame and cover adjustments for manholes, valve boxes, survey monuments, sewer clean-outs, etc., shall be completed by the Contractor within the given segments being surfaced.

On roads without curb and gutter, the existing shoulder elevation shall be adjusted by the Contractor to match the elevation at the edge of new overlay and slope away from the new pavement surface at a rate that the existing quantity of shoulder material will allow. Shoulder material includes the existing shoulder, millings, untreated base materials, or a granular material approved by

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the Engineer. Shoulder material shall be compacted to a minimum of 95% of maximum density, determined in accordance with section 301.3.

325.5 MEASUREMENT:

Asphalt-Rubber Concrete shall be measured by the ton, for the mixture actually used, which shall include the required quantities of mineral aggregates, filler material, rubberized asphalt binder and anti-strip agent.

Application of Lime Water shall be measured by the square yard. The measured area shall be the area of asphalt-rubber pavement to which the lime water is applied. The measured area shall only be counted one time regardless of the number of applications applied to the asphalt-rubber pavement section.

Shoulder adjustment to match the new pavement surface elevation shall not be measured. The cost of this work shall be included in the price paid for Asphalt-Rubber Concrete or other related pay items.

325.6 PAYMENT:

Payment for Asphalt Milling will be as specified in Section 317.

Payment for Tack Coat will be as specified in Section 321.

Payment for Asphalt-Rubber Concrete will be at the contract unit price, complete in place.

Application of Lime Water as approved by the Engineer will be paid at the contract unit price.

Payment for frame and cover adjustments will be at the contract unit prices specified in the proposal.

End of Section



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SECTION 340

CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY ENTRANCE

340.1 DESCRIPTION:

The various types of concrete curb, gutter, sidewalk, sidewalk ramps, driveways, and alley entrances shall be constructed to the dimensions indicated on the plans and standard detail drawings.

340.2 MATERIALS:

Concrete shall be class B unless otherwise noted. Concrete shall conform to the requirements of Section 725.

Expansion joint filler shall comply with Section 729.

340.2.1 Detectable Warnings Detectable warnings shall consist of raised truncated domes aligned in a square grid pattern in conformity to the Americans with Disabilities Accessibility Guidelines. Truncated domes shall have the following nominal dimensions: base diameter of 1.0 inches (0.9 inches minimum) top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and height of 0.2 inches. Dome center-to-center spacing of 2.35 inches, measured between the most adjacent domes on the square grid. Dome center-to-center spacing for radial installations shall be 1.6 inches minimum and 2.4 inches maximum with a base-to-base spacing of 0.65 inches minimum. Detectable warnings shall contrast visually with adjoining surfaces. Visual contrast shall be obtained by color, use safety yellow or other approved color. The color shall be an integral part of the material surface. The material is to be durable with a non-slip surface not subject to spalling, chipping, delamination, or separation. All detectable warnings shall be approved by the jurisdictional agency prior to installation.

340.3 CONSTRUCTION METHODS:

Existing pavements and concrete, that are joined by new construction, shall be cut in accordance with Section 601.

The subgrade shall be constructed and compacted true to grades and lines shown on the plans and as specified in Section 301. All soft or unsuitable material shall be removed to a depth of not less than 6 inches below subgrade elevation and replaced with material satisfactory to the Engineer. When the Engineer determines that the existing subgrade consists of soils with swelling characteristics, the moisture content shall be brought as close as possible to the optimum required for compaction. This shall be done by the addition of water, by the addition and blending of dry suitable material or by the drying of existing material. The subgrade shall then be compacted to a relative density of 75% minimum to 85% maximum with 80% as ideal.

Material displaced in the construction shall not be placed on the base and/or surfacing material already in place on the roadway nor shall the excavated material be placed in such a manner as to interfere with access to property or traffic flow in the street.

Existing concrete sidewalks and driveways which abut the new sidewalks and driveway entrances shall be removed to a distance required to maintain a slope as indicated by standard details or not to exceed 1 inch per foot where sidewalks are concerned. Sawcutting is required at the match lines and payment will be made under the respective pay items as provided in the proposal.

Concrete curbs, gutters and sidewalks shall be constructed by the conventional use of forms, or may be constructed by means of an appropriate machine when approved by the Engineer.

If machines designed specifically for such work and approved by the Engineer are used, the results must be equal to or better than that produced by the use of forms. If the results are not satisfactory to the Engineer, the use of the machine shall be discontinued and the Contractor shall make necessary repairs at his own expense. All applicable requirements of construction by use of forms shall apply to the use of machines.

Forms conforming to the dimensions of the curb, gutter, sidewalk, sidewalk ramps, driveway, and alley entrance shall be carefully set to line and grade, and securely staked in position. The forms and subgrade shall be watered immediately in advance of placing concrete.

Forms shall be thoroughly cleaned each time they are used, and shall be coated with a light oil, or other releasing agent of a type which will not discolor the concrete. The concrete shall be thoroughly spaded away from the forms so that there will be no rock pockets next to the forms. The concrete may be compacted by mechanical vibrators approved by the Engineer. Tamping or vibrating shall continue until the mortar flushes to the surface, and the coarse aggregate is below the concrete surface.

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Unless otherwise specified, expansion joints shall be installed at all radius points, at both sides of each driveway, at both sides of each alley entrance, at adjoining structures and at every change of depth in the concrete. The maximum distance between expansion joints shall be 50 feet. Expansion joints shall be constructed in a straight line, vertical plane and perpendicular to the longitudinal line of the sidewalk, curb and gutter, single curb, etc., except in cases of curved alignment, where they will be constructed along the radial lines of the curve. Expansion joints shall be placed to match the joints of the adjacent concrete such as sidewalk to the curb and gutter or single curb, etc. Expansion joints shall be constructed to the full depth and width of the concrete and extend one inch into the subgrade with the top of the expansion joint material one-quarter inch below the top surface as depicted in Detail 230. Expansion joint material shall be secured in place prior to placement of concrete. Unless otherwise specified, all expansion joints installed against newly placed concrete, sawcut or other smooth surfaces shall comply with Section 729.1 - Premolded Joint Filler per ASTM D-1751, 1/2 inch, Bituminous Type. Expansion joints installed against existing uneven surfaces shall be per Section 729.2 - Pour Type Joint Filler.

Contraction joints, unless otherwise specified, shall be constructed in accordance with the standard details, and in a straight line and vertical plane perpendicular to the longitudinal line of the sidewalk, sidewalk ramp or curb and gutter, except in cases of curved alignment when they will be constructed along the radial lines of the curb.

Sidewalk or sidewalk ramp score marks, unless otherwise specified, shall be constructed in accordance with the standard detail.

All edges shall be shaped with a suitable tool so formed as to round the edges to a radius as indicated on the standard details.

The front face form shall not be removed before the concrete has taken the initial set and has sufficient strength to carry its own weight, gutter forms and rear forms shall not be removed until concrete has hardened sufficiently to prevent damage to the edges. Special care shall be taken to prevent any damage. Any portion of concrete damaged while stripping forms shall be repaired or if the damage is severe, replaced at no additional cost to the Contracting Agency. The face, top, back, and flow line of the curb and gutter shall be tested with a 10-foot straightedge or curve template, longitudinally along the surface. Any deviation in excess of 1/4 inch shall be corrected at no additional cost to the Contracting Agency.

The surface of concrete sidewalk or sidewalk ramp shall be tested with a 5-foot straightedge. Any deviation in excess of 1/8 inch shall be corrected at no additional cost to the Contracting Agency.

When required by the Engineer, gutters having a slope of 0.8 foot per hundred feet or less, or where unusual or special conditions cast doubt on the capability of the gutters to drain, they shall be water tested. Water testing shall consist of establishing flow in the length of gutter to be tested by supplying water from a hydrant, tank truck or other source. One hour after the supply of water is shut off, the gutter shall be inspected for evidence of ponding or improper shape. In the event water is found ponded in the gutter to a depth greater than 1/2 inch, or on the adjacent asphalt pavement, the defect or defects shall be corrected in a manner acceptable to the Engineer without additional cost to the Contracting Agency.

Any section of the work deficient in depth or not conforming to the plans or specifications shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency.

Finishing and Curing of the concrete shall be done in the manner specified in Section 505.

The Contractor shall stamp his name and year on all work done by him, on each end of the curb, gutter, sidewalk or sidewalk ramp. The letters shall not be less than 3/4 inch in height.

340.3.1 Detectable Warnings The detectable warning surface shall be located so that the edge nearest the curb line is 6 inches minimum and 8 inches maximum back from the face of curb. Detectable warning surfaces for railroads shall be located so that the edge nearest the rail crossing is 6 inches minimum and 8 inches maximum from the vehicle dynamic envelope.

Detectable warnings shall be installed perpendicular to the direction of pedestrian/wheelchair travel and have a minimum width of 24 inches measured perpendicular to the edge of the roadway or rail crossing. The base surface of detectable warnings shall be installed flush with the adjacent walkway surface, the truncated domes shall extend above the walkway surface. The boundary between detectable warnings and the adjacent walkway shall provide a flush uniform surface that will not cause ponding of water nor present a tripping hazard. Partial domes at the edge of the detectable warning shall be made flush to match the base surface of the detectable warning. Detectable warnings installed on curb ramps shall extend the full width of the ramp depression.

PART 500
STRUCTURES

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505	Concrete Structures	505-1 ■
506	Precast Prestressed Concrete Members	506-1
510	Concrete Block Masonry	510-1
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520	Steel and Aluminum Handrails	520-1
525	Pneumatically Placed Mortar	525-1
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SECTION 505

The quantity of concrete will be calculated considering any mortar used to cover construction joints as being concrete. The cost of cement used in any mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the cost of the item of work of which said mortar is a part.

