BIA KINLICHEE ROAD IMPROVEMENTS

99% SUBMITTAL

SPECIFICATIONS

Specifications include selected sections from Arizona Department of Transportation Standard Specifications for Road and Bridge Construction, 2021.

TABLE OF CONTENTS

SECTION 201 CLEARING AND GRUBBING:

201-1 Description:

The work under this section shall consist of removing and disposing of all vegetation, rubbish, debris and other objectionable matter from within the highway right-of-way, bridge construction areas, road approaches, areas through which ditches and channels are to be excavated, and such other areas as may be specified in the Special Provisions. Clearing and grubbing shall be performed in advance of grading operations and in accordance with the requirements of these specifications.

All vegetation and objects designated to remain shall be preserved from injury or defacement. Property and landscape shall be protected and restored in accordance with the requirements of Subsection 107.11 of the specifications.

201-2 Blank:

201-3 Construction Requirements:

201-3.01 Clearing and Grubbing:

The entire length of the project, to the widths specified below, shall be cleared and grubbed, unless otherwise shown on the project plans or specified in the Special Provisions.

The area above the natural ground surface shall be cleared of all vegetation, such as trees, logs, upturned stumps, roots, brush, grass, weeds, and all other objectionable material within the following limits:

(A) Highway construction areas, including structures, frontage roads, streets, ramps, road approaches, ditches and channels, and all access roads and connections that are to be constructed. Such areas shall extend to a width of 5 feet outside of structures and excavation and embankment slope lines.

(B) Areas enclosed by interchange loops and ramps.

Within the limits of clearing, the areas below the natural ground surface, except in embankment areas where the finished subgrade elevation is 5 feet or more above the natural ground, shall be grubbed to a depth necessary to remove all stumps, roots, buried logs and other objectionable material.

In embankment areas, where the subgrade is 5 feet or more above the natural ground line, all trees, stumps and roots shall be cut off not more than 1 foot above the natural ground or shall be completely

removed where a structure is to be constructed, piles are to be placed or driven, or where unsuitable material is to be removed.

Cavities resulting from the removal of stumps or other materials, except in areas to be excavated, shall be backfilled with material approved by the Engineer. The material shall be compacted to a density of not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Scarred surfaces, resulting from the work, on trees and shrubs that are to remain, shall be treated with an approved asphaltum base tree paint.

Unless specified otherwise in the Special Provisions, merchantable timber and other vegetation not designated to remain shall become the property of the contractor.

In national forest areas, clearing and grubbing shall also conform to the applicable rules and regulations of the United States Forest Service in accordance with the requirements of Subsection 107.12 of the specifications.

201-3.02 Removal and Disposal of Materials:

All materials removed in clearing and grubbing shall be disposed of at locations outside of the right-of-way which are not visible from the roadway and in accordance with the requirements of Subsection 107.11 of the specifications.

In the disposal of all tree trunks, stumps, brush, limbs, roots, vegetation and other debris, the contractor shall comply with the requirements of A.R.S. Title 49, Chapter 3, and with the Rules and Regulations for Air Pollution Control, Title 18, Chapter 2, Article 6, adopted by the ADEQ pursuant to the authority granted by the Arizona Administrative Code.

Burning will be permitted only after the contractor has obtained a permit from the ADEQ and from any other Federal, State, County or City Agency that may be involved.

Combustible material may be reduced to chips of a maximum thickness of 1/2 inch and disposed of in areas between the slope lines and right-of-way lines as approved by the Engineer. The chips may either be buried or distributed uniformly on the ground surface and mixed with the underlying earth to such extent that the chips will not support combustion.

The roadway and adjacent areas shall be left with a neat and finished appearance. No accumulation of material shall remain on or adjacent to the right-of-way.

201-4 Method of Measurement:

Clearing and grubbing will be measured either on a lump sum basis or by the acre. Measurement by the acre will be to the nearest tenth of an acre, measured on a horizontal plane.

201-5 Basis of Payment:

The accepted quantities of clearing and grubbing, measured as provided above, will be paid for at the contract lump sum price or by the acre as designated in the bidding schedule, including furnishing, placing, and compacting the material required to fill the cavities resulting from the removal of tree stumps or other materials.

No payment will be made for clearing and grubbing outside the specified limits, unless such work is authorized by the Engineer.

SECTION 202 REMOVAL OF STRUCTURES AND OBSTRUCTIONS:

When clearing and grubbing is not included as a contract pay item, full compensation for any clearing and grubbing necessary to perform the construction operations designated on the project plans or specified in the Special Provisions shall be considered as included in the price of contract item.

202-1 Description:

The work under this section shall consist of the removal, wholly or in part, and satisfactory disposal of all structures and obstructions within the right-of-way which have not been designated on the project plans or specified in the Special Provisions to remain, except for those structures and obstructions which are to be removed and disposed of under other items of work in the contract. The work shall also include salvaging of designated materials and backfilling the resulting cavities.

Existing structures, pavement, sidewalks, curbs, gutters, and other existing improvements which are to become an integral part of the planned improvements shall remain even though not specifically noted.

Materials removed and not designated to be salvaged or incorporated into the work shall become the property of the contractor.

202-2 Blank:

202-3 Construction Requirements:

202-3.01 General:

Bridges, culverts, and other structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate the traffic.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to commencing the new work.

Items designated to be salvaged shall be carefully stockpiled or stored by the contractor at locations designated in the Special Provisions or as directed by the Engineer.

Items which are to be salvaged or reused in the new construction and are damaged or destroyed as a result of the contractor's operations shall be repaired or replaced by the contractor at no additional cost to the Department.

Holes, cavities, trenches, and depressions resulting from the removal of structures or obstructions, except in areas to be excavated, shall be backfilled with suitable material which shall be compacted to a density of not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

202-3.02 Removal of Pipe:

All removed pipe which is to be salvaged or relaid shall be cleaned of all earth and other material inside and outside prior to being stockpiled or reused. Pipe to be reused shall be stored when necessary to avoid damage or loss before relaying.

Existing pipe to be partially removed shall be cut with straight and smooth edges on a plane perpendicular to the center line of the pipe.

202-3.03 Removal of Pavement:

(A) Portland Cement Concrete Pavement:

Unless otherwise specified in the Special Provisions, concrete pavement designated on the project plans to be removed shall either be removed from the job site and disposed of at a site secured by the contractor or buried in embankment areas. If the contractor elects to bury the concrete in embankment areas, the concrete shall be broken

into pieces and placed in the embankment in accordance with the requirements of Subsection 203-10.03(A) of the specifications.

Where new construction is to join the existing concrete pavement, the pavement shall be saw cut to a true line perpendicular to the centerline of the pavement with straight vertical edges free from irregularities.

(B) Bituminous Pavement:

Unless milling is specified in the Special Provisions, all bituminous pavement designated on the project plans to be removed, shall be completely removed down to the underlying base course or subgrade. The pavement material shall be removed and disposed of as specified in the Special Provisions.

Where new construction is to join existing bituminous pavement, the existing pavement shall be cut to a true line perpendicular to the centerline of the pavement with straight vertical edges free from irregularities. The removal of asphaltic concrete at the approaches to structures shall be accomplished in a manner approved by the Engineer.

(C) Bituminous Pavement Removal by Milling:

When milling is specified, the existing asphaltic concrete shall be removed in accordance with the details shown on the project plans with equipment specifically designed to remove such material by means of grinding or chipping to a controlled line and grade. The equipment used shall be capable of removing the existing asphaltic concrete within 0.01 feet of the specified removal depth. The removal shall be accomplished in a manner which does not destroy the integrity of any asphaltic concrete pavement that remains and which does not result in a contamination of the milled asphaltic concrete with the underlying base material. The milled material shall be removed and disposed of as specified in the Special Provisions.

Under no circumstance shall the removal of existing asphaltic concrete begin until the mix design for replacement asphaltic concrete has been approved by the Engineer.

The extent of removal of existing asphaltic concrete must be in keeping with the contractor's ability to produce, haul, place, and compact replacement asphaltic concrete so that at all times the length of open "trench" is at a minimum. If the contractor's production of replacement asphaltic concrete is stopped for any reason, the removal of asphaltic concrete shall either cease or shall be reduced. The Engineer will be the sole judge as to whether the removal shall cease or be reduced. The Engineer’s decision will be based on the reason for the stoppage in asphaltic concrete production, the expected length of the stoppage, the type and depth of the material being removed, and the time of day.

Replacement asphaltic concrete shall be placed as soon as possible after the "trench" has been opened up. The surface on which the material is to be placed shall be uniform and free of loose material. Any exposed base material shall be compacted to the extent required by the Engineer.

The "trench" in which asphaltic concrete is being placed shall be filled before the end of each day's work and the lane shall be opened to traffic. The length of open "trench" at any one time shall not exceed two miles or half the length of the work, whichever is the lesser.

In the event of circumstances beyond the control of the contractor, such as equipment breakdown, or if the production of the replacement asphaltic concrete has been stopped by the Engineer and the contractor is unable to comply with the requirements in the preceding paragraph, the contractor shall provide and maintain such traffic control devices that the Engineer deems necessary under the circumstances in order to provide safe and efficient passage through the work zone.

If the Engineer deems it to be warranted, the Engineer will require that the contractor provide for the surface drainage of areas where the pavement surface has temporarily been removed.

Pavement, to be removed by milling, adjacent to manholes, valve boxes, small radius curbs, and other fixed objects that produce confined areas shall be removed with milling equipment specifically designed to operate in restricted areas and capable of removing asphaltic concrete of the specified thickness without damage or displacement of the adjacent object.

On projects with existing curb and gutter, any asphaltic concrete buildup in the gutter designated to be removed, shall be removed prior to the pavement removal operation by equipment and methods approved by the Engineer. The equipment and methods used shall be capable of removing the asphaltic concrete buildup without causing damage to the curb and gutter.

202-3.04 Removal of Miscellaneous Concrete:

Miscellaneous concrete shall be defined as all or portions of mortared rubble masonry, curbs, gutters, sidewalks, driveways, aprons, slope paving, island paving, retaining walls, spillways, drainage structures, concrete box culverts, foundations, footings, and all other Portland cement concrete or masonry construction, except bridges and pavement. All existing miscellaneous concrete shall be removed to a depth of at least 5 feet below finished subgrade elevation unless otherwise specified in the Special Provisions or on the project plans.

Where new concrete is to join existing concrete, the existing concrete shall be saw cut to a true line with straight vertical edges free from irregularities.

Concrete removal operations shall be performed without damage to any portion that is to remain in place. All damage to the existing concrete, which is to remain in place, shall be repaired to a condition equal to that existing prior to the beginning of removal operations. The repairing of existing concrete damaged by the contractor's operations shall be at no additional cost to the Department.

Existing reinforcement that is to be incorporated in new work shall be protected from damage and shall be thoroughly cleaned of all adhering material before being embedded in new concrete.

Concrete shall be disposed of as provided in Subsection 202-3.03(A) of the specifications.

The floors of concrete basements, pits and structures, that are not required to be removed and which are located within the roadway shall be broken in a manner that will prevent the entrapment of water.

202-3.05 Removal of Bridges:

The removal of existing bridges, either wholly or in part, shall be as shown on the project plans or as described in the Special Provisions. Bridge removal operations shall be conducted in such a manner as to cause the least interference to public traffic.

At least 10 days before beginning bridge removal over or adjacent to public traffic or railroad property, the contractor shall submit to the Engineer details of the removal operations showing the methods and sequence of removal and equipment to be used.

When total bridge removal is specified, all materials designated for salvage, such as structural steel, structural steel members, timber, and other reusable materials shall be carefully dismantled, removed and salvaged in accordance with the requirements of Subsection 202-3.01 of the specifications. Steel members shall be match marked as directed by the Engineer.

Piling, piers, abutments, footings, and pedestals shall be removed to at least 1 foot below ground line or 5 feet below finished subgrade elevation unless specified otherwise in the Special Provisions or on the project plans.

When partial bridge removal is specified or alteration of an existing bridge requires removal of portions of the existing structure, such removal shall be performed with sufficient care as to leave the remaining portion of the structure undamaged.

In case of damage to the existing bridge structure, the contractor shall make all necessary repairs at no additional cost to the Department. Reinforcing steel extending from the remaining portion of the structure shall be protected, cleaned, and incorporated in the new portion of the structure in accordance with the details shown on the project plans or as directed by the Engineer.

Flame cutting and saw cutting may be used for removing, widening, or modifying bridges provided the contractor complies with all protection, safety and damage requirements.

Explosives shall not be used in bridge removal operations unless approved by the Engineer.

Before beginning concrete removal operations involving the removal of a portion of a monolithic concrete element, a saw cut approximately 1 inch deep shall be made to a true line along the limits of removal on all faces of the element which will be visible in the completed work.

Concrete shall be disposed of as provided in Subsection 202-3.03(A) of the specifications.

202-3.06 Removal of Signs and Delineators:

Existing warning, regulatory, guide, route marker signs and delineators that are to be removed will be designated by the Engineer. The contractor shall dismantle the sign panels and delineators and remove the sign posts from the ground in such a manner as to prevent damage to the posts. The contractor shall not remove the existing signs prior to the completion of the new sign installation, but shall remove them within five working days after the installation of the new signs or as directed by the Engineer. Signs, delineators, and sign posts shall be removed and salvaged in accordance with the requirements of Subsection 202-3.01 of the specifications.

202-3.07 Removal of Embankment Curb:

The existing embankment curb, down-drain inlets, and spillway inlets, designated on the project plans to be removed, shall be removed in such a manner as to preserve the existing bituminous surfacing.

Asphaltic concrete obtained from sources approved by the Engineer shall be used to fill and repair voids on the existing pavement surface that result from the removals.

202-3.08 Removal of Fence:

All fence to be removed, shall become the property of the contractor unless designated for salvage on the project plans. If fence is designated to be removed and salvaged, all fence, including gates

shall be salvaged in accordance with the requirements of Subsection 202-3.01 of the specifications.

When designated for salvage, fence and gates shall be carefully dismantled and neatly rolled or coiled. Posts shall be cleaned of all concrete and dirt.

In areas where new fence or relocated fence is to be installed, the contractor shall perform the removals in such a manner as to prevent the escape of any livestock.

202-3.09 Removal of Guardrail:

All guardrail to be removed shall become the property of the contractor unless otherwise specified on the project plans. Guardrail removal shall include complete removal of posts, concrete foundations, and foundation tubes, and subsequent backfill of the remaining holes with moist soil in compacted lifts, as approved by the Engineer.

If guardrail is designated to be removed and salvaged, the contractor shall carefully dismantle the guardrail and remove the blocks and posts in such a manner as to prevent any damage to the removed items. The guardrail, including panels, end sections, posts, and all hardware shall be salvaged in accordance with the requirements of Subsection 202-3.01 of the specifications.

202-3.10 Removal of Asbestos Material and Asbestos Concrete Pipe

The work under this subsection consists of removal, handling, and satisfactory disposal of the asbestos materials as shown on the project plans and described in the Special Provisions in accordance with the requirements specified herein.

(A) General:

The contractor and its abatement subcontractor shall comply with 40 CFR 61, Subpart M, except that asbestos material shall be removed and disposed of in accordance with ALL provisions of 40 CFR 61.145, including “Notification Requirements” and “Procedures for Asbestos Emission Control” specified therein, regardless of the quantity of asbestos present on the project.

(B) Asbestos Abatement Subcontractor:

The contractor shall select an asbestos abatement subcontractor that has the ability to remove, manage, and dispose of asbestos materials. All individuals performing asbestos abatement related work on this contract shall possess at least one of the following certifications:

(1) AHERA Contractor/ Supervisor for asbestos abatement; or

(2) AHERA Worker Certification for all asbestos abatement workers/laborers.

The certification shall be current, and must be valid throughout the duration of the project.

The asbestos abatement subcontractor shall have three years of documented experience performing related work in the State of Arizona.

The contractor shall submit documentation of the asbestos abatement subcontractor's certifications for all employees to be working on the project and the qualifications of the firm at the preconstruction conference. The contractor's documentation of qualifications shall provide details indicating the types of relevant experience, and shall provide the number of months of each type of experience to be considered for approval.

The Engineer will approve or reject the abatement subcontractor within 10 calendar days after receipt of documentation of experience and certifications.

The contractor will not be allowed an extension in contract time for any delays to the work because of the failure of the contractor's asbestos abatement subcontractor to meet the Department's qualifications.

(C) Removal Plan:

The asbestos abatement subcontractor shall be responsible for preparation of a comprehensive removal and disposal plan (hereinafter referred to as the removal plan) for removal, handling, and disposal of the asbestos materials. The removal plan shall comply with 40 CFR 61, Subpart M, as specified above. The removal plan shall include environmental measures and worker safety and health regulations required in OSHA and other applicable federal, state, and local requirements for the removal and disposal of asbestos material.

The contractor shall submit the removal plan to the Engineer for review a minimum of 10 working days prior to any work that will disturb the asbestos material.

The Engineer will determine if the removal plan addresses all the required elements, and will return it as approved or disapproved within 10 calendar days after receipt. The asbestos materials shall not be disturbed until the removal plan has been approved in writing by the Engineer.

(D) Compliance Responsibility:

All work involved with the removal, handling, and disposal of the asbestos materials shall be performed by the contractor's selected asbestos abatement subcontractor.

However, the contractor shall be fully responsible for the work, and for the proper disposal of the removed asbestos materials as specified herein, all in accordance with the applicable federal, state, and local standards, regulations, and requirements. The contractor shall bear the responsibility for any non-compliance, and shall hold the Department, its agents, officials, and employees harmless from all liability which may result from non-compliance with such applicable federal, state, and local standards, regulations, and requirements.

(E) Construction Requirements:

The asbestos abatement subcontractor shall supply potable water for their employees to wash their hands after handling the asbestos materials, prior to eating, drinking, or tobacco use of any kind.

The asbestos abatement subcontractor shall remove the asbestos materials in accordance with the approved removal plan. The asbestos materials shall not be abraded in any way including grinding, sanding, or heating.

The contractor shall also provide a letter and manifest certifying that the asbestos abatement subcontractor has disposed of the asbestos material in accordance with the final removal plan. Such letter and manifest shall be submitted to the Engineer within 10 working days of final disposal.

A time extension will not be granted due to the contractor's failure to comply with the requirements specified herein.

202-3.11 Removal of Lead-Based Striping and Paint Material

The work under this subsection shall consist of removing and appropriately disposing of lead-based paint materials in accordance with the requirements described herein.

The work under this subsection covers only the removal of the lead-based paint materials that is required to safely perform the work specified in the contract documents.

(A) Lead Abatement Subcontractor:

The contractor shall select a lead abatement subcontractor that has the ability to remove, manage and dispose of lead-based materials. All

individuals performing lead abatement related work on this contract shall possess at least one of the following certifications:

(1) EPA Lead Supervisor for lead abatement; or

(2) EPA Lead Worker Certification for all lead abatement workers/laborers.

The certification shall be current, and must be valid throughout the duration of the project. At least one individual with EPA Lead Supervisor certification shall be on-site when lead abatement work is being performed.

The lead abatement subcontractor shall have three years of documented experience performing related work in the State of Arizona.

The contractor shall submit documentation of the lead abatement subcontractor's certifications for all employees to be working on the project and the qualifications of the firm at the preconstruction conference. The contractor's documentation of qualifications shall provide details indicating the types of relevant experience, and shall provide the number of months of each type of experience to be considered for approval.

The Engineer will approve or reject the abatement subcontractor within 10 calendar days after receipt of documentation of experience and certifications.

The contractor will not be allowed an extension in contract time for any delays to the work because of the failure of the contractor's lead abatement subcontractor to meet the Department's qualifications.

(B) Removal Plan:

The lead abatement subcontractor shall be responsible for preparation of a comprehensive removal and disposal plan (hereinafter referred to as the removal plan) for removal, handling, storage, testing, and disposal of the lead-based paint materials. The removal plan shall also specify the proposed storage container, and the proposed location at which the removed lead-based paint materials are to be stored during testing. The removal plan shall include environmental and safety measures to comply with federal, state, and local requirements for the removal and disposal of regulated material.

The contractor shall submit the removal plan to the Engineer for review a minimum of 10 working days prior to any work that will disturb the lead-based paint materials. The Engineer will determine if the removal plan addresses all the required elements, and will return it as approved or disapproved within 10 calendar days after receipt.

(C) Compliance Responsibility:

All work involved with the removal, handling, temporary storage, testing, and disposal of the lead-based paint materials shall be performed by the contractor's lead abatement subcontractor.

However, the contractor shall be fully responsible for the work, and for the proper disposal of the removed lead-based paint materials as specified herein, all in accordance with the applicable federal, state, and local standards, regulations, and requirements, including 29 CFR, Lead Exposure in Construction, Interim Final Rule. The contractor shall bear the responsibility for any non-compliance, and shall hold the Department, its agents, officials, and employees harmless from all liability which may result from non-compliance with such applicable Federal, State, and Local standards, regulations and requirements.

(D) Construction Requirements:

The contractor shall supply potable water for their employees to wash their hands after handling the lead-based paint materials, prior to eating, drinking, or tobacco use of any kind.

The lead-abatement subcontractor shall remove the lead-based striping in accordance with the approved removal plan. The lead-based paint materials shall not be abraded in any way. The contractor will be allowed to use an approved grinding device for the removal of lead-based roadway striping

The lead-abatement subcontractor shall remove the lead-based paint materials in accordance with the approved removal plan. The lead-based paint materials shall not be abraded in any way.

The removed lead-based paint materials shall be placed in the approved storage container (barrel, roll-off, etc.) The lead abatement subcontractor shall perform the Toxicity Characteristic Leaching Procedure (TCLP) analysis on the removed lead-based paint materials. The storage container may be temporarily stored at an ADOT Maintenance facility until the final disposal determination is made. Should the lead abatement subcontractor choose to store the container at an ADOT Maintenance facility, the removal plan shall specify which facility, and the contractor shall contact the facility supervisor to schedule delivery of the container with the removed lead-based paint materials.

After completion of the TCLP analyses, the lead abatement subcontractor shall supplement the removal plan with specific requirements for disposal of the lead-based paint materials. The contractor shall submit the revised removal plan to the Engineer for approval within 10 working days of completion of all TCLP analyses, and before disposal of the lead-based paint materials.

If the TCLP analyses indicate that the lead-based paint materials must be disposed of at a hazardous waste facility, the cost of disposal will be paid under the force account item included in the bid schedule for disposal.

If the TCLP analyses indicate that the lead-based paint materials may be disposed of as a non-hazardous construction waste, the disposal shall be included in the cost of this item.

The contractor shall also provide a letter and manifest certifying that the lead abatement subcontractor has disposed of the lead-based paint materials in accordance with the final removal plan. Such letter and manifest shall be submitted to the Engineer within 10 working days of final disposal.

The contractor shall not store the lead-based paint materials beyond the duration of the contract time. Notice of substantial completion, as specified in Subsection 105.19 of the specifications, will not be given until the lead-based paint materials are removed from the temporary storage site and properly disposed of in accordance with the removal plan, and the Engineer has received the above-referenced certification letter and manifest.

A time extension will not be granted due to the contractor's failure to comply with the requirements specified herein.

202-4 Method of Measurement:

Removal of structures and obstructions will be measured on a lump sum basis except that when the bidding schedule contains specific items under this section on a unit basis, measurement will be made by the units designated in the bidding schedule.

Removal of asbestos materials will be measured on a lump sum basis.

Removal of asbestos concrete pipe will be measured by the linear foot of pipe removed.

Removal of lead-based striping will be measured by the linear foot of stripe removed. Skips in dashed lines will not be included in the measurement.

Measurement will be made along the center line of the stripe and will be based on a 4-inch wide stripe. Measurement for stripes with an actual width greater or less than the basic 4 inches will be made by the following method:

$$\frac{\text{Actual Width of Striping (inches)} \times \text{Linear Feet}}{\text{Four (inches)}}$$

Removal of lead-based paint material will be measured on a lump sum basis.

Disposal of lead-based paint and stripe materials at a hazardous waste facility will be measured on a force account basis.

202-5 Basis of Payment:

Payment for the accepted quantities of removal of structures and obstructions will be made by lump sum or by specific removal items or by a combination of both. Payment for removal of structures and obstructions not listed in the bidding schedule, but necessary to perform the construction operations designated on the project plans or specified in the Special Provisions shall be considered as included in the prices of contract items.

No measurement or payment will be made for saw cutting, the cost being considered as included in the price of contract items.

The prices shall include all excavation and subsequent backfill incidental to the removals, the furnishing, and placing of asphaltic concrete to fill and repair voids resulting from the work under Subsection 202-3.07 of the specifications, compaction of base material resulting from the work under Subsection 202-3.03(C) of the specifications, and the salvaging, hauling, storing, and disposing of all materials as provided herein.

Payment for removal of asbestos material will be made at the contract lump sum price, which price shall be full compensation for the item, including development of the removal plan, removal, handling, and disposal of the asbestos material.

Payment for removal of asbestos concrete pipe, measured as provided above, will be paid for at the contract price per linear foot for the total length of pipe removed rounded to the nearest foot, which price will be full compensation for the work, including development of the removal plan, removal, handling, and disposal of the asbestos material.

Payment for removal of lead-based striping, measured as provided above, will be paid for at the contract price per linear foot for the total length of stripe removed rounded to the nearest foot, which price will be full compensation for the work, including development of the removal plan, removal, handling, temporary storage, testing, and, if allowed, disposal of the lead-based striping material as a non-hazardous construction waste.

Payment for removal of lead-based material will be made at the contract lump sum price, which price shall be full compensation for the work, including development of the removal plan, removal, handling,

temporary storage, testing, and, if allowed, disposal of the lead-based paint material as a non-hazardous construction waste.

If the TCLP analyses indicate that the lead-based paint materials must be disposed of at a hazardous waste facility, the cost of disposal will be paid under a force account item.

For the force account work, the abatement subcontractor shall complete and submit the Subcontractor Force Account Weekly Data Sheet, available on the Department's Construction Group website. For work performed by the abatement subcontractor, the data sheet shall include the abatement subcontractor's itemized costs for labor, materials and equipment. The payment for the abatement subcontractor's labor, materials and equipment will be calculated in accordance with Subsection 109.04 of the specifications, as shown on the data sheet.

Additional costs of disposal of the lead-based paint materials will be paid based on an invoice, hereinafter called the Hazardous Waste Facility Invoice. A sum equal to 5 percent of the Hazardous Waste Facility Invoice amount will be added to the Hazardous Waste Facility Invoice amount to calculate Direct Charges.

Direct Charges = Hazardous Waste Facility Invoice x 1.05

The contractor will be allowed a supplemental markup of 5 percent of the subcontractor's costs. A Sub-total will be calculated as follows:

Sub-total = Lead Abatement Subcontractor Costs x 1.05

The Lead Abatement Subcontractor Costs are its labor, materials, equipment and direct charges.

An amount equal to 65 percent of the Sub-total, as determined above, and multiplied by the applicable sales tax rate, will be added to the Sub-total.

Finally, an amount will be added as an allowance for the Performance and Payment Bond, calculated as follows:

Bond allowance = 0.005 x [Sub-total + (0.65 x Sub-total x sales tax rate)].

The total contractor payment (TCP) will be as follows:

TCP = (Sub-total) + (0.65 x Sub-total x sales tax rate) + (Bond allowance).

SECTION 203 EARTHWORK:

203-1 Description:

The work under this section shall consist of performing all operations necessary to excavate all materials, regardless of character and subsurface conditions, from the roadway or adjacent thereto; to excavate drainage and irrigation ditches and channels; to excavate for structures, culverts, and other facilities; to furnish and place borrow material for use as specified; to construct embankments; to place backfills for structures, culverts and other facilities; to backfill holes, pits and other depressions within the roadway area; to remove and replace unsuitable material; to excavate and grade road approaches, driveways and connections; to construct dikes and berms; and to apply water for compaction, all as designated on the project plans, specified in the Special Provisions, or directed by the Engineer.

203-2 General:

Operations shall be conducted such that existing highway facilities, utilities, railroad tracks, and other nonhighway facilities which are to remain in place will not be damaged. The contractor, at its expense, shall furnish and install sheet piling, cribbing, bulkheads, shoring, or provide whatever means necessary to adequately support the facilities which are to remain, and maintain such supports until they are no longer needed. Temporary pavements, facilities, utilities, and installations shall also be protected until they are no longer required. When temporary supports and other protective means are no longer required, they shall be removed and disposed of by the contractor.

When hauling is done over highways or city streets, the loads shall comply with legal load requirements, all material shall be removed from shelf areas of vehicles in order to eliminate spilling of material, and loads shall be watered or covered to eliminate dust.

The bidding schedule quantities for roadway excavation, drainage excavation, and borrow, if applicable, will be considered to be the final quantities for payment unless adjusted in accordance with the requirements of Subsections 104.02 or 203-2.01 of the specifications.

All suitable material removed from excavated areas within the project limits shall be used in the construction of embankments and other designated areas.

203-2.01 Earthwork Adjustments:

Adjustments in the bidding schedule quantities for roadway excavation, drainage excavation, or borrow may be initiated by the contractor or the Engineer if evidence indicates that the required quantity varies by an amount greater than 5 percent of the bidding schedule quantity. The contractor shall advise the Engineer in writing, submitting

evidence in the form of a construction survey or photogrammetric survey with measurement for the proposed adjustment substantiated in accordance with Subsections 203-3.04, 203-4.04 and, 203-9.04 of the specifications and requesting an adjustment in quantities. The Engineer will determine the amount of adjustment, if any. The quantity upon which payment will be based will be the bidding schedule quantity plus or minus only that portion of the adjustment that exceeds 5 percent of the bidding schedule quantity.

Should the item of earthwork to be adjusted also be a major item, as specified in Subsections 101.02 and 104.02 of the specifications, the determination as to whether the unit price may be adjusted will be based on the difference between the final quantity and the bid schedule quantity plus or minus the 5 percent tolerance.

Neither variations in shrink or swell of material from those shown on plans, nor variations of shrink or swell from contractor obtained sources will be reason for establishing a quantity adjustment.

Adjustments in earthwork quantities due to revisions ordered by the Engineer will be isolated by measurement or calculations in accordance with the requirements of Subsections 203-3.04, 203-4.04, and 203-9.04 of the specifications. The bidding schedule quantities will be adjusted by the amount of the ordered change and will not be included in any other adjustment of the bidding schedule quantities as specified in this subsection.

203-3 Roadway Excavation:

203-3.01 Description:

Roadway excavation shall consist of excavating, grading, and hauling all types of materials encountered in constructing the roadway, lookouts, parking areas, turnouts, driveway entrances, ditches within the roadway, and other road-related areas as designated on the plans or specified in the Special Provisions; and the placement and compaction of excavated material in embankments as provided under Subsection 203-10 of the specifications.

Roadway excavation will not include drainage excavation or structural excavation when these items are designated as separate items of work in the bidding schedule.

203-3.02 Blank:

203-3.03 Construction Requirements:

(A) General:

All roadway excavation shall be finished to a reasonably smooth, uniform surface; shall not vary by more than 0.04 feet above or below

the grade established; and shall be in reasonably close conformance to the lines, dimensions and cross-sections shown on the project or established by the Engineer. When Portland Cement Concrete Pavement or Asphaltic Concrete Pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 feet above or 0.04 feet below the established grade. When roadway excavation is made in rock, the full cross-section width of the roadway between the ditches shall be over-excavated a minimum depth of 6 inches below the subgrade elevation. The over-excavated area shall be filled with embankment material satisfactory to the Engineer and compacted and finished in accordance with the requirements of the specifications. In situations where only part of the roadway section intersects areas of rock, that portion occurring in the rock zone shall be over-excavated and backfilled as specified above.

No measurement or direct payment will be made for the work in over-excavating the rock areas, or placing the embankment material, the cost being considered as included in the cost of contract items.

All suitable excavated material shall be used in the construction of embankments or in other designated areas.

No excavated material shall be wasted without the approval of the Engineer. Wasted material shall be disposed of by the contractor in a manner approved by the Engineer and in accordance with Subsection 107.11 of the specifications.

During construction, the roadway shall be maintained in a well-drained condition at all times.

The top 6 inches of the subgrade shall be compacted to a density of not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer, except that, when asphaltic concrete or Portland cement concrete is to be placed directly on subgrade, the required density shall be 100 percent of the maximum density.

(B) Slopes:

Earth slopes shall be finished to reasonably smooth surfaces and shall be free of all debris and loose material. When earth slopes are to be seeded, the surface shall be finished to a loose, evenly roughened condition, in accordance with the requirements of Subsection 805-3.02(B) of the specifications.

All shattered or loosened material shall be removed from rock cut slopes.

Adjustments in slopes shall be made, as directed by the Engineer, to avoid damage to standing trees, marring weathered rock or to

harmonize with existing landscape features. The transition of such adjusted slopes shall be gradual. At the intersections of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

Except in rock, the intersection of roadway cut slopes with the ground surfaces shall be rounded as shown on the plans or as directed by the Engineer. Rock that is disintegrated to such an extent that it will work and handle as earth shall be considered as earth, and the slopes shall be rounded the same as earth slopes. When earth overlays a rock cut, the top of slope shall be rounded in the same manner as earth slopes.

Where directed by the Engineer, the top 6 inches of topsoil, including duff, within the limits of the rounding, shall be removed and windrowed outside of the rounding limits. After completion of the rounding of the slope, the windrowed materials shall be uniformly spread over the rounded area.

(C) Blasting:

(1) General:

Overshooting or any method of blasting that might cause damage to the roadway section or highway structures, or that might be dangerous or destructive to adjacent property or landscape, will not be permitted. The contractor shall provide and install suitable protection for all trees, shrubbery, pole lines, and other existing facilities within the adjacent area.

(2) Controlled Blasting:

When controlled blasting is specified in the Special Provisions, all blasting in connection with roadway excavation shall be performed in accordance with the requirements of these specifications. Should the Engineer determine that controlled blasting procedures are to be followed, and such procedures are not specified in the Special Provisions, payment for any additional work will be made in accordance with Subsection 104.02 of the specifications.

Prior to any blasting operations that require controlled blasting, the contractor shall furnish the Engineer a written statement setting forth the details and materials to be used in the pre-splitting operations. The written statement shall include spacing of the drill holes, depth of the holes, amount of explosives to be used in each hole, method of loading, stemming depth, and the time delay between detonations. If the initial results obtained using the proposed method are satisfactory in relation to the character of the material to be pre-split, the procedures shall be continued. If, in the opinion of the Engineer, the results of the blasting are considered unsatisfactory for any reason, the contractor shall submit corrective modifications of the plan to the Engineer for review.

Drill holes for pre-splitting shall be spaced at centers not exceeding 3 feet and shall be drilled as near to the design slope lines and as parallel to one another as possible. Pre-drilling and pre-splitting to depths greater than one lift (approximately 20 feet) will be permitted only if satisfactory hole alignment is maintained.

Explosive charges placed in slope-drilled holes shall be uniformly spaced along the length of hole and shall be as light as possible to effect clean splitting of the rock along the plane of the slope and to minimize the fracturing of the remaining rock face or cut.

Loading of slope-drilled holes shall be by string charges connected so that all charges in a hole and all holes in the designated section are exploded simultaneously. Explosives for pre-splitting shall be detonated at least several milliseconds in advance of primary blasting. Primary blasting shall be accomplished by means of millisecond delay excavation blasting methods.

(D) Unsuitable Material:

Material below the natural ground surface in embankment areas and below the finished subgrade elevation in excavation areas that is unsuitable shall be excavated and disposed of as directed by the Engineer.

When unsuitable material is removed and disposed of, the resulting space shall be filled with material suitable for the planned use. Such suitable material shall be placed and compacted in accordance with the requirements of Subsection 203-10 of the specifications.

(E) Surplus Material:

Unless otherwise indicated on the project plans or specified in the Special Provisions, surplus excavated material shall be removed from the job site and disposed of by the contractor in a manner approved by the Engineer and in accordance with the requirements of Subsection 107.11 of the specifications.

Surplus material shall not be removed from the job site until the work specified in Subsection 203-1 of the specifications has been completed or when approved by the Engineer. Any surplus material removed prior to the completion of the specified work, which must subsequently be replaced, shall be at no additional cost to the Department.

203-3.04 Method of Measurement:

Measurement of roadway excavation for payment will not be required unless adjustments are made in accordance with Subsection 203-2.01 of the specifications. When adjustments are required, roadway excavation will be measured by the cubic yard in the original space

occupied and the volume of material removed will be computed in cubic yards by the average end area method.

Excavation originating outside of the neat lines of cut slopes as a result of necessary blasting operations will not be measured for additional payment.

203-3.05 Basis of Payment:

The quantities of roadway excavation as shown in the bidding schedule and any adjustments as specified in Subsection 203-2.01 of the specifications, will be paid for at the contract unit price per cubic yard. The price shall include full compensation for the work complete, in place, including slope rounding, blasting, hauling, stockpiling, placing, and compacting embankments, disposal of surplus material, and preparation of the subgrade in accordance with the requirements of these specifications.

Payment for removal of slides which are not deemed to be the result of carelessness on the part of the contractor will be made in accordance with the requirements of Subsection 104.02 of the specifications.

When unsuitable material is removed, as specified in Subsection 203-3.03(D) of the specifications, payment for this work will be in accordance with the requirements of Subsection 104.02 of the specifications. No adjustment to the contract unit price will be made because of increased excavation quantities resulting from the removal of unsuitable material.

203-4 Drainage Excavation:

203-4.01 Description:

Drainage excavation shall consist of the excavation of ditches, channels or waterways, except that excavation which is required to construct ditches paralleling the roadway and constituting a part of the roadway prism shall be considered as roadway excavation.

203-4.02 Blank:

203-4.03 Construction Requirements:

Ditches, channels, and waterways shall be constructed in reasonably close conformity to the lines and grades shown on the plans or as directed by the Engineer.

When directed by the Engineer to provide outfall, ditches, channels, and waterways shall be continued outside the limits of the right-of-way. Prior to performing work outside the right-of-way, the Engineer will

obtain proper authorization from the property owner. All waterways shall be constructed to drain effectively.

Suitable materials from ditch, channel or waterway excavation shall be used in the construction of embankment or for other purposes as shown on the project plans or specified in the Special Provisions. Unsuitable and surplus excavation material shall be disposed of as directed by the Engineer.

203-4.04 Method of Measurement:

Measurement of drainage excavation for payment will not be required unless adjustments are made in accordance with Subsection 203-2.01 of the specifications. When adjustments are required, drainage excavation will be measured by the cubic yard in the original space occupied and the volume of material removed will be computed in cubic yards by the average end area method.

203-4.05 Basis of Payment:

The quantities of drainage excavation shown in the bidding schedule and any adjustments as specified in Subsection 203-2.01 of the specifications, will be paid for at the contract unit price per cubic yard.

The unit price per cubic yard shall include hauling, placing and compacting the excavated material to form embankments or other features shown on the plans or directed by the Engineer and disposal of all surplus excavated material.

Payment for grader ditches and crown ditches will be made as specified under Subsections 203-6 and 203-7 of the specifications, respectively.

203-5 Structural Excavation and Structure Backfill:

203-5.01 Description:

Structural excavation shall consist of the excavation and removal of all materials necessary for the construction of bridges, concrete box culverts, inlet and outlet wings, retaining walls, or other specific items designated on the project plans or in the Special Provisions as structural excavation; the control and removal of water, the construction or installation of all facilities necessary to accomplish the work, and the subsequent removal of such facilities, except when designated on the project plans or specified in the Special Provisions to remain in place.

Structure backfill shall consist of furnishing, placing, and compacting backfill material around structures to the lines designated on the plans, specified in the Special Provisions, directed by the Engineer and as specified herein.

The work under this section includes the furnishing and installing of a geocomposite drainage system as an abutment or retaining wall drainage when specified in the plans. All geocomposite drainage materials and installation shall be as approved by the Engineer.

203-5.02 Materials:

(A) Geocomposite Drain:

The geocomposite wall drain materials shall conform to the requirements of Subsections 1014-1 and 1014-6 of the specifications.

(B) Geocomposite Packaging, Handling, and Storage:

The identification, packaging, handling, and storage of the geocomposite wall drain material shall be in accordance with ASTM D4873. Geocomposite wall drain shall be furnished in rolls, or in another acceptable manner, wrapped with a suitable protective covering to protect the fabric from mud, dirt, dust, debris or harmful ultraviolet light. The wall drain material shall be free of defects or flaws which significantly affect its physical properties at the time of delivery and installation. Each roll or package shall be labeled or tagged to provide product identification sufficient to determine the product type, manufacturer, quantity, lot number, roll number, date of manufacture, shipping date, and the project number and name to which it is assigned. Geocomposite wall drain materials shall be stored on the site or at another location approved by the Engineer in a manner which protects them from the elements. If stored outdoors, the materials shall be elevated and protected with a light colored, opaque, and waterproof cover. At no time shall the geocomposite wall drain materials be exposed to direct sunlight for a period exceeding 14 days.

203-5.03 Construction Requirements:

(A) Excavation:

The contractor shall notify the Engineer sufficiently in advance of the beginning of excavation to allow measurements to be taken of the undisturbed ground. The required excavation shall then be performed in reasonably close conformity to the lines, grades, and cross sections established by the Engineer or shown on the plans.

In lieu of providing approved shoring methods, the sides of excavations may be sloped as required by soil conditions to stabilize the sides for safe working conditions. Side slopes shall conform to the requirements specified in current OSHA regulations and be approved by the Engineer.

When structure footings, concrete box culverts, or other structures are to rest on an excavated surface other than rock and no piles are used, care shall be taken to protect the surface from water and not disturb

the bottom of the excavation. If suitable material in the bottom of the excavation is disturbed or is removed for the contractor's convenience, the foundation shall be restored by the contractor, at its expense, to a condition at least equal to the undisturbed foundation as determined by the Engineer.