505.11.3 Deck Joint Assemblies:

Deck joint assemblies will be measured to the nearest tenth of a foot. Measurement will be made along the centerline of the joint, at the surface of the roadway, from face-to-face of curb or barrier. No measurement will be made for that portion of the deck joint assembly required by plan details to extend through the barrier face or curb; that portion of the joint assembly will be considered incidental to the sealing of the joint.

505.11.4 Bridge Railing, Curbs, Barriers, and Approach Slabs

Bridge Pedestrian Fence and Curb, Bridge Pedestrian Fence and Parapet, and Bridge Fence and Parapet will be measured to the nearest tenth of a foot, from end post to end post.

Bridge Traffic and Pedestrian Rail will be measured to the nearest foot, determined from the outside dimensions of the rail.

Bridge Concrete Barrier will be measured to the nearest tenth of a foot.

Barrier Concrete Barrier Transition will be measured as a unit for each constructed.

Reinforced Concrete Approach Slab will be measured to the nearest square yard.

505.12 PAYMENT:

Payment for portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete and doing all work required to construct the structures in conformity with the plans and specifications.

505.12.1 Reinforcing Steel: The accepted quantities of reinforcing steel, of the type indicated on the Project Plans or specified in the Special Provisions, and measured in conformance with Section 505.11.1 will be paid for at the contract unit price per pound, complete in place.

The accepted quantity of dowels placed will be paid for at the contract unit price for Dowel Placement, which shall be full compensation for the work, complete in place. Steel reinforcement furnished for the dowels will be measured and paid for under the pay item Reinforcing Steel.

No measurement or direct payment will be made for dowels which are required to replace existing reinforcing steel that is damaged as a result of the Contractor's operations; the Contractor shall furnish and place such dowels at his own expense.

505.12.2 Concrete: Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices and/or lump sums as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, preparation of subgrade for placing of concrete, and doing all work required to construct the structures in conformity with the plans and specifications.

Where concrete is scheduled for payment on the basis of cubic yards, the calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, shall be absorbed in the item of work of which said mortar is a part.

SECTION 505

An adjustment in the contract unit price, to the nearest cent, will be made for the quantity of concrete represented by the results of cylinder strength tests that are less than the specified 28-day compressive strength. Strength tests will be conducted in accordance with Section 725.8. The adjustment in contract unit price, if the concrete is accepted, will be based on Table 725-2 in Section 725.9.

The contract unit price for structural concrete shall include full compensation for all items incidental to providing a concrete structure complete in place, including waterstops, roadway drains, scuppers, metal inserts, and bearing pads.

505.12.3 Minor Concrete Structures and Accessories:

The accepted quantities of:

Minor Structures	Each
Deck Joint Assemblies	0.1 Foot
Bridge Pedestrian Fence and Curb	0.1 Foot
Bridge Pedestrian Fence and Parapet	0.1 Foot
Bridge Fence and Parapet	0.1 Foot
Bridge Traffic and Pedestrian Rail	Foot
Bridge Concrete Barrier	0.1 Foot
Bridge Concrete Barrier Transition	Each
Reinforced Concrete Approach Slab	Square Yard

will be paid for at the unit price and/or lump sums as set forth in the proposal. The contract unit price shall include full compensation for all labor, materials, tools and equipment necessary to provide the concrete structure or accessory complete in place, including all concrete, reinforcing steel, and items embedded in the concrete, such as anchor bolts, grates and frames, metal inserts, etc.

End of Section

PART 600

WATER AND SEWER

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602	Encasement of Water or Sewer Pipe by Jacking or Tunneling Operation	602-1
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605	Subdrainage	605-1
610	Water Line Construction	610-1
611	Disinfecting Water Mains	611-1
615	Sewer Line Construction	615-1
616	Reclaimed Water Line Construction	616-1
618	Storm Drain Construction	618-1
620	Cast-In-Place Concrete Pipe	620-1
621	Corrugated Metal Pipe and Arches	621-1
625	Manhole Construction and Drop Sewer Connections	625-1
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631	Water Taps and Meter Service Connections	631-1



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SECTION 618

STORM DRAIN CONSTRUCTION

618.1 DESCRIPTION:

This section covers concrete pipe line and high density polyethylene (HDPE) pipe line construction used for the conveyance of irrigation water and storm drainage in streets, easements, and alley right of ways, under low hydrostatic heads.

Installation of pipe in laterals of Salt River Valley Water Users' Association or other irrigation districts shall conform to the specifications and permit of the respective irrigation district.

Installation of pipe in State Highways shall conform to the specifications and permit of the Arizona Department of Transportation.

618.2 MATERIALS:

The concrete pipe and HDPE pipe, specials, joints, gaskets, and testing shall be according to Sections 620 or 735, 736 and 738, except as specified below or as modified by special provisions.

(A) Specials: Pipe specials such as closure pieces, wyes, tees, bends, and manhole shafts shall be provided as indicated on the plans, and such specials shall be made equal in strength, diameter, and other physical characteristics to the standard straight pipe lengths by the use of extra concrete, extra reinforcing, or steel items. Drawings of specials shall be submitted to the Engineer for approval before their fabrication.

(B) Rubber Gasket Joints: When rubber gasket pipe is used, the joint shall be sealed with a continuous ring gasket made of a special composition rubber of such size and cross section as to fill completely the recess provided for it. The gasket shall be the sole element depended upon to make the joint watertight, and shall have smooth surfaces, free from pits, blisters, porosity, and other imperfections. The rubber compound shall contain not less than 60% by volume of first grade synthetic rubber.

The remainder of the compound shall consist of pulverized fillers free from rubber substitutes, reclaimed rubber and deleterious substances. The compound shall meet the following physical requirements when tested in accordance with appropriate ASTM Specifications:

- (1) Tensile Strength of the compound shall be at least 2,100 psi, ASTM D-412.
- (2) Elongation at Rupture shall be at least 400%, ASTM D-412.
- (3) Shore Durometer Hardness, Type A, Value 40 - 60(±5), ASTM D-2240.
- (4) Cold Flow: The percentage shall not exceed 20. The determination shall be made in accordance with Method B ASTM D-395, with the following exception. The disc shall be ½" thick and the diameter shall be that of the rubber gasket. The gaskets shall not be exposed to direct sunlight for a time greater than needed to accomplish normal installation.
- (5) Specific Gravity shall be consistent within +0.05 and shall be between 0.95 and 1.45, ASTM D-297.
- (6) Rubber Gaskets for HDPE pipe shall be in accordance with Subsection 738.2.3.

(C) Water Stops: Water stops will be required when connecting HDPE pipe to concrete structures, manholes, etc. The water stop shall comply with Section 738 and will be installed per manufacturer recommendations.

(D) Cement Mortar Joints for RCP will be in accordance with Subsection 736.3.

618.3 CONSTRUCTION METHODS:

Excavation, bedding, backfilling, and compaction or consolidation of backfill and bedding of trenches shall be accomplished in accordance with Sections 601 and 603 for HDPE pipe, except as specified below, or as modified by special provisions.

The Contractor shall over-excavate the trench and fill with select materials in accordance with standard details.

Where the cover over the top of the pipe is less than 10 feet, the maximum trench width is unrestricted. The pay width, however, for pavement replacement shall remain in accordance with Section 336. For pipe, with 10 feet or more cover, the maximum trench width shall be as required by Sections 601 and 603 for HDPE pipe.

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The laying of the pipe shall be in finished trenches free from water or debris, and shall be commenced at the lowest point, with the spigot ends pointing in the direction of the flow. Each pipe shall be laid firmly and true to line and grade, in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden off-sets of the flowline. Any adjustment to line and grade shall be made by scraping away or filling in under the body of the pipe, never by wedging or blocking under the pipe ends.

Variation from prescribed alignment and grade shall not exceed 0.10 foot and the rate of departure from or return to established grade or alignment shall be no more than 1 inch in 10 feet of pipe line unless otherwise approved by the Engineer. For closures and deflection angles greater than 10 degrees, joints shall be made by use of a bend, specially manufactured fitting, or by a concrete collar, per standard details.

Pipe shall be of the type, class and size shown on the plans or in the special provisions.

All pipe, for permit construction, shall be reinforced concrete pipe, ASTM C-76 Class III or HDPE pipe in accordance with ASTM F-894, AASHTO —252 or AASHTO —294. For reinforced concrete pipe, the minimum cover from the top of the pipe to the finished grade shall be 2 feet and the maximum cover shall be 12 feet. The minimum and maximum cover for HDPE pipe shall be as specified in the special provisions or the manufacturer's recommendations.

All pipes installed under railroad tracks shall be reinforced concrete pipe, ASTM C-76, Class V and the minimum cover over all pipes shall be as specified in the railroad permit and/or special provisions. Bedding shall be in accordance with standard details.

The allowable water loss for irrigation lines shall not exceed 2 gallons per hour per 100 feet of pipe per inch of diameter of pipe, under a minimum test head of 1 foot above the top of the pipe at the upper end when tested in accordance with the procedures of Section 615.

618.4 JACKING PIPE:

At locations where jacking is required, the storm drain line shall be installed by jacking to the lengths indicated on the plans, in accordance with the following. The methods and equipment used in jacking reinforced concrete pipe conduit shall be optional with the Contractor, provided that the proposed method is first approved in writing by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for damages of any nature which might occur as a result of the methods used.

Only workmen experienced in the operation of jacking concrete conduit shall be used.

The driving ends of the conduit shall be properly protected and the conduit shall be driven true to alignment and grade. The deviation from true line and grade at any single point within the jacked portion shall be limited to 0.5 feet horizontal deviation from line and ± 0.2 feet vertical deviation from grade.

Any section of conduit which may show signs of failure shall be removed and replaced with a new section of precast conduit or with a cast-in-place section, which in the opinion of the Engineer is adequate to carry the loads imposed upon it. In this respect it shall be understood that where pipe is specified on the drawings to be jacked into place the jacked pipe shall be reinforced concrete of the strength specified in these specifications and the design of such pipe is based upon superimposed loads and not upon loads which may be placed upon the pipe as a result of jacking operation. Any increase in pipe strength required in order to withstand jacking loads shall be the responsibility of the Contractor. The reinforcing shall be circular and of either single or double cage design.

Spacer blocks shall be placed in the inside circular space which will allow sufficient width for point mortaring when jacking is completed and to equalize pressures during jacking. Three grout holes per 8-foot section of pipe shall be made during manufacturing.

Double rubber gaskets and band type joints shall be provided for 36 inches diameter and larger pipe.

One hole shall be made on the top midway between the ends. Two additional holes, each approximately 1.5 feet from each end and approximately midway between the springline and top on opposite sides shall be made.

SECTION 630

All gaskets shall be of virgin styrene butadiene rubber (SBR), or equal, compound for water services. The complete circle gasket shall be 0.25 inch ± 0.03 thick and permanently attached to the sleeve. A dielectric insulating flange insulation kit shall be installed between the stainless steel flange and the cast iron valve. The kit shall contain full faced gaskets, full length sleeves, and single insulating washers. Insulation gasket material shall be neoprene-faced phenolic, insulation sleeves shall be mylar or minlon and full length, insulation washers shall be phenolic, or approved equal. All insulation material shall be of a type designated by the manufacturer as suitable for service at the operation temperatures and pressure specified.

(B) Tapping sleeves for concrete pressure pipes shall be fabricated tapping sleeves and comply to the following.

The sleeves shall be installed in accordance with AWWA Manual M-9. They shall also meet AWWA C-301, and AWWA C-303 standards pertaining to design, manufacturing, testing and welder qualifications. When tapping AWWA C-301 pipe, additional considerations pertaining to installation, testing and tapping shall be noted in the special provision and/or the plans.

The tapping sleeve assembly shall be designed to meet or exceed the pressure rating of the pipe using the same safety factors.

The tapping sleeve assembly shall be pressure tested to at least 5 percent over the actual working pressure in the pipeline. The main shall be pressurized to full working pressure during the test of the sleeve. The test shall occur prior to tapping of the main.

The sleeve shall be a three part design, back half, front half with draw flange and a gland as shown in Detail 342. The sleeve shall be designed to permit the cutting of the of the rods or prestressing wires of the pipe after installation of the two sleeve halves. The gland shall have a sealing gasket set in a retaining groove on the pressure plate. The sealing portion of the gasket shall be square or rectangular in shape and have minimum dimensions of $\frac{1}{2}$ inch x $\frac{1}{2}$ inch. The pressure plate on the gland shall be stabilized to eliminate flexing. The gland shall be equipped with load bearing set screws to protect the pipe cylinder from any excess loading caused by the valve, tapping machine, etc. The annular space between the sleeve and the gland shall be grouted through an opening in the sleeve.

Both halves of the sleeve shall be the same thickness and width. With approval from the Engineer, stainless steel strapped back sleeves will be permitted when the outside pipe diameter is irregular and can not accommodate a full back sleeve.

The sleeves shall be furnished with grout horns/openings through which the annular space between the outside pipe surface and the sleeve shall be grouted.

All interior and exterior ferrous surfaces shall be epoxy coated to a minimum dry film thickness of 12 mils. Epoxy coating shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550 for use in a potable water system.

All bolts shall be 304 stainless steel.

No weld-on sleeves or nozzles will be permitted.

Tapping sleeves shall be JCM #415 Type 2 ESS or approved equal.

All external surfaces of the tapping sleeve shall be covered with a minimum of two inches of mortar. The mortar shall be Type "M" per Section 776 using Type II low alkali cement. The mortar shall be held in place by use of wire mesh.

The Contractor shall obtain the necessary dimensions for ordering the sleeve from direct field measurements. Excavation may be required to obtain the measurements. If an excavation is required, the Engineer may require the Contractor to return the land to its original use until the materials are delivered.

The contractor shall provide, for approval of the Engineer, the manufacture, shop drawings, calculations, and any other technical data as required by the Engineer for the tapping sleeve. Also, the contractor shall submit the manufacture history of 6 successful production of the sleeves over the last year. The submittal shall include but not limited to the number, size, location, agency and contact person, etc.

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The Contractor shall also provide, for approval by the Engineer, the name of the company/contractor/subcontractor to install the sleeve and perform the tap. The submittal shall include a history of 5 successful sleeve installations and taps per year over the last 3 years. The submittal shall include but not limited to the sizes and locations of the taps, the agencies and contact persons, the addresses and telephone numbers, etc.

630.4.3 Tapping and Associated Fees: Except for meter service connections, taps shall be made by the Agency at prevailing rates or by approved Contractors when allowed or requested by the Contracting Agency. After installation of the tapping sleeve and valve, the Contractor shall provide an excavation sufficient in size to accommodate the tapping operation.

The Contractor shall pay the established shutdown charge to the Contracting Agency every time it is necessary to shut off valves and take a section of a water main out of services.

The above charges, as well as charges for tap connections to steel cylinder and reinforced concrete pipe, are subject to change, as established by the Contracting Agency.

630.5 BUTTERFLY VALVES:

(A) 16 inches and larger:

Valves shall be in accordance with AWWA C-504 latest revision as modified herein:

- (1) Valve body shall be of cast iron or ductile iron with connecting ends one of or a combination of Flanged (Short Body), mechanical joint or ACP Hub End.
- (2) Valves shall be Class 150-B unless otherwise specified.
- (3) When requested the manufacturer shall furnish records of tests specified in AWWA C-504.
- (4) Shaft seal may be O-ring seal, V-type packing or pull down packing.
- (5) The valve disc may be either cast iron or ductile iron.
- (6) Valves and operators shall be for direct burial installation.
- (7) Valves to be furnished with manual operators and 2 inch square operating nut. Operator torque rating shall be calculated in accordance with AWWA C-504.
- (8) Valves shall open when turning the operating nut counter-clockwise.
- (9) Valves shall be installed with valve shaft in a horizontal position and the operating shaft vertical.
- (10) All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils. Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions. The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements of AWWA C-550, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.
- (11) All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.
- (12) A manufacturer's affidavit of compliance shall be furnished.
- (13) Shop drawings shall be furnished.

(B) 3 inches through 12 inches:

SECTION 630

This specification generally describes valves and operator assemblies designed for underground service, as manufactured by Dresser Industries, B-I-F Industries Incorporated, Henry Pratt Company, Allis Chambers Manufacturing Company, or approved equal.

Where material or equipment is designated on the plans or in this specification by a trade or manufacturer's name, it is so designated primarily to establish standards of quality, finish, appearance and performance.

All specific requirements of this specification must be adhered to, and all necessary modifications shall be made in the article specified by the trade name, type or model or manufacturer's equipment to make it conform to all specific requirements of this specification.

The valves shall be in accordance with AWWA C-504, Class 150-B, except as modified herein:

- (1) Valve ends may be the thin type or wafer type to be installed between flanges drilled in conformance with ASA B 16.1-125 or may be flanged both ends or the valves may have bell ends with rubber gaskets, for cast iron pipe or asbestos cement pipe conforming to the kind of pipe being used.
- (2) Valves shall be designed for buried service with the valve shaft in a horizontal position and the operating shaft vertical.
- (3) Valves shall be left-hand opening, counter-clockwise unless shown otherwise on the plans.
- (4) Discs shall be Ni-Resist, ASTM A-436, Type 1, or cast iron, ASTM A-48, Class 40, in accordance with the following variations:
 - (a) Cast iron disc may be used providing the rubber seat ring is contained on the disc with the rubber ring closing against a Type 304 stainless steel ring or a bronze ring contained in the body of the valve.
 - (b) Ni-Resist disc may be used where rubber seat is contained in the valve body.
 - (c) Valves with rubber seats in the valve body may have cast iron discs with a Type 304 stainless steel or bronze edge seating surface retained on the edge of the disc.

Shafts and disc shaft fasteners shall be constructed of Type 304, stainless steel, unless the shaft is completely sealed from the line fluid. Valve shafts completely sealed from the line fluid may be of high strength steel with all other metal parts in contact with the line fluid to be Type 304 stainless steel.

Valves with rubber seat mounted in the body shall have the rubber either bonded or mechanically retained in its final position. Rubber seats which are on the disc edge shall be retained by a clamping ring and screws. Clamping ring and screws shall be made of 18-8 stainless steel, Type 304, or bronze conforming to ASTM B-61 or ASTM B-584.

Manual operators shall have AWWA 2 inch square operating nuts and shall require at least 2 turns per inch diameter to rotate the disc 90 degrees. Operators must accept a minimum of 300 ft. lbs. input torque on stops at ends of travel without damage to valve or operator. The operator torque rating shall equal, or exceed, the valves shown in Table I of AWWA C-504 for valve class specified above.

All interior ferrous surfaces exposed to fluid flow shall be epoxy coated to a minimum dry film thickness of 6 mils.

Epoxy coatings shall be factory applied by an electrostatic or thermosetting process in accordance with the manufacturer's printed instructions.

The epoxy materials used shall be 100% powder epoxy or liquid epoxy that conforms to the requirements AWWA C550-81, and to the prevailing requirements of the Food and Drug Administration and of the Environmental Protection Agency.

All exterior ferrous surfaces, except finished or bearing surfaces, shall be factory coated with 2 coats of asphaltic varnish conforming to Federal Specification TT-V-51c, or shall be epoxy coated as required above for interior surfaces.

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630.6 AIR RELEASE AND VACUUM VALVES:

Valve assemblies shall be furnished and installed where shown and as detailed on the drawings.