When material at the planned grade of the excavation is determined by the Engineer to be unsuitable, such material shall be removed to the limits directed by the Engineer and the resulting excavation backfilled with structure backfill material.

When structures are to rest on rock, the surface shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled or cut to steps, and the surface roughened. Any seams in the rock shall be grouted under pressure or treated as directed by the Engineer.

Where rock or other unyielding material is encountered at the planned grade of a structure and a yielding material is encountered in an adjacent area for the same structure, the unyielding material shall be removed to a minimum depth of 2 feet below grade and replaced with structure backfill conforming to the requirements of Subsection 203-5.03(B) of the specifications.

When structures are to be supported on piles, excavations shall be completed to the bottom of the footings before any piles are drilled or driven therein. When swell or subsidence results from driving piles, the contractor shall, at its expense, excavate or backfill with suitable material the footing area to the grade of the bottom of the footings as shown on the project plans.

When during the course of structural excavation, material is removed outside the designated pay limits, the contractor shall backfill said excavated areas in accordance with the requirements for structure backfill as specified herein, and no compensation will be made for the additional material or work required.

Excavated material which is suitable for and not used as structure backfill shall be used either for the construction of embankment or in filling other areas as designated on the plans. Material which, in the opinion of the Engineer, is not suitable for use or which is deemed surplus shall be disposed of in accordance with Subsection 203-3 of the specifications.

Prior to placing concrete or masonry the area excavated shall be inspected and approved by the Engineer.

(B) Backfill:

(1) Structure Backfill:

Structure backfill material shall be selected from excavation or from a source selected by the contractor. It shall not contain frozen lumps, chunks of clay, or other objectionable material. Backfill material shall not contain salvaged asphaltic concrete materials. Backfill material shall have a value of resistivity not less than 2,000 ohm-centimeters. Backfill material to be used for metal piles or similar items of metal shall have a value of resistivity not less than 2,000 ohm-centimeters or the value shown on the plans. Backfill material shall have a pH value between 6.0 and 10.0, inclusive, when placed against metal installations, except aluminum. Backfill material shall have a pH value between 6.0 and 9.0, inclusive, when placed against aluminum installations. Backfill material shall have a pH value between 6.0 and 12.0, inclusive, when placed against installations other than metal. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

Structure backfill material shall conform to the following gradation (Arizona Test Method 201):

Sieve Size	Percent Passing
3 inch	100
3/4 inch	60 - 100
No. 8	35 - 80
No. 200	0 - 12

The plasticity index shall not exceed 5 when tested in accordance with the requirements of AASHTO T 90.

Structure backfill may be comprised in part of salvaged Portland cement concrete material. Structure backfill shall not contain salvaged asphaltic concrete materials.

The source of all salvaged materials shall be approved by the Engineer prior to use. Salvaged Portland cement concrete material shall not contain hazardous materials. All metal reinforcement materials shall be removed from salvaged Portland cement concrete prior to its use in structure backfill.

Salvaged Portland cement concrete material to be used in structure backfill shall be derived from crushing.

The contractor shall submit the percentage of salvaged Portland cement concrete materials intended for use to the Engineer for approval. The percentage shall not be adjusted after approval except to maintain a consistent gradation. Any significant change in the proportions must be approved by the Engineer prior to use.

A maximum of 50 percent salvaged concrete, by weight or volume, will be allowed. Changes in proportions that result in more than 50 percent salvaged concrete will not be allowed.

Structure backfill material containing salvaged Portland cement concrete materials shall be thoroughly mixed by means of a mechanical mixing device prior to placement. The mechanical mixing device shall be a pugmill-type mixer consisting of at least two motorized shafts with mixing paddles. The mixing device shall be designed such that the mixture of soil and aggregate materials and salvaged concrete is moved in a near horizontal direction by the mixing paddles, without the aid of conveyor belts, for a distance of at least 3 feet. The rate of feed of the combined soil and aggregate materials and salvaged concrete shall not exceed the mixing device's rated capacity in tons per hour.

Structure backfill composed of soil and aggregate materials and salvaged concrete shall conform to the gradation requirements specified for structure backfill. When soil and aggregate materials are blended with salvaged concrete, the soil and aggregate portion shall conform to the pH, resistivity, and plasticity index requirements specified for structure backfill.

(2) Use of Slurry:

As an alternate to the material requirements of Structural Backfill, the Engineer may allow material conforming to the following requirements to be used in a slurry mixture in situations where the slurry will be confined by free-draining soils (Arizona Test Method 201):

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	90 - 100
No. 8	35 - 80
No. 200	0 - 8.0

The plasticity index shall not exceed 8 when tested in accordance with the requirements of AASHTO T 90.

Salvaged materials shall not be used as a slurry unless approved by the Engineer.

(3) Placement of Backfill:

All earth material which has loosened or collapsed into the excavation from the adjacent ground and all trash, forms, and loose large rock shall be removed from the excavation before backfill is placed.

Backfill material shall not be placed against the back of concrete abutments, concrete retaining walls, or cast-in-place concrete structures until the concrete has developed its full design strength.

Backfill material shall not be placed against concrete structures not designed to retain earth loads until the concrete has attained a minimum compressive strength of 2,000 pounds per square inch and in no case before 72 hours after casting. Backfill shall be placed uniformly on each side of the structure, and at all times during placement shall be not more than 2 feet above any other side.

Unless otherwise shown on the plans or designated in the Special Provisions, minor structures such as catch basins or cattle guards which are furnished as precast structures shall be placed on a layer of structure backfill at least 6 inches in depth. The layer shall have been shaped to fit the bottom surface of the precast unit and compacted to a density of not less than 100 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. At the time the unit is placed, the moisture content of the layer shall be at or near the optimum moisture as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. After the unit has been initially set in place and checked for line and grade, it shall be removed and any defects in its bearing area shall be corrected by trimming and by placing and compacting similarly moistened structure backfill. The process of removal, correction, and replacement shall continue until the imprint of the unit on the bearing area indicates essentially uniform contact, and the unit is in reasonable conformity with the lines and grades shown on the project plans.

Where a structure is located within a paved area, all backfill material above finished subgrade elevation shall conform to the requirements of the typical pavement section of the same elevations.

Backfill compacted by pneumatic or mechanical tamping devices, shall be placed in layers not more than 8 inches in depth before compaction.

Backfill material placed as a slurry shall be placed in uniform layers not exceeding 4 feet in depth. The maximum water content of the slurry mixture shall be 40 gallons of water per ton of backfill material. Aggregate slurry shall be thoroughly mixed in a mixer approved by the Engineer. Unless otherwise approved by the Engineer, the slurry shall be compacted with internal vibrators in accordance with the requirements of Subsection 601-3.03(D) of the specifications.

(4) Compaction of Backfill:

Each layer of structure backfill material shall be compacted to at least 100 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Backfill material may be compacted by either mechanical or pneumatic tamping devices or backfill material may be placed as a slurry.

Compaction equipment or methods which may cause excessive displacement shall not be used.

If backfill is placed as a slurry, and when directed by the Engineer, the contractor shall excavate holes in the compacted slurry to the depths and at the locations designated by the Engineer. Upon completion of the tests, the contractor shall refill the excavated areas and compact the material to the required density in a manner approved by the Engineer.

(C) Geocomposite Wall Drain:

Geocomposite wall drains shall be installed on the soil side of abutment walls, retaining walls, and culvert wing walls. If shown on the plans, geocomposite wall drains shall also be installed on the soil side of culvert sidewalls. The concrete surface of the structure against which the geocomposite drain is to be placed shall be free of soil, debris, and excessive irregularities that will prevent continuous contact between the concrete surface and the drain material. The geocomposite drain shall be installed with the single fabric surface in contact with the backfill material. When the core of the geocomposite wall drain is not perforated during manufacture, perforations shall be made in the core where the wall drain will lay against a weephole or other drainage outlet. When making these perforations, the fabric shall not be damaged in any way.

Unless otherwise specified, geocomposite wall drains shall be constructed in horizontal courses and in accordance with the details shown on the plans. To prevent infiltration of the backfill material, the geocomposite material shall be firmly secured to the face, top, and sides of the wall by using adhesive or 1.5 to 2 inch long concrete nails with approved washers or wood battens of not less than 4 square inches in area. The adhesive or alignment of the core shall not affect the drainage area or downward flow within the core. The spacing of concrete nails shall be as directed by the Engineer, but shall not be more than 4 feet apart, both horizontally and vertically. When nails are utilized, there shall be at least one horizontal row of nails in each course of geocomposite.

Horizontal seams shall be formed by utilizing the 4-inch flap of geotextile fabric extending from the upper geocomposite course and lapping over the top of the fabric on the next lower course. The fabric flap shall be securely fastened to the lower fabric by means of a continuous strip of 3-inch wide, waterproof plastic tape.

Where vertical splices are necessary at the end of a geocomposite roll or panel, an 8-inch wide continuous strip of geotextile fabric may be placed, centering over the seam and continuously fastened on both sides with the 3-inch wide, waterproof plastic tape.

As an alternative method of splicing, either horizontally or vertically, rolls of geocomposite drain material may be joined together by turning

back the fabric at the roll edges and interlocking the cuspations approximately 2 inches. For overlapping in this manner, the fabric is then lapped over and tightly taped beyond the seam with the 3-inch wide, waterproof tape. Interlocking of the core shall always be in the direction of water flow.

To prevent soil intrusion, all exposed edges of the geocomposite drainage core shall be covered by tucking the 4-inch fabric lap over and behind the core edge. Alternatively, a 12-inch wide strip of fabric may be utilized in the same manner, taping it to the exposed fabric 8 inches in from the edge with a continuous strip of 3-inch wide, waterproof, plastic tape and folding the remaining 4 inches over and behind the core edge.

Should the fabric become damaged during installation by tearing or puncturing, the damaged section shall be cut out and replaced completely. If, in the judgment of the Engineer, the damage is not serious enough to warrant removal, the damaged area may be repaired by overlaying with a piece of fabric, large enough to cover the damaged area and provide a 4 inch overlap on all sides, and taping it in place with 3-inch wide strips of waterproof, plastic tape.

Structural backfill operations shall be started as soon as possible after placing the geocomposite material, but in no case shall the geocomposite material be exposed to sunlight for more than 14 days after installation. Care shall be taken during the backfill operation not to damage the geotextile surface of the drain and to avoid excessive settlement of the backfill material.

203-5.04 Method of Measurement:

(A) Structural Excavation:

Structural excavation will be measured for payment by the cubic yard based on the volume calculated from the pay limits shown on the plans.

No deduction will be made from the pay quantities when the contractor elects not to excavate material which is within the pay limits shown on the plans.

Where it is necessary to excavate to a greater depth than shown on the plans for a footing, or to remove unsuitable material in accordance with the requirements of Subsection 203-5.03(A) of the specifications, such additional excavation which is less than 3 feet below the elevation shown on the plans will be measured for payment as structural excavation.

No measurement for payment will be made of excavation required because of slides, cave-ins, silting, or filling due to the lack of support

of sides, the action of the elements or the carelessness of the contractor.

No measurement for payment will be made for structural excavation when structures are to be supported on piles or drilled shafts in new embankment sections.

(B) Structure Backfill:

Structure backfill will be measured by the cubic yard of material based on the volume calculated from the pay limits shown on the plans.

203-5.05 Basis of Payment:

The accepted quantities of structural excavation and structure backfill, measured as provided above, will be paid for at the contract unit price. The price shall be full compensation for the work complete as hereinbefore specified.

Full compensation for hauling, placing, and compacting surplus structural excavation in embankments or otherwise disposing of the material shall be considered as included in the contract price paid for excavating the material.

Payment for additional excavation, where it is found necessary to excavate to a depth greater than 3 feet below the elevation shown on the plans for a footing, to treat seams in rock, or to remove unsuitable material in accordance with the requirements of Subsection 203-5.03(A) of the specifications, will be made in accordance with the provisions of Subsection 104.02 of the specifications.

No measurement or payment will be made for furnishing and installing geocomposite drains, the cost being considered as included in the cost of contract items.

203-6 Grader Ditch:

203-6.01 Description:

Grader ditch shall consist of a triangular shaped ditch as detailed on the plans, excavated and finished with a motor grader or similar type equipment.

203-6.02 Blank:

203-6.03 Construction Requirements:

Grader ditches shall be constructed at the locations designated on the plans or as directed by the Engineer.

203-6.04 Method of Measurement:

Grader ditch will be measured by the linear foot along the center line of the ditch, parallel to the ground surface.

203-6.05 Basis of Payment:

The accepted quantities of grader ditch, measured as provided above, will be paid for at the contract unit price per linear foot.

203-7 Crown Ditches:

203-7.01 Description:

Crown ditches shall consist of excavating and finishing ditches, as detailed on the plans, to intercept surface water.

203-7.02 Blank:

203-7.03 Construction Requirements:

Crown ditches shall be constructed at the locations designated on the plans or as directed by the Engineer.

203-7.04 Method of Measurement:

Crown ditches will be measured by the linear foot along the center line of the ditch, parallel to the ground surface.

203-7.05 Basis of Payment:

The accepted quantities of crown ditches, measured as provided above, will be paid for at the contract unit price per linear foot.

203-8 Crown Dike:

203-8.01 Description:

Crown dikes shall consist of placing material to the lines and grades required to intercept the flow of the surface water and to direct it down continuing slopes to an appropriate discharge point.

203-8.02 Blank:

203-8.03 Construction Requirements:

Crown dikes shall be constructed as designated on the plans or as directed by the Engineer.

The material shall be placed in layers not exceeding 8 inches in depth before compaction and compacted to a density of at least 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

203-8.04 Method of Measurement:

Crown dike will be measured by the linear foot along the center line of the dike, parallel to the ground surface.

203-8.05 Basis of Payment:

The accepted quantities of crown dike, measured as provided above, will be paid for at the contract unit price per linear foot.

203-9 Borrow:

203-9.01 Description:

The work under this section shall consist of furnishing and placing suitable and satisfactory material obtained from sites outside of the right-of-way for use in embankments, shoulders, berms, dikes, and other similar purposes. The widening of roadway cuts and ditches and similar work within the right-of-way shall be considered as roadway excavation, not borrow.

203-9.02 Materials:

Borrow shall be secured from material sources in accordance with the requirements of Section 1001 of the specifications. The material shall be of a quality suitable for the purpose intended, free of vegetation or other unsatisfactory material. Borrow placed within 3 feet of the finished subgrade elevation shall conform to the requirements of the Special Provisions.

203-9.03 Construction Requirements:

Borrow material shall be placed in accordance with the requirements of Subsection 203-10 of the specifications.

203-9.04 Method of Measurement:

Measurement of borrow for payment will not be required unless adjustments are made in accordance with Subsection 203-2.01 of the specifications. When adjustments are required, Borrow will be documented for payment as shown in the bidding schedule by either of the two following methods:

(A) Borrow (Pit):

When the contract provides for Borrow (Pit), the borrow will be measured by the cubic yard in the original space occupied and volume of material removed will be computed in cubic yards by the average end area method.

(B) Borrow (In Place):

When the contract provides for Borrow (In Place), the borrow will be calculated by the cubic yard in the final space occupied and volume of material placed will be computed in cubic yards by the average end area method.

No measurement for payment will be made for borrow material placed prior to completion of roadway excavation, drainage excavation, or structural excavation, when such placement results in unauthorized wasting of roadway, drainage, or structural excavation materials.

203-9.05 Basis of Payment:

The quantities of borrow as shown in the bidding schedule and adjustments to same as described in Subsection 203-2.01 of the specifications, will be paid for at the contract unit price per cubic yard. The price shall be full compensation for the item complete in place, including furnishing, hauling, placing, compacting the material, and applying water.

203-10 Embankment Requirements:

203-10.01 Description:

Embankment requirements shall apply to the construction of roadway embankments, including the widening of embankment sections with surplus material and the preparation of the areas upon which embankment material is to be placed; the construction of dikes and berms; the placing and compacting of material where unsuitable material has been removed; and the placing and compacting of embankment material in holes, pits and other depressions within the roadway area, in accordance with the requirements of these specifications.

203-10.02 Embankment Materials:

(A) Metal Pile Locations:

Where metal piles are to be driven through a newly placed embankment, the embankment material within 10 feet of the pile shall have a value of resistivity not less than 2000 ohm-centimeters or the value shown on the plans, whichever is less. When resistivity is not

shown on the plans, Embankment material shall have a pH value between 6.0 and 9.0, inclusive. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

(B) Drilled Shaft Locations:

Embankment material containing broken concrete, rock, or other solid material which is larger than 12 inches in its greatest dimension shall not be placed horizontally within 10 feet or three shaft diameters, whichever is greater, of any proposed drilled shaft.

(C) Abutment, Wingwall and Anchor Slab Locations:

Embankment material placed adjacent to bridge abutments and wingwalls, as shown on the plans or as directed by the Engineer, will be structure backfill and shall conform to the requirements specified in Subsection 203-5 of the specifications. The limits of the structure backfill material placed adjacent to abutments and wingwalls shall be as shown on the plans or as directed by the Engineer. Fill materials shall not be placed against the back of abutments or wingwalls until the concrete has reached design strength.

When anchor slabs are specified, the embankment material placed under and adjacent to the anchor slabs shall be of a cohesive nature which will allow a neat line excavation of the anchor slab lugs.

(D) Milled Asphaltic Concrete:

Unless otherwise specified in the Special Provisions, embankment material may contain up to 50 percent milled asphaltic concrete. The milled asphaltic concrete shall be thoroughly blended with soil into a homogenous mixture using motor grader mixing of windrows or other blending methods approved by the Engineer.

The contractor shall submit the percentage of milled asphaltic concrete which is intended to be used to the Engineer for approval. Production tolerances shall be controlled to within ± 5 percent of the approved percentage in order to maintain material consistency for testing. Any change in the target percentage must be approved by the Engineer prior to use.

Embankment containing milled asphaltic concrete shall meet the requirements for sampling, testing, placement, and compaction specified in Subsection 203-10.03 of the specifications.

Shoulder buildup or road surfacing identified on the plans or by the Engineer as milled asphaltic concrete will not require blending with soil.

203-10.03 Embankment Construction Requirements:

(A) Placement:

All embankments shall be constructed to a reasonably smooth and uniform surface and shall not vary by more than 0.04 feet above or below the grade established and in reasonably close conformity to the lines, dimensions, and cross sections shown on the project plans or established by the Engineer. When Portland cement concrete pavement or asphaltic concrete pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 feet above or 0.04 feet below the established grade.

All embankment material, whether from sources within the site or from borrow, to be placed within 3 feet of the finished subgrade elevation shall have a resilient modulus value equal to or greater than the design resilient modulus value for the pavement structure.

Embankment construction shall not be started until clearing and grubbing for the embankment area is completed in accordance with the requirements of Section 201 of the specifications. When embankment material is to be placed over existing bituminous surfacing, the surfacing shall be scarified prior to placing embankment material, unless otherwise directed by the Engineer. When directed by the Engineer, surplus material or unsuitable material, as specified in Subsection 203-3.03 of the specifications, shall be disposed of by flattening embankment slopes within the project limits.

In constructing embankments on hillsides, or against existing embankments or when constructing embankments one half width at a time, the slopes of the original hillside except where solid rock is encountered, the existing embankments, or the half width of new embankments shall be cut into a minimum of 6 feet horizontally, as the work is brought up in layers, in order to minimize the possibility of slippage between the existing materials and the new embankment material. The material thus cut out shall be re-compacted along with the new embankment material.

Embankment of earth material shall be placed in uniform horizontal layers not exceeding 8 inches in depth before compaction and shall be compacted in accordance with the requirements of these specifications before the next layer is placed.

When the embankment material, resulting from the required excavations, consists predominately of rock fragments of such size that the material cannot be placed in an 8-inch layer without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment in layers not exceeding in thickness the approximate average size of the larger rocks being excavated, but not larger than 2 feet. It may be necessary to reduce the size of the excavated material by crushing or otherwise breaking down the material in order to comply with this requirement.

The placing of individual rocks and boulders greater than 24 inches in diameter will be permitted provided they do not exceed 36 inches in maximum dimension, are carefully distributed to prevent nesting and the interstices are filled with finer material and compacted to form a dense and compact mass. Each layer shall be leveled and smoothed by evenly distributing spalls and finer fragments of rock and earthen material with suitable leveling equipment.

Embankment material containing broken concrete, rock, or other solid materials which are larger than 6 inches in greatest dimension shall be placed so that no surface of said material is within 3 feet horizontally of any planned piling, structure, pole or sign foundations, and underground conduit. No additional compensation will be allowed for the excavation and installation of any planned facility when the additional work is caused by material in excess of 6 inches within the embankment area. It may be necessary to reduce the size of the excavated material by crushing or otherwise breaking down the material in order to comply with this requirement.

Embankment material placed at bridge abutments, as specified in Subsection 203-10.03(B) of the specifications, shall have a Plasticity Index of not more than 15 when tested in accordance with AASHTO T 90. Material placed within these limits shall contain no rocks or other solid material greater than 12 inches in its largest dimension between the subgrade elevation and a depth of 7 feet. Embankments deeper than 7 feet within these limits shall contain no rocks or other solid material greater than 24 inches in its largest dimension.

Concrete with any dimension greater than 2 feet shall be removed and wasted or reduced to a maximum of 24 inches before placing in embankment.

Embankment construction shall not take place when the material is frozen or a blanket of snow prevents proper compaction of the embankment material.

When embankment slopes are to be seeded, the surface shall be finished to a loose, evenly roughened condition, in accordance with the requirements of Subsection 805-3.02(B) of the specifications.

(B) Compaction:

(1) Earth:

Each layer of the embankment material shall be compacted by rolling, tamping, or other suitable means to the specified density before the next layer is placed. Effective spreading equipment shall be used on each layer to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulation of the material shall be required to assure uniform density. The moisture content of the material shall be adjusted, if

necessary, to obtain the required density. As far as practicable, construction equipment shall be continuously routed uniformly over the entire surface of each layer.

Where embankments 5 feet or less in height are to be constructed, the top 6 inches of the ground on which the embankment material is to be placed shall be compacted to a density of not less than 95 percent of the maximum density.

When embankments are to be constructed at bridge abutments, each layer of embankment material placed beneath the approach slab, anchor slab if specified, and an additional 50 feet beyond the limits of these slabs, shall be compacted to a density of not less than 100 percent of the maximum density, including the material specified in Subsection 203-10.02(C) of the specifications. Density requirements will not apply to rocky material placed within these limits, when, in the opinion of the Engineer, the specified Arizona Test Methods for density are not appropriate.

Each layer of roadbed embankment shall be compacted to a density of not less than 95 percent of the maximum density, except that when asphaltic concrete is to be placed directly on subgrade, the top 6 inches of the embankment shall be compacted to a density of not less than 100 percent of the maximum density. Embankment material placed in dikes shall be compacted to a density of not less than 95 percent of the maximum density.

All density determinations will be made in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Arizona Test Method 235, shall not be used to determine the field density or moisture content of embankment material containing salvaged asphaltic concrete.

When testing embankment materials containing milled asphaltic concrete, drying to a constant weight shall be performed at a temperature of 140 ± 5 degrees F.

(2) Rock:

Density requirements will not apply to portions of embankments constructed of materials that cannot be tested by approved methods.

Rocky materials shall be placed, spread, and leveled in 24 inches thick layers, when possible, over the full width of the embankment, with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. The average dimension of the largest rock shall not exceed 24 inches. Vibratory compactors, grid, paddle-foot, vibratory rollers, or other compacting equipment

approved by the Engineer shall be used for fills constructed of materials which are predominately rock.

Rolling may be omitted on any layer, or portion thereof, when, in the judgment of the Engineer, it is physically impractical. In addition to the above rolling, each layer shall be further compacted by routing the hauling equipment uniformly over the entire width of the embankment. Additional compaction of rock embankments may be required at the discretion of the Engineer.

203-10.04 Blank:

203-10.05 Basis of Payment:

No measurement for payment will be made for hauling, placing, shaping, applying water to, and compacting embankment materials.

203-11 Shoulder Build-Up:

203-11.01 Description:

The work under this section consists of furnishing, placing, shaping, and compacting shoulder build-up material along the edge of pavement in accordance with the details shown on the project plans, the requirements of the specifications, and as approved or directed by the Engineer.

203-11.02 Materials:

(A) Earthen:

Shoulder build-up material shall be obtained from excavated areas within the project limits when shown on the project plans. If no excavation is identified for shoulder buildup on the project plans, shoulder build-up material shall be obtained from off-site borrow sources.

Roadway, drainage, or structural excavation materials will require the Engineer's approval before being placed as shoulder build-up. The Engineer's determination of the suitability of these materials for use as shoulder build-up shall be final.

Borrow for shoulder build-up material shall conform to the requirements of Subsection 203-9.02 of the specifications. The gradation will be provided in the Special Provisions.

The plasticity index shall be as shown in the Special Provisions. The plasticity index shall be tested in accordance with the requirements of AASHTO T 90. The soluble salts, when tested in accordance with the requirements of Arizona Test Method 237, shall not exceed 3,000 parts

per million unless the level of soluble salts in the in-place native soil exceeds 3,000 parts per million, in which case the shoulder build-up material may not exceed the level of soluble salts in the in-place native material.

(B) Milled AC:

Shoulder build-up material shall be minus 1-1/2 inch milled asphaltic concrete obtained from within the project limits. Screening will not be required; however, the Engineer's determination of the suitability of the material shall be final.

203-11.03 Construction Requirements:

(A) Placement

Shoulder build-up material shall be placed and shaped along the edge of pavement in accordance with the details shown on the project plans, the applicable requirements of Subsection 203-10.03(A) of the specifications, and as directed by the Engineer. Clearing and grubbing will not be required.

Prior to placing any shoulder build-up material, the contractor shall provide an inventory of all existing delineators, signs, object markers, and milepost markers to the Engineer for approval. The inventory shall indicate the type of device and milepost or station number for each item.

After placing and shaping the material, the material shall be compacted in accordance with the requirements of the specifications and as directed by the Engineer.

Shoulder build-up material placed around guardrail terminals and breakaway- or slip-bases for signing and lighting shall be immediately shaped to allow proper functioning of the supports. No material shall be placed on any signing or lighting base plates or against any sign posts.

The contractor shall also remove shoulder build-up material from pull boxes, valve and meter boxes, vaults, and any other roadway-related items located within the shoulder.

Delineators, signs, valve boxes, vaults, and all other public and private property damaged as a result of the placement of the shoulder build-up material shall be replaced by the contractor at no additional cost to the Department.

Any windrows of shoulder build-up material stockpiled along the shoulders by the contractor shall be placed and shaped, as shown on the plans, by the end of the work shift.

When the drop-off between the newly paved surface and existing shoulder is greater than 2 inches, and the adjacent shoulder build-up will not be completed before traffic is allowed on the new pavement, a temporary fillet shall be placed adjacent to the drop-off at a slope of 3:1 (horizontal to vertical). Material for the fillet shall be as specified above.

Unless otherwise approved by the Engineer, shoulder build-up shall not be placed beyond the width shown on the project plans.

Unless otherwise shown on the project plans, shoulder build-up shall not be placed along guardrail sections.

For shoulder build-up constructed from earthen materials, all suitable materials removed from excavated areas shall be used instead of borrow in the construction of shoulder build-up, unless otherwise approved by the Engineer.

(B) Compaction:

No density requirement is specified for this material; however, compaction shall be required for all areas deemed practicable by the Engineer.

The equipment type proposed for obtaining the compaction, and the extent of compaction required shall be as approved by the Engineer.

The contractor shall compact temporary slope fillets if directed by the Engineer.

203-11.04 Method of Measurement:

Shoulder build-up will be measured for payment by the linear foot. Measurement will be along the edge of pavement against which the material is placed.

Compaction of shoulder build-up, regardless of type of equipment used, will be measured by the hour for the compacting unit, but only for the time that the unit is actually used for compacting the shoulder material, except that in any half-shift during which the unit is operated for necessary compaction, measurement will be made for the full half-shift, provided that the unit is not inoperative due to breakdown or other causes determined by the Engineer to be the responsibility of the contractor.

203-11.05 Basis of Payment:

The accepted quantities of shoulder build-up, measured as provided above, will be paid for at the contract unit price per linear foot, which

price shall be full compensation for the work, complete in place, as specified herein and as shown on the project plans.

The accepted quantities of shoulder build-up compaction, measured as provided above, will be paid for at the contract unit price per hour, which price shall be full compensation for the work complete, as herein described and specified.

No additional measurement or direct payment will be made for the construction or compaction of temporary slope fillets, or for borrow used for shoulder build-up, the costs being considered as included in the price of shoulder build-up.

SECTION 204 RESHAPING AND GRADING EXISTING IMPROVEMENTS:

204-1 Description:

The work under this section shall consist of reconstructing or restoring existing dikes, berms, and median slopes, including furnishing, placing, and compacting embankment material, as required, at the locations and in accordance with the details shown on the project plans, and the requirements of these specifications.

204-2 Blank:

204-3 Construction Requirements:

Reconstructing or restoring shall be the rebuilding of existing improvements, at or near the same location, to either new lines, grades, and cross sections or to their original lines, grades, and cross sections as shown on the project plans.

The reconstruction or restoring of dikes, berms, and median slopes shall be accomplished in accordance with the same requirements as for new work of equivalent type and character and conform to the applicable requirements of Section 203 of the specifications.

204-4 Method of Measurement:

Reshaping and grading existing improvements will be measured on a lump sum basis.

204-5 Basis of Payment:

The accepted quantities of reshaping and grading existing improvements will be paid for at the contract lump sum price, which price shall be full compensation for the work, complete in place, as described and specified herein.

SECTION 205 GRADING ROADWAY FOR PAVEMENT:

205-1 Description:

The work under this section shall consist of removing pavement, excavating, removal, and disposal of excess material, furnishing and placing embankment material, and all grading, shaping and compacting of materials necessary to construct the subgrade to the lines and grades shown in the plans and as depicted by the new pavement section specified and in accordance with the requirements of these specifications.

205-2 Blank:

205-3 Construction Requirements:

205-3.01 General:

All existing pavement shall be removed as designated on the project plans. Where new asphaltic concrete is to match existing bituminous surfaces, the edges of the existing bituminous surfaces abutting the new paving shall be either saw cut or wheel cut to a minimum depth of 1-1/2 inches to form a neat true line with straight vertical edges free from irregularities. Should the contractor elect to wheel cut the edges, the cutter wheel shall be adequate for the work, in the opinion of the Engineer, to produce the desired result.

If at the time of removing any portion of the existing roadway, in-place materials from which the new subgrade is to be constructed contain an excess of moisture, so that the required compaction cannot be obtained with reasonable and customary aeration and manipulation, the Engineer will determine the cause of such condition and will determine whether the material shall be further aerated or removed and replaced.

If the cause of such condition is determined to have been unforeseeable and beyond the control of and without fault or negligence of the contractor, such further work shall be done as directed and will be paid for as extra work in accordance with the requirements of Subsection 104.02 of the specifications. Excess moisture caused by irrigation water, storm drainage, weather, breakage of mains, or other similar cause will be considered as within the responsibility of the contractor.

205-3.02 Excavation:

Excavation shall conform with the requirements of Subsection 203-3 of the specifications.

205-3.03 Embankment:

The placement and compaction of embankment shall conform with the requirements of Subsection 203-10 of the specifications.

205-3.04 Compacting and Finishing:

The top 6 inches of the subgrade shall be compacted to a density not less than 95 percent of the maximum density as determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer, except that when asphaltic concrete or Portland cement concrete is to be placed directly on subgrade, the required density shall be 100 percent.

The surface of the subgrade shall be finished to a reasonably smooth and uniform surface and in reasonably close conformity to the lines, grades, dimensions, and cross section shown on the project plans or established by the Engineer. The finished surface of the subgrade shall not vary by more than 0.04 feet above or below the grade established by the Engineer except when Portland cement concrete pavement or asphaltic concrete pavement are to be placed directly on the subgrade, the finished surface shall not vary by more than 0.02 feet above or 0.04 feet below the established grade.

205-4 Method of Measurement:

Measurement of grading roadway for pavement will be made by the square yard of the area prepared and subsequently covered with a subbase, base, asphaltic concrete, or Portland cement concrete; however, when raised median islands are constructed, the area occupied by these islands will be included in the area measured for payment. Where the new pavement is not bounded by curb and gutter and additional shoulder work is necessary to construct the typical section shown in the project plans, such work shall be considered as incidental and the cost will be considered as included in the cost of the contract bid item Grading Roadway for Pavement.

205-5 Basis of Payment:

The accepted quantities of grading roadway for pavement, measured as provided above, will be paid for at the contract unit price per square yard for the work, complete in place, as specified herein and as shown on the project plans.

SECTION 207 DUST PALLIATIVE:

207-1 Description:

The work under this section shall consist of applying all water required for the control of dust as considered necessary for the safety and convenience of the traveling public, and for the reduction of the dust nuisance to adjacent property.

207-2 Blank:

207-3 Construction Requirements:

The use of pressure pumps and spray bars on all sprinkling equipment used for the application of dust palliative will be required. The use of gravity flow spray bars and splash plates will not be permitted.

Water applied for dust control shall be as approved or directed by the Engineer. The contractor shall provide appropriate equipment for effective control of dust.

207-4 Method of Measurement and Basis of Payment:

No measurement or payment will be made for application of dust palliative, including furnishing water and all necessary equipment and labor, the cost being considered as included in contract items.

SECTION 208 SEPARATION GEOTEXTILE FABRIC:

208-1 Description:

The work under this section shall consist of furnishing and placing a permeable separation geotextile fabric. The fabric shall be placed in accordance with the details shown on the project Plans and the requirements of these specifications.

208-2 Materials:

208-2.01 Geotextile Fabric:

The separation geotextile fabric shall be supplied in accordance with and conform to the material requirements of Subsections 1014-1 and 1014-4 of the specifications. Special attention shall be given to the

required survivability of the fabric material which will be as called out in the Special Provisions or as shown on the plans.

208-2.02 Fabric Packaging, Handling, and Storage:

The identification, packaging, handling, and storage of the geotextile fabric shall be in accordance with ASTM D4873. Fabric rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement. 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, shipping date, and the project number and name to which it is assigned. Rolls will be stored on the site or at another identified storage location in a manner which protects them from the elements. If stored outdoors, they shall be elevated and protected with a waterproof, light colored, opaque cover. At no time, shall the fabric be exposed to sunlight for a period exceeding 14 days.

208-3 Construction Requirements:

208-3.01 Weather Limitations:

Separation geotextile fabric shall not be placed when weather conditions, in the opinion of the Engineer, are not suitable to allow placement or installation. This will normally be at times of wet or snowy conditions, heavy rainfall, extreme cold or frost conditions, or extreme heat.

208-3.02 Equipment:

Mechanical or manual laydown equipment shall be capable of handling full rolls of fabric, and laying the fabric smoothly, without wrinkles or folds. The equipment shall be in accordance with the fabric manufacturer's recommendations or as approved by the Engineer.

208-3.03 Surface Preparation:

The surface upon which the separation fabric will be placed shall be compacted and finished according to the requirements of these specifications.

208-3.04 Fabric Placement:

The separation geotextile fabric shall be unrolled on the finished surface and laid smooth without wrinkles. The placement of fabric by dragging across the finished surface will not be allowed. The geotextile fabric shall be overlapped a minimum 24 inches for longitudinal and transverse joints. The center of a longitudinal overlapped joint shall be located in the same manner as a longitudinal pavement joint. Transverse overlaps shall be in the direction of aggregate placement.

208-3.05 Placement and Compaction of Aggregate:

Aggregate materials shall be placed by back dumping the aggregate in a manner which does not damage the fabric and then spreading the aggregate material onto the geotextile fabric in a constant forward direction. Traffic or construction equipment shall not be permitted directly on the geotextile unless approved by the Engineer for emergency purposes. Pins or piles of aggregate can be used to hold the geotextile in place while being covered.

Overstressing the subgrade soil shall be avoided by utilizing equipment in spreading and dumping that exerts only moderate pressures on the soil. If ruts of 2 inches or greater occur in the aggregate, the contractor shall use lighter equipment which transmits less ground pressure. Any ruts which develop during spreading or compacting aggregate shall be filled with additional aggregate rather than bladed from adjacent areas so that the final design aggregate thickness is maintained. Construction equipment shall not be allowed to turn or stop suddenly on the aggregate placed over the geotextile fabric.

Aggregate base shall be compacted as specified in Subsection 303-3.02 of the specifications. Aggregate base material shall not be mixed or processed on the separation geotextile fabric. The aggregate base material shall be premixed at the stockpile area or at another location in a manner approved by the Engineer. Aggregate base materials will be sampled for acceptance after premixing and prior to placement on the separation fabric. Contamination and segregation of aggregate base materials prior to or during placement shall be minimized.

Any damage to the fabric occurring during placement of the aggregate must be repaired immediately. The aggregate shall be removed from the damaged area to allow placement of a fabric patch extending three feet on all sides beyond the damaged area, followed by replacement of the aggregate.

208-4 Method of Measurement:

Separation geotextile fabric will be measured by the square yard in-place. Measurement will be to the nearest square yard. No allowance will be made for material in laps.

208-5 Basis of Payment:

The accepted quantity of separation geotextile fabric, measured as provided above, will be paid for at the contract unit price per square yard, which price shall be full compensation for furnishing all labor, materials, and equipment, and performing all operations in connection with placing the separation geotextile fabric as shown on the project plans. No payment will be made for separation geotextile fabric

rejected, or patches which are necessary, due to either contamination or damage due to either the fault or negligence of the contractor.

SECTION 303 AGGREGATE SUBBASES AND AGGREGATE BASES:

303-1 Description:

The work under this section shall consist of furnishing, placing, and compacting aggregate subbases and aggregate bases in accordance with the details shown on the project plans and the requirements of these specifications.

Aggregate subbases and aggregate bases are designated as Class 1 through Class 6. The class of aggregate subbase and aggregate base will be shown on the project plans or specified in the Special Provisions.

303-2 Materials:

Aggregate for the various classes of aggregate subbases and aggregate bases shall consist of stone, gravel, or other approved inert material of similar characteristics, and shall be clean and free from vegetable matter and other deleterious substances.

Aggregate subbases and aggregate bases shall conform to the requirements shown in the following table for the class specified:

TABLE 303-1

Class of Aggregate	Percent Passing Sieve (Inch or No.)							PI, Max.
	3	1-1/2	1	3/4	1/4	8	200	
1			100	90 - 100		35 - 55	0 - 8.0	3
2		100	90 - 100			35 - 55	0 - 8.0	3
3								
4	100				35 - 70		0 - 10.0	5
5	100				30 - 75		0 - 10.0	5
6								

Notes:

(1) The percentage, by weight, passing each sieve will be determined in accordance with the requirements of Arizona Test Method 201.

(2) The PI (Plasticity Index) will be determined in accordance with the requirements of AASHTO T 90.

(3) Classes 1, 2 and 3 are bases; Classes 4, 5 and 6 are subbases.

(4) The requirements for Class 3 and for Class 6 will be specified in the Special Provisions.

(5) For Class 1 through Class 4 aggregate, the amount of fractured coarse aggregate particles shall be at least 30 percent, when tested in accordance with the requirements of Arizona Test Method 212.

(6) Resistance to abrasion for Class 1 through Class 4 aggregate will be determined in accordance with the requirements of AASHTO T 96 and shall meet the following requirements:

Maximum loss of 9 percent at 100 revolutions

Maximum loss of 40 percent at 500 revolutions

When production of Class 1 through Class 4 aggregate requires composite mixing of materials from more than one source to meet the gradation requirements of Table 303-1, the material from each source shall meet the abrasion requirements specified in herein.

Aggregate subbase and aggregate base material may be comprised in part of salvaged asphaltic concrete, existing aggregate base material, or Portland cement concrete materials.

The source of all salvaged materials shall be approved by the Engineer prior to use. Salvaged asphaltic concrete and Portland cement concrete materials shall not contain hazardous materials. All metal reinforcement materials shall be removed from salvaged Portland cement concrete prior to its use in aggregate subbase and aggregate base material.

Salvaged asphaltic concrete to be used in aggregate subbase and aggregate base material shall be produced by milling, pulverizing, or crushing. Salvaged Portland cement concrete materials shall be produced by crushing.

The contractor shall submit the percentages of salvaged materials and virgin aggregate materials which are intended to be used to the Engineer for approval. The percentages shall not be adjusted after approval, except to maintain a consistent gradation. Any significant change in the proportions must be approved by the Engineer prior to use.

A maximum of 50 percent salvaged material, by weight or volume, will be allowed. The 50 percent maximum shall include all salvaged materials, including any underlying base material recovered when full depth milling or pulverizing is used to remove the asphaltic concrete. Changes in proportions that result in more than 50 percent salvaged material will not be allowed.

Aggregate subbase and aggregate base material containing salvaged materials shall be thoroughly mixed using one of the following methods unless another method is approved by the Engineer:

(A) By means of a mechanical mixing device prior to placement.

The mechanical mixing device shall be a pugmill type mixer consisting of at least two motorized shafts with mixing paddles. The mixing device shall be designed such that the mixture of virgin aggregate and salvaged materials is moved in a near horizontal direction by the mixing paddles without the aid of conveyor belts for a distance of at least 3 feet. The rate of feed of the combined virgin aggregate and salvaged material shall not exceed the mixing device's rated capacity in tons per hour.

(B) By means of mechanical mixing on grade.

Mixing on grade shall be accomplished using a full depth reclamation machine or pulverizer, manufactured for this purpose. The machine shall be equipped with electronic grade control to ensure that underlying materials are not disturbed during mixing. Motor graders, gannon boxes, auger scrapers, or other similar devices will not be allowed for mechanical mixing on grade.