(A) Air release on water mains shall be controlled by the use of an air release valve assembly, of size and type as shown on the plans. Air release valves shall be of the flanged or screwed type as designated on the Agency's approved products list or in the special provisions.

(B) Vacuum and Air Relief when called for on the plans shall be controlled by a vacuum relief valve on the air release valve noted above. The valves shall be of the same manufacture or may be a combination air and vacuum valve assembly designated on the Agency's approved products list or in the special provisions.

630.7 CONSTRUCTION METHODS:

All valves, their supports, manholes, vaults, and valve boxes shall be installed in accordance with Section 610.

Valves 16 inches and larger, before being shipped from the factory, shall have the flanged ends completely covered with plywood. Plywood shall be left on the valve until just before installation in the line.

630.8 MEASUREMENT:

Measurement will be by the unit each of the various kinds and sizes of valves, manholes, vaults, or tapping sleeves and valves, including valve boxes and covers.

630.9 PAYMENT:

Payment will be made at the contract unit price and shall be compensation in full for the complete installation in place including all labor, materials, equipment, and all incidentals necessary to complete the installation. The compensation will also include the cost of necessary pavement replacement in excess of the pay widths allowed in Section 336 for pavement replacement over pipe trenches.

End of Section

PART 700

MATERIALS

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SECTION 701

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.

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.

SECTION 701

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 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 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, 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:

(A) 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

SECTION 701

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.

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.

End of Section



SECTION 702

BASE MATERIALS

702.1 GENERAL:

Materials for use as aggregate base shall be classified in the order of preference as follows:

- (A) Crushed Aggregate.
- (B) Processed Natural Material.
- (C) Processed Steel Slag.
- (D) Decomposed Granite.

When base material without further qualification is specified, the Contractor shall supply crushed aggregate. When a particular classification of base material is specified, the Contractor may substitute any higher classification of base material for the specified classification.

Except where materials are being obtained from a previously approved source, the Contractor shall give the Engineer 10 days advance notice, in writing, of the source of the base material he intends to use in order to allow sufficient time to perform the necessary tests.

702.2 CRUSHED AGGREGATE:

Crushed aggregate shall consist of crushed rock or crushed gravel or a combination thereof as defined in Section 701.

702.2.1 Soundness: The percentage of wear of crushed aggregate to be used as base will be determined as in Section 701, except that Grading B of ASTM C-131 shall be used. The percentage of wear of the material shall not exceed 40 after 500 revolutions.

702.2.2. Grading: The aggregate shall be well graded when tested in accordance with ASTM C-136 and C-117. The percentage composition by weight shall be within Table 702-1.

Table 702-1			
CRUSHED AGGREGATE GRADATION			
Percentage by Weight Passing Sieve			
Sieve Sizes (Square Openings)	Select Material		Aggregate Base
	Type A	Type B	
3"	100		
1 1/2"		100	
1 1/4"			100
No. 4	30-75	30-70	38-65
No. 8	20-60	20-60	25-60
No. 30	10-40	10-40	10-40
No. 200	0-12	0-12	3-12

702.2.3 Plasticity Index: Unless otherwise noted, the Plasticity Index as tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90 shall not be more than 5.

SECTION 702

702.3 PROCESSED NATURAL MATERIAL:

702.3.1 General: Processed natural material shall consist of hard, durable fragments of stone or gravel and a filler of sand or other finely divided mineral matter. It shall be free from an excess of soft or disintegrated pieces, alkali, adobe, vegetable matter, loam, or other deleterious substances.

702.3.2 Physical Requirements: When sampled and tested in accordance with standard test methods, the aggregate shall meet the following requirements:

(A) Percentage of Wear: When tested in accordance with ASTM C-131, the percentage of wear shall not exceed 40 percent after 500 revolutions.

(B) Plasticity Index: When tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90, the plasticity index shall not be more than 5.

(C) Liquid Limit: When tested in accordance with AASHTO T-89, the liquid limit shall not be more than 25 percent.

702.3.3 Crushed Material: Crushed material is not required, but may be incorporated in the finished product.

702.3.4 Grading: The aggregate shall conform to the sieve analysis in this specification except that the least dimension of the maximum particle size shall not exceed 2/3 of the compacted thickness of the specified lift being placed.

702.4 DECOMPOSED GRANITE:

Decomposed granite shall be any granitoid igneous rock which has been weathered in place and which has as principal constituents granular fragments of quartz and feldspar. It may also contain fragments of granitic rock not yet broken down into the component minerals. This material shall remain stable when saturated with water. Particles larger than 3 inches, which will not be broken in the process of rolling and tamping during construction, shall not be used.

Decomposed granite shall conform to the following requirements:

(A) When tested in accordance with this specification, not more than 20 percent shall pass the No. 200 mesh sieve.

(B) The P.I. of material passing the No. 200 sieve prior to testing shall not be less than 3 nor greater than 10. The Plasticity Index shall be tested in accordance with AASHTO T-146 Method A (Wet Preparation), T-89 and T-90.

702.4.1 Preparation of Test Specimens: A quantity of sufficient size to have a dry weight of 15 pounds shall be selected and dried to constant weight at a temperature between 215°F. and 230°F. Fifteen pounds of this material shall then be subjected to 500 revolutions in a Los Angeles abrasion machine, as described in Section 701, except that nothing shall be placed in the drum other than the material to be tested.

The material that has been subjected to the breakdown shall be tested in accordance with ASTM C-117 to determine the percentage of material finer than a No. 200 mesh sieve by washing.

End of Section

SECTION 703

RIPRAP

703.1 STONE:

Stone for plain and grouted riprap shall meet the requirements of Section 701.4. Stone shall be angular, rounded stone shall only be allowed when specified. Flat or needle shapes will not be acceptable unless the thickness of the piece is more than 1/3 the length.

Stone shall be color-matched with adjacent landscape aggregate if specified on the plans or in the special provisions.

703.2 SIZE OF STONE:

Unless otherwise indicated the maximum stone size shall be 150% of the indicated D_{50} size and the minimum stone size shall be 50% of the indicated D_{50} size.

End of Section



SECTION 715

SLURRY SEAL MATERIALS

715.1 GENERAL:

Slurry seal shall consist of a properly proportioned mixture of emulsified asphalt, mineral aggregate, mineral fillers, and water.

All material source must be approved prior to their use. The Contractor will submit material samples at least seven days prior to start of construction. When requested, additional samples will be furnished during the construction period at no cost to the Contracting Agency. This is a non-pay item.

715.2 AGGREGATE:

715.2.1 Mineral Filler: Mineral filler shall consist of finely divided matter, such as hydrated lime, portland cement, limestone dust or fly ash, conforming to the requirements of ASTM D-4318. Mineral filler shall be used only when needed to reduce the setting time, to improve the workability or to reduce the stripping characteristics of the aggregate emulsion mixture. The minimum amount of the required filler will be used and it will be considered as part of the blended aggregate. The expected range shall be between .25% and 2.0% by weight of aggregate.

715.2.2 Mineral Aggregate: Mineral aggregate shall consist of sound and durable sand and/or crushed stone as per MAG Section 701 combined with an approved mineral filler where it is required. The mineral filler will be considered as part of the blended aggregate. The material shall be non-plastic (ASTM D-4318) with a sand equivalent (ASTM D-2419) of at least 50. The abrasion loss (ASTM C-131) shall not exceed 35 percent. Ninety percent of the aggregate retained on the No. 50 sieve shall have at least one fractured face. The gradation of material aggregate shall conform to Table 715-1.

715.3 BITUMINOUS MATERIAL:

The emulsified asphalt used for seal coating shall be quick setting or slow setting as per Section 713.

The quick setting emulsified asphalt shall be of the anionic or cationic quick set type such as QSH or CQSH that will react to chemically active mineral fillers such as portland cement in such a way that the applied slurry mixture can support controlled traffic in 45-60 minutes after application. The amount of chemically active filler shall be determined by mix design and field performance.

Quick Set Emulsion Mix Properties

Slurry Seal Mixing, 70-85 degree F., Sec.	120 Sec. Min.
Slurry Seal Setting text, 70-85 degree F., 1 hour cure	No Brown Stain
Slurry Seal Water Resistance Test, 70-85 degree F., 30 minute cure	No More Than Slight Discoloration

Slow setting emulsion may be used when traffic control is not a critical item.

Placement of slurry seal is temperature dependent and should be tested under field conditions.

715.4 WATER:

Water shall be potable and be compatible with the slurry ingredients used.

715.5 TEST CERTIFICATES & REPORTS:

Test certificates and reports for the bituminous material shall be furnished in accordance with Section 711.

715.6 CONVERSION OF QUANTITIES:

Volumetric conversions shall be accomplished in accordance with Section 713.

SECTION 715

TABLE 715-1			
SLURRY SEAL AGGREGATE			
SIEVE SIZE	Type I % PASSING	Type II % PASSING	Type III % PASSING
3 \pm	100	100	100
No. 4	100	85/100	70/90
No. 8	90/100	65/90	45/70
No. 16	65/90	45/70	28/50
No. 30	40/60	30/50	19/34
No. 50	25/42	18/30	12/25
No. 100	15/30	10/21	7/18
No. 200	10/20	5/15	5/15
Emulsified Asphalt content as a % of Dry Wt. Of Aggregate (approx.) ASTM D-3910 (W.T.A.T. TEST)	18	16	14
Residual Asphalt Range requirements % of Dry Wt. of Aggregate ASTM D-3910 (W.T.A.T. TEST)	10-16	7.5-13	6.5-12
Pounds of Aggregate per Square Yard (approx.)	8-10	12-18	18-25

End of Section

SECTION 719

The RAP and the combined new aggregate shall be weighed on separate belt scales. They shall be of such accuracy that, when the plant is operating between 30 percent and 100 percent of belt capacity, the average difference between the indicated weight of the material delivered and the actual weight delivered will not exceed 1 percent of the actual weight for three 2-minute runs. For any of the three individual 2-minute runs, the indicated weight of material delivered shall not vary from the actual weight delivered by more than 2 percent of the actual weight. The actual weight of material delivered shall be determined by a vehicle platform scale or other certified weighing device approved by the Engineer.