The total thickness of subbase or base material being placed shall include a layer of virgin aggregate immediately above the prepared underlying subgrade, subbase, or base. This layer shall not contain any salvaged material and shall not be disturbed during placement and mixing of subsequent subbase or base material. The required minimum thickness of this layer shall be 1 inch when geotextile or geogrid is not used and 4 inches when geotextile or geogrid is used. In addition, this virgin aggregate layer will not be included when the percentage of salvaged material allowable in the subbase or base is calculated. The percentage of salvaged material shall only apply to the weight or volume

of subbase or base material placed above the layer of virgin aggregate specified herein.

Prior to mixing on grade, the required amount of virgin aggregate and salvaged material necessary to achieve the approved percentages of each shall be placed and uniformly spread on grade; the virgin aggregate being placed and spread first, followed by the salvaged material being placed and spread. Mechanical mixing of the virgin aggregate and salvaged material shall be performed such that the required minimum thickness of virgin aggregate is maintained as specified herein.

The method of mixing to be used shall be approved by the Engineer prior to the start of work.

When mixing of the virgin aggregate and salvaged materials is performed by means of a mechanical mixing device prior to placement, samples of the virgin aggregate shall be obtained from a stockpile or belt prior to blending with any salvaged materials. After blending and transport to the roadway area, samples of the blended virgin aggregate and salvaged materials shall be obtained from the windrow.

When mixing of the virgin aggregate and salvaged materials is performed by means of mechanical mixing on grade, samples of the virgin aggregate shall be obtained from the windrow prior to blending with any salvaged materials. After blending the virgin aggregate and salvaged materials, the contractor shall prepare a windrow area, at a location specified by the Engineer, for the purpose of obtaining samples of the blended material.

Virgin aggregate shall conform to the gradation, plasticity index, fractured coarse aggregate particles, and abrasion requirements for the class of aggregate specified.

Aggregate subbase and aggregate base material composed of virgin aggregate and salvaged materials shall conform to the gradation requirements for the class of aggregate specified. In addition, aggregate subbase and aggregate base material composed of virgin aggregate and salvaged Portland cement concrete shall conform to the plasticity index requirements for the class of aggregate specified.

If salvaged asphaltic concrete material contains underlying base material, the plasticity index of the salvaged material (including the underlying base material) shall conform to the requirements for the class of aggregate specified.

When determining gradation of aggregate subbase or aggregate base material composed of virgin aggregate and salvaged asphaltic concrete materials, drying to a constant weight shall be performed at a temperature of 140 $\pm$ 5 degrees F.

If suitable in-place aggregate subbase or aggregate base materials are available, the contractor shall have the option of re-using such materials as virgin aggregate. Should this option be selected, all existing pavement surface materials shall be removed first. The in-place aggregate subbase or aggregate base material shall then be processed and formed into a windrow for acceptance testing prior to use. When tested, the re-used aggregate subbase or aggregate base material shall conform to the gradation, plasticity index, fractured coarse aggregate particles, and abrasion requirements for the class of aggregate specified. Salvaged asphaltic concrete or Portland cement concrete materials shall be blended with the accepted, re-used aggregate subbase or re-used aggregate base materials by means of either a mechanical mixing device prior to placement, or by mechanical mixing on grade, both as specified above. The blended material shall be sampled and tested as specified above.

303-3 Construction Requirements:

303-3.01 Placement:

Aggregate subbases and aggregate bases shall have water added to them and shall be mixed and processed to produce a uniform blend of material before final placement. After processing, the material shall be placed and spread on the prepared subgrade, subbase or base in a uniform layer or layers not exceeding 6 inches in compacted depth, unless otherwise approved in writing by the Engineer. The method of dumping or spreading shall be determined by the contractor. The spread material shall be free of segregation.

303-3.02 Compaction:

Each layer of aggregate subbase and aggregate base shall be compacted to a density of not less than 100 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Each layer of aggregate subbase and aggregate base material consisting in part of salvaged asphaltic concrete or Portland cement concrete material shall be compacted to at least 100 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer. Arizona Test Method 235, "Field Density and Moisture Content of Soil and Soil-Aggregate Mixtures by the Nuclear Method", shall not be used to determine the field density or moisture content of aggregate subbase and aggregate base material containing salvaged asphaltic concrete.

When determining maximum density and optimum moisture content for aggregate subbase and aggregate base material composed of virgin aggregate and salvaged asphaltic concrete materials, drying to a

constant weight shall be performed at a temperature of 140 ± 5 degrees F.

303-3.03 Finishing:

The final layer of subbase or base shall be finished with equipment capable of shaping and grading the finish surface within the tolerances specified herein.

The finished surface of aggregate subbase or aggregate base shall not vary from the grades established by the Engineer by more than ± 0.04 feet.

The compacted layers of aggregate subbase and aggregate base shall be maintained in a condition satisfactory to receive any subsequent subbase, base, or surfacing material or traffic, when so required.

Areas not within the allowable tolerance shall be corrected by scarifying, placing additional material, re-mixing, reshaping, and re-compacting to the specified density and surface tolerance.

303-4 Method of Measurement:

The quantity of aggregate subbase and aggregate base will be calculated by the cubic yard in place, using plan dimensions.

303-5 Basis of Payment:

The accepted quantities of aggregate subbase and aggregate base, measured as provided above, will be paid for at the contract unit price per cubic yard for the class or classes involved, complete in place.

SECTION 403 ASPHALTIC CONCRETE HOT PLANT REQUIREMENTS:

403-1 Description:

When referenced in individual specifications, the asphaltic concrete hot plant shall meet the requirements specified herein.

403-2 Requirements:

Mixing plants shall conform to the requirements of AASHTO M 156 except as modified herein.

Mineral admixture shall be proportioned by weight.

The mineral admixture shall be added and thoroughly mixed with the mineral aggregate by means of a mechanical mixing device prior to the mineral aggregate and mineral admixture entering the dryer. For all asphaltic concrete mixes except ACFC (specified in Sections 407 and 411 of the specifications) and AR-ACFC (specified in Section 414 of the specifications), the moisture content of the combined mineral aggregate shall be a minimum of 3 percent by weight of the aggregate during the mixing process. For ACFC and AR-ACFC mixes, the mineral aggregate shall be wet with free moisture on the surface of the aggregate just prior to the mixing process. To ensure that adequate mixing water is available on the surface of the aggregate, the Engineer may require that the mineral aggregate for ACFC and AR-ACFC mixes have a moisture content of up to 1-1/2 percent above the combined water absorption.

The mineral admixture shall be weighed utilizing an approved weigh system, with a weight totalizer prior to entry into the mechanical mixing device. The mechanical mixing device shall be a pugmill type mixer which is in good working condition and which consists of at least two motorized shafts with mixing paddles. The mixing device shall be designed such that the mixture of aggregate and admixture is moved in a near horizontal direction by the mixing paddles, without the aid of

conveyor belts, for a distance of at least 3 feet. The rate of aggregate feed shall not exceed the mixing device's rated capacity in tons per hour. The mixer shall be constructed to minimize the loss of mineral admixture. The mixer shall be located in the aggregate delivery system at a location where the mixed material can be readily inspected on a belt prior to entry into the dryer. The mixing device shall be capable of effective mixing in the full range of asphaltic concrete production rates.

A positive signal system shall be provided and utilized during production whereby the mixing shall automatically be stopped if the mineral admixture is not being introduced into the mineral aggregate. The plant will not be permitted to operate unless the signal system is in good working condition.

The contractor's plant and equipment shall be constructed and operated so that there is not a significant loss of mineral admixture through the dust collection system of the plant.

For mixing plants other than batch plants, bituminous material and mineral aggregate shall be proportioned by either volume or weight.

When a batch plant is used, bituminous material and mineral aggregate shall be proportioned by weight. Weighing shall be performed with all receptacles and scales insulated against the vibration or movement of the rest of the plant. The insulated receptacles and scales shall be such that the error in weighing, while the entire plant or any part of the plant is operating, shall not exceed 2 percent for the bituminous material and the individual mineral aggregate components, or 1-1/2 percent for any batch. Weighing of bituminous material shall be done in a heated, insulated bucket suspended from a springless dial scale system.

Mineral aggregate from each individual stockpile/hot bin shall be properly proportioned and introduced into the asphaltic concrete.

A positive signal system shall be provided and utilized during production to indicate the low level of mineral aggregate in the bins. The plant will not be permitted to operate unless the signal system is in good working condition. Each bin shall have an overflow chute or a divider to prevent material from spilling into adjacent bins.

The introduction of bituminous material shall be controlled by an automated system fully integrated with the controls for mineral aggregate and mineral admixture.

The contractor shall provide daily documentation of the weight and proportion of each individual component (mineral aggregate, mineral admixture, and bituminous material) incorporated into the mix, within three days of the production, excluding weekends and holidays. When a dedicated plant is being used, plant startup waste shall be shown in the hot plant documentation. In addition, when reclaimed asphaltic pavement (RAP) is used, the contractor shall provide daily

documentation of the weight, determined by a calibrated or certified belt scale, and proportion of material from each individual RAP stockpile incorporated into the mix. The percent moisture content of the RAP material from each stockpile shall also be determined and provided daily by the contractor.

When Warm Mix Asphalt (WMA) technologies are used, the contractor shall provide the percent of water (for WMA water foaming processes) and/or the percent of WMA additive incorporated in the mix. The percent of each WMA technology shall be reported either by weight of total mix or by weight of total binder.

When incorporating WMA technologies, the hot plant shall be modified as required by the WMA technology manufacturer to introduce the WMA technology. Plant modifications may include additional plant instrumentation, the installation of asphalt binder foaming systems and/or WMA additive delivery systems, adjusting the plant burner and/or the mixing drum flights in order to operate at lower production temperatures, and/or reducing the production rate of WMA.

The production of the plant shall be governed by the rate required to obtain a thorough and uniform mixture of the materials.

Drying and heating shall be accomplished in such a manner as to preclude the mineral aggregate from becoming coated with fuel oil or carbon.

A continuous recording pyrometer sensitive to a rate of temperature change not less than 10 degrees F per minute shall automatically record the temperature of asphaltic concrete or mineral aggregate at the discharge chute of the dryer. A copy of the pyrometer reading shall be provided to the Engineer daily.

If the asphaltic concrete is discharged from the mixer into a hopper, the hopper shall be constructed so that segregation of the asphaltic concrete will be minimized.

403-3 Measurement and Payment:

No measurement or direct payment will be made for providing a hot plant meeting the requirements specified herein, the cost being considered as included in the respective contract items.

SECTION 404 BITUMINOUS TREATMENTS:

404-1 Description:

The work under this section shall consist of furnishing all materials and constructing or applying a single or multiple course bituminous treatment

in accordance with the requirements of the specifications and in reasonably close conformity to the lines shown on the project plans or established by the Engineer.

The kind of bituminous treatment may consist of one or a combination of the following:

(A) Prime Coat;
(B) Tack Coat;
(C) Fog Coat;
(D) Emulsified Asphalt Chip Seal with Fog Coat; and/or
(E) Hot Applied Chip Seal with Fog Coat.

404-2 Materials:

404-2.01 Bituminous Materials:

The bituminous material shall be of the type and grade specified in the Special Provisions and shall conform to the requirements of the following subsections:

Asphalt Cement	1005-3.01
Liquid Asphalt	1005-3.02
Emulsified Asphalt	1005-3.03
Emulsified Asphalt (Special Type)	1005-3.04
Recycling Agents	1005-3.05
Emulsified Recycling Agents	1005-3.06
Crumb Rubber Asphalt	1009-2

Application temperatures of bituminous materials shall conform to the requirements of Table 1005-6. Polymer modified bituminous materials shall not exceed 390 degrees F, or less as specified by the supplier.

If emulsified asphalt of any type is held overnight, it shall be reheated and agitated prior to further application.

404-2.02 Aggregate Materials:

(A) General:

The contractor shall provide a source of aggregate material in accordance with the requirements of Section 1001 of the specifications.

Aggregate material will be sampled for gradation acceptance in the final stockpile before incorporation into the work. For precoated aggregate, sampling will occur prior to precoating.

The aggregate material will be acceptable when the test values for each specified aggregate characteristic are within the specified limits.

(B) Blotter Material:

Blotter material shall be natural sand, crushed sand, volcanic cinders, or other approved material and shall be free of deleterious materials or foreign substances.

The grading shall meet the following requirements when tested in accordance with the requirements of Arizona Test Method 201:

Sieve Size	Percent Passing
3/8 inch	100
No. 4	80 - 100
No. 16	45 - 80
No. 200	0 - 5.0

(C) Cover Material:

Aggregate for cover material shall be of clean sand, gravel, or crushed rock and shall be free from lumps or balls of clay and shall not contain calcareous or clay coatings, caliche, synthetic materials, organic matter, or foreign substances.

The gradation shall meet the following requirements for the Class specified in the Special Provisions when tested in accordance with the requirements of Arizona Test Method 201.

Sieve Size	Percent Passing	
	Class 1	Class 2
1/2 inch	100	
3/8 inch	70 – 90	100
1/4 inch	0 – 10	70 – 90
No. 4	---	0 – 10
No. 8	0 – 5	0 – 5
No. 200	0 – 1.0	0 – 1.0

Cover material shall meet the following requirements:

Aggregate Characteristics	Test Method	Requirement
Abrasion	AASHTO T 96	100 Rev., Max 9% 500 Rev., Max 40%
Carbonates	Arizona Test Method 238	Maximum 20%
Fractured Coarse Aggregate Particles	Arizona Test Method 212	Minimum 85% (at least two fractured faces) and minimum 92% (at least one fractured face) determined on plus No. 4 material
Flakiness Index	Arizona Test Method 233	Maximum 20%
Bulk Oven Dry Specific Gravity	Arizona Test Method 210	2.350 – 2.850
Water Absorption	Arizona Test Method 210	0 – 2.5%

(D) Precoated Cover Material:

The aggregate for cover material shall meet the requirements given above for aggregate characteristics prior to precoating with bituminous material.

Prior to placing, the cover material shall be precoated with a grade of PG asphalt cement which meets the requirements of Section 1005 of the specifications. The precoating shall be accomplished by mixing at a central plant until the aggregate is evenly coated. The cover material shall have a minimum temperature of 250 degrees F at the time of precoating with asphalt cement. The cover material shall be precoated with approximately 0.40 to 0.60 percent asphalt cement, by weight of the aggregate. The final percentage of asphalt cement used for precoating will be as directed by the Engineer. The end result shall be a dust free material.

For hot applied chip seal coats, no more than the quantity of precoated cover material needed for one day of chip seal production shall be stockpiled, unless otherwise approved by the Engineer.

404-3 Construction Requirements:

404-3.01 Seasonal and Weather Limitations:

The contractor's bid submittal and initial construction schedule shall adhere to the beginning and ending dates shown in Subsection 404-7 of the specifications for placement of bituminous material used in chip seal coats. Bituminous material used in chip seal coats shall only be placed when the existing bituminous surface is dry, the pavement surface

temperature is at least 85 degrees F, and the ambient temperature at the beginning of the application of bituminous material is at least 65 degrees F and rising. The application of bituminous material shall be stopped when the ambient temperature is 70 degrees F or less and falling.

No placement of bituminous material for chip seals shall occur if ambient temperatures are forecasted to be at or below 40 degrees F at any time during the day or night after placement.

For hot applied chip seals, no placement shall occur if ambient temperatures exceed, or are forecasted to exceed, 110 degrees F the day before, the day of, or the two days after paving.

Placement shall cease for the day if sustained wind velocities in excess of 15 MPH occur at the project.

Placement of chip seals may be stopped by the Engineer at any time, and all other contract requirements, including stoppage due to weather, shall remain in place.

Bituminous material used in prime coats shall normally be applied to an existing aggregate surface only when the ambient air temperature in the shade is at least 70 degrees F and when the existing aggregate surface is slightly damp.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions, either existing or expected, are anticipated to have an adverse effect upon the bituminous treatment.

404-3.02 Equipment:

(A) Distributor Truck:

Distributor trucks shall be so designed, equipped, maintained, and operated that bituminous material at even heat may be applied uniformly on variable widths of surface at readily determined and controlled rates from 0.03 to 1.00 gallons per square yard, with uniform pressure, and with an allowable transverse variation from any specified rate not to exceed 10 percent or 0.02 gallons per square yard, whichever is less. Distributor equipment shall include a tachometer, pressure gauges, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperatures of the tank contents. Distributors shall be equipped with a power unit for the pump and a spray bar which is adjustable laterally and vertically. The distributor shall provide for continuous circulation of the bituminous material through the tank and spray bar.

Prior to the spreading of bituminous material, all distributor trucks proposed for use shall have been tested for rate of transverse spread,

in accordance with the requirements of Arizona Test Method 411, and certified within 12 months prior to the date of spreading. Upon certification, an ADOT Bituminous Distribution Truck Certification sticker shall be applied in a clearly visible location inside the driver's side door of the truck. A valid copy of the Certificate of Test (Arizona Test Method 411) shall be carried in the distributor truck. The Engineer may at any time require that each distributor truck be tested to determine the rate of the transverse spread.

All testing and sampling, including the preparation of test pads and test plates, shall be performed by an independent testing laboratory which has been approved by the Engineer to perform Arizona Test Method 411. A professional engineer, registered in the State of Arizona and employed by the independent testing laboratory, shall be responsible for all testing and test results. Testing shall be performed at no cost to the Department.

Distributor trucks shall be equipped with the appropriate size nozzles adjusted to the proper angle with the associated adjustment wrench to achieve maximum overlap of spray and an even application.

Distributor trucks shall have a calibrated thermometer and volume gauge or other device with which the volume of material in the tank may be measured to within 50 gallons. The pump shall be shown to have been verified by a mass flow meter or other acceptable means within the last 12 months. The spray bar shall be adequately flushed of prior materials, solvents, or other contaminants.

Equipment which fails to provide an acceptable application of bituminous material shall be removed from the project.

(B) Power Brooms:

Power brooms shall be of the rotary or pickup type, capable of completely removing all excess chips, and cleaning without gouging or tearing the surface.

(C) Rollers:

Rollers shall be of the oscillating type having a width of not less than 4 feet with pneumatic tires of equal size and diameter. Wobble-wheel rollers will not be permitted. The tires shall be spaced so that the gaps between adjacent tires will be covered by the following tires. Unless foam filled, the tires shall be inflated per the manufacturer's specifications and maintained so that the air pressure will not vary more than 5 pounds per square inch from the designated pressure. Pneumatic-tired rollers shall be properly ballasted and constructed so that the total weight of the compactor can be varied to produce an operating weight per tire of not less than 2,000 pounds.

(D) Aggregate Spreaders:

The application of cover material shall be accomplished by means of a calibrated spreader. The spreader shall be a self-propelled, computerized rate-controlled unit capable of an application width of 14 feet or greater. The spreader shall be in good mechanical condition and capable of applying aggregate uniformly across the spread width.

Chip spreader boxes shall be calibrated to ensure consistent discharge across all of the chutes except where the discharge is intentionally adjusted to compensate for site conditions and construction operations.

The application of blotter material shall be accomplished by means of a sand slinger or other equipment approved by the Engineer.

Aggregate application rates are expected to vary from 4 to 32 pounds per square yard, depending on the type of construction.

404-3.03 Traffic Control:

In the construction or application of a bituminous treatment, the treated roadway surface shall not be used by the contractor, its agents, or others until it has been established to the satisfaction of the Engineer that the treated roadway surface will not be damaged or marred under the action of traffic. No traffic of any description shall be allowed on any bituminous application until approved by the Engineer. The contractor shall erect and maintain approved barricades, signs, and other traffic control devices and shall use every possible means to protect the work and to exclude traffic from the roadway surface for as long a time as may be required. Traffic shall be handled in the manner most convenient to the traveling public. When traffic is handled on a one-way basis, the contractor shall provide such flaggers and pilot trucks as deemed necessary to ensure adequate protection for the roadway surface. Traffic may be detoured around the work, provided that detours are constructed and maintained in a satisfactory manner and properly signed. When it is necessary to provide for traffic across a bituminous treated surface, the crossing shall be blotted with material, as directed, before the crossing is opened to traffic.

404-3.04 Preparation of the Surface:

The surface to be treated shall be thoroughly cleaned to the satisfaction of the Engineer prior to applying the bituminous material.

When the work consists of a chip seal coat or when blotter material is applied, self-propelled rotary power brooms and/or pickup brooms, along with hand brooms, if necessary, shall be used immediately in advance of applying the bituminous material.

When a bituminous treatment is to be applied to an existing aggregate surface, the surface shall be uniformly smooth, firm and reasonably true

to grades and cross sections as shown on the project plans, and shall be so maintained throughout the placing of the bituminous treatment. In no event shall a bituminous treatment be placed on a soft, uneven base. Any holes, depressions or irregularities shall be repaired. All loose and unsuitable material shall be removed and replaced by suitable material, which shall be compacted to produce a dense surface conforming to the adjacent area. Uniformity of surface texture is of the utmost importance.

When required, the existing aggregate surface on which the bituminous treatment is to be placed shall be lightly bladed, watered and compacted immediately prior to the application of bituminous material. In extremely dry areas, additional light applications of water may be required prior to the application of the bituminous material to facilitate penetration of the bituminous material.

404-3.05 Application of Bituminous Material:

The types, grades, and approximate rates of application of bituminous material for fog coat, prime coat, and tack coat will be as specified in the Special Provisions. The application rates for chip seal coats shall be determined by the contractor in accordance with the requirements herein, subject to approval by the Engineer.

The rates to be applied may vary substantially because of different surface conditions within the project limits. The actual bituminous material application shall not vary more than 10 percent from the application rate specified by the Engineer.

The bituminous material shall be uniformly applied to the prepared surface at the rate specified by the Engineer and in one application.

The various types or grades of bituminous materials shall be applied at temperatures within the limits given in Table 1005-6, and at no time shall the contractor increase the temperature of the bituminous material above the higher limit specified.

In order to obtain uniform distribution, the distribution shall be promptly started or stopped at the junction of two applications in a manner that will not result in overlaps or gaps in the applications.

The distribution shall be promptly cut off prior to the decrease in uniform flow caused by the distributor tank becoming empty, when there is a decrease in uniform flow due to any reason, or when the forward movement of the distributor slows down or stops.

In the event that any spots are missed in the application, or any areas develop that do not have a uniform spread or penetration, such areas shall be remedied without unnecessary delay.

Care shall be taken to prevent the spraying or splattering of bituminous material on adjacent pavements, structures, curb, guardrail, trees and

shrubbery, or any other object outside of the area designated for spraying.

Unused bituminous material shall be the responsibility of the contractor.

404-3.06 Application of Blotter Material:

The approximate amount of blotter material, when required as a part of a bituminous treatment, will be specified in the Special Provisions; however, the Engineer will specify the exact rate to be applied based on the characteristics of the bituminous treated surface.

Blotter material, at the time of spreading, shall be wet but free from running water.

Blotter material shall be uniformly spread. Any oversize aggregate or foreign material picked up during stockpiling or loading operations shall be eliminated before entering the spreader. Supplemental spreading or smoothing shall be done by hand methods where necessary.

For chip seals with an emulsified asphalt binder coat, the application rate shall be 8 pounds per square yard or as specified by the Engineer.

If blotter material is required for a hot applied chip seal, the blotter material shall be applied in one or more applications for a total application of 2 pounds per square yard. The Engineer may reduce or eliminate blotter material if deemed to be unnecessary.

Prior to final acceptance and when ordered by the Engineer, the contractor shall remove and dispose of any excess blotter material. The method of removal and the disposal of any excess blotter material shall be the contractor's responsibility.

404-3.07 Joints:

Transverse joints with the preceding work, at intersections, and at all existing pavements and structures shall be made by a method approved by the Engineer prior to the start of the work.

Unless otherwise directed by the Engineer, transverse joints with the preceding work shall be made by placing building paper over the end of the previous application, and the joining application shall start on the building paper. Once the application process has progressed beyond the paper, the paper shall be disposed of as directed by the Engineer. Transverse joints at other locations shall be made by a method approved by the Engineer prior to the start of the work.

Longitudinal joints shall be overlapped between 2 to 6 inches.

Joints shall be cleaned as deemed necessary by the Engineer prior to the application of bituminous material in the adjacent strip.

Regardless of the width of the roadway to be sealed, the number of longitudinal joints shall be kept to a minimum and shall be located to the greatest degree possible so that they will coincide with painted lines between traffic lanes.

404-4 Prime Coat:

The type of bituminous material and the approximate application rate shall be as specified in the Special Provisions.

When it is deemed necessary, areas having excess bituminous material shall be blotted with material as directed.

When so directed, the surface of the completed prime coat shall be rolled with a pneumatic-tired roller.

The integrity of the prime coat shall be maintained at all times until the next course is placed or until final acceptance. In the event traffic has caused holes or breaks in the surface, such holes or breaks shall be satisfactorily repaired by the contractor.

404-5 Tack Coat:

Tack coat shall be applied prior to placing a bituminous mixture on a primed surface, an existing bituminous surface, or an existing Portland cement concrete pavement surface. Tack coat shall also be applied between layers of bituminous mixtures. A light coat of bituminous material shall also be applied to edges or vertical surfaces against which a bituminous mixture is to be placed.

The contractor shall choose the bituminous material to be used for tack coat. The Engineer must approve the contractor's choice of bituminous material prior to its use.

The rate of application for the specific usage will be specified by the Engineer. The following table shows approximate tack coat application rates:

Type of Bituminous Material	Approximate Tack Coat Application Rates: Gallons / Square Yard		Payment Factor
	Prior to Placing ACFC or AR-ACFC	All Other Tack Coats	
Emulsified Asphalt (Special Type) – See Note Below.	Not Allowed	0.12	0.7
Emulsified Asphalt (Other than Special Type)	0.08	0.08	1.0
Asphalt Cement	0.06 to 0.08	0.06 to 0.08	1.0

Note:

(1) Emulsified Asphalt (Special Type) shall consist of Type SS-1 or CSS-1 emulsified asphalt diluted with water to provide an asphalt content of not less than 26 percent.

The Engineer may adjust the application rate.

If emulsified asphalt of any type is used, it shall have broken before the bituminous mixture is placed.

Tack coat shall be applied only as far in advance of the placement of the bituminous mixture as is necessary to obtain the proper condition of tackiness. In no event shall more tack coat be applied in one day than will be covered by the bituminous mixture during that same day.

404-6 Fog Coat:

The type of bituminous material and the approximate application rate shall be as specified in the Special Provisions. The material shall be diluted with one part water to one part bituminous material.

Blotter material shall be applied to the treated surface in one or more applications for a total application as specified in the Special Provisions at a time specified by the Engineer and before opening to traffic.

Blotter material shall be applied to the treated surface in one or more applications for a total application of approximately 2 pounds per square yard at a time specified by the Engineer and before opening to traffic.

The Engineer may adjust the actual application rate based on specific trials and visual observations performed on test areas for different pavement types.

404-7 Chip Seal Coat:

404-7.01 General:

The contractor shall prepare their bid submittal and initial construction schedule, submitted at the Preconstruction Conference as described in Subsection 108.03 of the specifications, based on the following beginning and ending dates for asphaltic concrete production.

Average Elevation of Project, Feet	Beginning and Ending Dates
0 – 3499	March 15 – May 31
0 – 3499	September 1 – October 31
3500 – 4999	May 1 – September 30
5000 and over	June 1 – August 31

Any proposed placement deviating from the beginning and ending days shall be detailed in the written schedule of construction submitted at the weekly meeting described in Subsection 108.04 of the specifications. No contract time extension will be granted for placement outside of the beginning and ending dates. Any placement deviating from the beginning and ending dates shall be at the sole risk of the contractor.

For hot applied chip seals, the type and grade of asphalt binder shall be as specified in the Special Provisions.

The contractor shall determine the application rates and corresponding quantities of bituminous material and cover material for chip seal coat in accordance with Arizona Test Method 819. Application rates are subject to approval by the Engineer. Areas and locations anticipated to require adjustment to the rate(s) shall also be identified.

The application rates and performance of emulsified asphalt chip seals shall be verified using the Sweep Test in accordance with ASTM D7000. The performance of bituminous material shall be verified using the Vialit Retention Test in accordance with EN 1272-3, modified as necessary to accommodate the specific characteristics of the proposed chip seal. However, the occurrence of failure of polymer modified asphalt during the Vialit Retention Test does not constitute an unacceptable performance of bituminous material.

The actual application rate shall be such that the aggregate is embedded approximately 70 percent (80 percent above 4,000 feet elevation) and tracking of bituminous material does not occur under construction equipment or when opened to traffic.

The actual rate of cover material to be applied shall be such that no more than 5 percent of the chips applied are removed during sweeping and approximately 20 percent void space exists between the aggregate particles once realigned after opening to traffic.

The proposed rate(s), locations requiring adjustment, rate adjustments, and the associated basis for each adjustment, shall be submitted to the Engineer for approval no later than five days following completion of the Pre-Activity Walkthrough as described in Subsection 404-7.02 of the specifications and at least five days prior to placement of the test strip.

The basis for any anticipated adjustments shall include use of one or more of the following:

(A) Sand Patch tests performed in accordance with STP762 Pavement Surface Characteristics and Materials; Haydon, C.E. (ASTM, 1982);

(B) Appendix B of Chip Seal Guide for Application and Construction; Pavement Preservation Committee of the Arizona Chapter of The Associated General Contractors (AGC-Arizona Chapter, 2013); and/or

(C) Arizona Test Method 742 for mean macrotexture.

The approved application rate(s) and adjustments shall be clearly marked at the corresponding locations and remain visible to equipment operators prior to placement.

The contractor shall submit a minimum 75-pound sample of the cover material to the Engineer at least 10 calendar days prior to beginning application of the cover material for testing. In addition to the submitted cover material, the contractor shall also submit 3 gallons of emulsion (5 to 8 gallons for hot applied) in 1-gallon cans, and 40 pounds of granulated rubber if included in the bituminous material.

404-7.02 Pre-Activity Walkthrough:

Prior to placement, the contractor shall conduct a Pre-Activity Walkthrough with all parties expected to work on the chip seal.

Locations where adjustments in application rate may be appropriate shall be documented.

A location for a test strip, approximately 1,000 feet in length shall be identified. If additional test strip locations are desired due to varying surface conditions, these shall also be identified.

Other factors or site conditions such as turn or deceleration lanes, changes in surface characteristics, crack fill, and recent patchwork which may affect placement of the chip seal coat shall also be identified. A description of any affecting conditions and the corresponding locations and action to be taken to minimize their impact shall be documented.

In addition to the requirements herein, the items contained on the checklists provided in AGC-Arizona Chapter's Chip Seal Guide for Application and Construction (pages 11 and 12) shall be considered.

404-7.03 Application of Cover Material:

Cover material shall be immediately and uniformly spread over the freshly applied bituminous material such that aggregate particles are securely adhered and will not roll, tumble, or be picked up during the rolling process. Any oversize aggregate or foreign material picked up during stockpiling or loading operations shall be eliminated before entering the aggregate spreader hopper. Supplemental spreading and smoothing shall be done by hand methods where necessary.

When emulsified asphalt is used, the cover material shall be at a saturated surface-dry condition at the time of spreading. When bituminous material other than emulsified asphalt is used, the cover material shall be precoated as described in Subsection 404-2.02(D) of the specifications.

The class, aggregate requirements, and for bidding purposes, the approximate rates of application of cover material will be as specified herein.

404-7.04 Rolling Cover Material:

Following the spreading of cover material, the surface shall be promptly rolled with self-propelled pneumatic-tired compactors. A sufficient number of compactors shall be provided to cover the width of the material spread in one pass of the compactors and this rolling shall continue until a minimum of three passes has been completed. For chip seals with a hot applied binder coat, the third pass shall be completed within 15 minutes after the initial rolling commences.

404-7.05 Minimum Traffic-Free Period:

The minimum traffic-free period for a newly applied emulsion chip seal coat shall be three hours; however, the contractor's hauling equipment may use the new seal coat during the traffic free period at a speed not to exceed 15 miles per hour. After the traffic free period, but prior to removing the loose cover material, all traffic allowed by the Engineer shall be limited to a speed not to exceed 25 miles per hour.

404-7.06 Removal of Loose Cover Material:

Prior to opening to traffic and at least two hours after placement of the cover material, all loose cover material shall be removed from the paved surface by brooming within 36 hours after application.

For chip seals with a hot applied binder coat, the removal of loose cover material shall commence approximately 30 minutes after the final rolling is completed.

If the Engineer determines that conditions are not conducive to obtaining the best results, brooming shall be discontinued until the Engineer has considered all conditions and has determined the best time for the removal of the cover material. The cover material shall be removed by means of a power broom which shall be in good condition and of a design suitable for the work. The action of the broom shall be such that particles which are stuck to the bituminous material will not be dislodged.

404-7.07 Fog Coat on New Chip Seals:

Unless otherwise specified in the Special Provisions, following the curing period of new chip seal coats, a fog coat shall be placed on the final chip seal coat surface, in accordance with the application rates described in 404-6.

404-7.08 Chip Seal Test Strip:

Prior to the start of placement, all equipment used in the placement of the chip seal coat shall be verified to be in satisfactory operating condition and in accordance with the requirements herein.

Cover material shall be verified to be in a condition consistent with that in which it existed at the time initial acceptance samples were obtained with adequate moisture. Bituminous material certifications shall be verified to indicate that the required type of material is on hand and at the proper temperature.

The existing pavement surface to receive the test strip shall be verified to have been adequately swept and cleaned and meeting the requirements herein. Anticipated application rates shall have been marked and clearly visible to equipment operators.

During placement of the test strip, all equipment shall be observed to confirm proper operation. The application rate of the both bituminous material and cover material shall be measured and verified using a catch-and-weigh “tarp” method. The application rate of the bituminous material shall also be measured and verified by means of a volume per area calculation using the distributor trucks calibrated thermometer and volume measuring gauge or device.

Rolling shall immediately follow placement of the cover material and be verified to be in conformance with the requirements herein.

For emulsion chip seals, the contractor shall broom the surface to remove excess cover material only after the emulsion has fully broken.

Prior to any subsequent placement, the test strip shall be observed to have adequate embedment of the cover material without excessive void space between the chips, stacking of chips, or accumulation of chips on the shoulders. If the condition of the test strip is not acceptable, adjustments shall be made as appropriate, and an additional test strip shall be performed.

404-7.09 Contractor Quality Control:

The contractor shall be responsible for the chip seal design, performing quality control testing on materials, and designating an individual charged with constant observation and monitoring.

Need for an adjustment to application rates or a correction to process or equipment shall be communicated immediately to the necessary personnel.

The initial condition of equipment, materials, and the project and pavement surface conditions shall be documented. The performance and results of the test strip shall be documented. Observations of monitoring activities and quantification of application rates during the test strip and production shall be documented no less frequently than every other placement run.

The cause for any adjustments, including quantifying tests performed, the adjustments made, and the result of such adjustments with regard to acceptability and performance of the chip seal coat shall be documented.

404-8 Method of Measurement:

Bituminous materials will be measured by the ton.

Bituminous material that is required to be diluted prior to application will be measured by the ton of diluted material.

Cover material will be measured by the square yard.

The contractor shall be responsible to determine the amount of cover material that will be required to complete the work from the source or sources from which the cover material is obtained.

Blotter material, when required, will be measured by the square yard.

Measurement for payment will be made only for the quantity of bituminous material and for the quantity of aggregate material used in accordance with the requirements of these specifications.

Time to apply tack coat, when required, is defined as the hours within a work shift that an approved distributor truck containing the specified bituminous material is required by the Engineer to be at the work site.

The time which is required to apply tack coat, when required, will be measured to the nearest hour for the actual number of hours required in any one work shift; however, when the time required is less than four hours in any workday, the time will be measured as four hours.

404-9 Basis of Payment:

The accepted quantities of bituminous treatments, complete in place, measured as provided above, will be paid for at the contract unit price, except the contract unit price for bituminous material will be adjusted for quantities of material represented by the corresponding test results. Adjustments will be made in accordance with Section 1005 of the specifications.

For chip seal coats, no measurement or direct payment will be made for precoating the cover material, material for precoating, and rolling and removal of loose cover material.

Payment for all measures necessary to direct and escort traffic through the area being bituminous treated will be made as specified under Section 701 of the specifications.

No measurement or direct payment will be made for rolling.

No measurement or direct payment will be made for furnishing, applying, and removing blotter material, furnished in conjunction with the application of a prime coat.

No measurement or direct payment will be made for the maintenance or repair of a prime coat surface.

The bidding schedule quantity for tack coat is based on an estimated application rate of 0.06 gallons per square yard for each application shown on the project plans.

The unit price for bituminous tack coat is deemed to be the cost to furnish, transport, and store asphalt cement or emulsified asphalt at the project location. Payment for bituminous tack coat will be made at the unit price multiplied by the respective payment factor listed under Subsection 404-5 of the specifications, and adjusted to the nearest dollar.

Unless otherwise specified, the accepted quantity of bituminous tack coat, measured as provided above, will be paid at the contract unit price per ton adjusted as provided above which price shall be full compensation for furnishing, transporting, and storing the exact type, grade or designation of bituminous tack coat specified by the Engineer.

Unless otherwise specified, the accepted quantity of time to apply bituminous tack coat, measured as provided above, will be paid for at

the contract unit price per hour which payment shall be full compensation for applying bituminous tack coat.

The term "bituminous material" as used herein shall include asphalt cement, liquid asphalt, and emulsified asphalt.

The contract unit price for each item of bituminous material will be considered to include all costs for furnishing, hauling, handling, spreading, and mixing of the material as required, including the "initial cost" of bituminous material, but excluding any difference in the cost of bituminous material that occurs between the date of bid opening and the date that the material is used on the project.

A cost for bituminous material will be determined monthly by the Department based on the selling prices of asphalt cement published by the Asphalt Weekly Monitor, a publication of Poten & Partners, Inc. The cost will be the arithmetic average of the high and low selling prices for asphalt cement shown in the previous four reports for the Arizona/Utah and Southern California regions.

This cost will be deemed the “initial cost” (IC) for bituminous material for projects on which bids are opened during the following month. This cost will also be deemed the "current price" (CP) for bituminous material for the following month for projects in construction.

This value will be effective as of the last Wednesday of each month, and will be posted on the ADOT Contracts and Specifications Group website, on or shortly after the last Wednesday of month.

For each item of bituminous material for which there is a specific pay item, and for the bituminous material used in Asphaltic Concrete (Miscellaneous Structural), an adjustment will be made as follows for each month that a quantity of bituminous material was used on the project.

The “initial cost” (IC) for the month in which the project was bid will be compared with the “current price” (CP) as specified above for the appropriate current month. The “current price” (CP) will be as posted on the Department’s website on the last Wednesday of each month, and will be used to adjust costs for bituminous material incorporated into the job during the following month (for example; bituminous material used in May will be adjusted, as specified herein, based on the “current price” (CP) for May as posted on the last Wednesday of April). Any difference in price between these two values will be applied to the quantity of eligible bituminous material incorporated into the work.

Determination of the eligible quantities of bituminous material will be based on contractor furnished invoices, except as modified below.

The tons of emulsified products to which the adjustment will be applicable will be the tons of the emulsified asphalt prior to dilution.

Adjustments in compensation for emulsified asphalts will be made at 60 percent of either the increase or decrease. For emulsified asphalts containing polymer, adjustments in compensation will be made at 66 percent of either the increase or decrease.

The tons of Bituminous Material (Asphalt Rubber) to which the adjustment will be applicable will be 0.80 multiplied times the total quantity of the item used. The adjustment will not apply to the 20 percent of the material which constitutes the crumb rubber additive.

The tons of bituminous material incorporated in Asphaltic Concrete (Miscellaneous Structural) or Asphaltic Concrete (Miscellaneous Structural Special Mix) to which an adjustment will be applicable shall be as follows:

(A) For mixes without reclaimed asphalt pavement (RAP), the adjustment will be equal to 5 percent of the quantity, measured in tons, of asphaltic concrete placed, regardless of the actual percentage of bituminous material incorporated into the mix;

(B) For mixes with reclaimed asphalt pavement (RAP), the adjustment will be equal to 4 percent of the quantity, measured in tons, of asphaltic concrete placed, regardless of the actual percentage of bituminous material incorporated into the mix; and

(C) If the quantity of asphaltic concrete is measured by volume, the supplemental agreement establishing the method of measurement will specify the manner in which the tons of bituminous material eligible for the adjustment is determined.

The tons of bituminous materials which are paid for on the basis of testing by nuclear asphalt content gauge, ignition furnace, or other approved methods to which the adjustment will be applicable, are the tons which have been incorporated into the mixture.

When reclaimed asphalt pavement (RAP) is used in asphaltic concrete, only the virgin asphalt cement will be subject to a bituminous material price adjustment. RAP binder is not subject to a price adjustment.

No additional compensation will be made for any additional or increased charges, costs, expenses, taxes, etc., which the contractor may have incurred since the time of bidding and which may be the result of any increase in the "initial cost" of bituminous material.

Adjustment in unit prices of items governed by this provision will be made in the next regular monthly progress payment following actual use or application of the bituminous material.

Any adjustment in compensation made for bituminous material incorporated into the work after the expiration of the specified completion time set forth in the contract, or as may be extended in accordance with the provisions of Subsection 108.08 of the specifications, will be on the basis of the price of bituminous material shown on the Department's website and applicable for the date of the expiration of the specified completion time as hereinbefore specified.

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SECTION 407 ASPHALTIC CONCRETE FRICTION COURSE:

407-1 Description:

The work under this section shall consist of constructing Asphaltic Concrete Friction Course, hereinafter asphaltic concrete, by furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture, and bituminous material (asphalt cement) to form a pavement course or to be used for other specified purposes, in accordance with the details shown on the project plans and the requirements of the specifications, and as directed by the Engineer.

407-2 Asphaltic Concrete Mix Design:

Mix designs will be developed on the basis of and tested in accordance with the requirements of Arizona Test Method 814. The allowable range of percent absorbed asphalt shall be 0-1.0, when tested in accordance with Arizona Test Method 806.