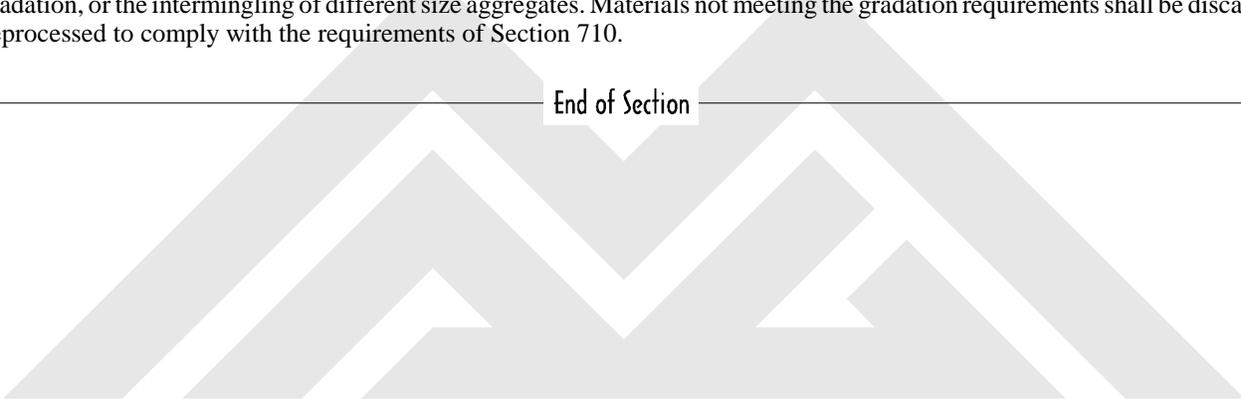
The individual belt scales for the RAP and the combined new aggregate, the proportioning meters for the new asphalt and RA, and the other proportioning devices, shall be interlocked so that the rates of feed of the RAP, new aggregate, new asphalt, and RA will be adjusted automatically to maintain the proper proportions. The plant shall not be operated unless this automatic system is operating and in good working condition.

Belt scales and proportioning meters shall be equipped with resettable totalizers, so that the actual weight of asphalt, RA, RAP, and combined aggregates can be determined. The bins containing the mineral filler, if used, shall be equipped with a vibrating unit or other equipment which will prevent any hang-up of material while the plant is operating. Before the quantity of material in any one bin reaches the strike-off capacity of the feed gate, a device shall automatically close down the plant.

When mineral filler is used, a safe and suitable sampling device shall be installed in each feed line or surge tank preceding the proportioning device.

719.7.3 RAC Miscellaneous Requirements: New aggregate consisting of sand, rock dust, and various sizes of aggregates shall be stored separately at the plant and evenly fed to the dryer to ensure a uniform flow of properly combined aggregates. In placing materials in storage or in moving them from storage to the feeder, no method shall be used which may cause segregation, degradation, or the intermingling of different size aggregates. Materials not meeting the gradation requirements shall be discarded or reprocessed to comply with the requirements of Section 710.

End of Section



SECTION 725

PORTLAND CEMENT CONCRETE

725.1 GENERAL:

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

TABLE 725-1		
CONCRETE CLASSES - MINIMUM REQUIREMENTS		
Class of Concrete	Minimum Cementitious Materials Content (lbs. per cubic yard)	Minimum Compressive Strength (1) at 28 Days (psi)
AA	600	4000
A	520	3000
B	470	2500
C	420	2000

(1) In accordance with section 725.8.

725.2 CEMENTITIOUS MATERIALS:

Cementitious materials to be used or furnished under this specification shall be:

- Portland cement, meeting the requirements of ASTM C-150
 - Type II, low alkali, when no other specific type is specified
 - Type III, low alkali, for high early strength, when applicable or specified
 - Type V, low alkali, when specified in the special provisions for applications requiring high sulfate resistance

- Portland Pozzolan Cement ASTM C-595
 - Type IP (MS), when no other specific type is specified

Supplementary Cementitious Materials (SCM) shall not be used as an additional cementitious materials replacement in concrete in combination with Portland Pozzolan Cement.

Cementitious materials shall be sampled and tested as prescribed in the applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the material manufacturer, identifying the cementitious material and stating that the cementitious material delivered to the batching site complies with the appropriate specifications. When requested by the Engineer, the Contractor shall furnish 3 copies of the cementitious materials certification. The cost of furnishing tested cementitious materials shall be considered as included in the contract bid price and no additional allowance will be made therefore.

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

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

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

Fly ash or natural pozzolan	ASTM C-618 and C-311
Silica Fume	ASTM C-1240

Up to 25 percent by weight of the Table 725-1 minimum cementitious materials requirements may be an approved fly ash or natural pozzolan. Additional pozzolanic material in excess of the minimum Table 725-1 requirements may be incorporated into a concrete mix design to achieve enhanced performance, upon approval of the Engineer.

The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the pozzolan supplier identifying the pozzolanic material and stating the pozzolan delivered to the batching site complies with the appropriate specifications. The cost of furnishing tested pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolanic materials shall be handled and stored in the same manner as other cementitious materials. When facilities for handling a bulk pozzolan are not available, the pozzolan shall be delivered in original unopened sacks bearing the name and brand of the supplier, the type and source of the pozzolan, and the weight contained in each sack plainly marked thereon.

725.3 AGGREGATES:

Coarse aggregates, consisting of crushed rock or gravel or a combination thereof, and fine aggregate shall conform to the requirements prescribed in Section 701.3.3. Prior to the delivery of the aggregates and whenever required during concrete production, the Contractor shall make stockpiles available to the Engineer for testing. All required samples shall be furnished at the expense of the Contractor, and the cost of sampling and testing shall be at the expense of the Contracting Agency.

725.4 WATER:

The water used for mixing concrete shall be potable or shall meet the requirements of ASTM C-1602, when tested by a qualified independent testing laboratory.

725.5 ADMIXTURES AND ADDITIVES:

Admixtures or additives of any type, except as otherwise specified, shall not be used unless identified in the approved mix design or authorized by the Engineer.

Water reducing admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C-494 for the appropriate type.

Air entraining admixtures incorporated into the approved concrete mix design shall meet the requirements of ASTM C-260.

Pigments incorporated into the approved concrete mix design for integrally colored concrete shall meet the requirements of ASTM C-979.

Fibers incorporated into the approved concrete mix shall meet the requirements of ASTM C-1116.

Any admixtures used shall be included in the price for that item.

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725.6 MIX DESIGN PROPORTIONING:

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

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

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

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

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

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

725.7 MIXING:

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

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

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

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The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight. The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

Machine mixing will be required in all cases unless pre-approved by the Engineer. Regardless of the method employed, mixing shall be commenced as soon as possible after the cementitious material is placed in contact with the aggregates or water. All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

725.7.1 Paving and Stationary Mixers: Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cementitious materials, admixtures/additives and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum.

The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

725.7.2 Transit Mixers: Transit mixers shall meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association or the National Ready Mixed Concrete Association. Ready mix concrete and shall comply with ASTM C-94 except as herein specified.

Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this section, the amount of materials charged into the mixer shall be reduced.

The rotation speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible delivery ticket which shall contain the following information:

Date and Truck Number.

Name of the Supplier.

Name of the Contractor.

SECTION 725

Specific designation of job (name and location).

Number of cubic yards in the batch.

Time the transit mixer is loaded.

Amount of water added at the job site at request of receiver, and his signature or initials.

Suppliers' mix design code number.

Type and amount of admixture or additive that is not already included in the approved mix design, if any.

Serial number of the ticket.

Additional water may be added on the jobsite in accordance with ASTM C-94 Tolerances in Slump section to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications in section 725.9 (A) (1) and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete shall be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the job site.

725.7.3 Job Mixed Concrete: All job mixed materials and procedures shall be pre-approved by the Engineer. A prepackaged commercial product shall be used for job mixed concrete placement in accordance with the manufacturer's recommended procedure.

In lieu of the use of a prepackaged commercial product, individual ingredients for concrete placement shall be prepared in a watertight container of suitable volume in batches not to exceed 1/3 cubic yard each. Proportioning of batches shall be in accordance with the applicable required mix design in Table 725-1 and section 725.6. All mixing shall be done prior to placement in the forms and in accordance with the following procedure:

- (A) Mixing shall be done in a mechanical batch mixer of approved type.
- (B) The mixer shall be rotated at a speed recommended by the manufacturer.
- (C) Mixing shall continue for at least 1-1/2 minutes after all materials are in the mixer, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of ASTM C-94.
- (D) Materials handling, batching, and mixing shall conform to the applicable provisions of ASTM C-94.
- (E) Suitable records shall be kept to indentify the number of batches, proportions of materials used, and time and date of mixing and placement along with the approximate location in the structure.

725.7.4 Dry Batched Unmixed Concrete: All dry batched unmixed concrete materials and procedures shall be pre-approved by the Engineer. An accurate batch weight shall be provided to record the quantities of cementitious materials, aggregate, admixtures/additives, and water batched into the containers. The date of batching, the container number and the batching certificate number shall be recorded at the time of batching. Copies of the batch weight records shall be submitted to the Engineer upon request.

All dry batched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot come in contact with the water and aggregate within the container. Any admixture/additive added in powder form shall be added to the cement; if added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

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Any spillage of cementitious materials, aggregate, water or admixtures/additives during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

725.7.5 Volumetric Batching and Continuous Mixing Concrete and Equipment: Volumetric-batching and continuous-mixing concrete and equipment may be utilized upon approval of the Engineer for job site concreting applications. Material handling, procedures, and operations shall be in accordance with ACI 304.6R, Guide for the use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment and all concrete produced and all test performed shall be in accordance with ASTM C-685, Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing. All equipment shall meet the requirements of the Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau and shall have a suitable copyrighted rating plate furnished by the Bureau and attached to the volumetric mixing equipment.

725.8 TESTS AND TEST METHODS:

725.8.1 Field Sampling and Tests: Concrete shall be sampled in accordance with ASTM C-172 for determination of temperature, slump, unit weight and yield (when required) and air content (when required) as well as for fabrication of test cylinders for compressive strength determination at 28 days. Samples shall be of sufficient size to perform all the required tests and fabricate the necessary test cylinders but in no case less than 1 cubic foot. Concrete shall be sampled during discharge of the middle portion of the batch. At the discretion of the Engineer, a sample may be obtained at the beginning of the discharge if the properties of the concrete do not appear to be within the specification limits for slump or temperature.

All sampling and testing shall be done by a certified technician meeting the requirements of the ACI Concrete Field Testing Technician, Grade I or equivalent.

Temperature of the concrete mixture shall be determined in accordance with ASTM C-1064.

Slump of the concrete mixture shall be determined in accordance with ASTM C-143.

Air content of the concrete mixture (when required) shall be determined in accordance with ASTM C-231 or C-173, whichever is applicable.

Unit weight and yield of the concrete mixture (when required) shall be determined in accordance with ASTM C-138.

All compressive strength test specimens shall be made, cured, handled, protected, and transported in accordance with the requirements of ASTM C-31. The contractor shall provide and maintain for the sole use of the testing laboratory/technician adequate facilities for safe storage and proper curing of concrete test cylinders on the project site including sufficient access on weekends and holidays to allow the timely pick-up of cylinders specimens. Any and all deviations from the standard procedure of any test method shall be promptly identified and corrected. Any deviations shall be clearly noted by the testing laboratory on all written reports. Testing results obtained from non-standard testing procedures shall be considered invalid and discarded by Engineer.

Sampling and testing performed for concrete acceptance will be at the expense of the Contracting Agency. Sampling and testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

725.8.2 Concrete Cylinder Test: A cylinder strength test shall be the average of the strengths of at least two 6 inch by 12 inch cylinders or at least two 4 inch by 8 inch cylinders made from the same sample of concrete and tested at 28 days. An adequate number of cylinder specimens shall be made for each 50 cubic yards or not less than each half-day's placement of each class of concrete. All specimens will be tested in a laboratory approved by the Engineer in accordance with ASTM C-39 for concrete acceptance. Should an individual cylinder show evidence of improper sampling, molding, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining cylinder(s). Additional cylinder specimens may be made and tested at other ages to obtain additional compressive strength information and shall not be considered as acceptance tests. Cylinder testing performed for concrete acceptance will be at the expense of the Contracting Agency. Cylinder testing for the Contractor's purposes of quality control or other needs shall be at the Contractor's expense.

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725.8.3 Additional Concrete Testing: If the 28-day strength test does not meet the compressive strength requirements, additional concrete testing may be performed to further evaluate the concrete in question for purposes of acceptability or payment. This may involve testing of additional cylinders at later ages, (for example - hold cylinders at 56 days or more), or core testing to determine in-place concrete strengths. This additional testing and all coring repairs shall be pre-approved by the Engineer and at the expense of the Contractor. If core testing is performed, at least three representative cores shall be obtained, conditioned and tested in accordance with ASTM C-42 from each concrete member or area of concrete to be tested at locations designated by the Engineer. Cores damaged subsequent to or during removal shall be rejected and additional core samples taken. Cores shall be obtained and delivered to a laboratory acceptable to the Engineer in time to allow complete strength testing within 48 days of original concrete placement. The Contractor may elect to have a representative present during sampling and testing. A core strength test shall be the average of the results of the three cores. Should an individual core show evidence of improper sampling, curing, or testing, the results shall be discarded and the compressive strength shall be the result of the average of the remaining core(s). Results of the core strength testing shall replace the results of the cylinder strength test for that sample.

725.9 ACCEPTANCE:

(A) Plastic Concrete Properties

(1) The slump of the concrete shall meet the requirements of ASTM C-94 Tolerances in Slump section. When the approved mix design or project specification requirements for slump are a “maximum” or “not to exceed”, the following tolerances apply:

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

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

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

(2) Limit the maximum allowable temperature of the concrete mixture immediately before placement to 90 degrees F unless otherwise specified or unless a higher allowable temperature is pre-approved by the Engineer. At the discretion of the Engineer, recommended practices in ACI 305, Specification for Hot Weather Concreting, can provide good reference information and may be used to modify maximum allowable concrete temperature and acceptance.

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

(3) Air entrained concrete shall meet the requirements of ASTM C-94 Air-Entrained Concrete section. The air content of air-entrained concrete when sampled from the transportation unit at the point of discharge shall be within the approved mix design tolerance or +/- 1.5 % of the specified value. When a representative sample taken prior to discharge shows an air content below the specified level by more than the allowable tolerance, additional air entraining admixture shall be added to the concrete mix to achieve the desired air content level, followed by a minimum of 30 revolutions at mixing speed.

(4) Per ASTM C-94 Mixing and Delivery section, discharge of the concrete shall be completed within 1 1/2 hour after the introduction of the mixing water to the cementitious materials or the introduction of the cementitious materials to the aggregates. The Engineer may allow the continuation of concrete placement after the 1 1/2 hour time limit has been reached if the concrete is of such slump or workability that it can be placed without the addition of water to the batch.

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

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(B) Hardened Concrete Properties – Compressive Strength

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

When compressive strength test results are less than the specified minimum, an Engineering Analysis to determine the impact of the strength reduction may be required by the Engineer prior to the decision to accept or reject the concrete. The Engineering Analysis will be at the Contractor's expense. Any concrete that is rejected by the Engineer shall be removed and replaced by the Contractor at the Contractor's expense.

When concrete is accepted by the Engineer on the basis of test results of less than 100% of the required minimum compressive strength, an adjustment in the concrete unit price may be made for the quantity of concrete represented by such strength tests in accordance with Table 725-2.

TABLE 725-2			
ADJUSTMENT IN CONCRETE UNIT PRICE BASED ON STRENGTH DEFICIENCY			
Class AA and Class A		Class B and Class C	
Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed	Percent of Specified Minimum 28-day Compressive Strength Attained (Nearest 1%)	Percent of Concrete Unit Price Allowed
100 % or greater	100	100 % or greater	100
98-99	90	95-99	95
96-97	85	90-94	90
95	80	85-89	85

End of Section



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SECTION 728

CONTROLLED LOW STRENGTH MATERIAL

728.1 GENERAL:

Controlled Low Strength Material (CLSM) is a mixture of portland cement, aggregate and water that, as the cement hydrates, forms a soil replacement. CLSM is a self-compacting, flowable, cementitious material that is primarily used as a backfill or structural fill in lieu of compacted fill or unsuitable native material.

728.2 MATERIALS:

Portland Cement shall conform to Section 725.2.

Coarse and fine aggregates shall conform to Section 701.

Water shall conform to Section 725.4

728.3 PROPORTIONING OF MIXTURES AND PRODUCTION TOLERANCES:

Proportioning of the mixture shall comply to Section 701.3.5, Section 725.6 and Table 728-1. 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.

TABLE 728-1			
CONTROLLED LOW STRENGTH MATERIAL REQUIREMENTS			
Description of CLSM	Cement Content, lbs/cu yd	Slump, inches	Compressive Strength at 28 days, psi
1/2 Sack CLSM	47±5%	7±1	70±30
1 Sack CLSM	94±5%	7±1	150±50
1 1/2 Sack CLSM	141±5%	7±1	425±75

Notes for Table 728-1:

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 1×10^{-5} cm/sec or more, based on ASTM D-5048.

728.4 MIXING:

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 725.7. 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.

SECTION 729

EXPANSION JOINT FILLER

729.1 PREMOLDED JOINT FILLER:

Expansion joint filler materials shall consist of premolded strips of a durable resilient compound and comply with ASTM D-1751, D-1752, or D-2628, as specified by the Contracting Agency.

729.2 POUR TYPE JOINT FILLERS:

Pour type joint fillers shall comply with ASTM D-1850, D-1190, D-1854, or with the following formulation, as specified by the Contracting Agency.

Asphalt latex joint filler shall consist of asphalt latex emulsion and sodium fluosilicate furnished in separate containers and mixed on the site. The emulsion shall consist by volume of 60 parts AR-1000 asphalt conforming to the requirements of Section 711, 40 parts of synthetic latex, GRS-Type 4, and 5 to 10 parts of sodium fluosilicate, half strength. The emulsion and sodium fluosilicate shall not be mixed until the joint is ready to be filled. The amount of sodium fluosilicate to be mixed with the emulsion shall be approximately 3 to 5 percent by weight of the emulsion. The joint to be filled shall be thoroughly cleaned and surface dry.

The sealing compound shall consist of paving asphalt, Grade AR-1000 conforming to the provisions of Section 711, emulsified with rubber latex in the presence of a suitable emulsifying agent. Rubber latex designated as GRS-Type 4, or any other approved type, containing approximately 40 percent solids.

The resulting emulsion shall consist of a minimum of 55 percent of paving asphalt and a minimum of 36 percent of rubber latex and shall conform to the requirements set forth in Table 729-1.