407-3 Materials:

407-3.01 Mineral Aggregate:

The contractor shall provide a source of mineral aggregate in accordance with the requirements of Section 1001 of the specifications.

When the contractor selects a source or sources, it shall notify the Engineer. The contractor shall be solely responsible for assuring that the mineral aggregate meets all requirements and, when processed, is fully capable of providing asphaltic concrete which meets all the requirements of these specifications.

Mineral aggregate shall be separated into at least two stockpiles. No individual stockpile or hot bin usage shall be less than 3 percent of the total mineral aggregate.

Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert materials with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Fine mineral aggregate or blend material shall consist of natural sand, sand prepared from rock, or other approved inert materials, or a combination thereof, conforming to the requirements of these specifications.

Mineral aggregate furnished for mix designs shall be representative of the source(s) and sampled from the material stockpiles to be used in asphaltic concrete production. Mix designs shall conform to the grading limits in Table 407-1, when tested in accordance with Arizona Test Method 201.

TABLE 407-1
MIX DESIGN GRADING LIMITS

Sieve Size	Percent Passing	
	Without Admixture	With Admixture
3/8 Inch	100	100
No. 4	35 – 55	36 – 55
No. 8	9 – 14	10 – 15
No. 200	0 – 2.0	0 – 3.0

Mineral aggregate shall conform to the requirements in Table 407-2 when tested in accordance with the applicable test methods.

Tests on aggregates outlined in Table 407-2, other than abrasion, shall be performed on materials furnished for mix design purposes and composited to the mix design gradation. Abrasion shall be performed separately on samples from each source of mineral aggregate. All sources shall meet the requirements for abrasion.

TABLE 407-2 MINERAL AGGREGATE CHARACTERISTICS		
Characteristic	**Test Method**	**Requirement**
Combined Bulk Oven Dry Specific Gravity	Arizona Test Method 251	2.350 – 2.850
Combined Water Absorption	Arizona Test Method 251	0 – 2.5%
Sand Equivalent	Arizona Test Method 242 (After thoroughly sieving the sample, no additional cleaning of the fines from the plus No. 8 material is required.)	Minimum 55
Fractured Coarse Aggregate Particles	Arizona Test Method 212	Minimum 85% (at least two fractured faces) and minimum 92% (at least one fractured face)
Flakiness Index	Arizona Test Method 233	Maximum 25%
Carbonates	Arizona Test Method 238	Maximum 20%
Abrasion	AASHTO T 96	100 Rev., Max. 9% 500 Rev., Max. 40%

407-3.02 Mineral Admixture:

Mineral admixture will be required. The amount used shall be 1.0 percent, by weight of the mineral aggregate. Mineral admixture shall be either Portland cement, blended hydraulic cement, or hydrated lime conforming to the requirements of Table 407-3.

TABLE 407-3 MINERAL ADMIXTURE	
Material	**Requirement**
Portland Cement, Type I or II	ASTM C150
Blended Hydraulic Cement, Type IP	ASTM C595
Hydrated Lime	ASTM C1097

Certification and acceptance of Portland cement, blended hydraulic cement, and hydrated lime shall be in accordance with ADOT Materials Practice and Procedure Directive No. 13, "Certification and Acceptance of Hydraulic Cement, Fly Ash, Natural Pozzolan, Silica Fume, and Lime".

407-3.03 Bituminous Material:

Asphalt cement shall be a performance grade (PG) asphalt binder, conforming to the requirements of Section 1005 of the specifications. The type of asphalt binder shall be as shown in the Special Provisions.

The percent of asphalt cement used shall be based on the weight of total mix (asphalt cement, mineral aggregate, and mineral admixture).

The percent of asphalt cement to be used will be specified by the Engineer.

407-4 Mix Design:

Approximately 300 pounds of produced mineral aggregate, in proportion to the anticipated percent usage, shall be obtained by the contractor and witnessed by the Engineer so that both parties are satisfied that samples are representative of the mineral aggregate to be utilized in the asphaltic concrete production.

In addition to the mineral aggregate samples, the contractor shall also furnish the Engineer with representative samples of the following materials: 3 gallons of asphalt cement from the intended supplier, and a 1-gallon can of the proposed mineral admixture. These materials must be representative of the material which will subsequently be used in the production of asphaltic concrete.

If the mineral aggregate does not meet the requirements of Subsection 407-3.01 of the specifications, no mix design will be prepared. The contractor shall take the necessary steps to provide material meeting the specified requirements.

Along with the samples furnished for mix design testing, the contractor shall submit a letter explaining in detail its methods of producing mineral aggregate including wasting, washing, blending, proportioning, etc., and any special or limiting conditions it may propose. The contractor's letter shall also state the source(s) of mineral aggregate, the source and type of asphalt cement, and the source and type of mineral admixture.

Within 10 working days of receipt of all samples and the contractor's letter in the Central Laboratory, the Department will provide the contractor with a mix design containing the type, source, and percentage of asphalt cement; the type, source, and percentage of mineral admixture; the source(s) of mineral aggregate and the percentage from each stockpile; the composite mineral aggregate gradation; the combined mineral aggregate and mineral admixture gradation; and any special or limiting conditions.

The contract time established for the completion of the work includes 10 working days for the required testing and the developing of the approved mix design.

Asphaltic concrete friction course production shall not begin until there is an approved mix design.

The contractor may propose the use of a mix design that has been developed for a previous project. The proposed mix design shall meet the requirements of these specifications. The contractor shall provide evidence that the type and source of bituminous material, the type of mineral admixture, and the source and methods of producing mineral

aggregate have not changed since the formulation of the previous mix design. The contractor shall also provide current test results for all specified characteristics of the mineral aggregate proposed for use. The Engineer will determine if the previously used mix design is suitable for the intended use and if the previous use of the mix design was satisfactory to the Department. The Engineer will either approve or disapprove the proposed mix design. Should the Engineer disapprove the use of the previously used mix design, the contractor shall prepare and submit a new mix design proposal in accordance with the requirements of these specifications.

A previously used mix design older than two years from the date it was formulated, sealed, signed, and dated shall not be allowed for use. Once approved for use on a project, a mix design may be used for the duration of the project.

407-5 Mix Design Revisions:

At any time after production of asphaltic concrete has been started using the approved mix design, changes may be proposed by the contractor or directed by the Engineer.

The contractor shall not change its methods of crushing, screening, washing, or stockpiling from those used during production of material used for mix design purposes without approval of the Engineer, or without requesting a new mix design.

If the contractor elects to change its source or type of bituminous material, the type of mineral admixture, or the source(s) of mineral aggregate, or if the contractor adds or deletes the use of a mineral aggregate stockpile(s) regardless of source, testing to the extent deemed necessary by the Engineer will be performed in order that the Engineer may be satisfied that the mix design criteria will be met.

During production of asphaltic concrete the contractor, on the basis of field test results, may request a change to the approved mix design. The Engineer will evaluate the proposed changes and notify the contractor of the Engineer's decision within two working days of the receipt of the request.

If, at any time, unapproved changes are made by the contractor in the source or type of bituminous material, source(s) of mineral aggregate, production methods, or proportional changes in violation of approved mix design stipulations, production shall cease until a new mix design is developed at no additional cost to the Department, or the contractor complies with the approved mix design.

At any time after the mix design has been approved, the contractor may request a new mix design. The costs associated with the testing of materials in the developing of mix designs requested by the contractor

after a mix design acceptable to the Department has been developed shall be borne by the contractor.

If the Engineer determines that a new mix design is necessary due to changes in mineral aggregate characteristics or gradation, costs associated with the development of the new mix design shall be borne by the contractor.

A new mix design can be developed by the Engineer at any time the Engineer deems necessary. Should such a new mix design require revisions to the contractor's operations which result in additional cost to the contractor, it will be reimbursed for these costs. However, the Engineer reserves the right to modify the asphalt cement content without compensation being made to the contractor involving additional operation costs.

407-6 Acceptance of Materials:

407-6.01 General:

The contractor's attention is directed to the requirements of Subsection 105.13 of the specifications.

If the production of asphaltic concrete is stopped either for failure to meet the requirements specified in Subsection 407-6.03 of the specifications or because changes are made in the mix design, samples will be taken for calculating new consecutive averages either after production resumes or after the changes in the mix design have been made. The acceptance of the mineral aggregate gradation and the bituminous material content will be determined on the basis of the tests as specified in Subsection 407-6.03 of the specifications. The Engineer reserves the right to increase the frequency of sampling and testing upon the resumption of asphaltic concrete production.

407-6.02 Mineral Aggregate:

Aggregate shall be free of deleterious materials, clay balls, and adhering films or other material that prevent thorough coating of the aggregate with the bituminous material.

Prior to and during asphaltic concrete production, the Engineer shall obtain and test samples of mineral aggregate for determination of the sand equivalent, fractured coarse aggregate particles, and flakiness index. Samples shall be obtained from the cold feed belt prior to the addition of mineral admixture, or from the stockpiles when sampling from the cold feed belt is not possible. Should such testing indicate results not meeting the requirements of Table 407-2 for sand equivalent, fractured coarse aggregate particles, and flakiness index, operations shall cease and the contractor shall have the option of requesting a new mix design or correcting deficiencies in the aggregate stockpiles.

407-6.03 Asphaltic Concrete:

(A) Mineral Aggregate Gradation:

Prior to the initial startup of asphaltic concrete production, and prior to startup after any subsequent mix design revisions affecting gradation, a sample of the combined mineral aggregate shall be tested. The mineral aggregate shall meet the gradation requirements for the three consecutive test limits indicated below. If the mineral aggregate does not meet these requirements, production shall not begin until the mineral aggregate is in compliance with this requirement.

For each approximate 500 tons of asphaltic concrete produced, at least one sample of mineral aggregate will be taken. Samples will be taken in accordance with the requirements of Arizona Test Method 105 on a random basis. For batch plants, the sample shall be taken from the hot bins. For plants other than batch plants, the sample shall be taken from the cold feed belt. Samples will be taken by means of a sampling device which is capable of obtaining representative samples. The device, which shall be approved by the Engineer, shall be furnished by the contractor. In any shift that the production of asphaltic concrete is less than 500 tons, at least one sample will be taken.

Samples will be tested for conformance to the mix design gradation, with or without mineral admixture as appropriate, in accordance with the requirements of Arizona Test Method 201.

The gradation will be considered to be acceptable unless the average of any three consecutive tests or the result of any single test varies from the mix design gradation percentages as follows:

Passing Sieve	Number of Tests	
	Three Consecutive	One
No. 4	± 4	± 6
No. 8	± 4	± 6
No. 200	± 1.5	± 2.0

One hundred percent of the material shall pass the 3/8-inch sieve.

At any time that test results indicate that the gradation does not fall within all of the limits indicated, the production of asphaltic concrete shall cease immediately and shall not begin again until a calibration test indicates that the gradation is within the three consecutive test limits indicated.

(B) Bituminous Material Content:

During production of asphaltic concrete, the contractor shall maintain at the plant site a nuclear asphalt content gauge calibrated and operated in accordance with Arizona Test Method 421. At the discretion of the Engineer, the Department may choose to prepare the calibration samples

for use by the contractor. Under the observation of the Engineer, the contractor shall determine the asphalt content by means of the nuclear asphalt content gauge a minimum of four times per full shift. The Engineer shall determine the times that the samples are taken. The contractor's technicians performing the testing, including the calibration of the nuclear gauge, shall meet the technician requirements given in ADOT Materials Practice and Procedure Directive No. 19, "ADOT System for the Evaluation of Testing Laboratories".

Production of asphaltic concrete shall cease immediately and the plant and/or the nuclear asphalt content gauge re-calibrated if any single test result varies by an amount greater than ± 0.60, or the average of three consecutive test results varies by an amount greater than ± 0.40, from the amount directed by the Engineer. Material that has already been produced may be used on the project if the single test value representative of that material varies by an amount from ± 0.61 to ± 0.75, inclusive, from the amount directed by the Engineer. Material that has already been produced may not be used on the project if the single test value representative of that material varies by an amount greater than ± 0.75 from the amount directed by the Engineer unless, by retesting, the material is found to be acceptable.

407-6.04 Material Spread:

The estimated target spread rate will be as shown in the table in Subsection 407-3 of the specifications. The Engineer may adjust the estimated target spread rate, and establish a new target spread rate, as necessary to maintain a suitable thickness.

The thickness behind the screed shall be measured by the contractor continuously throughout each spread lot to ensure that the minimum compacted thickness specified in Subsection 407-3 of the specifications is being met.

A spread lot shall be considered to be one-half shift of production. The contractor shall record information pertaining to each spread lot on forms provided by the Engineer. Information shall include the project number, date and period of time that each spread lot was placed, the spread lot number, beginning and ending station, the plans thickness, target spread rate, and tons placed in each spread lot. Completed spread lot forms shall be signed by the contractor and given to the Engineer at the end of each shift.

The Engineer will calculate the quantity required in each spread lot using the target spread rate.

The calculated quantity required in each spread lot will be compared to the actual quantity placed. A spread lot will be considered to be acceptable if the actual quantity placed does not vary by more than +5.0 percent from the required quantity.

407-7 Construction Requirements:

407-7.01 Quality Control:

Quality control of mineral aggregate production and asphaltic concrete production shall be the responsibility of the contractor. The contractor shall perform sufficient testing to assure that mineral aggregate and asphaltic concrete are produced which meet all specified requirements. The Engineer reserves the right to obtain samples of any portion of any material at any point of the operations for the Engineer's own use.

407-7.02 Stockpiling:

The contractor will not be allowed to feed the hot plant from stockpiles containing less than two full days of production unless only two days production remain to be done or special conditions exist where the Engineer deems this requirement waived.

Mineral aggregate shall be separated and stockpiled so that segregation is minimized. An approved divider of sufficient size to prevent intermingling of stockpiles shall be provided.

407-7.03 Proportioning, Drying, Heating, and Mixing:

The asphaltic concrete hot plant shall conform to the requirements of Section 403 of the specifications.

Unless approved by the Engineer, no individual mineral aggregate stockpile or hot bin usage shall be less than 3 percent of the total mineral aggregate.

No fine material which has been collected in the dust collection system shall be returned to the mixture unless the collected fines are accurately and uniformly metered into the mixture.

The moisture content of the asphaltic concrete shall not exceed 0.5 percent. The moisture content will be determined in accordance with the requirements of Arizona Test Method 406.

The temperature of asphaltic concrete or mineral aggregate upon discharge from the dryer shall not exceed 275 degrees F (325 degrees F when PG TR+ asphalt cement is used), unless otherwise approved by the Engineer.

407-7.04 Placing and Finishing:

(A) General Requirements:

The handling of asphaltic concrete shall at all times be such as to minimize segregation. Any asphaltic concrete which displays segregation shall be removed and replaced.

All wheels and tires of compactors shall be wetted with water, or if necessary soapy water, or a release agent in order to prevent the sticking of asphaltic concrete. All other equipment surfaces shall be treated when necessary with a release agent. Only release agents evaluated through NTPEP are acceptable for use. The results from NTPEP testing, when tested in accordance with AASHTO TP 102, shall meet the following criteria:

RELEASE AGENT TEST	REQUIREMENT
Asphalt Stripping Test Diluted Non-Diluted (Full Strength)	 No Stripping No Stripping
Mixture Slide Test	10 g Retained, Max.
Asphalt Performance Test	Less than or equal to 10.0% after the third cycle

Release agents which degrade, dissolve, or in any way damage the bituminous material shall not be used. Diesel fuel shall not be used as a release agent.

Before asphaltic concrete is placed, the surface to be paved shall be cleaned of all objectionable material and tacked with bituminous material in accordance with the requirements of Section 404 of the specifications.

Unless otherwise specified on the project plans, asphaltic concrete shall not be placed on the 2-foot widened section where guardrail is to be installed.

(1) Placement Dates and Weather Requirements:

Asphaltic concrete shall be placed when the temperature of the surface on which the asphaltic concrete is to be placed is at least 85 degrees F and the ambient temperature at the beginning of placement is at least 70 degrees F and rising. The placement shall be stopped when the ambient temperature is 75 degrees F or less and falling. Night time placement may occur during falling temperature if the low temperature is 70 degrees F or higher.

No placement of asphaltic concrete shall occur if ambient temperatures are forecasted to be at or below 40 degrees F at any time during the day or night after placement.

No placement of asphaltic concrete shall occur if ambient temperatures exceed, or are forecasted to exceed, 110 degrees F the day before, the day of, or the day after paving.

No placement of asphaltic concrete shall occur if sustained wind speeds in excess of 15 MPH are forecast on the day of the scheduled placement. However, the Engineer may allow placement of asphaltic concrete during high wind conditions if the ambient temperature is 85 degrees F and rising.

No asphaltic concrete placement shall take place if rain occurs at any time in the two days prior to the scheduled placement of the asphaltic concrete, nor shall placement be expected to occur if rain is forecast during the proposed day of placement. However, at the discretion of the Engineer, placement may commence if actual conditions are conducive to placement.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions are anticipated to have an adverse effect upon the asphaltic concrete.

Unless otherwise directed by the Engineer, no traffic (including construction traffic, with the exception of required striping equipment) shall be allowed on the AR-ACFC overlay until at least eight hours after the placement of AR-ACFC. The Engineer may reduce this time for materials placed on ramps and auxiliary lanes, or for traffic related purposes. Prior to opening to any traffic, the Engineer may require up to three applications of lime water (a minimum of 50 pounds of lime per 2,000 gallons of water). Reasons may include, but are not limited to, opening prior to the eight hour curing time, or ambient temperatures above 100 degrees F. Lime water shall be applied in a manner that uniformly covers the entire surface of the paving pass. No separate payment will be made for lime water or its application, the cost being considered as included in this contract item.

The contractor shall prepare their bid submittal and initial construction schedule, submitted at the Preconstruction Conference as described in Subsection 108.03 of the specifications, based on the following beginning and ending dates for asphaltic concrete production.

Average Elevation of Project, Feet	**Beginning and Ending Dates**
0 – 3499	March 15 – May 31
0 – 3499	September 1 – October 31
3500 – 4999	April 15 – October 15
5000 – 5999	June 1 – September 15
6000 and over	June 1 – August 15

Any proposed placement deviating from the beginning and ending days shall be detailed in the written schedule of construction submitted at the weekly meeting described in Subsection 108.04 of the specifications.

No contract time extension will be granted for placement outside of the beginning and ending dates. Any placement deviating from the beginning and ending dates shall be at the sole risk of the contractor.

(2) Delivery to Screed Unit:

Asphaltic concrete delivered to the screed unit shall be a free flowing, homogeneous mass in which there is no segregation, crusts, lumps, or migration of the bituminous material. Should any of these conditions be evident in the material delivered to the screed unit, the contractor shall take the necessary corrective action to eliminate such conditions. If any of these conditions persist, the Engineer will order the work to be stopped until satisfactory corrective action has been taken.

(B) Loading Material into the Paving Machine:

If the asphaltic concrete is dumped directly into the paving machine from the hauling trucks, care shall be taken to avoid jarring the machine or moving it out of alignment. No vertical load shall be exerted on the paving machines by the trucks. Trucks, while dumping, shall be securely attached to the paving machine.

If the asphaltic concrete is dumped upon the surface being paved and subsequently loaded into the paving machine, it shall not be dumped at a distance greater than 150 feet in front of 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 asphaltic concrete shall be picked up and loaded into the paving machine.

(C) Placing and Finishing Asphaltic Concrete by Means of Self-Propelled Paving Machines:

All courses of asphaltic concrete shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the Engineer deems the use of self-propelled paving machines impractical.

In order to achieve, as far as practical, a continuous operation, the speed of the paving machine shall be coordinated with the production of the plant.

Self-propelled paving machines shall spread the mixture within the specified tolerances, without segregation or tearing, true to the line, grade, and crown indicated on the project plans. Pavers shall be equipped with hoppers and augers which will distribute the mixture uniformly in front of adjustable screeds.

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.

Tapered sections not exceeding 8 feet in width, or widened sections not exceeding 4 feet in width may be placed and finished by other means approved by the Engineer.

(D) Automatically Actuated Control System:

Except under certain conditions or at certain locations where the Engineer deems the use of automatic controls impractical, asphaltic concrete shall be placed and finished by means of self-propelled paving machines equipped with an automatically actuated control system.

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, alternately when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with the following devices which shall be furnished with the machine:

(1) Ski-type device at least 30 feet in length, supported throughout its entire length; and

(2) Short ski.

Failure of the control system to function properly shall be cause for the suspension of the asphaltic concrete operations.

407-7.05 Joints:

Longitudinal joints shall be staggered a minimum of 1 foot with relation to the longitudinal joint of the immediate underlying course.

The contractor shall schedule its paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the contractor shall limit the placement of asphaltic concrete courses, in advance of adjacent courses, to one shift of asphaltic concrete production. The contractor shall schedule its paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

Longitudinal joints shall be located within 1 foot of the centerline between two adjacent lanes.

407-7.06 Compaction:

(A) General Requirements:

The temperature of the asphaltic concrete just prior to compaction shall be at least 200 degrees F (250 degrees F when PG TR+ asphalt cement is used).

(B) Equipment:

Compacting and smoothing shall be accomplished by the use of static steel wheel compactors. Vibrator compactors may be used in the static mode only. The compactors shall be self-propelled and shall be operated with the drive wheel in the forward position. A minimum of three compactors shall be provided; however, sufficient compactors shall be provided so that the drums of the compactors when staggered will cover the entire width of the paving machine during initial breakdown.

Compactors shall be operated in accordance with the manufacturer's recommendations. Compactors shall be designed and properly maintained so that they are capable of accomplishing the required compaction.

Compactors shall weigh not less than 8 tons.

(C) Rolling Procedure:

A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

Compaction shall consist of the following rolling sequence:

Rolling Sequence	Number of Coverages
Initial	1
Finish	1 – 2

A sufficient number of compactors shall be used for initial breakdown so that when the compactors are staggered the entire width of the mat being laid is compacted with one forward pass of the compactors. The distance between the paving machine and the initial rolling shall not exceed 200 feet.

A separate roller(s) shall be used for final compaction. The roller(s) used for final compaction shall follow as closely behind the initial breakdown rollers as possible.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified,

ballasted and operated in accordance with the manufacturer's recommendations and with the number of coverages of the compactors as specified.

407-7.07 Compacting Miscellaneous Items and Surfaces:

Asphaltic concrete used in the construction of miscellaneous items and surfaces shall be compacted using compactors, hot-hand tampers, smoothing irons, mechanical vibrating hand tampers, or with other devices to the extent considered necessary by the Engineer.

407-7.08 Smoothness and Surface Tolerances:

Asphaltic concrete shall be compacted as required, smooth and true to the required lines, grades, and dimensions.

The Special Provisions may require the smoothness of the final pavement surface to be tested in accordance with Subsection 109.13 of the specifications.

Regardless of whether testing in accordance with Subsection 109.13 of the specifications is specified or not, the following requirements shall be met:

(A) The finished asphaltic concrete surface shall be tested and shall not vary by more than 1/8 inch from the lower edge of a 10-foot straightedge when it is placed in the longitudinal direction (including across transverse joints), and when it is placed in the transverse direction across longitudinal joints; and

(B) All deviations exceeding the specified tolerances above shall be corrected by the contractor, to the satisfaction of the Engineer.

407-7.09 Acceptance:

Asphaltic concrete will be accepted complete in place if, in the judgment of the Engineer, the asphaltic concrete reasonably conforms to the requirements specified herein. Asphaltic concrete that is not acceptable and is rejected shall be replaced to the satisfaction of the Engineer and at no additional cost to the Department.

407-8 Method of Measurement:

Asphaltic concrete will be measured by the ton for the mixture actually used, which will include the weight of mineral aggregate, bituminous material, and mineral admixture. Measurement will include any weight used in construction of intersections, turnouts, miscellaneous items, or other surfaces.

Asphalt cement will be measured by the ton.

Mineral admixture will be measured by the ton for the mineral admixture actually used in accordance with Subsection 403-2 of the specifications.

407-9 Basis of Payment:

The accepted quantities of asphaltic concrete, measured as provided above, will be paid for at the contract unit price per ton, adjusted if necessary for spread, which price shall be full compensation for the work, complete in place, as specified herein.

If the quantity in a spread lot is found to vary by more than +5.0 percent from the required quantity, as determined in accordance with Subsection 407-6.04 of the specifications, no payment will be made for the material which exceeds the +5.0 percent, including asphalt cement and mineral admixture.

The Engineer may exclude asphaltic concrete from the spread lot if the Engineer determines that the proposed use of the material or the existing surface conditions are not conducive to the use of spread lots.

Payment for asphalt cement will be made by the ton. The results of a nuclear asphalt content gauge shall not be used to determine the weight of asphalt cement as the basis of payment. Adjustments in payment shall be made in accordance with the requirements of Subsection 1005-3.01 of the specifications.

Mineral admixture will be paid for at the predetermined price established in the Bidding Schedule.

When required in the Special Provisions, payment for smoothness shall be made in accordance with the requirements of Subsection 109.13 of the specifications.

When lime water is used, no separate payment will be made for the lime water or its application, the cost being considered as included in this contract item.

SECTION 408 COLD RECYCLING (BITUMINOUS SURFACE)

408-1 Description:

The work under this section shall consist of furnishing all materials and reclaiming (milling) a portion of the existing asphaltic concrete pavement, or utilizing stockpiled reclaimed asphalt pavement, sizing the material, and mixing the material with an engineered emulsion, water, and other additives as necessary and as required by the mix design, to produce a homogeneous recycled asphalt mixture which is placed and

SECTION 409 ASPHALTIC CONCRETE (MISCELLANEOUS STRUCTURAL):

409-1 Description:

The work under this section shall consist of constructing Asphaltic Concrete (Miscellaneous Structural), hereinafter asphaltic concrete, by furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, reclaimed asphalt pavement (RAP) if used, mineral admixture, and bituminous material (asphalt cement) to form a pavement course or to be used for other specified purposes, in

accordance with the details shown on the project plans and the requirements of the specifications, and as directed by the Engineer.

The contractor shall acquire and make all arrangements for a source or sources of material, furnish a mix design which will meet the design criteria specified hereinafter, and provide all the equipment, materials, and labor necessary to complete the work.

409-2 Materials:

409-2.01 Mineral Aggregate:

Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

Mineral Aggregate Characteristics	Test Method	Requirement
Combined Bulk Oven Dry Specific Gravity	Arizona Test Method 251	2.350 - 2.850
Combined Water Absorption	Arizona Test Method 251	0 - 2.5%
Abrasion	AASHTO T 96	100 Rev., Max 9% 500 Rev., Max 40%
Sand Equivalent	AASHTO T 176 (After thoroughly sieving the sample, no additional cleaning of the fines from the plus No. 4 material is required.)	Minimum 55
Fractured Coarse Aggregate Particles	Arizona Test Method 212	Minimum 70% (plus No. 4 material)
Carbonates (1)	Arizona Test Method 238	Maximum 20%

Notes:

(1) Testing for carbonates only applies if either of the following conditions exist:

(a) The asphaltic concrete is the designed final pavement surface normally used by traffic; or

(b) The asphaltic concrete, temporary or otherwise, will be subject to traffic for more than 60 days.

The gradation will be determined in accordance with Arizona Test Method 201, and shall conform to the requirements given below.

Mix Design Grading Limits						
Sieve Size	Percent Passing					
	Lift Thickness Less Than 1½ Inches		Lift Thickness 1½ to 2 Inches		Lift Thickness Greater Than 2 Inches	
	Without Admixture	With Admixture	Without Admixture	With Admixture	Without Admixture	With Admixture
1 Inch					100	100
3/4 Inch			100	100	90-100	90-100
1/2 Inch	100	100	90-100	90-100	---	---
3/8 Inch	90-100	90-100	70-85	70-85	70-85	70-85
No. 8	41-55	42-56	41-51	42-52	41-51	42-52
No. 40	9-19	10-20	---	---	---	---
No. 200	2.0-5.0	3.0-6.5	2.0-5.0	3.0-6.5	2.0-5.0	3.0-6.5

409-2.02 Bituminous Material:

Asphalt cement shall be a performance grade (PG) asphalt binder conforming to the requirements of Section 1005 of the specifications. The type of asphalt binder shall be as shown in the Special Provisions.

The percent of asphalt cement used shall be based on the weight of total mix (asphalt cement, mineral aggregate, and mineral admixture).

The contractor shall provide the laboratory mixing and compaction temperature ranges to the mix design laboratory for each PG asphalt binder used for mix design purposes. The laboratory mixing temperature range is defined as the range of temperatures where the un-aged asphalt binder has a rotational viscosity of 0.17 ± 0.02 Pascal·seconds, measured in accordance with AASHTO T 316. The laboratory compaction temperature range is defined as the range of temperatures where the un-aged asphalt binder has a rotational viscosity of 0.28 ± 0.03 Pascal·seconds, measured in accordance with AASHTO T 316. The testing required in AASHTO T 316 shall be performed at 275 degrees F and 350 degrees F, and a viscosity-temperature curve developed in accordance with ASTM D2493. The viscosity-temperature curve shall be included in the mix design report. For PG asphalt binders that have a maximum laboratory mixing temperature exceeding 325 degrees F or a maximum laboratory compaction temperature exceeding 300 degrees F, the laboratory mixing and compaction temperature ranges shall be specified in writing by the asphalt binder supplier. The laboratory mixing and compaction temperature ranges, as well as the actual laboratory mixing and compaction temperatures used, shall be reported on the mix design. The contractor shall ensure that the asphalt binder supplier information required in this paragraph is provided to all appropriate parties in a timely manner, and that copies are included in the mix design report. The laboratory mixing and compaction temperatures are for mix design purposes only. Field mixing and compaction temperatures are specified in Subsection 409-3 of the specifications.

409-2.03 Mineral Admixture:

Mineral admixture shall be either Portland cement, blended hydraulic cement, or hydrated lime conforming to the following requirements:

Material	Requirement
Portland Cement, Type I or II	ASTM C150
Blended Hydraulic Cement, Type IP	ASTM C595
Hydrated Lime	ASTM C1097

The mineral admixture content shall be 2.0 percent, by weight, of the mineral aggregate. However, a minimum of 1.0 percent mineral admixture may be used if the contractor submits test information showing a lowered percentage of mineral admixture produces mix design results for Index of Retained Strength of at least 60 percent and a Minimum Wet Strength of 150 pounds per square inch when tested in accordance with Arizona Test Method 802.

The certification and acceptance of Portland cement, blended hydraulic cement, and hydrated lime shall be in accordance with ADOT Materials Practice and Procedure Directive No. 13, "Certification and Acceptance of Hydraulic Cement, Fly Ash, Natural Pozzolan, Silica Fume, and Lime".

409-2.04 Mix Design:

Utilizing mineral aggregate which has been crushed, processed, separated, and stockpiled, a mix design shall be formulated and submitted by the contractor to the Engineer. The mineral aggregate samples used for mix design purposes shall be representative of aggregate materials to be used during production.

The mix design shall be based on the mix design criteria and other requirements specified herein, utilizing asphalt cement and mineral admixture of the type and from the sources proposed for use in the production of asphaltic concrete.

The mix design shall be prepared by or under the direct supervision of a professional engineer experienced in the development of mix designs and mix design testing. Reclaimed asphalt pavement (RAP) may be used in the mixture if properly designed per Arizona Test Method 833; however, RAP will not be allowed in the mixture when asphalt cement type PG 76 22 TR+ or PG 70 22 TR+ is specified in Subsection 409-2.02 of the specifications. Limits for the usage of RAP shall be per ADOT Materials Practice and Procedure Directive No. 20, “Guidance on the Use of Reclaimed Asphalt Pavement (RAP) in Asphaltic Concrete”. The mix design engineer shall meet the requirements given in ADOT Materials Practice and Procedure Directive No. 4, “Asphaltic Concrete Mix Design Proposals and Submittals”. The mix design shall be provided in a format that clearly indicates all the mix design requirements and shall be sealed, signed, and dated by the mix design engineer.

The mix design shall be prepared by a mix design laboratory that has met the requirements of ADOT Materials Practice and Procedure Directive No. 19, "ADOT System for the Evaluation of Testing Laboratories".

If approved by the Engineer, as an alternative to meeting the mix design requirements specified herein, a 1/2 inch or 3/4 inch mix design meeting the requirements of either Section 416 or Section 417 of the specifications may be substituted for use. The type of asphalt binder used in the alternative mix design must be the same as that specified in Subsection 409-2.02 of the specifications. The alternative mix design may include reclaimed asphalt pavement (RAP) if properly designed per Arizona Test Method 833. The lift thickness for the alternative mix design shall conform to the following table.

Alternative Mix Design	Minimum Lift Thickness
Section 416 (1/2 inch mix)	1-1/2 inches
Section 416 (3/4 inch mix)	2 inches
Section 417 (1/2 inch mix)	2 inches
Section 417 (3/4 inch mix)	2-1/2 inches

The contractor may propose the use of a mix design that has been developed for a previous project. The proposed mix design shall meet the requirements of these specifications. The contractor shall provide evidence that the type and source of bituminous material, the type of mineral admixture, and the source and methods of producing mineral aggregate, and RAP material if applicable, have not changed since the formulation of the previous mix design. The contractor shall also provide current test results for all specified characteristics of the mineral aggregate, and RAP material if applicable, proposed for use. The Engineer will determine if the previously used mix design is suitable for the intended use and if the previous use of the mix design was satisfactory to the Department. The Engineer will either approve or disapprove the proposed mix design. Should the Engineer disapprove the use of the previously used mix design, the contractor shall prepare and submit a new mix design proposal in accordance with the requirements of these specifications.

A previously used mix design older than two years from the date it was formulated, sealed, signed, and dated shall not be allowed for use. Once approved for use on a project, a previously used mix design may be used for the duration of that project.

Test results used in the formulation of the mix design must be from testing performed no earlier than 45 days prior to the date the mix design is signed by the mix design engineer. Historical abrasion values may be supplied on sources provided the testing was conducted within the past two years.

The mix design shall be submitted to the Engineer under a cover letter signed by an authorized representative of the contractor.

The mix design shall be submitted to the Engineer for review a minimum of five working days prior to the start of production.

The mix design shall meet the following criteria when tested in accordance with the requirements of the following test methods:

Criteria	Requirement	Arizona Test Method
1.Voids in Mineral Aggregate: %, Range	14.5 - 18.5	(See Note 1)
2.Effective Voids: %, Range	5.3 - 5.7	(See Note 1)
3. Absorbed Asphalt: %, Range	0 - 1.0	(See Note 1)
Note: (1) For mixes without RAP, Arizona Test Method 815. For mixes with RAP, Arizona Test Method 833.		

The Engineer reserves the right to adjust the asphalt content during production from the mix design value without additional compensation to the contractor in order to obtain desirable effective voids.

409-2.05 Sampling and Testing:

Sampling and testing the materials and mixture for quality control purposes shall be the contractor's responsibility. The contractor shall perform sufficient testing to assure that mineral aggregate and asphaltic concrete are produced which meet all specified requirements. The Engineer reserves the right to sample and test the materials and mixture when necessary to determine that they reasonably conform to the requirements specified herein.

409-3 Construction Requirements:

409-3.01 General:

All courses of asphaltic concrete shall be compacted as required, smooth and true to the required lines, grades, and dimensions.

The following smoothness requirements shall be met:

(A) The surface of the final lift of asphaltic concrete placed under this section of the specifications shall be tested and shall not vary by more than 1/8 inch from the lower edge of a 10-foot straightedge when it is placed in the longitudinal direction (including across transverse joints), and when it is placed in the transverse direction across longitudinal joints;

(B) The surface of any lift of asphaltic concrete placed under this section of the specifications, other than the final lift, shall be tested and shall not vary by more than 1/4 inch from the lower edge of a 10-foot straightedge when it is placed in the

longitudinal direction (including across transverse joints), and when it is placed in the transverse direction across longitudinal joints; and

(C) All deviations exceeding the specified tolerances above shall be corrected by the contractor, to the satisfaction of the Engineer.

The asphaltic concrete hot plant shall conform to the requirements of Section 403 of the specifications.

No fine material which has been collected in the dust collection system shall be returned to the mixture unless the collected fines are accurately and uniformly metered into the mixture.

The temperature of asphaltic concrete or mineral aggregate upon discharge from the drier shall not exceed 325 degrees F, unless a higher temperature is recommended in writing by the asphalt binder supplier and approved by the Engineer.

The moisture content of the asphaltic concrete immediately behind the paver shall not exceed 0.5 percent. The moisture content will be determined in accordance with the requirements of Arizona Test Method 406.

Asphaltic concrete shall be placed only when the temperature of the surface on which the asphaltic concrete is to be placed is at least 65 degrees F.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions, either existing or expected, are anticipated to have an adverse effect upon the asphaltic concrete.

All wheels and tires of compactors shall be wetted with water, or if necessary soapy water, or a release agent in order to prevent the sticking of asphaltic concrete. All other equipment surfaces shall be treated when necessary with a release agent. Only release agents evaluated through NTPEP are acceptable for use. The results from NTPEP testing, when tested in accordance with AASHTO TP 102, shall meet the following criteria:

RELEASE AGENT TEST	REQUIREMENT
Asphalt Stripping Test Diluted Non-Diluted (Full Strength)	 No Stripping No Stripping
Mixture Slide Test	10 g Retained, Max.
Asphalt Performance Test	Less than or equal to 10.0% after the third cycle

Release agents which degrade, dissolve, or in any way damage the bituminous material shall not be used. Diesel fuel shall not be used as a release agent.

Asphaltic concrete immediately behind the laydown machine shall be in a thoroughly mixed, free-flowing, and workable condition, be free of lumps and crusts, and have a minimum temperature of 275 degrees F.

All courses of asphaltic concrete shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the Engineer deems the use of self-propelled paving machines impractical.

The speed of the paving machine shall be coordinated with the production of the plant and an adequate number of trucks for hauling asphaltic concrete shall be available in order to achieve, as far as practical, a continuous operation.

Self-propelled paving machines shall spread the mixture within the specified tolerances, without segregation or tearing, true to the line, grade, and crown indicated on the project plans. Pavers shall be equipped with hoppers and augers which will distribute the mixture uniformly in front of adjustable screeds.

Pavers shall be equipped with a screed for the full width being paved, heated if necessary, and capable of spreading and finishing all courses of asphaltic concrete.

Pavers shall be equipped with automatic screed controls with sensors for either or both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals which operate the screed to maintain the desired grade and transverse slope.

Failure of the control system to function properly shall be cause for the suspension of the placing of asphaltic concrete.

The base or subgrade upon which asphaltic concrete is to be placed shall be prepared and maintained in a firm condition until asphaltic concrete is placed. It shall not be frozen or excessively wet.

Before asphaltic concrete is placed, the surface to be paved shall be cleaned of all objectionable material and tacked with bituminous material in accordance with the requirements of Section 404 of the specifications.

Longitudinal joints of each course shall be staggered a minimum of 1 foot with relation to the longitudinal joint of any immediate underlying course. Longitudinal joints shall be located within 1 foot of the center of a lane or within 1 foot of the centerline between two adjacent lanes.

The contractor shall schedule its paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the contractor shall limit the placement of asphaltic concrete courses, in advance of adjacent courses, to one shift of asphaltic concrete production. The contractor shall schedule its paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

409-3.02 Compaction:

Compaction shall consist of an established sequence of coverage using specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used and the number of coverages required shall be as follows:

Rolling Sequence	Type of Compactor		No. of Coverages	
	Option No. 1	Option No. 2	Option No. 1	Option No. 2
Initial	Static Steel	Vibrating Steel	1	1
Intermediate	Pneumatic Tired	Vibrating Steel	2 - 6*	2 - 4*
Finish	Static Steel	Static Steel	1 - 3	1 - 3
Note: * Based on the roller pattern which exhibits the best performance.				

The Engineer shall select the option for compaction and, when pneumatic-tired compactors are used, will designate the tire pressure.

Steel wheel compactors shall not be used in the vibratory mode for courses of 1 inch or less in nominal thickness nor when the temperature of the asphaltic concrete falls below 180 degrees F. Steel wheel compactors shall weigh not less than 8 tons.

Initial and intermediate compaction shall be completed before the temperature of the asphaltic concrete falls below 200 degrees F. All edges shall be rolled with a pneumatic tired compactor, or other methods approved by the Engineer, while the mixture is still hot.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated as specified and with the number of coverages of the compactors as specified.

409-3.03 Acceptance:

Asphaltic concrete will be accepted complete in place, if, in the judgment of the Engineer, the asphaltic concrete reasonably conforms to the

requirements specified herein. Asphaltic concrete that is not acceptable and is rejected shall be replaced to the satisfaction of the Engineer and at no expense to the Department.

409-4 Method of Measurement:

Asphaltic concrete will be measured by the ton for the mixture actually used, which will include the weight of mineral aggregate, bituminous material, and mineral admixture. Measurement will include any weight used in construction of intersections, turnouts, curbs, spillways and spillway inlets, ditches, catch basin entrances, median strips, sidewalks, or other miscellaneous items or surfaces.

409-5 Basis of Payment:

409-5.01 General:

The accepted quantities of asphaltic concrete, measured as provided above, will be paid for at the contract unit price per ton for the bituminous mixture complete in place.

No direct payment will be made for the bituminous material and mineral admixture in the asphaltic concrete, or the bituminous material for tack coat and application of tack coat, the price being considered as included in the price paid for asphaltic concrete.

Asphaltic concrete may be measured, by volume, upon the execution of a supplemental agreement which will specify the manner in which the volume is determined. The volume will include the volume of mineral aggregate, bituminous material, mineral admixture, and any necessary blending material.