TABLE 729-1			
ASPHALT-LATEX EMULSION JOINT SEALING COMPOUND-			
SPECIFICATION DESIGNATION	TEST METHOD	LIMITS	REMARKS
Furol Viscosity at 77°F.	AASHTO T-72	50-250 seconds	Before adding gelling agent.
Sieve Test	AASHTO T-59	1% Max.	Before adding gelling agent.
Penetration at 77°F.	ASTM D-217	50-250	The penetration test is made on a specimen prepared by stirring 5% of sodium fluosilicate into the asphalt latex emulsion in a 6 ounce deep ointment can. The specimen is then allowed to stand in the air at a temperature of 77°F. ±2° for a period of 30 minutes and is then penetrated with a grease cone under a total load of 150 grams.
Elasticity		70% Min.	After addition of 5% of sodium fluosilicate and curing for 24 hours at 100°F. ±2°, the specimen shall have an elastic recover of not less than 70%.
Dehydration		Loss 30% maximum	Twenty-five grams of emulsion, prior to adding the gelling agent, is placed in an 8 ounce flat ointment can and dehydrated in a suitable oven maintained at a temperature of 200°F. ±2° for a period of 24 hours.
Time of Set		15-60 minutes	After mixing the emulsion with 1% to 4% by weight of powdered sodium fluosilicate the emulsion shall harden or develop a set in from 16 to 60 minutes, under field conditions.

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Paint Number	Type
1-A	(Red Lead — Linseed Oil)
1-B	(Red Lead — Alkyd Resin)
1-D	(Zinc Chromate)
4	(Dull Black)
5	(Jet Black)
6	(Black — For Timber Primer Only)
7	(White — For Timber Primer Only)
8	(White)
9	(Light Grey)
10	(Aluminum)
11	(White Enamel)
15	(Zinc)

End of Section



SECTION 792

DUST PALLIATIVE

792.1 GENERAL:

Dust palliatives shall consist of various chemical dust suppressants which work by binding together lighter soil particles.

All materials must meet the environmental requirements of Section 792.3 and must be approved by the Engineer prior to their use.

792.2 TYPE OF MATERIALS AND APPLICATION RATES:

Emulsions shall be miscible with water in all proportions as noted in Table 792-1. The dilution ratio will vary based upon the local soil and weather conditions. The ratios shall be proposed by the Contractor and agreed upon by the Engineer.

The rate of application noted in Table 792-1 shall be for the treatment, method and use specified by the Contracting Agency, or as directed by the Engineer. To compensate for local conditions or changes in soil type, the Contractor may adjust the application rate within the ranges specified.

Products specifically formulated as tackifiers which prevent wind-blown erosion shall not be acceptable as dust palliatives for vehicular traffic, but may be used for their intended purposes.

TABLE 792-1				
DUST PALLIATIVE DILUTION RATIOS AND APPLICATION RATES				
Product Type	Use/Treatment ⁽¹⁾	Dilution Ratio ⁽²⁾		Application Rate ⁽³⁾ (gal/sy)
		Range	Typical	
Acrylic Copolymer And Polymers	Topical - Road or parking Lot	20:1 to 4:1	9:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 4:1	15:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 4:1	9:1	0.08 to 0.06
Lignin-Based Type (Lignosulfonate)	Topical - Road or parking Lot	1:1	1:1	0.10 to 0.05
	Topical - Road Shoulder	7:1 to 4:1	8:1	0.05 to 0.03
	Surface Course (per inch of depth)	1:1	1:1	0.30 to 0.10
Organic Resin	Topical - All	10:1 to 2:1	5:1	0.25 to 0.15
	Surface Course (per inch of depth)	2:1 to 1:1	1:1	0.15 to 0.10
Petroleum Resin	Topical - Road or parking Lot	4:1	4:1	0.15 to 0.10
	Topical - Road Shoulder	10:1 to 7:1	8:1	0.15 to 0.07
	Surface Course (per inch of depth)	4:1	4:1	0.11 to 0.07
Tall Oil Pitch Emulsion	Topical - Road or parking Lot	20:1 to 5:1	5:1	0.20 to 0.15
	Topical - Road Shoulder	20:1 to 3:1	3:1	0.16 to 0.12
	Surface Course (per inch of depth)	20:1 to 2:1	10:1	0.08 to 0.06
Other	As approved by the Engineer			

(1) Topical application rates shown are to obtain 1/2 to 1 inch penetration. Higher rates should be used if greater penetration is anticipated.

(2) The dilution ratio (water:product) is variable and shall be appropriate for the local soil and weather conditions, as proposed by the Contractor and agreed upon by the Engineer.

(3) Application rate of undiluted concentrate.

Contractor shall submit proof of conformance in the form of test reports to verify that the dust palliative product proposed for use meets the minimum material requirements specified in this section. Testing must be specific to the proposed product and not generic to similar type palliative products. Testing shall be performed by independent AASHTO accredited laboratories, and signed and sealed by Professional Engineers registered in the State of Arizona. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

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(A) Acrylic Copolymer and Polymer Types:

The material shall be a white or clear emulsion that can penetrate, saturate and bond together treated soils to create a hard, dust-free and water resistant surface. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Composition	--	Acrylics, acrylates & acetates
pH	E 70	4.0 – 9.5
Residue (active solids content), %	D 2834	40 min.
Flash Point	D 92	None
Absolute Viscosity (Brookfield), cP, 77°F	--	1500 max.
Specific Gravity, 60/60°F	D 1298	1.00 – 1.15

(B) Lignin-Based Types:

Lignin-based dust palliative shall be an aqueous lignosulfonates (a residual co-product of wood pulping by the sulfite process in the manufacturer of cellulose products) that dispersed readily in water to yield a stable, brown-colored solution. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	<1000
Residue (total solids content), %	D 2834	48 min.
Lignin sulfonate content (% of solids)	D 2834	60 min.
pH	E 70	5.0 - 7.0
Specific Gravity (liquid), 77/60°F	D 1298	1.00 min.

(C) Organic Resinous Types:

The material shall be a tan emulsion designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that utilize non-petroleum based organic esters and resins combined with other additives to penetrate, bond and coat treated soils. The material shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
Absolute Viscosity (Brookfield), cP, 77°	--	50 – 200
pH	E 70	3.0 - 9.0
Residue (active solids content), %	D 2834	45 min.
Flash Point	D 92	None
Specific Gravity, 60/60°F	D 1298	1.00 min.

(D) Petroleum Resinous Types:

The materials shall be a light yellow petroleum resinous emulsion suitable for use as agglomerate for soil particles. The material shall have the following properties in its undiluted emulsified state:

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Specification Designation	ASTM Test Method	Requirements
Kinematic Viscosity, SFS at 77°F	D 244	188 min.
pH	E 70	4.0 – 7.0
Residue, % wt ⁽¹⁾	D 2834	60 min.
Sieve Test, % wt. Retained ⁽²⁾	D 244	0.1 max.
Particle Charge Test	D 244	Positive
Flash Point of base product, CO, °F.	D 92	400 min.
Specific Gravity, 60/60°F	D 1298	1.00 min.

(1) ASTM test modified by heating 50 g of sample to 300 °F until foaming ceases, then cooling immediately and calculation results.

(2) Replace 2% sodium oleate solution with distilled water in test.

The emulsion shall be stable, i.e., should not break when stored in clean closed containers at temperatures between 35°F and 200 °F for a minimum of 3 months. The sequestering agents shall make the preparation stable against hard water, thus permitting dilution of the emulsion with almost all types of water. The emulsion shall be non-corrosive to metal containers. The materials shall penetrate into the soil and not form a skin at the surface or a crusted surface.

(E) Tall Oil Pitch Emulsion:

The material shall be a light brown tree resinous emulsion produced from distilled tall oil and not associated with the use of chlorine-based chemicals to bleach pulp from the production of paper. The product shall be designed specifically for dust control of unpaved roads, traffic surfaces, and road shoulders that can penetrate, saturate and bond together soils to create a hard, dust-free and water repellant surface. The product shall be non-water soluble once cured. The emulsion shall have the following properties in its undiluted state:

Specification Designation	ASTM Test Method	Requirements
pH	E 70	2.5 - 9.0
Residue (active solids content), %	D 2834	35 min.
Flash Point	D 92	None
Specific Gravity, 60/60°F	D 1298	0.998 min.

(F) Other Types:

Other types of dust palliative may be approved for use by the Engineer. Test methods, requirements, dilution ratios and application rates shall be as specified by the manufacturer.

792.3 PERFORMANCE STANDARDS AND TEST METHODS:

Product shall be blended at the specified stabilizer content application rate with soil that is either representative of the site soils to be treated or be a local A-7 in accordance with AASHTO M145 (as determined by the Engineer) and tested in accordance with ASTM D1883. Results of treated soil must show a minimum 25% increase in CBR (California Bearing Ratio) value over the untreated soil for the product to be accepted for either topical dust suppression or soil stabilization.

Testing shall be in accordance with ASTM D1883, as modified herein. Test reporting shall include all the information required by ASTM D1883, Section 10.0 for both treated and untreated CBR samples. In addition, the penetration vs. stress plot for each test shall be included (ASTM D1883, Fig. 2) along with the rate of product application and the percent stabilizer solids. CBR specimens, after molding, shall be left in their mold, on their sides and cured in the laboratory air for 7 days prior to being immersed in water for 96 hours and then tested for CBR. At least three CBR test specimens shall be compacted at the optimum moisture content, both treated and untreated (ASTM D698, method C), with the result reported as the average value. The surcharge weight shall be 10 pounds.

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792.4 ENVIRONMENTAL CRITERIA:

Contractor shall submit proof to the Engineer in the form of test reports and certificates to verify that the dust palliative product is in environmental compliance. The Contractor is responsible for any costs associated with the testing of soil and palliative product prior to the application of as specified herein.

Products shall not contain or emit chlorinated fluorocarbons (CFC's or Freon's) and shall not contain or emit volatile organic compounds (VOC's) that exceed Federal, State or Local air quality limitations.