409-5.02 Reduction for Noncompliance:

A reduction in payment to the contractor for asphaltic concrete will be made for quantities of asphalt cement (bituminous material) that do not meet the requirements of Section 1005 as determined by corresponding test results. Adjustments in payment will be made in accordance with the requirements of Table 1005-1 and the following formula:

$$R=(100-P) \times \left[\frac{(CP) \times T}{100}\right]$$

Where: R= Amount of reduction in payment (dollars)

T= Quantity of asphalt cement in failure (tons, rounded to nearest 0.1)

P= Percent of contract unit price allowed (Table 1005-1)

CP= Current Price for asphalt cement (bituminous material), as determined by the Department, for the month in which a deficiency was noted. This value will be posted on the ADOT Contracts and Specifications Group website, on or shortly after the last Wednesday of each month.

SECTION 411 ASPHALTIC CONCRETE FRICTION COURSE (MISCELLANEOUS):

411-1 Description:

The work under this section shall consist of constructing Asphaltic Concrete Friction Course (Miscellaneous), hereinafter asphaltic concrete, by furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture, and bituminous material (asphalt cement) to form a pavement course or to be used for other specified purposes, in accordance with the details shown on the project plans and the requirements of the specifications, and as directed by the Engineer.

411-2 Materials:

For comparative purposes, quantities shown in the bidding schedule have been calculated as shown in the Special Provisions.

411-2.01 Mineral Aggregate:

Mineral aggregate shall be separated into at least two stockpiles. No individual stockpile or hot bin usage shall be less than 3 percent of the total mineral aggregate.

Coarse mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert materials with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

Fine mineral aggregate or blend material shall consist of natural sand or of sand prepared from rock, or other approved inert materials, or a combination thereof, conforming to the requirements of these specifications.

Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

Mineral Aggregate Characteristics	Test Method	Requirement
Abrasion	AASHTO T 96	100 Rev., Max 9% 500 Rev., Max 40%
Sand Equivalent	Arizona Test Method 242 (After thoroughly sieving the sample, no additional cleaning of the fines from the plus No. 8 material is required.)	Minimum 55
Fractured Coarse Aggregate Particles	Arizona Test Method 212	Minimum 85% (at least two fractured faces) and minimum 92% (at least one fractured face)
Flakiness Index	Arizona Test Method 233	Maximum 25%
Carbonates	Arizona Test Method 238	Maximum 20%

The gradation will be determined in accordance with Arizona Test Method 201, and shall conform to the requirements given below.

Sieve Size	Percent Passing	
	Without Mineral Admixture	With Mineral Admixture
3/8 Inch	100	100
No. 4	35 - 60	36 - 60
No. 8	10 - 18	11 - 19
No. 200	0 - 2.5	0 - 3.5

411-2.02 Mineral Admixture:

Mineral admixture will be required. The amount used shall be 1.0 percent, by weight of the mineral aggregate. Mineral admixture shall be either Portland cement, blended hydraulic cement, or hydrated lime conforming to the following requirements:

MINERAL ADMIXTURE	
Material	**Requirement**
Portland Cement, Type I, or Type II	ASTM C150
Blended Hydraulic Cement, Type IP	ASTM C595
Hydrated Lime	ASTM C1097

The certification and acceptance of Portland cement, blended hydraulic cement, and hydrated lime shall be in accordance with ADOT Materials Policy and Procedure Directive No. 13, "Certification and Acceptance of Hydraulic Cement, Fly Ash, Natural Pozzolan, Silica Fume, and Lime".

411-2.03 Bituminous Material:

Asphalt cement shall be a performance grade (PG) asphalt binder conforming to the requirements of Section 1005 of the specifications. The type of asphalt binder shall be as shown in the Special Provisions.

The exact percent of asphalt cement to be used will be specified by the Engineer.

The percent of asphalt cement used shall be based on the weight of total mix (asphalt cement, mineral aggregate, and mineral admixture).

411-2.04 Proportions:

The asphalt cement content will be specified by the Engineer and will be appropriate with the characteristics of the mineral aggregate furnished from which the asphaltic concrete is to be produced.

411-2.05 Sampling and Testing:

Sampling and testing the materials and mixture for quality control purposes shall be the contractor's responsibility. The contractor shall perform sufficient testing to assure that mineral aggregate and asphaltic concrete are produced which meet all specified requirements. The Engineer reserves the right to sample and test the materials and mixture when necessary to determine that the materials and mixture reasonably conform to the requirements specified herein.

411-3 Construction Requirements:

411-3.01 General:

The asphaltic concrete hot plant shall conform to the requirements of Section 403 of the specifications.

Just prior to being placed, the asphaltic concrete shall be in a thoroughly mixed condition, free of lumps and crusts and at such a temperature as to be in a free flowing, workable condition.

Before asphaltic concrete is placed, the surface to be paved shall be cleaned of all objectionable material and tacked with bituminous material in accordance with the requirements of Section 404 of the specifications.

The temperature of asphaltic concrete or mineral aggregate upon discharge from the dryer shall not exceed 275 degrees F, unless otherwise approved by the Engineer.

Asphaltic concrete shall be placed only when the temperature of the surface on which the asphaltic concrete is to be placed is at least 75 degrees F.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions, either existing or expected, are anticipated to have an adverse effect upon the asphaltic concrete.

The asphaltic concrete shall be placed, using approved equipment and methods, to the lines and grades shown on the project plans and as directed by the Engineer.

The contractor shall schedule its paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the contractor shall limit the placement of asphaltic concrete courses, in advance of adjacent courses, to one shift of asphaltic concrete production. The contractor shall schedule its paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

411-3.02 Compaction:

(A) General Requirements:

The temperature of the asphaltic concrete just prior to compaction shall be at least 200 degrees F.

(B) Equipment:

Compacting and smoothing shall be accomplished by the use of static steel wheel compactors. Vibrator compactors may be used in the static mode only. The compactors shall be self-propelled and shall be operated with the drive wheel in the forward position. A minimum of three compactors shall be provided; however, sufficient compactors shall be provided so that the drums of the compactors when staggered will cover the entire width of the paving machine during initial breakdown.

Compactors shall be operated in accordance with the manufacturer's recommendations. Compactors shall be designed and properly maintained so that they are capable of accomplishing the required compaction.

Compactors shall weigh not less than 8 tons.

(C) Rolling Procedure:

A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

Compaction shall consist of the following rolling sequence:

Rolling Sequence	Number of Coverages
Initial	1
Finish	1 - 2

A sufficient number of compactors shall be used for initial breakdown so that when the compactors are staggered the entire width of the mat being laid is compacted with one forward pass of the compactors. The distance between the paving machine and the initial rolling shall not exceed 200 feet.

A separate roller(s) shall be used for final compaction. The roller(s) used for final compaction shall follow as closely behind the initial breakdown rollers as possible.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated in accordance with the manufacturer's recommendations and with the number of coverages of the compactors as specified.

411-3.03 Acceptance:

Asphaltic concrete will be accepted complete in place, if, in the judgment of the Engineer, the asphaltic concrete reasonably conforms to the requirements specified herein. Asphaltic concrete that is not acceptable and is rejected shall be replaced to the satisfaction of the Engineer and at no expense to the Department.

411-4 Method of Measurement:

Asphaltic concrete will be measured by the ton for the mixture actually used, which will include the weight of mineral aggregate, mineral admixture, and bituminous material. Measurement will include any quantity used in construction of intersections, turnouts, curbs, spillways and spillway inlets, ditches, catch basin entrances, median strips, sidewalks, or other miscellaneous items or surfaces.

411-5 Basis of Payment:

411-5.01 General:

The accepted quantities of asphaltic concrete, measured as provided above, will be paid for at the contract unit price per ton for the bituminous mixture complete in place.

No direct payment will be made for the bituminous material and mineral admixture in the asphaltic concrete, or the bituminous material for tack coat and application of tack coat, the price being considered as included in the price paid for asphaltic concrete.

Asphaltic concrete may be measured, by volume, upon the execution of a supplemental agreement which will specify the manner in which the volume is determined. The volume will include the volume of mineral aggregate, mineral admixture, and bituminous material.

411-5.02 Reduction for Noncompliance:

A reduction in payment to the contractor for asphaltic concrete will be made for quantities of asphalt cement (bituminous material) that do not meet the requirements of Section 1005 of the specifications as determined by corresponding test results. Adjustments in payment will be made in accordance with the requirements of Table 1005-1 and the following formula:

$$R=(100-P) \times \left[\frac{(CP) \times T}{100}\right]$$

Where:

R= Amount of reduction in payment (dollars)

T= Quantity of asphalt cement in failure (tons, rounded to nearest 0.1)

P= Percent of contract unit price allowed (Table 1005-1)

CP= Current Price for asphalt cement (bituminous material), as determined by the Department, for the month in which a deficiency was noted. This value will be posted on the ADOT Contracts and Specifications Group website, on or shortly after the last Wednesday of each month.

SECTION 416 ASPHALTIC CONCRETE - END PRODUCT:

416-1 Description:

The work under this section shall consist of constructing Asphaltic Concrete-End Product, hereinafter asphaltic concrete, by furnishing all materials, mixing at a plant, hauling and placing a mixture of aggregate materials, mineral admixture, and bituminous material (asphalt cement) to form a pavement course or to be used for other specified purposes, in accordance with the details shown on the project plans and the requirements of the specifications.

Reclaimed asphalt pavement (RAP), as defined in Subsection 416-3.04 of the specifications, may be used in the mixture provided all requirements of the specifications are met; however, RAP will not be allowed in the mixture when asphalt cement type PG 76-22 TR+ or PG 70-22 TR+ is specified in Subsection 416-3.03 (B) of the specifications. References to the use of RAP in this section apply only if RAP is utilized

as part of the mixture. ADOT Materials Practice and Procedure Directive No. 20, "Guidance on the Use of Reclaimed Asphalt Pavement (RAP) in Asphaltic Concrete", shall be used in conjunction with the requirements of the specifications.

Warm Mix Asphalt (WMA) technologies may be used in the mixture at the option of the contractor provided all requirements of the specifications are met. WMA is defined as asphaltic concrete that is produced within the temperature range of 215 to 275 degrees F. WMA can be produced by one or a combination of several WMA technologies including plant water foaming processes, mineral additives, and chemical additives. The requirements for incorporating WMA technologies in the mixture are given in these specifications and in Materials Practice and Procedure Directive No. 23, "Requirements for the Use of Warm Mix Asphalt (WMA) Technologies in Asphaltic Concrete".

The contractor shall acquire and make all arrangements for a source or sources of material, furnish a mix design which will meet the design criteria specified hereinafter, and provide all the equipment, materials, and labor necessary to complete the work.

416-2 Asphaltic Concrete Mix Design Criteria:

Mix designs shall be developed by the contractor on the basis of the following criteria and tested in accordance with the requirements of the following test methods:

Criteria	Requirements			Arizona Test
	1/2" Mix	3/4" Mix	Base Mix	Method
1. Voids in Mineral Aggregate: %, Range	15.5 - 18.5	15.0 - 18.0	14.5 - 17.0	Note (3)
2. Effective Voids: %, Range	Note (1)	Note (1)	Note (1)	Note (3)
3. Absorbed Asphalt: %, Range	0 - 1.0	0 - 1.0	0 - 1.0	Note (3)
4. Index of Retained Strength: %, Minimum	60 (Note 2)	60 (Note 2)	60 (Note 2)	Note (4)
5. Wet Strength: psi, Minimum	150	150	150	Note (4)
6. Stability: pounds, Minimum	2,000	2,000	3,000	Note (3)
7. Flow: 0.01-inch, Range	8 - 16	8 - 16	8 - 16	Note (3)
8. Mix Design Grading Limits				201

	Percent Passing					
Sieve Size	1/2 inch Mix		3/4 inch Mix		Base Mix	
	Without Admix.	With Admix.	Without Admix.	With Admix.	Without Admix.	With Admix.
1-1/4 inch					100	100
1 inch			100	100	90 -100	90 - 100
3/4 inch	100	100	90 - 100	90 - 100	85 - 95	85 - 95

1/2 inch	90 - 100	90 - 100	---	---	---	---
3/8 inch	67 - 82	67 - 82	62 - 77	62 - 77	57 - 72	57 - 72
No. 8	40 - 48	41 - 49	37 - 46	38 - 47	32 - 42	33 - 43
No. 40	10 - 18	11 - 19	10 - 18	11 - 19	8 - 16	9 - 17
No. 200	1.5 - 4.5	2.5 - 6.0	1.5 - 4.5	2.5 - 6.0	1.5 - 3.5	2.5 - 5.0

Notes:

(1) As specified in the Special Provisions.

(2) If the average elevation of the project is above 3,500 feet, the index of retained strength shall be a minimum of 70 percent.

(3) For mixes without RAP, Arizona Test Method 815. For mixes with RAP, Arizona Test Method 833.

(4) For mixes without RAP, Arizona Test Method 802 (as modified by Arizona Test Method 815). For mixes with RAP, Arizona Test Method 802 (as modified by Arizona Test Method 833).

The ratio of the mix design composite gradation target for the No. 200 sieve, including mineral admixture, to the effective asphalt content shall be within the range specified in the Special Provisions.

416-3 Materials:

416-3.01 Mineral Aggregate:

(A) General:

Mineral aggregate shall consist of virgin aggregate, or a combination of virgin aggregate and aggregate from RAP (RAP aggregate). When the terms “mineral aggregate” or “aggregate” are used without being further described as “virgin” or “RAP”, the intended meaning is the total aggregate material used in the mixture.

No individual stockpile or hot bin usage of either virgin aggregate or RAP aggregate shall be less than 3 percent of the total mineral aggregate.

(B) Virgin Mineral Aggregate:

The contractor shall provide a source in accordance with the requirements of Section 1001 of the specifications, except that sub-paragraph (3) under Subsection 1001-3.01(B) of the specifications shall not apply.

Coarse virgin mineral aggregate shall consist of crushed gravel, crushed rock, or other approved inert material with similar characteristics, or a combination thereof, conforming to the requirements of these specifications.

For areas or applications where Special Mix is not called for on the plans, fine virgin mineral aggregate shall consist of natural sand or of sand prepared from rock, or other approved inert materials, or a combination thereof, conforming to the requirements of these specifications.

For areas or applications where Special Mix is called for on the project plans, the following shall apply:

Fine virgin mineral aggregate shall be obtained from crushed gravel or crushed rock. All uncrushed material passing the No. 4 sieve shall be removed prior to the crushing, screening, and washing operations necessary to produce the specified gradation. The contractor shall notify the Engineer a minimum of 48 hours in advance of crushing the material to be used as virgin mineral aggregate, so all crushing operations can be inspected. Existing stockpile material which has not been inspected during crushing will not be permitted for use unless the contractor is able to document to the Engineer's satisfaction that the virgin mineral aggregate has been crushed. Any material inspected by the Department as crushed material for the project shall be separated from the contractor's other stockpiles and reserved for use throughout the project duration.

The contractor may blend uncrushed fine virgin aggregate up to a maximum of 15 percent of the total aggregate for mixes not containing RAP, or up to a maximum of 10 percent of the total aggregate for mixes containing RAP. The total composite of virgin fine aggregate shall meet the requirement for uncompacted void content. The uncrushed fine virgin aggregate shall be 100 percent passing the 1/4 inch sieve and contain not more than 4.0 percent passing the No. 200 sieve. Should the contractor modify the method of producing either the uncrushed or crushed fine aggregate, the Engineer shall be immediately notified and the materials sampled and tested for determination of uncompacted void content.

(C) RAP Mineral Aggregate:

RAP aggregate shall consist of the aggregate portion of the reclaimed asphalt pavement. A maximum of 25 percent RAP aggregate, by weight of total aggregate in the mix, may be used in mixes placed in a lower lift (minimum 2 inches below finished surface). A maximum of 20 percent RAP aggregate, by weight of total aggregate in the mix, may be used at all other locations.

(D) Mineral Aggregate Characteristics:

Aggregates shall be free of deleterious materials, clay balls, and adhering films or other material that prevent the thorough coating with the asphalt cement.

SECTION 416

Mineral aggregate shall conform to the following requirements when tested in accordance with the applicable test methods.

Mineral Aggregate Characteristics	Test Method	Requirement
Combined Bulk Oven Dry Specific Gravity (1)	Arizona Test Method 251	2.350 - 2.850
Combined Water Absorption (1)	Arizona Test Method 251	0 - 2.5%
Sand Equivalent (1)	AASHTO T 176 (After thoroughly sieving the sample, no additional cleaning of the fines from the plus No. 4 material is required.)	Minimum 55
Abrasion (2)	AASHTO T 96	100 Rev., Max. 9% 500 Rev., Max. 40%
Fractured Coarse Aggregate Particles (3)	Arizona Test Method 212	Minimum 70% (4) (at least one fractured face, determined on plus No. 4 material)
Uncompacted Void Content (1) (Special Mix Only)	Arizona Test Method 247	Minimum 45%
Carbonates (3) and (5)	Arizona Test Method 238	Maximum 20%

Notes:

(1) When the mix design contains RAP, the requirements shall be for the virgin aggregate portion only.

(2) Abrasion shall be performed separately on materials from each source of mineral aggregate, including RAP aggregate. All sources shall meet the requirements for abrasion.

(3) When the mix design contains RAP, the requirements shall be for the composite of virgin and RAP aggregate.

(4) When Special Mix is called for on the project plans, this value shall be minimum 85% with at least two fractured faces and minimum 92% with at least one fractured face, determined on plus No. 4 material.

(5) Testing for carbonates only applies if either of the following conditions exist:

(a) The asphaltic concrete is the designed final pavement surface normally used by traffic.

(b) The asphaltic concrete, temporary or otherwise, will be subject to traffic for more than 60 days.

Tests on aggregates outlined above, except for abrasion, shall be performed on materials furnished for mix design purposes and composited to the mix design gradation. When RAP is used in the mixture, RAP aggregates for testing shall be obtained from the RAP material using Method A of AASHTO T 164, prior to combining with the virgin aggregate.

Virgin mineral aggregate from a source or combination of sources which does not meet the requirements given in the table above for combined bulk oven dry specific gravity, and/or combined water absorption (up to a maximum of 3.0 percent), but meets the other specified requirements, will be considered for acceptance by the Engineer if: a) the total estimated cost of all asphaltic concrete components, using the mix design unit weight, asphalt cement content, and mineral admixture percentage, does not exceed the total amount bid for these items by more than 5.0 percent; or b) a supplemental agreement is executed adjusting the unit prices of asphaltic concrete components such that the total estimated cost does not exceed the total amount bid by more than 5.0 percent.

416-3.02 Mineral Admixture:

Mineral admixture will be required. The amount used shall be 1.0 percent, by weight of the mineral aggregate, unless testing demonstrates that additional admixture is required in order to meet the mix design criteria for Wet Strength and Index of Retained Strength. A maximum of 2.0 percent admixture will be permitted. The exact amount of admixture required shall be specified in the mix design. Mineral admixture shall be either Portland cement, blended hydraulic cement or hydrated lime conforming to the following requirements.

Material	Requirement
Portland Cement, Type I, or Type II	ASTM C150
Blended Hydraulic Cement, Type IP	ASTM C595
Hydrated Lime	ASTM C1097

The certification and acceptance of Portland cement, blended hydraulic cement, and hydrated lime shall be in accordance with ADOT Materials Practice and Procedure Directive No. 13, "Certification and Acceptance of Hydraulic Cement, Fly Ash, Natural Pozzolan, Silica Fume, and Lime".

416-3.03 Bituminous Material:

(A) General:

Bituminous material shall consist of performance grade (PG) asphalt binder (virgin binder), or a combination of virgin binder and binder from RAP (RAP binder). When the terms “bituminous material”, “asphalt cement”, “asphalt binder”, or “binder” are used without being further described as “virgin” or “RAP”, the intended meaning is the total bituminous material used in the mixture.

The percent of asphalt cement used shall be based on the weight of total mix (asphalt cement, mineral aggregate, and mineral admixture).

(B) Virgin Bituminous Material:

Virgin asphalt cement shall be a performance grade (PG) asphalt binder, conforming to the requirements of Section 1005 of the specifications. The type of virgin asphalt binder shall be as shown in the Special Provisions or, if RAP is used in the mixture, the virgin asphalt binder shall be as required to meet the blending requirements in Subsection 416-3.03(C) of the specifications and Arizona Test Method 833.

The contractor shall provide the laboratory mixing and compaction temperature ranges to the mix design laboratory for each PG asphalt binder used for mix design purposes. The laboratory mixing temperature range is defined as the range of temperatures where the un-aged virgin asphalt binder has a rotational viscosity of 0.17 ± 0.02 Pascal·seconds, measured in accordance with AASHTO T 316. The laboratory compaction temperature range is defined as the range of temperatures where the un-aged virgin asphalt binder has a rotational viscosity of 0.28 ± 0.03 Pascal·seconds, measured in accordance with AASHTO T 316. The testing required in AASHTO T 316 shall be performed at 275 degrees F and 350 degrees F, and a viscosity-temperature curve developed in accordance with ASTM D2493. The viscosity-temperature curve shall be included in the mix design report. For PG asphalt binders that have a maximum laboratory mixing temperature exceeding 325 degrees F or a maximum laboratory compaction temperature exceeding 300 degrees F, the laboratory mixing and compaction temperature ranges shall be specified in writing by the virgin asphalt binder supplier. A viscosity-temperature curve will meet this requirement for written documentation if the viscosity-temperature curve is developed and submitted by the binder supplier and includes language that the recommended laboratory mixing and compaction temperatures are within acceptable ranges, and the submittal includes a statement indicating the maximum laboratory mixing temperature to which the binder can be heated without damage. The laboratory mixing and compaction temperature ranges, as well as the actual laboratory mixing and compaction temperatures used, shall be reported on the mix design. The contractor shall ensure that the asphalt binder supplier information required in this paragraph is provided to all appropriate parties in a timely manner, and that copies are included in the mix design report.

The laboratory mixing and compaction temperatures are for mix design purposes only. Field mixing and compaction temperatures are specified in Subsections 416-6 and 416-7 of the specifications.

(C) RAP Bituminous Material:

RAP binder shall consist of the asphalt binder portion of the reclaimed asphaltic pavement. A maximum of 25 percent RAP binder, by weight of total binder in the mix, may be used in mixes placed in a lower lift (minimum 2 inches below finished surface). A maximum of 20 percent RAP binder, by weight of total binder in the mix, may be used at all other locations.

When less than or equal to 15 percent RAP binder is used, by weight of total binder in the mix, no testing is required on the RAP binder. When greater than 15 percent RAP binder is used, by weight of total binder in the mix, the RAP binder shall be extracted, recovered, and tested in accordance with the requirements of Arizona Test Method 833. The virgin binder grade shall be modified if necessary to ensure the blend of virgin and RAP binder meets the PG grade specified in the Subsection 416-3.03(B) of the specifications. However, a change of only one virgin PG binder grade (6 degrees C on either or both the high and low temperatures) will be allowed from that shown in Subsection 416-3.03(B) of the specifications.

416-3.04 Reclaimed Asphalt Pavement (RAP):

RAP shall consist of salvaged, milled, pulverized, broken, or crushed asphalt pavement. If RAP is generated by milling, the minimum removal depth shall be 1-1/2 inches. The source of RAP may be from ADOT or other projects. The contractor shall be responsible for determining the suitability of the RAP for use in the mixture, regardless of its source.

For asphaltic concrete containing less than or equal to 15 percent RAP aggregate, all RAP material shall pass the 1-1/4 inch sieve. For asphaltic concrete containing greater than 15 percent RAP aggregate, the RAP material shall be processed into uniform coarse and fine stockpiles such that there will be a minimum amount of fines. The use of more than two RAP stockpiles is prohibited. The gradation, when tested in accordance with Arizona Test Method 240, shall meet the following requirements:

Stockpile	Sieve Size	Percent Passing
Coarse	1-1/4 inch	100
	3/8 inch	0-25
Fine	3/4 inch	100
	3/8 inch	75-100

The contractor may propose gradation bands differing from those shown in the table above. The proposal shall be submitted to the Engineer

prior to the start of RAP processing. If approved, the required gradation bands will be adjusted accordingly.

RAP shall be stockpiled so that segregation is minimized. When two RAP stockpiles are used, acceptable methods to prevent intermingling of stockpiles shall be provided.

The Engineer reserves the right to reject obviously defective salvaged material or salvaged material that is not representative of the material used in the mix design.

416-3.05 Warm Mix Asphalt Technologies:

Warm Mix Asphalt (WMA) technologies include plant water foaming processes, mineral additives, and chemical additives. WMA technologies must be approved prior to their use in accordance with Materials Practice and Procedure Directive No. 23, "Requirements for the Use of Warm Mix Asphalt (WMA) Technologies in Asphaltic Concrete".

416-4 Mix Design:

Utilizing mineral aggregate and RAP which has been crushed, processed, separated and stockpiled, a mix design shall be formulated and submitted by the contractor to the Engineer. The mineral aggregate and RAP samples used for mix design purposes shall be representative of materials to be used during production.

The mix design shall be based on the mix design criteria and other requirements hereinbefore specified, utilizing asphalt cement and mineral admixture of the type and from the sources proposed for use in the production of asphaltic concrete.

The mix design shall be prepared by or under the direct supervision of a professional engineer experienced in the development of mix designs and mix design testing. The mix design engineer shall meet the requirements given in ADOT Materials Practice and Procedure Directive No. 4, "Asphaltic Concrete Mix Design Proposals and Submittals". The mix design shall be provided in a format that clearly indicates all the mix design requirements and shall be sealed, signed, and dated by the mix design engineer.

The mix design shall be prepared by a mix design laboratory that has met the requirements of ADOT Materials Practice and Procedure Directive No. 19, "ADOT System for the Evaluation of Testing Laboratories".

The contactor may propose the use of a mix design that has been developed for a previous project. The proposed mix design shall meet the requirements of these specifications. The contractor shall provide evidence that the type and source of bituminous material, the type of

mineral admixture, and the source and methods of producing virgin mineral aggregate and RAP have not changed since the formulation of the previous mix design. The contractor shall also provide current test results for all specified characteristics of the mineral aggregate and RAP proposed for use. The Engineer will determine if the previously used mix design is suitable for the intended use and if the previous use of the mix design was satisfactory to the Department. The Engineer will either approve or disapprove the proposed mix design. Should the Engineer disapprove the use of the previously used mix design, the contractor shall prepare and submit a new mix design proposal in accordance with the requirements of these specifications.

A previously used mix design older than two years from the date it was formulated, sealed, signed, and dated shall not be allowed for use. Once approved for use on a project, a mix design may be used for the duration of that project.

The mix design shall contain as a minimum:

(A) The name and address of the testing organization and the person responsible for the mix design testing;

(B) The specific location(s) of the source(s) of mineral aggregate;

(C) The supplier, refinery, type of asphalt cement, and any modifiers including polymers. The source and type of mineral admixture. The percentage of asphalt cement and mineral admixture to be used;

(D) The anticipated mineral aggregate gradation in each stockpile;

(E) Mix design gradation. The mix design shall contain the mineral aggregate gradation, and also the gradation with mineral admixture;

(F) The results of all testing, determinations, etc., such as: specific gravity of each component, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, uncompacted void content (for Special Mix), percent carbonates (if required), immersion compression results (Index of Retained Strength, wet and dry strengths), Marshall stability and flow, asphalt absorption, percent air voids, voids in mineral aggregate, and bulk density; and

(G) Viscosity-temperature curve along with the laboratory mixing and compaction temperature ranges, as well as the actual laboratory mixing and compaction temperatures used.

When RAP is used in the mixture, the following additional information shall be included in the mix design:

(H) The specific location(s) of the source(s) of RAP;

(I) The anticipated RAP gradation, RAP aggregate gradation, and RAP binder content in each stockpile;

(J) If greater than 15 percent RAP binder is used in the mixture, the results of all tests on the recovered RAP binder, as well as all tests on the blend of virgin binder and recovered RAP binder;

(K) The percent RAP binder, virgin binder, and total binder in the mixture;

(L) The composite gradation of virgin and RAP aggregates, with and without mineral admixture. The composite gradation of the virgin aggregate and RAP, with and without mineral admixture;

(M) The results of all testing, determinations, etc., for the RAP, virgin aggregate, RAP aggregate, and composite of virgin and RAP aggregates as required, such as: specific gravity, water absorption, sand equivalent, loss on abrasion, fractured coarse aggregate particles, uncompacted void content (for Special Mix), and percent carbonates; and

(N) The viscosity-temperature curve along with the laboratory mixing and compaction temperature ranges for the blended binder, if greater than 15 percent RAP binder is used in the mixture, as well as the actual laboratory mixing and compaction temperatures used.

When Warm Mix Asphalt (WMA) technologies are used in the mixture, the additional mix design requirements specified in Materials Practice and Procedure Directive No. 23, “Requirements for the Use of Warm Mix Asphalt (WMA) Technologies in Asphaltic Concrete”, shall also be included in the mix design.

Test results used in the formulation of the mix design shall be from testing performed no earlier than 45 days prior to the date the mix design is signed by the mix design engineer. Historical abrasion values may be supplied on sources provided the testing was conducted within the past two years.

The mix design shall be submitted to the Engineer under a cover letter signed by an authorized representative of the contractor.

A copy of the mix design and representative samples of the materials used in the mix design shall be submitted to the Engineer for calibration

of the ignition furnace, and for the determination of sand equivalent and fractured coarse aggregate particles. When Special Mix is used, the uncompacted void content shall also be determined. Approximately 300 pounds of virgin mineral aggregate (proportional to the mix design gradation), 3 gallons of asphalt cement, and 1 gallon of mineral admixture shall be submitted. When RAP is used, a minimum of 40 pounds of representative RAP material and a minimum of 10 pounds of solvent-extracted RAP aggregate, per AASHTO T 164, Method A, shall be submitted. If RAP is fractionated, the RAP and RAP aggregate from each stockpile shall be kept separate. The Engineer shall witness the sampling of the virgin mineral aggregate and RAP. The mix design and samples shall be submitted to the Engineer at least five working days prior to the start of asphaltic concrete production.

The sand equivalent, fractured coarse aggregate particles, and (for Special Mix) uncompacted void content shall meet the requirements specified in Subsection 416-3.01 of the specifications. Additional testing of the uncrushed and crushed fine aggregate for uncompacted void content will be required if the method of producing either fine aggregate is modified.

If the mineral aggregate fails to meet the requirements specified herein, asphaltic concrete production shall not commence, and the contractor shall either submit a revised mix design which is representative of the materials produced or correct the deficiencies in the aggregate stockpiles.

The Engineer will review the mix design to assure that it contains all required information. If it does not, it will be returned within two working days of receipt of all samples and mix design information, for further action and resubmission by the contractor.

If the contractor elects to change its source(s) of mineral aggregate or RAP, or adds or deletes the use of a stockpile(s) regardless of source, the contractor shall furnish the Engineer with a new mix design which meets the requirements specified hereinbefore.

If changes are made in the source or type of bituminous material, or the type of mineral admixture, the contractor shall provide verification testing results. Verification testing shall be performed at the original mix design asphalt content using the original mineral aggregate and RAP (if used), the proposed bituminous material, and/or the proposed mineral admixture. Three specimens shall be fabricated and tested for bulk density, maximum theoretical density, and effective voids. The percent effective voids must be within $\pm$ 0.2 of the percent effective voids in the original design and also be within the current effective voids mix design specification limits. Verification testing results shall not replace target values shown in the original mix design. All target values from the original design shall be used in future production with the exception of any self-directed target value changes that are requested. The verification process does not ensure that the contractor can meet the target values during production.

In addition to the verification testing specified above, verification testing for immersion compression may also be required. If there is a change in the type of mineral admixture, immersion compression testing is required. If there is a change in the source or type of bituminous material, immersion compression testing is required if the Index of Retained Strength of the original mix design is less than 10 percentage points greater than the specified minimum, or if the Wet Strength is less than 100 pounds per square inch greater than the specified minimum.

The contractor may make self-directed target changes to the approved mix design within the limits shown below. Requests for self-directed target changes shall be made in writing and acknowledged by the Engineer prior to start of production for a lot. Self-directed target changes shall meet contract requirements for mix design criteria and grading limits.

MEASURED CHARACTERISTICS	ALLOWABLE SELF-DIRECTED TARGET CHANGES
Gradation (sieve size):	
3/8 inch	±4% from mix design target value
No. 8	±4% from mix design target value
No. 40	±2% from mix design target value
Asphalt Cement Content	±0.2% from mix design target value
Effective Voids	None

The contractor may propose target changes to the approved mix design for the Engineer's approval. The Engineer will determine if the proposed target change will result in mix production that meets the contract requirements for mix design criteria and grading limits. For acceptance purposes, target changes will not be retroactive.

In no case shall the approval of mix design changes relieve the contractor of the responsibility for the results obtained by the use of such approved changes.

Should a mix design prove unsatisfactory to the contractor during production, the contractor shall furnish the Engineer with a revised mix design. For acceptance purposes, the revised mix design will not be retroactive.

The contractor shall not change its methods of crushing, screening, washing, or stockpiling from those used during production of material used for mix design purposes without approval of the Engineer or without preparing a new mix design.

416-5 Contractor Quality Control:

The contractor shall perform the quality control measures described in Subsection 106.04(C) of the specifications. At the weekly meeting, the contractor shall be prepared to explain and discuss how the following processes will be employed:

(A) Aggregate production, including crusher methods, pit extraction, and washing;

(B) RAP production, including milling, crushing, screening, and handling methods;

(C) Stockpile management, including stacking methods, separation technique, plant feed technique, stockpile pad thickness, and segregation prevention;

(D) Proportioning and plant control, including plant scale calibration, mix temperature control, storing method, and addition of admixture;

(E) Transporting and placing, including hauling distance and temperature control, segregation and non-uniform placement control, and joint placement and technique; and

(F) Compaction, including types and weight of rollers, establishing and monitoring of roller patterns, and temperature controls.

The contractor shall obtain samples and perform the tests specified in the following table:

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS			
Type of Test	**Test Method**	**Sampling Point**	**Minimum Testing Frequency**
Virgin Mineral Aggregate			
Gradation	Arizona Test Method 201	Crusher Belt or Stockpile	1 per stockpile per day
Sand Equivalent	AASHTO T 176	Crusher Belt or Stockpile	1 per 2,000 Tons of total virgin aggregate (1)
Fractured Coarse Aggregate Particles	Arizona Test Method 212		
Uncompacted Void Content (2)	Arizona Test Method 247		
Reclaimed Asphalt Pavement			
Gradation, Moisture Content, and Binder Content	Arizona Test Method 428 (Appendix A)	Crusher Belt or Stockpile	1 per stockpile per day
RAP Aggregate			
Gradation	Arizona Test Method 201	Crusher Belt or Stockpile	1 per stockpile per day
Fractured Coarse Aggregate Particles	Arizona Test Method 212		1 per stockpile every other day
Asphaltic Concrete			
Gradation	Arizona Test Method 201 or 427 (428 for RAP mixes)	Cold Feed, Hot Bins, Roadway, or Plant	1 per 1,000 Tons

CONTRACTOR QUALITY CONTROL TESTING REQUIREMENTS			
Type of Test	**Test Method**	**Sampling Point**	**Minimum Testing Frequency**
Asphalt Content	Arizona Test Method 421, 427 (428 for RAP mixes), or other approved methods	Roadway or Plant	1 per 1,000 Tons
Voids	Arizona Test Method 410, 415, 417, 424		1 per 1,000 Tons each day. Maximum of 4 per day.
Compaction	Arizona Test Method 412	Roadway	1 per 300 tons

Notes:

(1) Prior to the completion of the mix design, quality control tests on mineral aggregate shall be performed based on the anticipated percent use of each stockpile. Samples taken from individual stockpiles may be composited prior to performing the required tests, or testing may be performed on material from each stockpile and the composite test result for each required test determined mathematically.

(2) For Special Mix.

416-6 Construction Requirements:

The contractor shall be responsible for the proportioning of all materials, for the hauling, placing, loading, spreading, and finishing of asphaltic concrete and for the applying of bituminous material, such as tack coats, prime coats, and provisional seals, all in accordance with the appropriate portions of the specifications.

The asphaltic concrete hot plant shall conform to the requirements of Section 403 of the specifications.

During production, the percent RAP aggregate and percent RAP binder shall not exceed the maximum allowed in Subsections 416-3.01(C), 416-3.03(C), and 416-3.04 of the specifications. In addition, the percent RAP material shall be maintained to within plus 2 percent and minus 5 percent of the mix design value(s). When two RAP stockpiles are used, this tolerance shall apply to the total percent RAP material in the mixture, as well as the percent RAP material from each stockpile.

The temperature of asphaltic concrete or mineral aggregate upon discharge from the drier shall not exceed 325 degrees F unless a higher temperature is recommended in writing by the asphalt binder supplier and approved by the Engineer.

All courses of asphaltic concrete shall be placed and finished by means of self-propelled paving machines except under certain conditions or at certain locations where the Engineer deems the use of self-propelled paving machines impractical.

Self-propelled paving machines shall spread the mixture within the specified tolerances, without segregation or tearing, true to the line, grade, and crown indicated on the project plans. Pavers shall be equipped with hoppers and augers which shall distribute the mixture uniformly in front of adjustable screeds.

Pavers shall be equipped with a screed for the full width being paved, heated if necessary, and capable of spreading and finishing all courses of asphaltic concrete.

Pavers shall be equipped with automatic screed controls with sensors for either or both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed, and providing the automatic signals which operate the screed to maintain the desired grade and transverse slope.

Failure of the control system to function properly shall be cause for the suspension of the placing of asphaltic concrete.

The base or subgrade upon which asphaltic concrete is to be placed shall be prepared and maintained in a firm condition until asphaltic concrete is placed. It shall not be frozen or excessively wet.

At any time, the Engineer may require that the work cease or that the work day be reduced in the event that weather conditions, either existing or expected, are anticipated to have an adverse effect upon the asphaltic concrete.

All wheels and tires of compactors shall be wetted with water, or if necessary soapy water, or a release agent in order to prevent the sticking of asphaltic concrete. All other equipment surfaces shall be treated when necessary with a release agent. Only release agents evaluated through NTPEP are acceptable for use. The results from NTPEP testing, when tested in accordance with AASHTO TP 102, shall meet the following criteria:

RELEASE AGENT TEST	REQUIREMENT
Asphalt Stripping Test Diluted Non-Diluted (Full Strength)	 No Stripping No Stripping
Mixture Slide Test	10 g Retained, Max.
Asphalt Performance Test	Less than or equal to 10.0% after the third cycle

Release agents which degrade, dissolve, or in any way damage the bituminous material shall not be used. Diesel fuel shall not be used as a release agent.

Longitudinal joints of each course shall be staggered a minimum of 1 foot with relation to the longitudinal joint of any immediate underlying course.

When surfacing courses are placed on 10 foot or wider shoulders which are to receive rumble strips, the contractor shall place any longitudinal joints approximately 1 foot away from the travel lane side of the rumble strip.

Longitudinal joints shall be located within 1 foot of the center of a lane or within 1 foot of the centerline between two adjacent lanes. Joints shall be formed by a slope shoe or hot-lapped, and shall result in an even, uniform surface.

Before a surface course is placed in contact with a cold transverse construction joint, the cold existing asphaltic concrete shall be trimmed to a vertical face by cutting the existing asphaltic concrete back for its full depth of the lift and exposing a fresh face. After placement and finishing of the new asphaltic concrete, both sides of the joint shall be dense and the joint shall be well sealed. The surface in the area of the joint shall conform to the requirements hereinafter specified for surface tolerances when tested with the straightedge placed across the joint.

All locations where plate samples are taken from the roadway shall be immediately repaired by the contractor utilizing hot asphaltic concrete. All holes where cores are taken shall be repaired within 48 hours after coring using a material approved by the Engineer. All holes shall be in a dry condition prior to repair. The patching material shall be thoroughly compacted in the holes by the contractor.

The handling of asphaltic concrete shall at all times be such as to minimize segregation. Any asphaltic concrete which displays segregation shall be removed and replaced.

Before asphaltic concrete is placed, the surface to be paved shall be cleaned of all objectionable material and tacked in accordance with the requirements of Section 404 of the specifications. The cleaning of the surface, the tacking of the surface, and the type of bituminous material used shall be acceptable to the Engineer. The amount of bituminous material used shall be as directed by the Engineer.

A light coat of bituminous material shall be applied to edges or vertical surfaces against which asphaltic concrete is to be placed.

The contractor shall schedule its paving operations to minimize exposed longitudinal edges. Unless otherwise approved by the Engineer, the contractor shall limit the placement of asphaltic concrete courses, in

advance of adjacent courses, to one shift of asphaltic concrete production. The contractor shall schedule its paving operations in such a manner to eliminate exposed longitudinal edges over weekends or holidays.

The moisture content of the asphaltic concrete immediately behind the paver shall not exceed 0.5 percent. The moisture content will be determined in accordance with Arizona Test Method 406.

When Warm Mix Asphalt (WMA) technologies are used, the contractor shall comply with the manufacturer's recommendations for incorporating additives and WMA technologies into the mixture. The contractor shall comply with the manufacturer's recommendations regarding transporting, storage, and delivery of additives and water foaming processes. The contractor shall maintain a copy of the manufacturer's recommendations on file at the asphalt mixing plant and make those recommendations available for reference while using WMA technologies.

416-7 Acceptance:

416-7.01 General:

In addition to the random acceptance samples taken from each lot, the Engineer may sample and reject material which appears to be defective. Such rejected material shall not be used in the work. The results of tests run on rejected material will not be included with the lot acceptance tests.

Acceptance will be on the basis of the following:

(A) Sand equivalent;
(B) Fractured coarse aggregate particles;
(C) Uncompacted void content (for Special Mix);
(D) Material spread;
(E) Gradation;
(F) Asphalt cement content;
(G) Effective voids;
(H) Stability;
(I) Compaction; and
(J) Smoothness

416-7.02 Sand Equivalent, Fractured Coarse Aggregate Particles, and Uncompacted Void Content of Mineral Aggregate:

During asphaltic concrete production, the Engineer shall obtain and test samples of material for the determination of the sand equivalent and fractured coarse aggregate particles. When Special Mix is used, the uncompacted void content shall also be determined. When RAP is used in the mixture, the sand equivalent and uncompacted void content shall be determined on the composite of virgin aggregates only. Samples

shall be obtained from the cold feed belt prior to the addition of mineral admixture, or from the stockpiles when sampling from the cold feed belt is not possible.

When RAP is used in the mixture, the material for determining the fractured coarse aggregate particles shall come from an asphaltic concrete sample taken and tested in accordance with Arizona Test Method 428, as specified in Subsection 416-7.04(A) of the specifications. However, if the Engineer determines that excessive breakdown of the aggregate has occurred due to the use of the ignition furnace, the fractured coarse aggregate particles testing shall be performed on the combination of RAP aggregate, as obtained in accordance with Arizona Test Method 428, and virgin mineral aggregate.

Virgin mineral aggregate will be acceptable for sand equivalent if it meets the minimum requirements specified in Subsection 416-3.01 of the specifications.

The fractured coarse aggregate particles shall meet the minimum requirements specified in Subsection 416-3.01 of the specifications.

For Special Mix, the uncompacted void content shall meet the minimum requirements specified in Subsection 416-3.01 of the specifications. Additional testing of the uncrushed and crushed fine aggregate for uncompacted void content will be required if the method of producing either fine aggregate is modified.

If the mineral aggregate fails to meet the requirements specified herein, operations shall cease and the contractor shall have the option of submitting a revised mix design conforming to the requirements of Subsection 416-4 of the specifications or correcting deficiencies in the aggregate stockpiles.

416-7.03 Material Spread:

A spread lot shall be considered to be one-half shift of production. Lots encompassing more than one project shall be separated in accordance with Subsection 416-9(D) of the specifications.

The contractor shall record information pertaining to each spread lot on forms provided by the Engineer. Information shall include the project number, date and period of time that each spread lot was placed, the spread lot number, beginning and ending station, the plans thickness, and tons placed in each lot. Completed spread lot forms shall be signed by the contractor and given to the Engineer at the end of each shift.

The Engineer will calculate the quantity required in each spread lot using the mix design bulk density unless a request is made by the contractor to use a production bulk density. If a request is made to use production bulk density, the first three non-rejected lots following the test lot will be used to determine the average production bulk density. All lots

placed prior to establishing the average production bulk density shall be calculated using the mix design bulk density. For each new mix design used on the project, a new production bulk density may be requested by the contractor. In addition, if conditions warrant during asphalt production, the contractor may request establishment of a new average production bulk density. All requests to use a production bulk density shall be made in writing and approved by the Engineer prior to use. The same procedure will be used for determining average production bulk density in all cases. Changes to the bulk density for calculating spread quantities will not be retroactive.

The calculated quantity required in each spread lot will be compared to the actual quantity placed. A lot will be considered to be acceptable, with a zero pay factor, if the actual quantity placed varies by no more than -2.0 to +5.0 percent from the required quantity.

If the quantity in a lot is found to vary from the required quantity by -2.1 to -12.0 percent, the appropriate pay factor will be determined in accordance with Table 416-1. This pay factor will be utilized in determining the pay adjustment as outlined in Subsection 416-9 of the specifications.

416-7.04 Gradation, Asphalt Cement Content, Effective Voids and Stability:

(A) General:

A mixture properties lot shall be considered to be one shift's production. In the event a shift's production is less than 1,200 tons, multiple shifts may be combined to form a lot. When a lot consists of production from more than one shift, the following conditions apply: at least one sample shall be taken each shift, at least one sample shall be taken every 500 tons, and no mix design or target value changes shall be made within the lot. If changes are made in the mix design or target values, new lots will be established.

Four samples of the asphaltic concrete shall be taken for each lot by the contractor, under the observation of the Engineer, at random locations designated by the Engineer. Samples will be taken in accordance with the requirements of Section 2 or 3 of Arizona Test Method 104 and delivered to the Engineer immediately after being taken. The minimum weight of the sample shall be 75 pounds. The Engineer will split the sample and save one-half for 15 days after written notification to the contractor of test results for that lot has been made. The material will be tested by the Engineer for the following properties:

Test Property	Test Method
Asphalt Cement Content	Arizona Test Method 427 (428 for RAP mixes) (See Notes 1 and 2 below)
Gradation	
Marshall Density and Stability	Arizona Test Method 410
Maximum Theoretical Density	Arizona Test Method 417
Effective Voids	Arizona Test Method 424

Notes:

(1) A new calibration of the ignition furnace shall be performed for each mix design, and at any other time the Engineer directs.

(2) Ignition furnace results will be corrected for asphalt cement content in accordance with Subsection 416-7.04(B) or (C) as required.

Acceptance testing results will be furnished to the contractor within four working days of receipt of samples by the Engineer.

A mixture-properties lot placed with an average stability below 2,500 pounds for base mixes, or 1,750 pounds for 1/2 inch or 3/4 inch mixes shall be rejected, and shall be subject to an engineering analysis of anticipated performance in accordance with Subsection 416-9(E) of the specifications. Production shall cease until the contractor proposes a corrective action the Engineer finds acceptable. If the Engineer rejects the proposed corrective action, the contractor shall submit a revised mix design.

The target values for gradation, asphalt cement content, and effective voids are given in the contractor's mix design. The Upper Limits (UL) and Lower Limits (LL) of acceptable production of each of the measured characteristics are as follows:

Measured Characteristics	LL (Note 1)	UL (Note 1)
Gradation (Sieve size):		
3/8 inch (Note 2)	TV - 6.0	TV + 6.0
No. 8	TV - 6.0	TV + 6.0
No. 40	TV - 5.0	TV + 5.0
No. 200	TV - 2.0	TV + 2.0
Asphalt Cement Content	TV - 0.50	TV + 0.50
Effective Voids	TV - 2.0	TV + 1.5

Notes:

(1) The limits are used in the statistical calculations for Quality Index. Acceptance is controlled by the variability of the produced material and every effort should be made to strive for the applicable target value (TV).

(2) In the case of the 3/8-inch sieve requirement, for the base mix only, the lower limit shall be the target value minus 8.0, and the upper limit shall be the target value plus 8.0.

The Engineer will determine the PT for each measured characteristic in accordance with Subsection 416-9(I) of the specifications, and utilizing Table 416-1 will determine the pay factor for each measured characteristic.

In the event the contractor elects to question the mixture property test results, the contractor may request referee testing in accordance with Subsection 416-9(J) of the specifications.

(B) Ignition Furnace Correction for Non-RAP Mixes:

For plants providing asphaltic concrete exclusively for the project, the difference between the asphalt cement content as measured by ignition furnace testing and the actual asphalt cement content shall be determined by the Engineer for each of the first five lots of asphaltic concrete produced for each mix design. If there are less than five lots for the mix design, the total number of available lots shall be used. If approved by the Engineer, a plant may be considered exclusive to the project if an asphalt cement tank is dedicated for the shift of asphaltic concrete production. The determination of the actual asphalt cement content may include weighing of asphalt cement deliveries, invoice quantities, volumetric tank measurements using a calibrated rod (tank stickings) corrected for temperature, computerized mass-flow meter, and accounting for wasted materials. If a computerized mass-flow meter is used, documentation of its calibration shall be submitted to the Engineer prior to asphaltic concrete production. At any time during asphaltic concrete production, the Engineer may require that a new calibration of the mass-flow meter be performed. If the average difference exceeds ± 0.10 percent asphalt cement content between the asphalt cement content measured by ignition furnace testing and the actual asphalt cement content, the contractor may request that a correction to the asphalt cement content by ignition furnace testing be made. The

contractor must make such a request in writing within two working days after receiving the test results for the fifth lot of asphaltic concrete production. If referee testing is performed on a lot of asphaltic concrete for which a correction, based on the actual asphalt cement content, was made to the asphalt cement content by ignition furnace testing, referee testing shall not apply to the determination of asphalt cement content. The correction, once documented and approved by the Engineer, shall be applied to test results from the beginning of asphaltic concrete production through the remainder of asphaltic concrete production using that mix design; however, a new correction may be determined at any time the Engineer believes it is necessary due to a change in material or other circumstances. If the contractor submits a new mix design, a new correction must be established and applied as specified above. For plants not providing asphaltic concrete exclusively for this project, no correction will be made to asphalt cement content values measured by ignition furnace testing.

(C) Ignition Furnace Correction for Mixes Containing RAP:

For mixes containing RAP, an asphalt cement tank shall be dedicated to the project for each shift of asphaltic concrete production. The difference between the asphalt cement content as measured by ignition furnace testing and the actual asphalt cement content shall be determined by the Engineer for each of the first five lots of asphaltic concrete produced for each mix design. If there are less than five lots for the mix design, the total number of available lots shall be used. The actual asphalt cement content shall be determined by adding the virgin asphalt cement content to the RAP binder content determined in Subsection 416-7.04(D) of the specifications, both expressed as a percent of the total mix. The determination of the virgin asphalt cement content may include weighing of asphalt cement deliveries, invoice quantities, volumetric tank measurements using a calibrated rod (tank stickings) corrected for temperature, computerized mass-flow meter, and accounting for wasted materials. If a computerized mass-flow meter is used, documentation of its calibration shall be submitted to the Engineer prior to asphaltic concrete production. At any time during asphaltic concrete production, the Engineer may require that a new calibration of the mass-flow meter be performed. If the average difference exceeds $\pm$ 0.10 percent asphalt cement content between the asphalt cement content measured by ignition furnace testing and the actual asphalt cement content, a correction to the asphalt cement content by ignition furnace testing shall be made. The correction shall be applied to test results from the beginning of asphaltic concrete production through the remainder of asphaltic concrete production using that mix design; however, a new correction may be determined at any time the Engineer believes it is necessary due to a change in material or other circumstances. If the contractor submits a new mix design, a new correction must be established and applied as specified above. Referee testing shall not apply to the determination of asphalt cement content for asphaltic concrete containing RAP.

(D) RAP Binder Content:

(1) General:

During asphaltic concrete production, the Engineer shall obtain and test samples of the RAP material to determine the RAP binder content in each stockpile at a minimum frequency of one sample per lot. The RAP will be tested by the Engineer for asphalt binder content in accordance with Arizona Test Method 428. When more than one RAP sample is tested for a given lot and stockpile, the average of the results shall be used.

(2) RAP Binder Content Correction Factor:

A RAP binder correction factor shall be determined for each RAP stockpile used in the mixture.

At the start of asphaltic concrete production, the first two samples of RAP material from each stockpile will be split and tested for asphalt binder content; one split is tested in accordance with Arizona Test Method 428 (ignition furnace) and the other split is tested in accordance with AASHTO T 164 (solvent extraction). A RAP binder correction factor will be determined by subtracting the average ignition furnace result from the average solvent extraction result. The appropriate correction factor shall be added to each asphalt binder test result determined on the material from each RAP stockpile in accordance with Arizona Test Method 428 to determine the RAP binder content. At the discretion of the Engineer, the correction factor may be determined prior to the start of asphaltic concrete production provided representative RAP samples are available. A new correction factor may be determined at any time the Engineer believes it is necessary due to a change in material or other circumstances.

416-7.05 Compaction:

(A) Courses 1-1/2 Inches or Less in Nominal Thickness:

(1) General Requirements:

Asphaltic concrete shall be placed only when the temperature of the surface on which the asphaltic concrete is to be placed is at least 65 degrees F and the ambient temperature at the beginning of placement is at least 65 degrees F and rising. The placement shall be stopped when the ambient temperature is 70 degrees F or less and falling.

When Warm Mix Asphalt (WMA) technologies are not used in the mixture, asphaltic concrete immediately behind the laydown machine shall be a minimum of 275 degrees F.

When Warm Mix Asphalt (WMA) technologies are used in the mixture, the recommended temperature range for compaction during production shall be shown on the mix design and shall be approved by the Engineer.

All edges shall be rolled with a pneumatic tired compactor, or other methods approved by the Engineer, while the mixture is still hot.

(2) Equipment:

Compacting and smoothing shall be accomplished by the use of self-propelled equipment. Compactors shall be pneumatic-tired and/or steel wheel.

Compactors shall be operated in accordance with the manufacturer's recommendations. Compactors shall be designed and properly maintained so that they are capable of accomplishing the required compaction.

Steel wheel compactors shall weigh not less than 8 tons.

Pneumatic-tired compactors shall be the oscillating type with at least seven pneumatic tires of equal size and diameter. Wobble-wheel compactors will not be permitted. The tires shall be spaced so that the gaps between adjacent tires will be covered by the following tires. The tires shall be capable of being inflated to 90 pounds per square inch and maintained so that the air pressure will not vary more than 5 pounds per square inch from the designated pressure. Pneumatic-tired compactors shall be constructed so that the total weight of the compactor will be varied to produce an operating weight per tire of not less than 5,000 pounds. 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.

(3) Rolling Method Procedure:

Compaction shall consist of an established sequence of coverage using specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used, and the number of coverages required shall be as follows:

Rolling Sequence	Type of Compactor		No. of Coverages	
	Option No. 1	Option No. 2	Option No.1	Option No. 2
Initial	Static Steel	Vibrating Steel	1	1
Intermediate	Pneumatic Tired	Vibrating Steel	4	2-4*
Finish	Static Steel	Static Steel	1-3	1-3

Note:

* Based on the roller pattern which exhibits the best performance.

The Engineer shall select the option for compaction and, when pneumatic-tired compactors are used, will designate the tire pressure.

One pneumatic-tired roller shall be furnished for each 300 tons of asphaltic concrete per hour.

Steel wheel compactors shall not be used in the vibratory mode for courses of 1 inch or less in thickness nor when the temperature of the asphaltic concrete falls below 180 degrees F.

Initial and intermediate compaction shall be accomplished before the temperature of the asphaltic concrete falls below 200 degrees F.

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors specified, ballasted and operated as specified, and with the number of coverages of the compactors as specified.

(B) Courses Greater than 1-1/2 Inches in Nominal Thickness:

Compaction control shall be the responsibility of the contractor. The number and types of rollers shall be the contractor's responsibility and shall be sufficient to meet these requirements.

All edges shall be rolled with a pneumatic tired compactor, or other methods approved by the Engineer, while the mixture is still hot.

A compaction lot shall be identical to the mixture properties lot described in Subsection 416-7.04 of the specifications. Lots encompassing more than one project shall be separated in accordance with Subsection 416-9(D) of the specifications. Each lot shall be tested for acceptance.

Twenty cores shall be taken for each lot by the contractor, under the observation of the Engineer. The Engineer will designate 10 random locations within the lot, and the contractor shall take two cores at each location; however, if more than one shift constitutes a lot, two cores shall be taken from a minimum of two random locations each shift, or as directed by the Engineer. The Engineer will save one core from each location for 15 days after written notification to the contractor of test

results for the lot has been made. Randomly selected locations will be determined to the nearest 0.5 foot in the transverse direction and to the nearest foot in the longitudinal direction of the pavement course; however, the outside 1 foot of the unconfined pavement course will be excluded from testing as shown in Materials ADOT Practice and Procedure Directive (P.P.D.) No. 18, "Determining Sample Times and Locations for End Product Asphaltic Concrete". P.P.D. No. 18 also addresses areas to be excluded relative to longitudinal joints. Areas excluded from testing will be compacted in accordance with Subsection 416-7.05(A) of the specifications. Cores shall be taken utilizing mechanical coring equipment in accordance with the requirements of Arizona Test Method 104. Cores shall be a minimum of 4 inches in diameter and shall be taken not later than two working days after placement of the asphaltic concrete. The cores shall be delivered to the Engineer immediately upon being taken. The bulk density of each core will be determined by the Engineer in accordance with the requirements of Arizona Test Method 415. The test results will be furnished to the contractor within four working days of receipt of cores by the Engineer. In areas where more than one lift is placed in the same lot, coring shall be accomplished through the full depth of the lifts after the final lift is placed, and the compaction density shall be based on the full depth of the lifts.

The target value for compaction shall be 7.0 percent in-place air voids. In-place air voids shall be determined in accordance with Arizona Test Method 424. The maximum theoretical density used in the determination of air voids will be the average of the four maximum theoretical densities determined for the lot in Subsection 416-7.04 of the specifications.

The Upper Limit (UL) is 9.0 percent in-place air voids and the Lower Limit (LL) is 3.5 percent in-place air voids. The Engineer will determine the PT for compaction in accordance with Subsection 416-9(I), and utilizing Table 416-1 of the specifications will determine the compaction pay factor.

In the event the contractor elects to question the core test results, the contractor may request referee testing in accordance with Subsection 416-9(J) of the specifications.

416-7.06 Smoothness and Surface Tolerances:

Asphaltic concrete shall be compacted as required, smooth and true to the required lines, grades, and dimensions.

The Special Provisions may require the smoothness of the final pavement surface to be tested in accordance with Subsection 109.13 of the specifications.

Regardless of whether testing in accordance with Subsection 109.13 of the specifications is specified or not, the following requirements shall be met:

(A) The surface of the final lift of asphaltic concrete placed under this section of the specifications shall be tested and shall not vary by more than 1/8 inch from the lower edge of a 10-foot straightedge when it is placed in the longitudinal direction (including across transverse joints), and when it is placed in the transverse direction across longitudinal joints;

(B) The surface of any lift of asphaltic concrete placed under this section of the specifications, other than the final lift, shall be tested and shall not vary by more than 1/4 inch from the lower edge of a 10-foot straightedge when it is placed in the longitudinal direction (including across transverse joints), and when it is placed in the transverse direction across longitudinal joints; and

(C) All deviations exceeding the specified tolerances above shall be corrected by the contractor, to the satisfaction of the Engineer.

416-8 Method of Measurement:

(A) Asphaltic Concrete:

Asphaltic concrete will be measured by the ton for the asphaltic concrete actually used, which will include the weight of mineral aggregate, asphalt cement, and mineral admixture. Measurement will include any quantity used in construction of intersections, turnouts, or other miscellaneous items or surfaces.

(B) Asphalt Cement:

(1) Non-RAP Mixes:

Asphalt cement will be measured by the ton on the basis of the asphalt cement content determined in accordance with Subsections 416-7.04(A) and (B) of the specifications for each lot of asphaltic concrete accepted. The average asphalt cement content will be multiplied by the number of tons of asphaltic concrete in that lot to determine the amount of asphalt cement. If the contractor has requested referee testing, the average asphalt cement content will come from the independent testing laboratory results unless a correction, based on the actual asphalt cement content, was made to the ignition furnace test value as allowed in Subsection 416-7.04(B) of the specifications. If a correction, based on the actual asphalt cement content, was made to the ignition furnace test value, the average asphalt cement content determined from the Department's acceptance testing will be used. At the discretion of the Engineer, asphalt cement may be measured by invoice quantities, adjusted as necessary for waste. Waste generated from startup of the asphalt plant will be considered to have a binder content of 3.0 percent. In no case shall the measured amount of asphalt cement for payment be greater than the total of the invoice quantities, adjusted for waste.

(2) Mixes Containing RAP:

Asphalt cement will be measured by the ton on the basis of the asphalt cement content determined in accordance with Subsections 416-7.04(A) and (C) of the specifications for each lot of asphaltic concrete accepted. The average asphalt cement content will be multiplied by the number of tons of asphaltic concrete in that lot to determine the amount of asphalt cement. At the discretion of the Engineer, asphalt cement may be measured by adding invoice quantities to the RAP binder used, adjusted as necessary for waste. RAP binder used shall be determined by multiplying the RAP binder content determined in Subsection 416-7.04(D) of the specifications by the number of tons of dry RAP material used in that lot. Waste generated from startup of the asphalt plant will be considered to have a binder content of 3.0 percent. In no case shall the measured amount of asphalt cement for payment be greater than the total of the invoice quantities plus the RAP binder as determined above, adjusted for waste.

(C) Mineral Admixture:

Mineral admixture will be measured by the ton for the mineral admixture actually used in accordance with Subsection 403-2 of the specifications.

416-9 Basis of Payment:

The accepted quantities of asphaltic concrete, measured as provided above, will be paid for at the contract unit price adjusted by the appropriate pay factors as hereinafter provided.

When Warm Mix Asphalt (WMA) technologies are used in the mixture, no separate payment will be made for WMA additives or technologies, necessary hot plant modifications, or other associated costs.

For the purpose of determining acceptability and appropriate pay factors, each unit of asphaltic concrete will be included in three separate lots: a "spread lot", a "mixture-properties lot", and a "compaction lot". The total unit price for any unit of accepted asphaltic concrete will be the contract unit price, adjusted by the applicable spread lot pay factor, mixture-properties lot pay factor, and compaction lot pay factor.

The contractor may request to place the first lot of each mix type as a test strip. Requests to place a test strip shall be made in writing and acknowledged by the Engineer prior to start of production. A test strip shall be limited to 1,000 tons and may only be placed on shoulders, ramps, cross roads, or other areas approved by the Engineer. A test strip shall be excluded from the mixture properties lot pay factor and the compaction lot pay factor; however, all other provisions of Subsection 416-9 of the specifications shall still apply to such areas.

The Engineer may exclude asphaltic concrete from the spread lot and from the spread lot pay factor calculations if the Engineer determines

that the proposed use of the material or the existing surface conditions are not conducive to the use of spread lots.

The Engineer may exclude certain locations from the mixture properties lot and/or the compaction lot and from the random sampling used in determining the mixture properties lot pay factor and/or the compaction lot pay factor should the Engineer determine that the location of the work precludes normal construction operations.

(A) Spread Lot Pay Factor:

The spread lot pay factor will be determined in accordance with Subsection 416-7.03 of the specifications. If the quantity in a spread lot is found to vary by more than +5.0 percent from the required quantity, no payment will be made for the material which exceeds +5.0 percent, including asphalt cement and mineral admixture. If the quantity is found to vary by more than -12.0 percent from the required quantity, the spread lot will be rejected.

(B) Mixture-Properties Lot Pay Factor:

The mixture properties lot pay factor shall be determined in accordance with the following procedure:

(1) The individual PT values and pay factors for gradation, asphalt cement content, and effective voids shall be determined as set forth in Subsection 416-7.04 of the specifications;

(2) A single pay factor shall be determined for gradation and asphalt cement content. that pay factor shall be the lowest pay factor for the individual measured characteristics for gradation and asphalt cement content; and

(3) If no individual PT value in (1) above is less than 50, the mixture properties lot pay factor shall be the sum of the pay factor determined in (2) above and the effective voids pay factor. The negative pay factor for mixture properties shall not exceed $3.00 per ton. If any individual PT value is less than 50, the lot is in reject and the provisions in Subsection 416-9(E) of the specifications shall apply.

(C) Compaction Lot Pay Factor:

The compaction lot pay factor shall be determined as set forth in Subsection 416-7.05(B) of the specifications.

(D) Determination of Lot Pay Factors on Contracts Involving Multiple Projects:

When more than one project is included in a single contract, placement during a shift or half shift of production may encompass more than one project. In such case, the applicable spread lot pay factor, mixture-properties lot pay factor, and compaction lot pay factor for each project shall be determined as follows:

(1) Spread lot pay factors will be determined separately for each project utilizing the procedure set forth in Subsection 416-7.03 of the specifications;

(2) The individual PT values and pay factors for gradation, asphalt cement content, and effective voids will be determined from the results of the random samples taken and tested in accordance with Subsection 416-7.04 of the specifications, regardless of which project(s) the samples fall within;

(3) PT values and pay factors for compaction, for those areas subject to Subsection 416-7.05(B) of the specifications, shall be determined from separate sets of core samples for each project utilizing the procedure set forth in that Subsection;

(4) The mixture-properties lot pay factor shall be determined separately for each project in accordance with Subsection 416-9(B) of the specifications, utilizing the individual pay factors determined in (2) above; and

(5) The compaction lot pay factor shall be determined separately for each project in accordance with Subsection 416-9(C) of the specifications, utilizing the pay factor determined in (3) above.

(E) Acceptability:

Asphaltic concrete included in any mixture properties lot possessing an individual PT value lower than 50 for gradation, asphalt cement content, or effective voids will be rejected. Asphaltic concrete included in any compaction lot possessing a PT value lower than 50 will be rejected.

Within 15 days after receiving notice that a spread lot, mixture properties lot, or compaction lot of asphaltic concrete has been rejected by the Engineer, the contractor may submit a written proposal to accept the material in place at the applicable maximum negative pay factor(s). Maximum negative pay factors are defined as a minus $1.00 per ton for spread lots, minus $5.00 per ton for compaction lots, minus $3.00 per ton for mixture properties lots in reject for gradation only, minus $5.00 per ton for mixture properties lots in reject for asphalt cement content

and/or effective voids only, and minus $5.00 per ton for mixture properties lots in reject for asphalt cement content and/or effective voids and also gradation. Positive mixture properties lot pay factors become zero when the compaction lot is in reject and the material is allowed to be left in place. In addition, for any mixture properties lot that is in reject due to asphalt cement content but allowed to remain in place, payment shall not be made for asphalt cement quantities in excess of the upper limit (UL) as determined in Subsection 416-7.04(A) of the specifications.

The proposal shall contain an engineering analysis of the anticipated performance of the asphaltic concrete if left in place. The engineering analysis shall also detail any proposed corrective action, and the anticipated effect of such corrective action on the performance. The engineering analysis shall be performed by an independent professional engineer experienced in asphaltic concrete testing and the development of asphaltic concrete mix designs. If a rejected mixture properties lot or a rejected compaction lot is submitted for referee testing by the contractor, the 15 days allowed to prepare an engineering analysis will begin upon notification of referee test results.

Within three working days, the Engineer will determine whether or not to accept the contractor's proposal. If the proposal is not accepted, the asphaltic concrete shall be removed at no additional cost to the Department and replaced with asphaltic concrete meeting the requirements of these specifications. If the proposal is accepted, the asphaltic concrete shall remain in place at the applicable maximum negative pay factor(s), and any necessary corrective action shall be performed at no additional cost to the Department.

The Department reserves the right to suspend the work should any of the following conditions occur:

(1) The occurrence of two or more rejected lots within any 10 consecutive production lots;

(2) The occurrence of three consecutive negative mixture properties lot pay factors or three consecutive negative compaction lot pay factors; and/or

(3) The occurrence of five or more pay factors that are negative either for a mixture properties lot or for a compaction lot within any 10 consecutive production lots.

If the Department elects to suspend the work for any of these conditions, the contractor shall either submit a revised mix design in accordance with Subsection 416-4 of the specifications, or submit for the Engineer's approval a written engineering analysis. The engineering analysis shall detail the course of action necessary to correct deficiencies in the contractor’s present production methods such that further production can be accomplished without excessive amounts of asphaltic concrete in penalty or rejection. If approved by the Engineer, the revised mix

design, or the course of action proposed in the engineering analysis, shall be implemented, and the work may continue. Costs or delays due to the provisions of this subsection are not compensable.

(F) Asphalt Cement:

(1) Non-RAP Mixes:

Payment for asphalt cement will be made by the ton. Adjustments in payment shall be made in accordance with the requirements of Subsection 1005-3.01 of the specifications.

(2) Mixes Containing RAP:

When RAP is used in the mixture, payment for asphalt cement will be made by the ton for the total asphalt cement as determined in Subsection 416-8(B)(2) of the specifications. Adjustments in payment shall be made in accordance with the requirements of Subsection 1005-3.01 of the specifications for the virgin binder only.

(G) Mineral Admixture:

Mineral admixture will be paid for at the predetermined price established in the Bidding Schedule.

(H) Smoothness:

When required in the Special Provisions, payment for smoothness shall be made in accordance with the requirements of Subsection 109.13 of the specifications.

(I) Statistical Acceptance:

The “Total Percentage of Lot within UL and LL (PT)” shall be determined in accordance with Subsection 109.11 of the specifications.

Pay Factors (PF) shall be determined by entering Table 416-1 with PT.

TABLE 416-1
PAY FACTORS

Material Spread		Mixture Properties and Compaction			
			Pay Factors (Dollars per Ton)		
Negative Variance %	Pay Factor (Dollars per Ton)	PT	Gradation and Asphalt Cement Content	Effective Voids	Compaction
2.1 - 3.0	- 0.10	100	0.00	+ 2.00	+ 2.00
3.1 - 4.0	- 0.20	95 - 99	0.00	+ 0.50	+ 0.50
4.1 - 5.0	- 0.30	90 - 94	0.00	0.00	0.00
5.1 - 6.0	- 0.40	85 - 89	0.00	- 0.25	- 0.25
6.1 - 7.0	- 0.50	80 - 84	- 0.25	- 0.50	- 0.50
7.1 - 8.0	- 0.60	75 - 79	- 0.50	- 0.75	- 0.75
8.1 - 9.0	- 0.70	70 - 74	- 0.75	- 1.00	- 1.00
9.1 - 10.0	- 0.80	65 - 69	- 1.00	- 1.25	- 1.25
10.1 - 11.0	- 0.90	60 - 64	- 1.50	- 1.50	- 1.75
11.1 - 12.0	- 1.00	55 - 59	- 2.00	- 2.00	- 2.25
More than 12.0	Reject	50 - 54	- 2.50	- 2.50	- 3.00
See Subsections 416-9(A) and (E)		Less than 50	Reject-See Subsection 416-9(E)		

(J) Referee Testing:

(1) Referee Testing Performed for Mixture Properties Only:

Within 15 days after written notification to the contractor of test results for a particular mixture properties lot, the contractor may make a written request for referee testing. The referee testing shall be performed by an independent approved laboratory designated by the Department. The testing of the samples will be performed by the independent testing laboratory without knowledge of the specific project conditions such as the identity of the contractor or mix design laboratory, the test results by the Department, or the mix design targets for gradation and effective voids. The asphaltic concrete samples previously saved will be tested for the following properties:

Test Property	Test Method
Asphalt Cement Content (See Note 1)	Arizona Test Method 427 (428 for RAP mixes)
Gradation	
Marshall Density and Stability	Arizona Test Method 410
Maximum Theoretical Density	Arizona Test Method 417
Effective Voids	Arizona Test Method 424

Note:

(1) If a correction to the asphalt cement content by ignition furnace testing is made in accordance with Subsection 416-7.04(B) of the specifications, or if RAP is used in the mixture, the asphalt cement content shall not be subject to referee testing.

The results of the referee testing will be binding on both the contractor and the Department.

Using the referee testing results, the Engineer will determine new PT's for all characteristics, with the exception of asphalt cement content if a correction to the ignition furnace value was made as specified in Subsection 416-7.04(B) of the specifications, or if RAP is used in the mixture.

When referee testing is performed on a mixture properties lot, the referee test result for the average maximum theoretical density will be used to determine a new PT for compaction.

The Department will pay for the referee testing; however, if the combined pay factor of the lot (mixture properties plus compaction) does not improve or is reduced, or if either the mixture properties lot or compaction lot remains in reject or is placed in reject, payment to the contractor for asphaltic concrete shall be reduced by the amount of the cost of the referee testing for the mixture properties of that particular lot.

(2) Referee Testing Performed for Compaction Only:

Within 15 days after written notification to the contractor of test results for a particular compaction lot, the contractor may make a written request for referee testing. The bulk density of each of the cores previously saved will be determined in accordance with the requirements of Arizona Test Method 415 by an independent testing laboratory designated by the Department. The testing of the cores will be performed by the independent testing laboratory without knowledge of the specific project conditions, such as the identity of the contractor or mix design laboratory, or the test results by the Department. The percent air voids will be determined in accordance with Arizona Test Method 424. The maximum theoretical density used in the determination of air voids will be the average of the four maximum theoretical densities determined for the lot in Subsection 416-7.04 of the specifications.

The results of the referee testing will be binding on both the contractor and the Department.

When referee testing is performed on the compaction lot, the Engineer will determine a new PT for compaction using the referee testing results.

The Department will pay for the referee testing; however, if the pay factor of the compaction lot does not improve or is reduced, or the compaction lot remains in reject or is placed in reject, payment to the contractor for asphaltic concrete will be reduced by the amount of the cost of referee testing for the compaction of that particular lot.

(3) Referee Testing Performed for Both Mixture Properties and Compaction:

When referee testing is performed, as described above, for both the mixture properties lot and the compaction lot, the Engineer will use the referee test results to determine new PT's as specified in Subsections 416-9(J)(1) and 416-9(J)(2) of the specifications.

The Department will pay for the referee testing; however, if the combined pay factor of the lot (mixture properties plus compaction) does not improve or is reduced, or if either the mixture properties lot or compaction lot remains in reject or is placed in reject, payment to the contractor for asphaltic concrete shall be reduced by the amount of the cost of the referee testing for the mixture properties and compaction of that particular lot.

SECTION 501 PIPE CULVERT AND STORM DRAINS:

501-1 Description:

The work under this section shall consist of furnishing pipe and all other materials required and the installing of pipe, including excavating, and furnishing, placing, and compacting backfill material, all in accordance with the details shown on the plans and the requirements of the specifications.

At each location where a pipe is to be installed, the project plans will specify the size and approximate length along with the requirements for each approved option at that location, such as the wall thickness, corrugation configuration, coatings, linings, class, and strength.

At each such specified location, pipe of one kind and material shall be selected by the contractor from the options shown. All contiguous pipe and all metal pipe in close proximity shall be of the same kind and material. Special sections, fittings, elbows, branch connections, tapered inlets, end sections, connectors, coupling, and other such items shall be of the same material and coating as the pipe to which they are attached unless otherwise stated in the specifications.

When trenching to depths in excess of 5 feet is required, prior to construction the contractor shall submit in writing to the Engineer a detailed description of its proposed trenching operations, including shoring methods.

501-2 Materials:

501-2.01 All Pipe Except Nonreinforced, Cast-In-Place:

Except for nonreinforced, cast-in-place concrete pipe, materials shall conform to the requirements of Section 1010 of the specifications.

501-2.02 Nonreinforced, Cast-In-Place:

Concrete for constructing the cast-in-place concrete pipe shall conform to the requirements of Section 1006 of the specifications for Class S concrete, except as specified herein.

Class S concrete shall have a minimum compressive strength of 3,000 pounds per square inch at 28 days.

The proposed slump in the mix design furnished by the contractor shall be the minimum required to permit proper placement of the concrete without harmful segregation, bleeding or incomplete consolidation.

The maximum size of the coarse aggregate for pipes 48 inches or less in diameter shall be 1 inch and for pipes larger than 48 inches in diameter shall be 1-1/2 inches.

501-3 Construction Requirements:

501-3.01 Preparation of Foundations, Trenches, and Embankments:

A trench condition is defined as a trench which has vertical slopes to a point at least 1 foot above the top of the pipe and its maximum width is as detailed on the plans.

Unless specified otherwise, the contractor may install pipe in either a non-trench condition or a trench condition in natural ground or in embankment.

Where rock, hardpan, or other unyielding material is encountered, such material shall be removed below the vertical limits as shown on the plans. The depth to be removed shall be at least 12 inches or as designated by the Engineer. The width to be removed shall depend on whether a trench or non-trench condition exists. If a trench condition exists, the width of the trench as shown on the plans shall be maintained throughout the additional depth. If a non-trench condition exists, the width of the removal shall be a minimum of the outside diameter of the pipe plus 2 feet for pipe under 4 feet in diameter, or a minimum of the outside diameter of the pipe plus 3 feet for pipe of 4 or more feet in diameter. The overexcavated area shall be backfilled with structure backfill material as designated in Subsection 203-5.03(B)(1) of the specifications and compacted in layers not exceeding 6 inches in depth.

When a firm foundation is not encountered at the bottom of the vertical limits as shown on the plans due to soft, spongy, or other unstable soil, such unstable soil shall be removed for a width of at least the horizontal outside dimension of the pipe on each side of the pipe and to the depth specified by the Engineer. The unstable soil removed shall be replaced with structure backfill material as designated in Subsection 203-5.03(B)(1) of the specifications and compacted in 6-inch lifts.

The completed foundation shall be firm for its full length and width. When specified on the project plans, the foundation shall have a longitudinal camber of the magnitude specified.

501-3.02 Bedding:

(A) Bedding Material:

(1) General:

Bedding material for all pipe may be selected from excavation or from a source selected by the contractor and shall conform to the following aggregate gradation:

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	90 - 100
No. 8	35 - 80
No. 200	0 - 8.0

In addition to the above gradation requirements, thermoplastic pipe bedding material shall include no more than 50 percent passing a No. 100 sieve.

The plasticity index of the bedding material for all pipe shall not exceed 8 when tested in accordance with the requirements of AASHTO T 90.

Bedding material for all pipe shall have a value of resistivity not less than 2,000 ohm-centimeters unless otherwise specified or approved by the Engineer. Bedding material shall have a pH value between 6.0 and 10.0, inclusive, for all metal pipe installations except aluminum. Bedding material for aluminum pipe installations shall have a pH value between 6.0 and 9.0, inclusive. Bedding material shall have a pH value between 6.0 and 12.0, inclusive, for all concrete or plastic pipe installations. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

(2) Standard Aggregate Bedding Material:

Standard aggregate bedding material shall conform to the requirements specified in Subsection 501-3.02(A)(1) of the specifications, and shall be placed and mechanically compacted in 8 inch lifts as herein specified. Other methods of placement and compaction, including aggregate slurry and jetting shall require prior approval from the Engineer.

When an aggregate slurry mixture is allowed, the maximum water content shall be 35 gallons of water per ton of bedding material. Unless otherwise approved by the Engineer, the slurry shall be compacted with internal vibrators in accordance with the requirements of Subsection 601-3.03(D) of the specifications. Aggregate slurry shall be thoroughly mixed in a mixer approved by the Engineer.

(3) Cement-Treated Slurry Bedding Material:

Aggregate for cement-treated slurry bedding material, prior to the addition of cement and water, shall conform to the requirements specified in Subsection 501-3.02(A)(1) of the specifications. One sack of cement shall be added to each cubic yard of aggregate. Cement-treated slurry shall be thoroughly mixed in a mixer or at a central batch plant as approved by the Engineer and shall have a slump of 8 to 11 inches.

(B) Placement of Bedding Material:

(1) General:

All trash, forms, sheeting, bracing, and loose rock or loose earth shall be removed from the area into which bedding material is to be placed.

Bedding material shall be placed under and around the pipe from the bottom of the trench or bedding limits to the elevation at the point of maximum width of the pipe (springline), as shown on the plans. At the contractor's option, bedding material may be placed above the springline of the pipe, at no additional cost to the Department.

For pipes placed in a non-trench condition, as shown on the plans, standard aggregate bedding material shall be used from 6 inches below the pipe to the springline.

For pipes placed in trench condition, a 6-inch layer of standard aggregate bedding material shall be placed, in accordance with the plans, between the bottom of the trench and the bottom of the pipe. The remainder of the bedding, from the bottom of the pipe to the springline, shall be either standard aggregate bedding material or cement-treated slurry as tabulated below:

(a) For pipe culverts or storm drains 36 inches or larger, cement-treated slurry shall be used as bedding material from the bottom of the pipe to springline; or

(b) For pipe culverts or storm drains less than 36 inches in diameter, cement-treated slurry may be substituted for standard aggregate bedding material from the bottom of the pipe to springline.

Bedding material shall be placed in a manner which will prevent distortion, damage to, or displacement of the pipe from its intended location. Bedding material shall also be placed so that adequate support will be provided in the haunch support areas for the pipe. Voids or loose soils which are found to occur due to improper placement or compaction of bedding materials will result in rejection of that portion of the pipe installation. Replacement of the pipe will be at no additional cost to the Department.

(2) Standard Aggregate Bedding Material:

Standard aggregate bedding material shall be placed in uniform horizontal layers not exceeding 8 inches in depth before compaction. When aggregate slurry or jetting is allowed, bedding material shall be placed in uniform horizontal layers not exceeding 4 feet in depth.

(3) Cement-Treated Slurry Bedding Material:

Cement-treated slurry bedding material shall be placed in a uniform manner that will prevent voids in, or segregation of, the bedding material, and will not float or shift the culvert or pipe. Cement-treated slurry bedding material shall be placed from bottom of pipe to pipe springline. No backfilling above the cement-treated slurry shall be commenced until 24 hours after the cement-treated slurry has been placed.

(C) Compaction of Bedding Material:

(1) General:

Compaction of bedding material shall be performed without damage to the pipe and surrounding in-place material. Special care shall be taken in placing, shaping and compacting all bedding material under haunches of pipe to prevent moving the pipe or raising it from its bedding.

(2) Standard Aggregate Bedding Materials:

Standard aggregate bedding material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

When standard aggregate bedding material is allowed to be placed as an aggregate slurry or compacted by jetting, the material placed below the springline of the pipe shall be compacted prior to placement of material above the springline of the pipe.

Jetting shall not be used for any material placed more than 1 foot above the top of the pipe.

Ponding will not be permitted in any case.

When allowed, jetting shall be done in such a manner that water will not be impounded. Jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required compaction. Bedding material compacted by jetting shall use the least amount of water that will properly consolidate the material and move the material under the pipe to eliminate voids. A jetting probe shall be inserted into the material. It shall be of such length as to reach

the material under the pipe. Water shall be provided to the jetting probe at a minimum pressure of 30 pounds per square inch. The jetting probe shall be inserted at uniformly spaced intervals on both sides of the pipe, a maximum spacing of 3 feet.

When aggregate slurry or jetting is allowed, the contractor shall excavate holes in the compacted aggregate slurry or jetted bedding material to the depths and at the locations designated by the Engineer. These holes shall be of such size as to allow the required density testing to be performed in a safe manner. Upon completion of the tests, the contractor shall refill the excavated areas and compact the material to the required density in a manner satisfactory to the Engineer.

(3) Cement-Treated Slurry Bedding Material:

Cement-treated slurry bedding material shall not require additional compaction after placement up to pipe springline if it meets the material requirements of Subsection 501-3.02(A) of the specifications and is placed as outlined in Subsection 501-3.02(B) of the specifications. The Engineer may require the use of vibrators with cement-treated slurry bedding if the fluidity of the mixture is not sufficient to fill all voids. No density tests will be required in the cement-treated slurry bedding material as placed up to pipe springline.