Products and their degradation products shall not be composed of elements, compounds, mixtures or produce runoffs with the characteristics identified under Arizona Revised Statutes 36-2822 of the Arizona Hazardous Waste Management Act, emit or off-gas during placement, use or degradation of any hazardous air pollutant listed under Section 112 of the Federal Clean Air Act [42 U.S.C. § 7412], be a hazardous chemical substance or mixture pursuant to Section 7 of the Federal Toxic Substances Control Act [15 U.S.C. § 2606], be designated by rule an extremely hazardous chemical substance pursuant to the Arizona Environmental Quality Act, be prohibited for use by the Arizona Department of Environmental Quality, the Environmental Protection Agency, or any applicable law, rule or regulation.

Product runoff and their degradation product runoffs shall not contain concentrations that exceed the parameters designated in Section 2.18 'Table 5' of the National Pollution Discharge Elimination System (NPDES) Multi-Sector General Permit for Industrial Activities (*see Note A*). Adequate proof can be shown by providing one of the following:

- (A) Complete aquatic toxicity test for lethal concentration at 50% (LC50).
- (B) Provide complete and accurate listing of all individual chemical constituents (including proprietary chemical information) and percentage of each in a given volume of pure chemical product.
- (C) Surface water runoff test. This test involves running distilled water over a treated soil area, collecting the test water, and submitting to a certified lab for analysis.

Contractor shall obtain from the dust palliative product manufacturer independent verification and certification of performance and environmental claims by a recognized agency of the United States, Canadian Precertification, Environmental Technology Verification, or EcoLogo Certification programs for chemical dust suppressants.

Products or their components and degradation products shall be tested and certified by the manufacturer not to be substances or composed of substances known to be, or reasonably anticipated to be carcinogenic or toxic by the U.S. Department of Health and Human Services.

Products must have hazardous Materials Identification System (HMIS) ratings equal to or less than the following for each category: H=1; F=1; R=1; PPE=X.

Note A: Parameter benchmark values shall be provided by the Engineer and based on the Contracting Agency's requirements.

End of Section



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SECTION 796

GEOSYNTHETICS

796.1 GENERAL:

This section defines the requirements for geosynthetic fabrics, grids and membranes typically used as pavement fabric beneath asphalt concrete overlays, filtration/drainage separation between soil/aggregate layers, erosion control filter/separators for riprap protection, and soil or base reinforcement to improve the stability of weak soils or reinforce aggregate bases.

796.2 MATERIALS AND REQUIREMENTS:

Identification, packaging, delivery, storage and handling of geosynthetic materials shall be in accordance with manufacturer's recommendations and ASTM D4873. Each roll shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number date of manufacture, and shipping date.

Geosynthetic materials shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no tears or defects which adversely affect or alter its physical properties.

Geosynthetic materials shall be packaged with material that will protect the geosynthetic (including ends of rolls) from damage due to shipment, water, sunlight and contaminants. During storage, geosynthetic materials shall be elevated off the ground and protected from the following: site construction damage, precipitation, extended ultraviolet radiation, strong acid or strong base chemicals, flames (including welding sparks), temperatures in excess of 160°F, and any other environmental condition that may damage geosynthetic material property values. Protection shall be in accordance with manufacturer's specifications and shall be maintained during periods of shipment and storage.

Materials required for complete and proper installation of geosynthetic materials that are not specifically described herein (such as pins, nails, washers, etc.) shall conform to the manufacturer's recommendations and be as selected and supplied by Contractor subject to final approval by the Engineer.

Requirements represent minimum average roll values in the weaker principal direction. Average of test results from any sampled roll in a lot shall meet or exceed the minimum values noted herein. Lot sampling shall be in accordance with ASTM D 4354.

796.2.1 Pavement: Pavement fabric geosynthetics are non-woven polyester or polypropylene fabrics that are field saturated with an asphalt binder and placed as an interlayer beneath a pavement overlay or between pavement layers. When placed, the fabric becomes an integral part of the roadway section, forming a barrier to water infiltration and absorbing stresses to reduce reflective and fatigue cracking of the new pavement surface layer.

Pavement fabric shall be constructed of at least 95 percent (by weight) nonwoven synthetic fibers of polyester or polypropylene, thermally bonded on one side. The fabric material shall additionally conform to the physical properties shown in Table 796-1.

TABLE 796-1			
PAVEMENT GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Weight: oz/yd ²	4.1 min.	4.0 min.	ASTM D3776
Grab tensile strength: lbs.	100 min.	90 min.	ASTM D4632
Elongation at break: %	50 min.	50 min.	ASTM D4632
Melting point: degree F	300 min.	300 min.	ASTM D276
Asphalt retention: gal/yd ²	0.25 min. ⁽¹⁾	0.20 min.	ASTM D6140

(1) May be reduced within street intersections, on steep grades or in other zones where vehicle braking is common, but not less than 0.20 gal/yd², when approved by the Engineer.

796.2.2 Filtration (Drainage) and Separation: Filtration and separation fabrics are nonwoven or woven polypropylene or polyester fabrics with specified strength characteristics used as permeable separators to restrain soil or other particles subjected to hydrodynamic forces while allowing the passage of fluids into or across a geotextile and to prevent inter-migration of adjacent soil layers of vastly different particle sizes and particle distributions.

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Filtration and separation fabrics shall be nonwoven or woven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed or woven into a stable network such that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table 796-2.

TABLE 796-2			
FILTRATION & DRAINAGE GEOSYNTHETIC PROPERTIES			
Property	Class A ⁽¹⁾	Class B ⁽²⁾	Test Method
Grab tensile strength: lbs.	180 min.	80 min.	ASTM D4632
Seam strength: lbs.	160 min.	70 min.	ASTM D4632
Puncture strength: lbs.	80 min.	25 min.	ASTM D4833
Trapezoidal tear: lbs	50 min.	25 min.	ASTM D4533
Apparent opening size: US Standard sieve size	>50	>50	ASTM D4751
Ultraviolet Stability: %	50 min.	50 min.	ASTM D4355

- (1) Class A - Use where installation stresses are more severe than for Class B application (i.e. very coarse sharp angular aggregate or high compaction requirements).
 (2) Class B – Use with smooth graded surface having no sharp angular projections and sharp angular aggregate.

796.2.3 Erosion Control: Erosion control fabrics are used below areas to receive aggregate or riprap slope protection and act as filter/separators to provide sustained permeability while maintaining structural stability.

Erosion control fabrics shall be a woven monofilament fabric or a nonwoven fabric consisting only of long chain polymeric filaments such as polypropylene or polyester formed into a stable network that the filaments retain their relative position to each other. The fabric material shall additionally conform to the physical properties shown in Table 796-3.

TABLE 796-3			
EROSION CONTROL GEOSYNTHETIC PROPERTIES			
Property	Class A	Class B	Test Method
Grab tensile strength: lbs.	270 min.	200 min.	ASTM D4632
Elongation at break: %	45min., 115 max.	15 min., 115 max.	ASTM D4632
Puncture strength: lbs.	110 min	75 min.	ASTM D4833
Burst strength: psi	430 min.	320 min.	ASTM D3786
Trapezoidal tear: lbs	75 min.	50 min.	ASTM D4533
Permittivity: second ⁻¹	0.07 min.	0.07 min.	ARIZ 730 ⁽¹⁾
Apparent opening size: US Standard sieve size	30 – 140	30 - 140	ASTM D4751
Ultraviolet Stability: %	70 min.	70 min.	ASTM D4355

- (1) Arizona Department of Transportation test method.

796.2.4 Soil or Base Reinforcement: Geogrid geosynthetic materials are used for improving the stability of weak soils or reinforcing aggregate bases. Geogrids are defined as biaxial or triaxial polymeric grids formed by a regular network of integrally connected polymer tensile elements with apertures of sufficient size to permit significant mechanical interlock with the surrounding soil, aggregate, or other fill materials to function primarily as reinforcement.

The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport and installation. Geogrids shall be integrally formed and deployed as a single layer; comprised of 100 percent polypropylene or high-density polyethylene. Geogrids shall additionally conform to the physical properties shown in Table 796-4.

SECTION 796

TABLE 796-4			
REINFORCEMENT GEOGRID PROPERTIES			
Property	Type 1	Type 2	Test Method
Aperture size: inches	1 min.	1-3/8 min.	ID callipered
Ultimate Tensile Strength: lb/ft	850 min.	1300 min.	ASTM D4945
Flexural Rigidity: Mg-cm	250,000 min.	750,000 min.	ASTM D1388
Tensile Strength @ 2% Strain: lb/ft MD ⁽¹⁾	270 min.	410 min.	ASTM D6637
Tensile Strength @ 2% Strain: lb/ft CMD ⁽²⁾	380 min.	620 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft MD ⁽¹⁾	550 min.	810 min.	ASTM D6637
Tensile Strength @ 5% Strain: lb/ft CMD ⁽²⁾	720 min.	1340 min.	ASTM D6637
Junction Efficiency: % Ultimate Tensile Strength	75 min.		GRI-GG2 ⁽³⁾
Ultraviolet Stability: % Retained Strength	70 min.		ASTM D4355

(1) MD = Test in the machine direction along roll length

(2) CMD = Test in the cross-machine (transverse) direction across roll width

(3) Geosynthetic Research Institute test method

796.3 TEST AND CERTIFICATION REQUIREMENTS:

Certificates of compliance shall be submitted to the engineer upon delivery of material for use on a specified project. Samples of materials shall be submitted for testing. Each geosynthetic material lot or shipment must be approved by the Engineer before the materials may be incorporated in the work.

Testing methods and results shown in the certificate of compliance shall conform to the listed specifications for the proposed geosynthetic use. Manufacturer's supporting documentation including, but not limited to, product information sheets, installation procedures and recommendations, recommended use, and project references shall be submitted to the Engineer for product evaluation and approval.

End of Section



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