501-3.03 Installation:

(A) General:

Pipe shall be handled carefully. Proper facilities shall be provided for handling and lowering the sections of pipe. All pipes which show defects due to negligence or rough handling shall be removed and replaced if so ordered by the Engineer. If damaged galvanized steel pipe is not replaced it shall be repaired in accordance with the requirements of AASHTO M 36. Damage to the coating of bituminous coated pipe shall be repaired using material conforming to the requirements of AASHTO M 190.

If the Engineer determines that the end of an existing pipe is damaged to the extent that it cannot be repaired sufficiently to be joined properly to the new pipe, the damaged portion shall be removed.

Pipe shall be installed in reasonably close conformity with the lines, grades and dimensions shown on the project plans or specified by the Engineer.

Prior to the staking of pipe culverts a study of the normal flow of the drainage shall be made. As a result of the study, a change in length or location of pipe may be required as approved by the Engineer to attain proper placement of the pipe. Pipe profiles shall be approved by the Engineer prior to constructing or installing each structure.

Unless otherwise permitted by the Engineer, the installing of the pipe shall begin at the downstream end.

Bell or groove ends of rigid conduits and outside circumferential laps of flexible conduits shall be placed facing upstream.

Helical corrugated pipe shall be installed with the separate sections firmly joined together with the corrugations in alignment.

Where there is restricted cover, the bolts of the bands connecting flexible pipe shall be advanced so that the tops of the bolts will be in line with or below the top of the pipe.

When aluminum alloys come in contact with concrete, the contacting surfaces shall be coated either with asphalt mastic conforming to the requirements of AASHTO M 243 or with aluminum-impregnated caulking compound.

When specified on the project plans, the vertical diameter of round, flexible conduit shall be increased 5 percent by shop elongation.

Any pipe which is not in true alignment or which shows undue settlement after laying or is damaged shall be removed. The trench shall be prepared as hereinbefore specified and the pipe shall be installed again. Any pipe which, in the opinion of the Engineer, is damaged so that it cannot be used shall be replaced.

Paved or partially lined flexible pipe shall be installed so that the longitudinal center line of the paved segment coincides with the flow line. Elliptical and elliptically reinforced rigid pipe shall be installed with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the pipe.

The interior of all pipes shall be free of dirt and foreign material as the work progresses and all pipes shall be left clean at the time of final acceptance.

Connections to new or existing pipes or structures shall be made in accordance with the details shown on the project plans or as may be ordered by the Engineer in order to complete the work specified.

When using metal safety end sections, the embankment slope shall be warped to match the end section.

For a skewed pipe installation, the toe of the embankment slope shall be warped to match the toe of the skewed metal safety end section in order to provide effective drainage.

When metal safety end sections are used, the bolts in the safety bars shall be torqued at 70 foot-pounds.

(B) Full Circle Corrugated Metal Pipe:

(1) General:

Field joints for each type of corrugated metal pipe shall provide circumferential and longitudinal strength to maintain the pipe alignment, prevent separation of the pipe, prevent infiltration of side fill material, and prevent leakage of water into the surrounding soil. Coupling bands and gaskets shall conform to the requirements of Subsection 1010-2.01 of the specifications.

Corrugations in the coupling bands shall have the same dimensions as the corrugations in the pipes being connected. Pipe fabricated with helical corrugations shall have the ends re-rolled to circumferential corrugations to facilitate coupling. The re-rolled end shall extend a minimum of two corrugations from the end of the pipe.

When a new pipe is to be connected to the end of an existing in-place helical pipe, a coupling band with projections (dimples) may be used to make the connection.

Bands for pipe diameters to 72 inches, inclusive, and corrugation sizes of 2-2/3 by 1/2 inches or 3 by 1 inches shall be at least 10-1/2 inches wide. Bands for pipes 36 to 72 inches in diameter, inclusive, with corrugations 5 by 1 inches shall be at least 12 inches wide. Bands shall have two circumferential rows of projections. The rows of projections shall be spaced to provide equal contact on each side of the pipes being joined.

When bands with projections (dimples) are used to join new pipe to existing pipe, the joints shall be sealed with a continuous sponge rubber strip. The strip shall conform to the minimum requirements of ASTM D1056, Grade 2A1, and shall be at least 7 inches wide and 3/8 inch thick.

Where existing pipes are to be extended, the ends of the existing pipe shall be in such condition that the new pipe can be firmly joined to form an acceptable joint. All existing pipe ends that are damaged or are out of shape such that they cannot be joined in an acceptable manner shall be repaired.

Where prefabricated pipe fittings are to be installed in existing pipes, a portion of the existing pipe shall be removed in order to accommodate the fitting.

(2) Watertight and Water-resistant Joints:

Watertight joints shall be provided for siphon and irrigation pipe installation and when specified in the Special Provisions, standard drawings, or shown on the project plans. Watertight joints, unless otherwise specified, will not be required for storm drains, culverts, or

other drainage pipe, however, joints for these pipes shall be water resistant.

Watertight and water-resistant joints shall conform to the requirements of Subsection 1010-2.01 of the specifications. When watertight joints are shown on the project plans or specified in the Special Provisions, the assembled joint shall pass a performance test, as specified herein or as approved by the Engineer, without significant leakage at the joint:

(a) A hydrostatic pressure test on a joint shall be made on an assembly of two sections of pipe, properly connected in accordance with the joint design. At the option of the contractor, suitable bulkheads shall be provided within the pipe adjacent to and on either side of the joint, or the outer ends of the two joined pipe sections shall be bulkheaded. No mortar or concrete coatings, fillings, or packings in addition to that normally required for the joint shall be placed prior to watertightness tests. After the pipe sections are fitted together with the gasket or gaskets in place, the assembly shall be subjected to a pressure resulting from a head of 10 feet of water above the crown of the pipe for 10 minutes. Moisture of beads of water appearing on the surface of the joint will not be considered as leakage. The tests on individual joints may be performed at the fabricator's facility or at the job site.

The joint watertightness test shall be performed on pipe sections in straight alignment and on pipe sections deflected from straight alignment. When testing pipe sections not on straight alignment, the pipe sections shall be positioned to create a gap on one side of the outside perimeter of the pipe that is 1/2 inch wider than the gap for pipe sections in straight alignment. When coupling bands are used to test pipe sections not on straight alignment and the maximum gap on one side of the outside perimeter of the pipe is less than 1/2 inch wider than that for pipe sections in straight alignment, said coupling band pipe sections shall be positioned to provide maximum gap.

(b) Joints, other than watertight joints, which employ rubber gaskets, whether flat or "O" rings, will be considered water resistant. No testing will be required to establish that condition.

The contractor shall furnish to the Engineer a Certificate of Compliance, in accordance with the provisions in Subsection 106.05 of the specifications, that the material being furnished conforms to the

joint property requirements as described herein. Field tests may be required by the Engineer whenever there is a question regarding compliance with these requirements.

(C) Slotted Pipe:

Slotted pipe shall be joined with coupling bands as shown on the project plans and the joint shall be made water resistant. Prior to attaching the coupling band, sealant material shall be placed between the coupling band and the periphery of the pipe section ends.

Prior to backfilling and paving operations, the slot shall be covered to prevent infiltration of material into the pipe. Heavy tape, roofing paper, timber or other material may be used. Coverings shall be removed when the paving operations have been completed.

Slotted pipe shall be backfilled with grout in accordance with the details shown on the project plans. The grout shall conform to the requirements of Subsection 1010-3 of the specifications. Grout shall not be placed when a descending air temperature falls below 40 degrees F or until an ascending air temperature exceeds 35 degrees F. Temperatures shall be taken in the shade and away from artificial heat. The grout shall be cured in accordance with the requirements of Subsection 912-3.09 of the specifications.

(D) Precast Concrete Pipe:

Pipe sections shall be jointed such that the inner surfaces are reasonably flush and even, and the ends are centered as required.

Unless a particular type of joint is specified on the project plans, joints shall be made with Portland cement mortar, Portland cement grout, rubber gaskets, plastic sealing compound, or any other type approved by the Engineer.

Self-centering tongue and groove mortar joints shall be finished smooth on the inside. For diapered joints, diapers shall be used to retain the poured grout. Joints shall be thoroughly wetted before mortar or grout is applied.

When Portland cement mixtures are used, the completed joints shall be protected against rapid drying by means of an approved curing method. No joint shall be grouted until the following two sections of pipe are laid.

When required, watertight gasketed joints shall be installed on the pipe in accordance with the requirements of AASHTO M 198, Paragraph 5.1, or AASHTO M 315.

(E) Spiral Rib Corrugated Metal Pipe:

Spiral rib corrugated metal pipe shall be installed in accordance with the requirements specified in Subsection 501-3.03(B) of the specifications for full circle corrugated metal pipe, except as otherwise specified herein. Special care shall be taken during placement of the pipe and backfilling to avoid damage to the pipe.

Lateral field connections between metal pipes shall be welded and any galvanizing damaged by welding shall be coated with asphalt mastic conforming to the requirements of AASHTO M 243. Coupling bands shall be supplied in accordance with Subsection 1010-2.02(C) of the specifications.

The coupling bands used to connect spiral rib pipe sections shall be hugger-type bands, made from the same material as the pipe, or other approved design, and shall be fitted with gaskets or "O" rings fabricated from neoprene or butyl rubber or other durable, resilient material approved by the Engineer, and assembled in such a manner as to form a sealed joint. "O" ring gaskets required for watertight joints shall be composed of rubber as specified in ASTM C361, Section 6.9, and shall be placed in the first corrugation of each pipe end and shall be compressed by tightening the coupling band, in accordance with the manufacturer's installation instructions.

(F) Concrete-Lined Corrugated Metal Pipe:

Concrete-lined corrugated metal pipe shall be installed in accordance with the requirements specified in Subsection 501-3.03(B) of the specifications for full circle corrugated metal pipe, except as otherwise specified herein.

Pipe shall be joined with hugger-type bands which are 0.064 inches in thickness, of the same material as the pipe, and shall be two-piece for pipe greater than 48 inches in diameter.

Coupling bands, in addition to the requirements specified in Subsection 1010-2.03(A) of the specifications, shall be a minimum of 10-1/2 inches wide, formed with two corrugations that are spaced to provide nesting in the second corrugation of each pipe end and shall be drawn together by a minimum of two galvanized bolts, 1/2 inch in diameter, inserted in a bar held in place by a strap welded to the pipe. Bands drawn together by other connection arrangements, such as angles, shall not be allowed. "O" ring gaskets required for watertight joints shall be composed of rubber as specified in ASTM C361, Section 6.9, and shall be placed in the first corrugation of each pipe end and shall be compressed by tightening the coupling bands in accordance with the manufacturer's installation instructions.

(G) Thermoplastic Pipe:

Thermoplastic pipe, which includes corrugated high-density polyethylene plastic pipe and corrugated polypropylene plastic pipe shall be assembled and installed in accordance with the manufacturer's instructions.

Watertight joints, unless otherwise specified, will not be required for storm drains, culverts, or other drainage pipes. However, joints for these pipes shall be water resistant. Watertight joints shall be provided for siphon and irrigation pipe installations.

Watertight and water-resistant joints shall conform to the requirements of Subsection 1010-8 of the specifications.

Tracer wire or tape for magnetic detection shall be placed in accordance with the requirements of Subsection 104.15 of the specifications.

To prevent damage and to assure that proper line and pipe grade are maintained throughout the backfilling operation, special care shall be taken in the handling and installation of corrugated high density polyethylene plastic pipe and fittings and corrugated polypropylene plastic pipe and fittings.

Thermoplastic pipe requires special bedding, backfill, and compaction requirements as specified in Subsections 501-3.02 and 501-3.04 of the specifications.

Thermoplastic pipe requires post installation inspection as specified in Subsection 501-3.08 of the specifications.

When end sections for the above listed pipes are called for on the plans, the contractor shall use metal safety end sections unless otherwise specified.

(H) Steel Reinforced Thermoplastic Pipe:

Steel reinforced thermoplastic pipe (i.e. steel reinforced high density thermoplastic ribbed pipe), shall be assembled and installed in accordance with the manufacturer's instructions.

Watertight joints, unless otherwise specified, will not be required for storm drains, culverts, or other drainage pipes. However, joints for these pipes shall be water resistant. Watertight joints shall be provided for siphon and irrigation pipe installations.

Watertight and water-resistant joints shall conform to the requirements of Subsection 1010-9 of the specifications.

To prevent damage and to assure that proper line and pipe grade are maintained throughout the backfilling operation, special care shall be taken in the handling and installation of steel reinforced thermoplastic pipe and fittings.

Steel reinforced thermoplastic pipe requires post installation inspection as specified in Subsection 501-3.08 of the specifications.

When end sections for steel reinforced thermoplastic pipe are called for on the plans, the contractor shall use metal safety end sections unless otherwise specified.

501-3.04 Backfilling and Compacting:

(A) Backfill Material:

(1) Pipe Backfill:

Pipe backfill material for concrete, corrugated metal, and steel reinforced thermoplastic pipes shall be selected from excavation or from a source selected by the contractor. It shall not contain frozen lumps, stones larger than 3 inches in diameter, chunks of clay or other objectionable material. Backfill material to be used for pipes, pipe-arches or arches made of metal shall have a value of resistivity not less than 2,000 ohm-centimeters or the value shown on the project plans. When resistivity is not shown on the plans, the backfill material shall have a value of resistivity not less than that of the existing in-place material or 2,000 ohm-centimeters, whichever is less. Backfill material shall have a pH value between 6.0 and 10.0, inclusive, for all metal pipe installations, except aluminum. Backfill material for aluminum pipe installations shall have a pH value between 6.0 and 9.0, inclusive. Backfill material shall have a pH value between 6.0 and 12.0, inclusive, for all concrete or plastic pipe installations. Tests for pH and resistivity shall be in accordance with the requirements of Arizona Test Method 236.

Pipe backfill material for concrete, corrugated metal, and steel reinforced thermoplastic pipes shall conform to the following gradation:

Sieve Size	Percent Passing
3 inch	100
3/4 inch	60 - 100
No. 8	35 - 80
No. 200	0 - 12.0

In addition to the above gradation requirements, steel reinforced thermoplastic pipe backfill material shall not contain particles with a maximum dimension larger than 1-1/2 inch.

The plasticity index shall not exceed 12 when tested in accordance with the requirements of AASHTO T 90.

As an alternate, pipe backfill may conform to the material requirements listed for bedding material as specified in Subsection 501-3.02(A) of the specifications, for standard aggregate bedding material or cement-treated slurry bedding material.

Pipe backfill for thermoplastic pipe shall conform to the material requirements listed for thermoplastic pipe bedding material as specified in Subsection 501-3.02(A) of the specifications, for standard aggregate bedding material or cement-treated slurry bedding material.

(2) Trench Backfill:

Trench backfill material shall not contain organic material, rubbish, debris, and other deleterious material and shall not contain solid material which exceeds 8 inches in greatest dimension and shall be soil selected from excavation or from a source selected by the contractor.

As an alternate, trench backfill may conform to the material requirements listed for bedding material as specified in Subsection 501-3.02(A) of the specifications for standard aggregate bedding material or cement-treated slurry bedding material.

(3) Slope Plating:

The roadway slope at the inlet ends of pipe culverts shall be plated with an impervious material. The plating material shall be a fine-grained, cohesive material with at least 50 percent of it passing the No. 40 sieve and with a plasticity index of at least 10 and shall be placed as shown on the plans. The plasticity index will be determined in accordance with the requirements of AASHTO T 90.

(B) Placement of Backfill Material:

(1) General:

All trash, forms, sheeting, bracing, and loose rock or loose earth shall be removed from the areas to be backfilled before backfill material is placed.

Backfill compacted by pneumatic or mechanical tamping devices, shall be placed in layers not more than 8 inches in depth before compaction.

Pipe backfill shall be brought up evenly on both sides of the pipe for the full length to an elevation 1 foot above the top of the pipe.

Trench backfill shall be placed from 1 foot above the top of the pipe to the elevation at which base or surfacing materials are to be placed or to the top of the trench.

Backfill material shall be placed around and over arches in accordance with the requirements of Section 502 of the specifications.

(2) Standard Aggregate Slurry:

With prior approval from the Engineer, pipe backfill may be placed as an aggregate slurry as herein specified. Pipe backfill or trench backfill mixed as a standard aggregate slurry shall be placed in uniform horizontal layers not exceeding 4 feet in depth. The slurry shall be compacted with internal vibrators in accordance with the requirements of Subsection 601-3.03(D) of the specifications.

(3) Cement-Treated Slurry:

Cement-treated slurry pipe backfill placement above springline shall not commence within 24 hours of the placement of the underlying cement-treated bedding material below springline. Cement-treated pipe backfill shall be placed in a uniform manner that will prevent voids in or segregation of the backfill to an elevation 1 foot above the top of the pipe. No backfilling above the cement-treated slurry pipe backfill shall be commenced until 24 hours after the cement-treated slurry has been placed.

If cement-treated slurry bedding material is used for trench backfill, it shall not be disturbed or loaded in any manner within 24 hours of placement as above.

(C) Compaction of Backfill Material:

Backfill material shall be compacted to at least 95 percent of the maximum density determined in accordance with the requirements of the applicable test methods of the ADOT Materials Testing Manual, as directed and approved by the Engineer.

Jetting shall not be used to compact pipe backfill, trench backfill, or any material placed more than 1 foot above the top of the pipe.

Ponding will not be allowed in any case.

If trench backfill or pipe backfill is allowed to be placed as an aggregate slurry, the contractor shall excavate holes in the compacted slurry to the depths and at the locations designated by the Engineer. These holes shall be of such size as to allow the required density tests to be performed in a safe manner. Upon completion of the tests, the contractor shall refill the excavated areas and compact the material to the required density in a manner satisfactory to the Engineer.

Cement-treated slurry bedding material for pipe backfill shall not require additional compaction after placement up to an elevation 1 foot above the top of pipe if it meets the material requirements of Subsection 501-3.02(A) of the specifications and is placed and compacted as outlined in

Subsection 501-3.04(B) and (C) of the specifications. No density tests will be required in the cement-treated slurry bedding material when it is utilized for pipe backfill to an elevation 1 foot above the top of pipe.

Cement-treated slurry bedding material used for trench backfill shall meet the requirements listed above for pipe backfill up to the elevation which it is placed.

501-3.05 Filter Material:

When shown on the project plans or specified in the Special Provisions, filter material shall be carefully placed around perforated pipe.

Filter material shall conform to the grading requirements for fine aggregate in Section 1006 of the specifications and shall be placed in accordance with the details shown on the project plans.

501-3.06 Encasement of Pipe:

When shown on the project plans, pipe shall be encased in Class B concrete. Portland cement concrete shall conform to the requirements of Section 1006 of the specifications.

501-3.07 Nonreinforced, Cast-In-Place Concrete Pipe:

(A) General Requirements:

The contractor shall have previously installed cast-in-place pipe similar to the pipe specified in this contract. The Engineer may require the contractor to submit a list of names of the contractor's key personnel with their cast-in-place pipe experience. When required, the list shall include the foreman and equipment operators.

When the project plans include cast-in-place concrete pipe as an alternate, the contractor shall review the geotechnical investigation report. The geotechnical investigation reports are available on the ADOT Contracts and Specifications Group Current Advertisements website. The contractor shall be responsible to determine if the in-place soil conditions will allow the specified trench to be constructed.

The contractor shall provide a quality control administrator who shall be responsible for cast-in-place pipe quality. The administrator shall be a full-time employee of the contractor or a consultant engaged by the contractor. The contractor shall provide documentation to the Engineer which demonstrates the quality control administrator's experience in the manufacture and placement of cast-in-place pipe. The administrator shall have the authority to control all activities necessary to ensure a product of acceptable quality, including strength, alignment, thickness, and grade.

The contractor's quality control administrator shall inspect the pipe construction and complete a daily observation form, supplied by the Engineer. The form shall be completed and submitted to the Engineer no later than 9:00 a.m. on the first working day following each day work is being performed on the pipe installation.

Nonreinforced, cast-in-place concrete pipe shall be cast monolithically in a prepared trench at the locations and in accordance with the details shown on the project plans and the requirements of these specifications.

The pipe shall be constructed with equipment specifically designed for constructing cast-in-place, monolithic concrete pipe. The equipment shall be approved by the Engineer prior to use, and the contractor may be required to furnish evidence of successful operation of the equipment on similar work. If, in the opinion of the Engineer, the equipment furnished is not suitable to produce the quality of work specified, its use will not be permitted for the work.

Pipe shall be constructed in trenches which have been excavated in either native soil or compacted fill. The trench walls shall be stable so that the planned shape of the trench is maintained.

The minimum inside diameter of the pipe, measured in any direction, shall be at least 98 percent of the nominal pipe size. The minimum wall thickness will be as specified on the project plans for each pipe size.

(B) Excavation:

The trench shall be excavated to the lines and grades shown on the project plans. Laser guided alignment instruments shall be used to control the grade and alignment of the trench. Departure from and return to the established grade for the finished trench shall not exceed 1 inch per 10 linear feet, with a total departure not to exceed 1.5 inches. Departure from and return to specified alignment for the trench shall not exceed 2 inches per 10 linear feet, with a total departure not to exceed 4 inches. The bottom of the trench shall be shaped in accordance with the details shown on the project plans and prepared to provide full, firm, and uniform support over the bottom 210 degrees of the pipe to be constructed.

The length of trench permitted to remain open at any one time shall not exceed 1,600 linear feet, unless otherwise specified in the Special Provisions or as may be permitted by the Engineer.

The bottom of the trench must consist of either undisturbed native soil or compacted backfill.

When, in the opinion of the Engineer, soft, spongy, or other unsuitable material is encountered in the bottom of the trench, such unsuitable material shall be removed to the depth and width directed by the Engineer. The resulting area shall be backfilled with material

conforming to the requirements of Subsection 501-3.04(A)(1) of the specifications. The backfill shall be compacted in accordance with the requirements of Subsection 501-3.04(C) of the specifications. The trench shall then be excavated as specified above.

When boulders, bedrock, or rock ledges are encountered in the bottom or side walls of the trench, such material shall be removed to a distance of at least 6 inches from the nearest surface of the pipe, and the space then backfilled, compacted, and reshaped as required above for unsuitable material.

The trench walls, from a point 1 foot above the top of the pipe to the top of the trench, may be sloped as required by soil conditions to provide more stability in the trench and safer working conditions in accordance with the provisions of Subsection 107.07 of the specifications. The steepness of the side slopes shall be limited to the degree of stability considered necessary for safety, unless an approved shoring system is used. Side slopes shall conform to current OSHA regulations and be approved by the Engineer.

(C) Concrete Placement:

At the time of concrete placement, all surfaces in the trench which will be in contact with the pipe shall be thoroughly moistened so that moisture will not be drawn from the freshly placed concrete; however, the trench shall be free of standing water, mud, and debris.

The concrete shall be placed around the full circumference of the pipe in one operation. When metal forms are used, they shall be of sufficient strength to withstand vibrating and tamping of the concrete.

The concrete shall be vibrated, rammed, tamped, or worked with suitable devices until the concrete has been thoroughly consolidated and completely fills the formed space.

Laser guided alignment instruments shall be used to control the grade and alignment of the pipe. Departure from and return to the established grade for the invert of the installed pipe shall not exceed 1 inch per 10 linear feet, with a total departure not to exceed 1.5 inches. The surface of the invert shall not vary by more than 0.10 feet when tested with a 10-foot straight edge. Departures from and return to specified alignment for the pipe shall not exceed 2 inches per 10 linear feet, with a total departure not to exceed 4 inches.

When placing operations stop for such a time that initial set of the concrete is likely to occur before placement resumes, a construction joint shall be made by leaving the end of the pipe rough with a slope of approximately 45 degrees and inserting 24-inch No. 4 dowels 1 foot into the center of the pipe wall at approximately 18-inch intervals.

Collars may be used in lieu of doweled joints. An excavation shall be made along the sides and bottom of the construction joint to permit casting of a concrete collar around the outside of the joint. The collar shall have a minimum thickness 1.25 times the pipe wall thickness and shall lap the entire joint by at least two times the wall thickness.

Immediately before resuming concrete placement, the joint shall be cleaned of all laitance, loose, or defective concrete, coatings and other deleterious materials, and thoroughly wetted.

Construction joints used for connections to another pipe or at junction structures shall be made by squaring off the end of the pipe. An excavation along the sides and bottom of the pipe to permit casting of the concrete collar shall be made as previously specified.

After the removal of forms, the inside of the pipe will be inspected for rock pockets, voids, form indentation, and excessive form lap. Any necessary repairs shall be made within 24 hours and to the satisfaction of the Engineer. Cracks shall be repaired in accordance with Subsection 501-3.07(G) of the specifications.

(D) Finishing:

The interior surface and exterior top surface of the pipe shall be as smooth as a wood-float finish and shall be essentially free of fractures, cracks, and roughness.

(E) Curing:

Within 15 minutes after the pipe is cast, the concrete forming the exposed top portion of the pipe shall be cured as follows:

The pipe shall be covered with a polyethylene film conforming to the requirements of AASHTO M 171 except that the nominal thickness shall be 0.0015 inches. The film shall be white opaque or clear and shall be held in place with loose soil to assure continuous contact. The loose soil shall not be greater than 6 inches in depth at any point and shall conform to the requirements herein before specified under pipe backfill. This curing method shall be used when the ambient temperature exceeds 100 degrees F.

For ambient air temperatures equal to or less than 100 degrees F, the pipe may be sprayed with a liquid membrane-forming compound conforming to the requirements of Subsection 1006-6.01(C) of the specifications. If the contractor elects to spray the pipe with a liquid membrane, such procedure shall be completed within 30 minutes.

During the curing period, the inside of the pipeline shall be kept in a humid condition for at least seven days following placement of the concrete. To prevent air drafts from drying the fresh concrete, openings in the pipeline shall be covered during the seven-day period, except at

locations where work on the pipe is required and only during the time that such work is actually in progress.

(F) Backfilling:

Backfilling shall not start until the concrete has developed a compressive strength of at least 2,500 pounds per square inch.

The type of backfill material, the placement of pipe and trench backfill material, and compaction shall conform to the requirements of Subsection 501-3.04 of the specifications.

(G) Pipe Repair:

The contractor shall perform all interior crack repairs only after backfilling.

Transverse cracks 0.05 inches or more in width shall be cleaned and filled with an elastomeric compound approved by the Engineer. The elastomeric compound shall penetrate into the crack at least 0.38 inches.

A longitudinal crack shall be defined as one which is generally oriented within 30 degrees of the alignment of the pipe.

Longitudinal cracks will be a cause for rejection under any of the following conditions:

(1) A crack which has caused a surface fault within the pipe with a displacement greater than 0.08 inches;

(2) A crack width greater than that determined by the formula 0.0005 x O.D. and that can be penetrated by a standard machinist gauge leaf designated in AASHTO T 280; and/or

(3) A crack width greater than 0.05 inches and that can be penetrated by a standard machinist gauge leaf designated in AASHTO T 280.

Longitudinally cracked pipes meeting any of the three rejection criteria above may be allowed to remain in place if approved by the Engineer. If the Engineer allows such rejectable pipe to remain, all longitudinal cracks meeting any of the three criteria above shall be repaired by full depth epoxy grouting.

Any section of pipe rejected by the Engineer shall be removed and replaced at no additional cost to the Department.

(H) Pipe Wall Thickness:

The contractor shall measure the thickness at the invert and crown by probing at 25-foot intervals during the placement of concrete. The probe shall be a 3/8-inch round bar at least 2 inches longer than the wall thickness to be measured. The measurements shall be reported on the daily observation form.

The wall thickness will be measured for acceptance. One hole each shall be drilled at the invert and on each side of the springline, within 200-foot intervals. The drill locations will be determined by the Engineer. The Engineer may require additional holes on curves or in areas which appear to be defective. All holes shall have a minimum diameter of 3/4 inch. If the wall thickness is less than the specified minimum thickness, a core shall be drilled adjacent to the drilled hole.

All cores shall have a minimum diameter of 3 inches.

The length of the core will be determined in accordance with the requirements of AASHTO T 148.

If the length of the drilled core is deficient, additional cores shall be taken at intervals not to exceed 10 feet in each direction from the deficient core until one core which is not deficient is obtained in each direction. The pipe between these two acceptable cores will be rejected. The rejected pipe section shall be removed and replaced with pipe of the specified thickness at no additional cost to the Department.

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

501-3.08 Post Installation Inspection of Thermoplastic Pipe:

A post installation inspection of all thermoplastic pipe and steel reinforced thermoplastic pipe shall be conducted by the contractor no sooner than 30 days after completion of installation and final fill, excluding pavement. Pipes shall be checked for deflection using a mandrel, or other device approved by the Engineer capable of physically verifying interior dimensions of the pipe. Pipes larger than 24 inches may be entered following OSHA requirements, and deflection levels may be measured directly.

The contractor shall notify the Engineer at least seven days in advance of any pipe inspections.

Mandrels used for deflection testing shall be a nine (or greater odd number) arm mandrel, sized to 95 percent of the Certified Mean Inside Diameter (CMID) of the pipe to be tested. CMID shall be as provided by the pipe manufacturer. The contractor shall provide a properly sized proving ring to the Engineer for verifying mandrel size prior to testing.

The contractor shall use rope or cable to manually pull the mandrel through the entire pipe. Any pipe not allowing passage of the mandrel shall be reported to the Engineer.

When direct measuring is used for deflection testing, the contractor shall take rise and span measurements every 10 feet for the full length of pipe. Measurements shall be taken at a minimum of four locations for shorter pipes. The contractor shall report to the Engineer any rise or span measurements that are less than 95 percent of the CMID.

Pipes with more than 5 percent deflection shall be removed, replaced and re-inspected at contractor's expense. Pavement and other features affected by the pipe removal shall be removed and replaced at contractor's expense.

501-4 Method of Measurement:

Pipe will be measured by the linear foot parallel to the central axis of the pipeline and shall include the length of fittings.

Tees, wyes, and other branches will be measured as pipe along the central axis of the pipes to the point of intersection of said central axes. Pipe reducers will be measured as pipe of the larger diameter along the central axis.

The end of pipe in closed structures will be considered to be at the intersection of the central axis and the inside face of the wall and for masonry and concrete headwalls it will be considered to be at the intersection of the central axis and the face of the headwall.

End sections will be measured by the number of units installed.

501-5 Basis of Payment:

The accepted quantities of pipe, measured as provided above, will be paid for at the contract unit price complete in place.

Except as hereinafter specified, no separate measurement or payment will be made for excavating trenches and for furnishing, placing, and compacting bedding and backfill material as described and specified herein and on the project plans, the cost thereof being considered as included in the contract unit price per foot of pipe.

Payment for the removal of rock, hard pan, other unyielding material, or soft, spongy, or other unstable soil below the vertical limits as shown on the plans, and the backfilling of these over-excavated areas, as specified herein and as directed by the Engineer, will be paid for in accordance with the requirements of Subsection 104.02 of the specifications.

When an embankment is constructed prior to the digging of a trench and the installation of a pipe, payment for the construction of the embankment will be made under the appropriate item, such as Roadway Excavation or Borrow. Removal of rock, hard pan, other unyielding material, or soft, spongy, or other unstable material from the trench within the embankment will not be considered for payment.

The repairing of the damage to existing pipe ends to which new pipe is to be joined and which cannot be seen in order to be assessed and the removal of any portion of a damaged existing pipe, as specified under Subsection 501-3.03(B) of the specifications will be paid for in accordance with the provisions of Subsection 104.02 of the specifications.

No measurement or direct payment will be made for furnishing and placing filter material, plating material, fittings, collars, bands, and the joining of new and existing pipes.

For cast-in-place pipe, no separate measurement or payment will be made for the excavation or preparation of the trench; for furnishing, placing, and compacting backfill material; for pipe repair, when authorized by the Engineer; or for quality control activities; the cost being considered as included in the unit price per foot of pipe.

For thermoplastic pipe and steel reinforced thermoplastic pipe, no separate measurement or payment will be made for post installation inspection, the cost being considered as included in the unit price per foot of pipe.

End sections, measured as provided above, will be paid for at the contract unit price complete in place.

SECTION 607 ROADSIDE SIGN SUPPORTS:

607-1 Description:

The work under this section shall consist of furnishing and installing roadside sign supports in accordance with the details shown on the plans and the requirements of the specifications.

Sign supports shall consist of breakaway, slip base, perforated and U-channel sign posts. The type, size, and installation location of the sign posts will be shown on the project plans.

607-2 Materials:

607-2.01 General:

Certificates of Analysis conforming to the requirements of Subsection 106.05 of the specifications shall be submitted for breakaway sign post shapes

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the specifications shall be submitted for perforated sign posts and U-channel sign posts.

607-2.02 Breakaway Sign Post Shapes:

Posts shall be fabricated from structural steel conforming to the requirements of ASTM A572, Grade 50 or ASTM A588 at the option of the contractor. Base plates for the breakaway connections and friction fuse plates and back plates for the post hinge assembly shall be fabricated from the same type structural steel selected for the sign posts.

All plate holes shall be drilled and all plate notches shall be saw cut, except that flame cutting will be permitted provided all edges are ground. Flange holes shall be drilled or sub-punched and reamed. The posts shall be saw cut for the hinge and bolted as detailed on the plans.

Bolts, nuts and washers shall conform to the requirements of ASTM A325.

Posts and plates shall be galvanized after fabrication in accordance with the requirements of ASTM A123. Bolts, nuts, and washers shall be cadmium plated in accordance with the requirements of ASTM B766, or zinc plated in accordance with the requirements of ASTM B633.

607-2.03 Perforated Sign Posts:

Single and telescoping perforated posts shall be square tube fabricated from galvanized sheet steel. The sheet steel shall have a thickness of 0.105 inches (12 gauge) or 0.135 inches (10 gauge) as required by the project specifications. Sheet steel shall conform to the requirements of ASTM A653 for either SQ Grade 40 or SQ Grade 50 Class 1, and be galvanized in accordance with the requirements of Coating Designation G-90. The posts shall have a wall thickness, including coating, of 0.097 to 0.116 inches for 12 gauge and 0.127 to 0.146 inches for 10 gauge.

Posts shall be welded directly in the corner by high frequency resistance welding or equal. The outside edges of the posts shall be scarfed as necessary to produce a standard corner radii of 5/32 ± 1/32 inch.

External welded surfaces and scarfed areas shall be re-galvanized after fabrication.

Holes 7/16 ± 1/64 inch in diameter shall be provided on 1-inch centers along all four sides over the entire length of the post. The holes shall be laterally centered on the longitudinal centerline of each face. Hole positioning and spacing shall be the same on all four faces, such that the hole centerlines for each group of four holes shall pass through a common point on the longitudinal centerline of the tube. For telescoping posts, holes shall be in proper alignment to allow 3/8-inch diameter bolts to pass through the entire post.

The finished posts shall be straight and have a smooth, uniform finish. All consecutive sizes of posts shall be freely telescoping for not less than 10 feet of their length without the necessity of matching any particular face to any other face.

Perforated sign posts shall be manufactured by an approved manufacturer. A list of approved manufacturers of perforated sign posts is shown on the Department's Approved Products List (APL). Copies of the most current version of the APL are available on the internet from the Arizona Transportation Research Center (ATRC), through its PRIDE program.

Bolts shall conform to the requirements of SAE Specification J429, Grade 5, or ASTM A449, Type 1. Nuts shall conform to the requirements of ASTM A563, Grade A. Washers shall conform to the requirements of ASTM F844.

Bolts, nuts, and washers shall be zinc coated in accordance with the requirements of ASTM B633 or cadmium plated in accordance with the requirements of ASTM B766.

607-2.04 U-Channel Sign Posts:

U-channel posts shall be fabricated from rerolled rail steel or hot-rolled carbon steel bars.

Prior to rerolling the rail steel, the rail nominal weight shall be 91 pounds per yard and shall meet the requirements of ASTM A1 pertaining to quality assurance.

Yield Point of the steel shall be 80,000 pounds per square inch minimum.

The cast heat analysis of the steel shall conform to the following requirements:

Element	Composition (Percent)
Carbon	0.67 - 0.82
Manganese	0.70 - 1.10
Phosphorus: Max.	0.04
Sulfur: Max.	0.05
Silicon	0.10 - 0.25

Posts shall be a uniform, modified, flanged channel-section as shown in the plans. Weight of the posts shall be three pounds per lineal foot, plus or minus 5 percent. The post shall be punched with continuous 3/8-inch diameter holes on 1-inch centers. The first hole shall be 1 inch from top and bottom of post.

The post shall consist of two parts, a sign post and a base post. The sign post lengths shall be supplied in 6-inch increments up to 12 feet as required for the installation location. The base posts shall be 42 inches in length, pointed at one end, and have at least 18 holes in the base post, starting 1 inch from the top and continuing at 1-inch increments.

Posts shall be machine straightened to have a smooth uniform finish, free from defects affecting their strength, durability, or appearance. All holes and rough edges shall be free from burrs. The permissible tolerance for straightness shall be within 1/16 inch in 3 feet.

Posts shall be galvanized after fabrication in accordance with the requirements of ASTM A123. Bolts, nuts, washers, and spacers shall be cadmium plated in accordance with the requirements of ASTM B766 or zinc plated in accordance with the requirements of ASTM B633.

For shipment, the posts shall be nested and fastened in such a manner that they will not slip. Care shall be taken during shipping to minimize the rubbing of posts together resulting in damage to the galvanized finished surface. Excessive damage to the finish of the posts during

shipping or handling will result in rejection of the damaged posts. Posts shall be bundled in groups of no more than 100.

U-channel base posts shall be driven into the ground to a depth of 38 inches. Where rock is encountered, the rock shall be cored, drilled, or removed to a minimum diameter of 8 inches and to a depth sufficient to place Portland cement concrete 2 inches below the bottom of the base post and fill the hole to within 1 inch of the top. Solid rock coring or drilling is not required to continue beyond 24 inches in depth regardless of the depth at which the rock is encountered. The base post may be cut at the bottom prior to being set in Portland cement concrete where rock does not permit use of full length base post.

607-2.05 Concrete:

Concrete for breakaway sign post foundations shall be Class B, except that utility concrete may be used for foundations using stub post sizes S 3 x 5.7 and S 4 x 7.7. Class B concrete shall conform to the requirements of Section 1006 of the specifications and utility concrete to the requirements of Section 922 of the specifications. Concrete for perforated sign posts foundations and U-channel sign post foundations, when required, shall conform to the requirements of Subsections 922-2 and 922-3 of the specifications.

Foundation stub posts shall be fabricated from the same type of steel selected for the appropriate sign posts. Breakaway stub posts shall be galvanized a minimum of 12 inches down from the top of the stub. Galvanizing shall be in accordance with the requirements of ASTM A123.

Reinforcing steel bars for breakaway sign post foundations shall conform to the requirements of ASTM A615. Unless otherwise specified, steel bars meeting the requirements of ASTM A706 may be substituted for ASTM A615 steel bars. When ASTM A706 bars are used, tack welding of the reinforcement will not be permitted unless approved in writing by the Engineer. Reinforcing steel wire shall conform to the requirements of ASTM A82.

607-2.06 Slip Base:

Slip bases shall be manufactured by an approved manufacturer. A list of approved manufacturers of slip bases is shown on the Department's Approved Products List (APL).

607-3 Construction Requirements:

Fabrication of the breakaway sign posts, stub posts, and base plates shall conform to the requirements of Subsection 604-3.02 of the specifications, except that shop drawings will not be required.

Breakaway sign post lengths will be determined by the Engineer at the time of construction staking and will be furnished to the contractor prior to ordering fabrication of the sign posts.

Perforated and U-channel sign post lengths shall be determined by the contractor at the time of construction staking. Posts shall be cut to the proper lengths in the field. Splicing will be permitted for single perforated posts; however, splices will be limited to one per each post installation and the splicing shall be accomplished in accordance with the details shown on the plans. The minimum length of any spliced piece of post shall be 2 feet.

Foundations for the breakaway sign posts, perforated sign posts and when required, U-channel posts shall be constructed to the details and dimensions shown on the plans. Concrete shall be placed in accordance with the requirements of Section 601 or 922 of the specifications, as the case may be. Excavation shall conform to the requirements of Subsection 203-5.03(A) of the specifications.

Sign posts shall be erected plumb and shall be bolted to the foundation stub or base posts in accordance with the procedure specified on the plans.

Slip bases shall be assembled as shown in the Standard Drawings and installed in accordance with the manufacturer's instructions.

607-4 Method of Measurement:

Breakaway sign posts will be measured by the linear foot for each size of post furnished and erected. The length of each size of post will be measured from the bottom of the upper base plate to the top of the post, measured to the nearest 0.1 feet. The total length of all posts of the same size will be rounded to the nearest foot.

Perforated sign posts will be measured by the linear foot of each type of post furnished and installed. The length of each type of post will be measured from the top of the concrete post foundation to the top of the post, measured to the nearest 0.1 feet. The total length of all posts of the same type will be rounded to the nearest foot. Telescoping post members will be considered as one post after installation and will not be measured separately. U-channel posts will be measured as each.

Foundations for signposts will be measured by the unit for each type of foundation constructed, except that concrete and excavation, when required for setting U-channel base posts, will be considered as part of the post.

Slip base for sign posts will be measured by the unit of each.

607-5 Basis of Payment:

The accepted quantities of breakaway posts, perforated posts, U-channel posts, and foundations for the sign posts, measured as provided above, will be paid for at the contract unit prices complete in place.

The contract unit price paid per linear foot for each size of breakaway sign post, each type of perforated sign post and each installation of U-channel post designated in the bidding schedule shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in furnishing and erecting the sign posts, complete in place, including galvanizing and furnishing all metal plates and hardware, all as shown on the plans and as specified herein.

The contract unit price paid per unit for each type of sign foundation designated in the bidding schedule shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing foundations, complete in place, including the steel stub posts, lower base plate, and steel reinforcement (except for stub posts S 3 x 5.7 and S 4 x 7.7) for the breakaway sign post foundation; the portion of perforated post within the foundations; galvanizing the posts; and excavation, all as shown on the plans and as specified herein.

The accepted quantities of slip base for the sign posts, measured as provided above, will be paid for at the contract unit price per each, complete in place.

SECTION 608 SIGN PANELS:

608-1 Description:

The work under this section shall consist of furnishing and installing sign panels in accordance with the details shown on the plans and the requirements set forth herein.

The sign panels shall be of the following types:

(A) Extruded Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, or Demountable Characters;

(B) Flat Sheet Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, Electronic-Cut, or Screen-Printed Characters;

(C) Warning, Marker, and Regulatory Sign Panels;

(D) Route Shields for Installation on Sign Panels; and/or

(E) EXIT ONLY Panels for Installation on Sign Panels

The work under this section shall also include furnishing and installing graffiti shield on overhead extruded sign panels in accordance with the details shown on the plans and as specified herein.

608-2 Materials:

608-2.01 General:

Certificates of Compliance, conforming to the requirements of Subsection 106.05 of the specifications, shall be submitted for all materials required for fabricating sign panels, including retroreflective sheeting.

Shipment, storage, and handling of sign panels shall conform to the recommendations of the manufacturers of the sign panel components. Fabricated signs and overlay sheets shall be shipped on edge. Damage to the sign panel or legend resulting from banding, crating, or stacking may be cause for rejection of the signs.

Signs shall be fabricated in accordance with the recommendations established by the manufacturer of the sign sheeting. All processes and materials used to make a sign shall in no way impact the performance, uniform appearance (day and night), or durability of the sheeting, or invalidate the sign sheeting manufacturers' warranty.

All sheeting used for background and legend shall be from the same manufacturer. Sign panels shall not be overlaid.

All text and numerals shall all be installed at the same orientation: either zero degrees or 90 degrees.

Design of letters and numbers shall be in accordance with the project plans with a tolerance of ± 1/16 of an inch.

The contractor shall not paint the bolts or the washers unless otherwise specified.

608-2.02 Extruded Aluminum Sign Panels with Direct-Applied, Digitally-Imaged, or Demountable Characters:

Panels shall be fabricated from 12-inch wide aluminum extrusions formed from Aluminum Alloy 6063-T6 conforming to the requirements of ASTM B221 and fastened together by bolt connections as shown on the plans.

Panel facing shall be covered with retroreflective sheeting of the color specified on the plans. The retroreflective sheeting shall conform to the requirements of Section 1007 of the specifications.

The letters, numerals, symbols, borders, and other features of the sign message shall be direct-applied, digitally-imaged, or demountable, and shall conform to the requirements of Subsection 608-2.02, Demountable Characters, Subsection 608-2.08, Screen-Printed, Direct-Applied, or Electronic-Cut Characters, Subsection 608-2.09, or Digitally-Imaged Characters, Subsection 608-2.10 of the specifications.

Panel surfaces to be covered with retroreflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer. Panel surfaces not covered with sheeting shall be etched in accordance with the recommendations of the extrusion manufacturer to reduce glare from reflected sunlight.

After all fabrication has been completed, including the cutting and punching of holes, except holes for demountable letters, numerals, symbols, and borders, the aluminum extrusions shall be degreased and the retroreflective sheeting shall be applied.

Aluminum extrusions shall be flat with 1/4 inch of tolerance allowed in an 8-foot length, with proportionally greater tolerances permitted on lengths greater than 8 feet. Flatness tolerance across the face of each extrusion shall be 0.5 percent of the width.

Aluminum extrusions shall be bolted together on 12-inch centers with a maximum allowable gap of 1/32 inch between extrusions.

Shop fabricated sub-assemblies shall be rigidly braced for transportation and erection. Hardware utilized to fasten panels to supports shall conform to the panel manufacturer's recommendations.

Each completed sign panel shall be provided with a side trim molding fabricated from extruded Aluminum Alloy 6063-T6 conforming to the requirements of ASTM B221. The trim molding shall be fastened to each individual 12-inch aluminum extrusion with two 5/32-inch diameter self-plugging aluminum blind rivets, 2-1/2 inches from either edge. The exposed surface of the side trim molding shall be treated by etching as recommended by the manufacturer to reduce glare from reflected sunlight.

Each completed sign panel shall be shipped with sufficient bolt clamps placed to install the panel on the sign posts as shown in the plans. Bent bolt channels will be cause for rejection of the sign panel.

608-2.03 Flat Sheet Aluminum Sign Panels With Direct-Applied, Digitally-Imaged, Electric-Cut or Screen-Printed Characters:

Panels shall be fabricated from 0.125-inch thick 5052-H36, or 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B209.

Panel facing shall be prepared and covered with retroreflective sheeting in accordance with the recommendations of the sheeting manufacturer. The color of the sheeting shall be as specified on the plans or as shown in the Manual of Approved Signs.

All surfaces not covered shall be etched to reduce glare from reflected sunlight.

The retroreflective sheeting shall conform to the requirements of Section 1007 of the specifications. Splicing of retroreflective sheeting shall not be allowed on sign panels having a minimum dimension up to and including 4 feet.

Messages shall be reflectorized white or, if called for on the plans, opaque black, and shall be produced by either screen printing, direct-applying, digital imaging, or electronic cutting, as specified under Subsections 608-2.09 and 608-2.10 of the specifications.

608-2.04 Warning, Marker, and Regulatory Sign Panels:

Panels shall be fabricated from flat sheet aluminum and shall be reflectorized as specified herein.

Panels shall be fabricated in one piece from 0.125-inch thick 5052-H36, 5052-H38, or 6061-T6 Aluminum Alloy conforming to the requirements of ASTM B209.

All surfaces of panels to be covered with retroreflective sheeting shall be prepared in accordance with the recommendations of the sheeting manufacturer. Surfaces not covered shall be etched to reduce glare from reflected sunlight. Retroreflective sheeting shall conform to the requirements of Section 1007 of the specifications.

Warning signs shall be reflectorized with fluorescent yellow retroreflective sheeting.

Regulatory signs shall be reflectorized with white retroreflective sheeting.

Reflectorized red signs shall be reflectorized with white retroreflective sheeting. The red color shall be produced by screen printing.

Regulatory signs with reflectorized red circles and slashes shall be reflectorized with white retroreflective sheeting. The red color shall be produced by screen printing.

Interstate route markers shall be cut to shape. The colors and legend shall be as shown on the plans and shall be reflectorized with white retroreflective sheeting. The Interstate route colors shall be screen-

printed. The numerals may be screen-printed, electronic-cut, or direct-applied characters.

United States, State Route, and Cardinal Direction markers shall be reflectorized with white retroreflective sheeting unless otherwise shown on the plans.

Splicing of retroreflective sheeting shall not be allowed on sign panels having the minimum dimension up to and including 4 feet.

608-2.05 Route Shields (For Installation on Sign Panels):

Route shields may be demountable, direct-applied, or digitally-imaged.

Demountable route shields shall be cut to shape and shall consist of 0.063-inch thick, 5052-H36, or 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B209. The aluminum shall be degreased and etched in accordance with the recommendations of the sheeting manufacturer. Retroreflective sheeting shall be white and shall conform to the requirements of Section 1007 of the specifications. Route shields shall be attached to the sign panel with self-plugging aluminum blind rivets.

608-2.06 EXIT ONLY Panels (For Installation on Sign Panels):

EXIT ONLY panels may be demountable, direct-applied, or digitally-imaged. Demountable EXIT ONLY panels shall be attached to the sign panel with self-plugging aluminum blind rivets.

Demountable EXIT ONLY panels shall be fabricated from 0.063-inch thick, 5052-H36 or 5052-H38 Aluminum Alloy conforming to the requirements of ASTM B209 with fluorescent yellow retroreflective sheeting adhered to the face side. The aluminum shall be degreased and etched in accordance with the recommendations of the sheeting manufacturer. Retroreflective sheeting shall conform to the requirements of Section 1007 of the specifications.

608-2.07 Retroreflective Sheeting, Inks, and Opaque Film:

Retroreflective sheeting, sign-making inks, and opaque films shall conform to the requirements of Section 1007 of the specifications.

608-2.08 Demountable Characters:

(A) General:

Letters, numerals, symbols, route shields, borders, and other features of the sign message shall consist of cut-out, flat sheet aluminum legends, with direct-applied sign sheeting or other finishes, that are

mounted to the sign panel with rivets as described herein. All characters shall be placed on the signs in a straight and true fashion.

Flat sheet aluminum substrates used for characters and borders shall be either aluminum alloy 3105-H14, 3003-H14, 5052-H36, or 5052-H38 as specified in ASTM B209. Characters produced from the flat sheet aluminum alloy shall sit flat on the face of the sign panel without visible gap or deformation.

The thickness for letters and numbers shall be 0.032 inches. The thickness for symbols, route shields, and borders shall be 0.063 inches.

All aluminum shall be chemically treated with a chromate acid conversion type coating, or equivalent, to form an oxidation resistant barrier film that is suitable for long term outdoor application. The coating shall prevent the occurrence of oxidation that may cause streaking or discoloration on the sign. The coating shall be applied in accordance with the manufacturer's specifications, and shall have a minimum thickness of 0.002 inches.

All corners and edges of the characters shall be clean and well-defined with no apparent waviness, tears, delamination, deformation, or flaws. Burrs and waste material generated from the cutting process shall be removed so characters have a clean, flat, and correct appearance.

Design of letters and numbers shall be in accordance with the project plans.

Splicing of aluminum panels will be acceptable for diagrammatic arrows or other large symbols and shields exceeding 48 inches in more than one direction. Splices, when required, shall include a continuous 4 to 6-inch wide aluminum back plate that overlaps the joint. The back plate shall ensure no gap at the splice joint when the symbol is assembled and attached to the sign.

Borders on signs with demountable characters shall also be made of aluminum substrate panels, unless otherwise specified. However, in all cases borders on signs with demountable characters shall be made of the same material as the legend.

(B) Sheeting and Colors:

Sheeting or film applied to demountable characters shall be a continuous monolithic piece, without splice or patch, that covers the entire front face of the character. Splicing of the sheeting for demountable borders or characters which have a dimension larger than 48 inches in more than one direction will be allowed. Only one splice shall be allowed every 4 feet. When a splice is necessary, the adjoining edges shall be placed so there is no visible gap between the two pieces.

The adhesive system for sheeting and opaque films shall form a durable bond which tightly adheres to the aluminum or sign background. After attachment, the sheeting and opaque films shall not discolor, crack, craze, blister, bubble, or delaminate. Sheeting and film adhesives must be warranted by the manufacturer against such defects as specified in Section 1007 of the specifications. Only those sheeting and film products which provide the specified warranty will be acceptable.

The color for demountable letters, numbers, symbols, and route shields on green, blue, and brown background signs shall be white, and shall conform to the requirements of Section 1007 of the specifications. Demountable legends on white and yellow background signs shall be black, and shall be opaque and non-reflective. Black characters shall be finished with laminated black opaque acrylic film.

When borders are used with demountable characters, white legend and border shall be used on green, blue, or brown sign backgrounds, and black legend and border shall be used on white or yellow sign backgrounds. Sign sheeting conforming to Section 1007 of the specifications shall be used for white borders. Black borders shall be laminated black opaque acrylic film.

Laminated black opaque acrylic film to be used for characters or borders, as specified above, shall be applied in accordance with the coating manufacturer's recommendations. The contractor shall provide copies of any warranties provided by the manufacturer to the Engineer.

On combination signs, such as a green background sign with white characters that also includes a smaller panel with yellow background and black characters, the color scheme used for the characters and border for each portion of the sign shall be as specified above, i.e. white legend and border shall be used on the green background portion of the sign and black legend and border shall be used on the yellow background portion.

(C) Attachment of Characters and Borders:

Self plugging aluminum, protruding, regular head blind rivets shall be used to secure all demountable characters. The rivets shall conform to the applicable requirements of International Fasteners Institute (IFI) 114 standard for break mandrel blind rivets. All rivets shall be 5/32 inch in diameter with the appropriate grip range.

Rivets shall be either IFI 114 Grade 10 or 11 aluminum alloy rivets. The rivets shall have an ultimate shear and tensile strength that has been determined by IFI 135 Specification 2.1 and 2.2. The ultimate shear and tensile strength shall meet or exceed those values specified for a 5/32 inch (0.1562) nominal rivet diameter per IFI 114 Table 6 for Grades 10 or 11. A higher strength and grade aluminum rivet can be used at the option of the sign fabricator.

Rivets securing the characters to the back panel shall be of sufficient length to ensure a secure attachment and conform to the grip length specifications of the rivet manufacturer. The determination of rivet grip length shall include the total thickness of the joint. This thickness shall include the character (sheeting and aluminum sheet), spacer (if applicable) and the sign back panel (sheeting and aluminum extrusion).

The hole size used to install the rivets shall conform to the recommendation of the rivet manufacturer and Table 2 of IFI 114. Rivets shall be placed a minimum of four times the diameter of the rivet from the edge of the character being attached, e.g., 5/8 inch clearance for a 5/32 inch diameter rivet. Clearance shall be measured to the outside of the rivet head.

Minimum requirements for attaching demountable characters shall be as follows:

Straight numerals and letters such as "1" shall have three rivets, one at the top, middle and bottom. The more complex numerals and letters shall have from four to seven rivets. Letters such as "W" and "M" typically require seven rivets. Letters and numerals such as "P", "H" and "9" typically require six rivets. Letters and numerals such as "G", "S", "2", "3" and "7" typically require five rivets. A rivet shall secure each corner of the letter or numeral. For shields and symbols, rivets shall be spaced evenly around the entire perimeter. Additional rivets shall be added in the middle of the shield or symbol as necessary to eliminate bowing. Rivets for borders shall be spaced evenly around the border.

The actual number of rivets used will depend on the thickness, configuration, weight, position (with or without spacers), size of the character being attached, and the recommendations of the rivet manufacturer. The number and location of rivets shall be sufficient to secure the character to the panel so it shall not miss-align, bend or move when subjected to wind loading. Additionally, the number of rivets used shall ensure that the character does not bow or pull away from the back panel for the life of the sign. Rivets shall be placed in a defined, evenly spaced pattern which is consistent from character to character. The placement and pattern of rivets shall not interfere with the appearance of the sign from normal drive-by viewing distances. The contractor shall supply standard punch details prior to fabrication.

The protruding head and shaft of the rivets shall closely match the color of the character on which they are being applied, e.g., black characters shall be applied with black rivets. Aluminum colored rivets are acceptable for mounting white characters.

The coating used to color the rivets shall be a factory-applied anodized type finish, or equivalent, that is suitable for long term outdoor application. The coating shall have durable colorfastness and shall be capable of preventing the occurrence of oxidation that may cause

streaking or discoloration on the sign. Non-factory painting of the protruding heads of the rivets is not acceptable.

608-2.09 Screen-Printed, Direct-Applied, and Electronic-Cut Characters:

Screen-printed letters, numerals, arrows, symbols, and borders, shall be applied on the retroreflective sheeting background of the sign by direct or reverse screen process. Messages and borders of a color darker than the background shall be applied to the retroreflective sheeting by direct process. Messages and borders of a color lighter than the sign background shall be produced by the reverse screen process.

Opaque or transparent colors, inks, and paints used in the screen process shall be of the type and quality recommended by the manufacturer of the retroreflective sheeting.

The screening shall be performed in a manner that results in a uniform color and tone, with sharply defined edges of legends and borders and without blemishes on the sign background that will affect intended use.

Signs, after screening, shall be air dried or baked in accordance with the manufacturer's recommendations to provide a smooth hard finish. Any signs on which blisters appear during the drying process will be rejected.

Direct-applied letters, numerals, symbols, borders, and other features of the sign message shall be cut from black opaque or retroreflective sheeting of the color specified and applied to the retroreflective sheeting of the sign background in accordance with the instructions of the manufacturer of the retroreflective sheeting.

Direct-applied legend may be moved vertically 1/2 inch to avoid placing only a small amount of material over the adjacent extruded panel. The bottom of all characters for a line of legend shall line up within 1/8 of an inch.

Electronic-cut characters shall be cut from translucent acrylic sheeting using computerized automated cutting processes.

608-2.10 Digitally-Imaged Characters:

Digitally-imaged characters shall consist of characters produced through ultraviolet jet-printing or thermal transfer. Signs with digitally-imaged characters shall be manufactured using matched component ink, transparent electronic-cuttable film, and/or overlay film as supplied by the reflective sheeting manufacturer. For digitally-imaged copy on white sheeting, the coefficient of retroreflection shall be not less than 70 percent of the original values for the corresponding integral color. When characters are spread over two adjacent extruded panels, the characters shall align with each other within 1/16 of an inch.

608-2.11 Graffiti Shield:

The graffiti shields shall be made from a single continuous panel made of sheet, coil, or drawn aluminum that conforms to the requirements of ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, Alloy 5052-H32 (bendable to 1t). The aluminum substrate shall be 0.125 and 0.1875 inches thick. Dimensional and flatness tolerances shall conform to the applicable standards of The Aluminum Association (TAA).

The contractor shall not paint the bolts or the washers unless otherwise specified.

Each completed graffiti shield panel shall be shipped with sufficient bolt clamps placed to install the graffiti shield on the extruded sign panels as shown in the plans.

608-3 Construction Requirements:

608-3.01 Fabrication:

Fabrication of the sign panels shall be in accordance with the details shown on the plans and the requirements of these specifications. If additional details for sign panel fabrication are required, the contractor shall submit shop drawings in accordance with the requirements of Subsection 105.03 of the specifications.

Panels shall be cut to size and shape and shall be free of buckles, warps, dents, cockles, burrs, and defects resulting from fabrication.

Fabricated signs shall be stored indoors and kept dry during storage. If packaged signs become wet, all packaging material shall be removed immediately and the signs allowed to dry. The signs may be repackaged using new dry materials. If outdoor storage is necessary, all packaging materials shall be removed. Signs shall be stored on edge, above ground, in an area where dirt and water will not contact the sign face. Materials used to support stored signs shall not contact sign faces.

During fabrication of the sign panels, the contractor shall ensure the bolt holes on each sign panel are placed so the holes will not coincide with any legend and any bolts, washers, or other hardware used will not cover any portion of the legend. If the bolt holes on a sign panel do not comply with these requirements, the Engineer may reject the sign panel or accept the sign panel and require the contractor to paint the bolts, washers, and any hardware coinciding with the sign legend to match the color of the legend.

The fabrication of graffiti shields shall conform to ADOT Graffiti Shields Standard Drawing S-18.

Graffiti shields shall be powder coated per the American Architectural Manufacturers Association (AAMA) coating specifications to minimize glare, improve visibility and to provide easy maintenance against graffiti vandalism. A flat black coating shall be applied to the graffiti shields. The powder coating pre-treatment shall be accomplished mechanically, chemically, or per the contractor's discretion via alternative processes. The powder coated products shall be wrapped and packaged by the contractor to protect the finished materials against damages.

The fabrication of the individual parts and hardware shall meet industry standards for metal work, welding, and painting, to ensure that the graffiti shields life span exceeds that of the sign it is to protect.

608-3.02 Installation of Sign Panels:

The sign panels shall be installed on overhead sign structures and roadside sign supports in accordance with the details shown on the plans and in accordance with the recommendations of the manufacturers of the sign panel components.

Minor scratches and abrasions resulting from fabrication, shipping and installation of panels may be patched; however, patching shall be limited to one patch per 50 square feet of sign area with the total patched area being less than 5 percent of the sign area. Panels requiring more patching than the specified limit will be rejected. Patches shall be edge sealed by a method approved by the retroreflective sheeting manufacturer.

Sign panels shall be attached to the posts with hex head bolts as shown in the Standard Drawings; slotted head bolts shall not be used. A cadmium-plated or zinc-plated fender washer shall be placed between the bolt head and panel face.

For flat sheet panels, bolts shall be fastened with a cadmium-plated or zinc-plated fender washer and two standard nuts. Nylon washers shall not be used. The fender washer shall be placed against the sign post, the first nut shall be tightened against the fender washer, and the second nut shall be tightened against the first nut. Bolts shall be tightened from the back by holding the bolt head stationary on the face of the panel. Twisting of the bolt head on the panel face will not be allowed.

The contractor shall provide a detailed list of all new signs installed on the project. The list shall include the sign identification code, the date each sign was installed (month and year), the fabricator of the sign, and the materials used to make the sign (manufacturer, type of sheeting, ink and film). Signs shall be listed in numerical order by route, direction, and milepost and, where more than one sign is installed at the same general location, a letter subscript. The list shall be provided in a commonly used electronic spreadsheet format and shall be submitted to the Engineer electronically. In addition to the electronic submission, the Engineer may request up to three hard copies.

Sign panels within the same sign assembly shall be placed at the same orientation along the roadway so that the entire legend of the signs appear uniform under normal viewing conditions, both day and night.

Upon fabrication or installation of each sign, the contractor shall place information on the back of the sign showing the sign identification code, the sign fabricator, the manufacturer of the sheeting used, and the month and year of the installation. The formatting of the required information shall be as shown on the standard drawings. The information shall be positioned to be readily visible from a vantage point outside the flow of traffic and not obstructed by sign posts, extrusions, stringers, or brackets. All letters shall be made of a long life material such as a black opaque acrylic film. Signs not marked as required will not be eligible for payment.

Temporary traffic control signs are exempt from the installation information requirement unless noted otherwise on the project plans.

608-3.03 Installation of Graffiti Shield:

The graffiti shield panels shall be installed on overhead extruded signage in accordance with the details shown on the standard drawing, plans and in accordance with the recommendations of the manufacturers of the sign panel components.

Graffiti shield panels shall be attached to the overhead extruded sign panels with clips as shown in the Standard Drawings.

Minor scratches and abrasions resulting from fabrication, shipping, or installation of panels may be patched. Patching shall be limited to one patch per 5 square feet of graffiti shield area. The total patched area shall be less than five percent of the graffiti shield area. Graffiti shield requiring more patching than the specified limit will be rejected.

608-3.04 Inspection:

An inspection of the completely installed sign panels will be made by the Engineer during the daytime and at night for proper appearance, visibility, color, specular gloss, and proper installation.

Each sign panel face shall be cleaned thoroughly just prior to the inspection by a method recommended by the manufacturer. The cleaning material shall in no way scratch, deface or have any adverse effect on the sign panel components.

All apparent defects disclosed by the inspection shall be corrected by the contractor at no additional cost to the Department. If color variations or blemishes between sign panel increments are visible from a distance of 50 feet either during the day or at night, the panels shall be removed and replaced at no additional cost to the Department.

Each graffiti shield component shall be cleaned thoroughly just prior to the inspection by a method recommended by the manufacturer. The cleaning material shall in no way scratch or have any adverse effect on the graffiti shield components. Inspection criteria shall include, but not be limited to; conformity to the specification, workmanship, quality, and materials.

608-3.05 Miscellaneous Work:

The work under this section shall also include furnishing all miscellaneous materials, tools, equipment, and labor necessary to relocate exit panels to the right side of the parent sign panel; removing, cutting, and installing side trims and new or salvaged aluminum extrusions on existing sign panels; relocating large guide and exit gore signs; and cutting post tops on existing installations, as required on the plans.

608-4 Method of Measurement:

Sign panels will be measured by the square foot for each type or types of sign panels furnished and installed. Individual sign panels will be measured to the nearest 0.1 square foot. The total area of each type of sign panel will be summed and rounded to the nearest square foot.

The area of each sign panel, except for warning, regulatory and marker sign panels, will be measured per plans dimensions.

For warning, regulatory and marker sign panels, the area of each sign panel will be determined as follows:

(A) The areas of each rectangular, square, or triangular sign panel will be determined from the dimensions shown on the plans; and

(B) The area of irregular shaped signs, such as stop signs and route markers, will be determined by multiplying the maximum height in feet by the maximum width in feet, using the dimensions shown on the plans.

Graffiti shield will be measured by the square foot for each graffiti shield furnished and installed. The area will be determined by multiplying the length of the outside perimeter of the graffiti shield to the nearest 0.1 feet multiplied by 2 feet. The total area of each type of graffiti shield will be summed and rounded to the nearest square foot.

Miscellaneous Work will be measured on a lump sum basis.

608-5 Basis of Payment:

The accepted quantities of each type of sign panel designated in the bidding schedule, measured as provided above, will be paid for at the contract unit price per square foot, complete in place, regardless of the type of sheeting or type of character used on the sign panel. Payment shall be made on the total area of each type of sign panel to the nearest square foot.

No additional payment will be made for signs with sheeting applied to both sides, the cost being considered as included in the contract unit price for the sign panel.

No measurement or payment will be made for Route Shields and EXIT ONLY Panels (for installation on sign panels), the cost being considered as included in the contract unit price for the sign panel.

The contract unit price shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for performing all the work involved in furnishing and installing the sign panels, complete in place, including furnishing and applying all retroreflective sheeting, all fastening hardware, all necessary sign supports, stringers, and post ties, all as shown on the plans and as specified herein.

The accepted quantities of graffiti shield, measured as provided above, will be paid for at the contract unit price per square foot, complete in place, as shown in the plans and as described and specified herein.

The accepted quantity of Miscellaneous Work will be paid for at the contract lump sum price, which price shall be full compensations for the work, complete in place, as shown on the plans and as described and specified herein.

SECTION 610 PAINTING:

610-1 Description:

The work under this section shall consist of furnishing paint and other materials and painting concrete, structural steel, or other surfaces where shown on the plans in accordance with the requirements of the specifications. The work shall include preparation of the surfaces to be painted, the protection and drying of the paint coatings and the protection of pedestrian, vehicular or other traffic near or under the work from paint spatter and disfigurement.

610-2 Materials:

Paint shall conform to the requirements of Section 1002 of the specifications, unless otherwise specified.

610-3 Construction Requirements:

610-3.01 Weather Conditions:

Paint shall be applied only on thoroughly dry surfaces and only when the atmospheric temperature is in the range from 50 degrees F to 100 degrees F, inclusive, and when the relative humidity is at or below 75 percent. Paint shall only be applied to a surface which is at least 5 degrees F above the dew point. The surface temperature should remain above the minimum temperature specified above until the paint is thoroughly dry. Paint shall not be applied when the air is misty or when weather conditions exist which might damage the work. If fresh paint is damaged by the elements, it shall be replaced or repaired by the contractor at no additional cost to the Department. The contractor may provide suitable enclosures to permit painting during inclement weather.

610-3.02 Surface Cleaning:

(A) Metal Surfaces:

All surfaces of structural steel or other metals, except galvanized surfaces, shall be cleaned prior to painting.

All surfaces of new structural steel or other metals which are to be painted shall be blast cleaned to a near-white finish in accordance with SSPC Standard SP10, unless otherwise specified or approved in writing by the Engineer.

When repainting existing steel structures, the method of cleaning will be specified in the Special Provisions. Areas not designated for repainting which are damaged as a result of the contractor's operations shall be repaired by the contractor, at no additional cost to the Department, and as approved by the Engineer.

(1) Blast Cleaning:

All dirt, rust, old paint, mill scale, and other foreign material shall be removed from steel or other metal surfaces with an approved blast cleaning apparatus. Blast cleaning shall leave all surfaces with a dense, uniform anchor pattern or profile of 1.0 to 3.0 mils, as measured with an approved surface profile comparator or pressed film replica tape.

Abrasives used for blast cleaning shall be clean dry sand, mineral grit, steel shot, or steel grit and shall be graded to produce satisfactory results. The use of other abrasives will not be permitted unless approved in writing by the Engineer.

When blast cleaning is being performed near machinery, all journals, bearings, motors and moving parts shall be sealed against entry of abrasive dust.

Blast cleaned surfaces shall be primed or treated the same day blast cleaning is done, unless otherwise authorized by the Engineer. If cleaned surfaces rust or are contaminated with foreign material before painting is accomplished, they shall be recleaned by the contractor at no additional cost to the Department.

(2) Steam Cleaning:

All dirt, grease, loose chalky paint, or other foreign material which has accumulated on previously painted surfaces shall be removed with a steam cleaning apparatus prior to all other phases of cleaning. It is not intended that sound paint be removed by this process. After steam cleaning, any paint which has become loose, curled, lifted, or loses its bond to the preceding coat or coats shall be removed to sound paint or metal surface by the contractor at no additional cost to the Department.

A detergent shall be added to the feed water of the steam generator or applied to the surface to be cleaned. The detergent shall be of such composition and shall be added in such quantity that the specified cleaning is accomplished.

Any residue, detergent or other foreign material which may accumulate on cleaned surfaces shall be removed by flushing with fresh water.

Steam cleaning shall not be performed more than two weeks prior to starting painting operations or other phases of cleaning.

Subsequent painting shall not be performed until the cleaned surfaces are thoroughly dry and in no case in less than 24 hours after cleaning.

(3) Hand Cleaning:

Manual or powered wire brushes, hand scraping tools, power grinders, or sandpaper shall be used to remove all dirt, loose rust, mill scale, or paint which is not firmly bonded to the surfaces.

(4) Water Blast Cleaning:

Water blast cleaning shall be done in accordance with NACE (National Association of Corrosion Engineers) Standard RP-01-72 with normal water, no additives to the water will be allowed. All areas of oil and grease on surfaces to be coated shall be hand cleaned with clean petroleum solvents. The solution of solvent and contaminates shall be wiped clean and the surfaces allowed to air dry prior to the water blast cleaning. The contractor shall not use power spray equipment or similar methods to apply the solvent. All the surfaces to be coated shall be power washed with a water pressure of not less than 2000 pounds per square inch and not greater than 5000 pounds per square inch. The water blasting equipment shall have a minimum water usage of 5 gallons per minute.

Water blast cleaning shall be performed no more than two weeks prior to the start of painting operations or other phases of cleaning.

Subsequent painting shall not be performed until the cleaned surfaces are thoroughly dry and in no case less than 24 hours after cleaning.

(B) Concrete Surfaces:

Prior to painting concrete surfaces, laitance and curing compounds shall be removed from the surface by abrasive blast cleaning in accordance with the requirements of ASTM D4259. The cleaned surface shall have a roughened, textured appearance consistent with the surrounding concrete surface.

Concrete surfaces shall be thoroughly dry and free of dust at the time the paint is to be applied. Any artificial drying procedures and methods shall be subject to approval by the Engineer.

(C) Surfaces other than Metal or Concrete:

Prior to painting any surfaces other than metal or concrete, the surface shall be in accordance with the manufacturer recommendations and as approved by the Engineer.

610-3.03 Application:

Painting shall be accomplished in a neat and professional manner.

For painting metal surfaces, paint shall normally be applied by spraying with limited use of hand brushes or rollers.

For painting concrete surfaces, the contractor shall develop an Application Plan according to the manufacturer's written recommendations. The Plan shall include:

(A) Rate of application;
(B) Number of necessary coats (minimum of two coats);
(C) Ambient air temperature;
(D) Ambient surface temperature;
(E) Application equipment;
(F) Qualification of workers;
(G) Safety and damage protection; and
(H) Proposed surface preparation.

For painting concrete surfaces, the contractor shall apply all paint applications to a test specimen or to the concrete surface, according to Application Plan, for the subsequent approval of the Engineer. The contractor shall refinish the test inspection areas to match the paint finish of the surrounding concrete surfaces.

610-3.04 Protection Against Damage:

The contractor shall provide protective devices as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations.

Paint which results in an unsightly appearance on surfaces not designated to be painted shall be removed or obliterated as approved by the Engineer.

All painted surfaces that are marred or damaged as a result of the contractor's operations shall be repaired with materials and to a condition equal to that of the paint coating specified herein.

Upon completion of all painting operations and of any other work the painted surfaces shall be thoroughly cleaned.

610-3.05 Painting:

(A) Metal Surfaces:

(1) General:

All surfaces of new metals shall be painted with one shop coat (primer) and two field coats (the intermediate coat and topcoat), unless otherwise specified.

All paints used shall be appropriately chosen from among the types described in Subsections 1002-2.01 through 1002-2.05 of the specifications and shall conform to the requirements given therein.

The dry film thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge in accordance with SSPC Standard PA2.

If the minimum dry film thickness is exceeded, it shall be limited to that which will result in uniform drying throughout the paint film.

(2) Primer:

The dry film thickness of the primer shall not be less than 2.0 mils and be sufficient to cover the blast profile pattern.

A deep profile pattern from steel shot blasting may require additional applications of primer to obtain sufficient coating of the steel surface.

After structural steel has been fabricated, blast cleaned and accepted by the Engineer, all surfaces, except metal surfaces which are to be embedded in concrete, or within 3 inches of a high strength bolted connection, shall be painted with a primer.

Structural steel which is to be welded shall not be painted before welding is complete. If it is to be welded only in the fabricating shop and subsequently erected by bolting, it shall receive one coat of primer after the shop welding is completed. Areas of structural steel to be field welded shall be masked and the remainder of the steel shall be given one coat of primer.

As soon as practicable after being accepted by the Engineer and prior to removal from the shop, machine-finished surfaces shall be coated with a rust inhibitor which can easily be removed. Surfaces of milled or finished iron and steel castings shall be painted with one coat of primer.

Erection marks for field identification of steel members and weight marks shall be painted upon surface areas previously painted with the primer.

(3) Intermediate Coat:

The intermediate coat shall be appropriately tinted to contrast with the primer. The dry film thickness of the intermediate coat shall not be less than 2.0 mils.

After erection of steel structures has been completed, including all riveting, welding, bolting, and any straightening of bent metal, all adhering rust, scale, dirt, grease, and other foreign material shall be removed as specified under Subsection 610-3.02 of the specifications. All areas where the primer is damaged or deteriorated shall be thoroughly cleaned and spot painted with the same type of paint used for the primer and to the specified dry film thickness.

When the spot painting coat is thoroughly dry, the intermediate coat shall be applied. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the paint film.

(4) Topcoat:

All small cracks and cavities which have not become sealed in a watertight manner by the intermediate coat shall be filled before the topcoat is applied.

At the option of the contractor, the intermediate coat and the topcoat may be applied in the shop. When finished coats are applied in the shop, the contractor shall repaint all damaged or deteriorated areas in the field as directed by the Engineer.

The dry film thickness of the topcoat shall be not less than 2.0 mils.

(B) Concrete Surfaces:

When painting is specified on the plans or in the special provisions, paint conforming to the requirements of Subsection 1002-2.06 of the

specifications, shall be applied to the exposed concrete surfaces tabulated below, except that sidewalks, appurtenant curbs, downdrains, and bridge deck surfaces shall be excluded.

All concrete shall be finished and cured in accordance with the requirements of the specifications prior to the application of the paint.

(1) Cast-in-Place Box Girder Bridges:

All surfaces of the superstructure, including the sides and bottoms of the box girders, shall be painted.

(2) Pre-cast I-Girder Bridges:

Bridge structures with vehicular traffic passing beneath at posted speeds of less than 55 miles per hour, or with pedestrian traffic beneath, shall be painted on all surfaces of the superstructure including both sides and bottoms of the pre-cast girders and the underside of decks.

Bridge structures with vehicular traffic passing beneath at posted speeds of 55 miles per hour or more, and with no pedestrian traffic beneath, shall be painted on all surfaces of the superstructure with the exception of the sides of the interior girders, the interior side of exterior girders, and the underside of the deck.

(3) Pre-cast Box and Slab Girder Bridges:

All surfaces of the superstructure including the sides of exterior girders and the bottom surfaces of the box or slab girder when exposed to traffic view shall be painted.

(4) Bridge Substructure and Walls:

All surfaces of bridge piers, including the pier caps and bottoms of integral pier caps, piles, columns, parapet walls and abutments, concrete retaining walls and noise barrier walls shall be painted to at least 1 foot below finished grade.

(5) Barriers:

All surfaces of bridge barriers and the sides and tops of permanent barriers not adjacent to the traveled way shall be painted.

(C) Surfaces other than Metal or Concrete:

Surfaces other than metal or concrete shall be painted as recommended by the paint manufacturer and as approved by the Engineer.

All miscellaneous steel items that are not elements of bridges, cantilever sign supports, or bridge truss sign structures, may be hand-cleaned and have the required field paint coats applied in the shop.

610-3.06 Painting Damaged Galvanized Coating:

Damaged areas of galvanized coating shall be roughened by sanding or acid treatment. The roughened areas shall be painted with two coats of zinc-rich primer, conforming to the requirements of Subsection 1002-2.02 of the specifications.

610-4 Field Adhesion Testing:

Random adhesion testing of the completed paint finish may be performed by the Department after a minimum of 30 days from the time of application.

If adhesion testing is performed, it will be done according to one or both of the following methods and shall meet the respective requirements. When testing is performed in accordance with ASTM D4541, Method E, a strength of at least 100 pounds per square inch is required. When testing is performed in accordance with ASTM D3359, Method A, a rating of 3A or higher is required.

610-5 Basis of Payment:

No measurement or payment will be made for painting as specified herein and on the plans, or for independent laboratory tests, surface preparation, and supplying samples, the cost being considered as included in the prices paid for the various contract items of work involving painting.

SECTION 701 MAINTENANCE AND PROTECTION OF TRAFFIC:

701-1 Description:

The work under this section shall consist of providing flagging services and pilot trucks, and furnishing, installing, maintaining, moving and removing barricades, warning signs, lights, signals, cones, and other traffic control devices to provide safe and efficient passage through and/or around the work and to protect workers in or adjacent to the work zone. The work shall be done in accordance with the requirements of Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and the associated Arizona Department of Transportation supplement. When referred to herein, these documents will be referred to as MUTCD and associated ADOT Supplement.

The requirements of the MUTCD and associated ADOT Supplement shall be considered as the minimum standards for the protection of workers and the traveling public.

When a traffic control plan is included in the project plans, this plan shall govern unless an alternate plan, acceptable to the Engineer, is submitted by the contractor. If no traffic control plan is provided or if the contractor desires to deviate from the provisions for maintaining traffic as described in this section, it shall submit to the Engineer for approval a proposed sequence of operations and a compatible method of maintaining traffic.

The contractor's submittal shall be prepared by an individual meeting one of the following criteria:

(A) Has successfully completed a recognized traffic control supervisor training and certification program. The traffic control supervisor training and certification provided by the American Traffic Safety Services Association (A.T.S.S.A.) or the International Municipal Signal Association (IMSA) shall be acceptable. Training and certification through other programs must be approved in advance by the Engineer. The individual's training and certification shall be current and must be valid throughout the duration of the project. In order to remain current with the Department, training and certification shall be completed or renewed at least once every four years; or

(B) Be a licensed professional engineer registered in the State of Arizona and have completed an approved traffic control supervisor training program, as specified in Subsection 108.03 of the specifications. The training shall be current and must be valid throughout the duration of the project. In order for the training to remain current with the Department, it shall be completed or renewed every four years.

The contractor shall submit proof of the proposed individual's credentials at the preconstruction conference. The contractor bears all responsibility for any such contractor-submitted traffic control plan, whether prepared by its direct employee or other individual.

The contractor's proposal shall be submitted early enough to allow at least two weeks for review and approval before use of the proposed traffic control plan.

The traffic control and safety plan of the contractor, along with the contractor's work schedule and actual operations, shall be such that no condition that is considered to be unsafe, in the opinion of the Engineer, shall exist. The traffic control plan shall assure that miscellaneous operations occurring throughout the work, as well as during the final stages, are adequately protected. As a result of effective planning and efficient scheduling of the type and quantity of work, the duration, degree, length, amount, size, etc., of any traffic restriction or lane closures shall be limited to that absolutely necessary to provide a safe condition for both traffic and construction personnel.

701-2 Materials (Equipment, Workers, Devices and Facilities):

701-2.01 General:

(A) Conformance:

Except as specified herein, all equipment, procedures used by workers, devices and facilities shall conform to the requirements of the MUTCD and associated ADOT Supplement.

(B) Safety:

(1) General Requirements:

All traffic control devices listed below as Category I and Category II devices shall meet the evaluation criteria for Test Level III per NCHRP (National Cooperative Highway Research Program) Report 350.

At the pre-construction conference the contractor shall submit a letter certifying that all such traffic control devices to be used on the project will meet the above-referenced criteria. The certification shall contain the following:

(a) A list of all Category I and II traffic control devices to be used on the project;

(b) The project number;

(c) A statement verifying that these devices, and their application, meet the requirements of NCHRP Report 350 Test Level III; and

(d) The name, title and signature of a person having legal authority to bind the manufacturer or supplier of the Category I and II devices. The binding authority shall be in accordance with the applicable requirements of Subsection 106.05(B) of the specifications .

If additional Category I and II devices are required at a later date, the contractor shall provide an amended certification letter to the Engineer specifying that such devices also comply with the requirements of NCHRP Report 350 Test Level III.

For all Category I and Category II devices used on the project the contractor shall also acquire or have access to reports which verify that such devices meet the above-referenced criteria. The reports shall contain the name and model of the tested traffic control devices, detailed drawings or product literature of each, and under what conditions the devices passed. The traffic control devices detailed in the report shall be the complete warning devices, including warning lights, flags, ballast and any other auxiliary attachment allowed. Reports for Category II devices are prepared by the FHWA. For Category I devices, the supplier is responsible for testing the product and providing a report which verifies that the device meets the criteria of NCHRP Report 350, Test Level III. If requested by the Engineer, the contractor shall provide copies of such reports within one working day.

(2) Category I Devices:

Category I devices are low-mass traffic control devices that will not cause an appreciable change in speed of an impacting vehicle, nor is it likely that any part of the device will intrude into the passenger compartment. The following traffic control devices will be considered Category I devices: rubber or plastic traffic cones, rubber or plastic tubular markers, single piece plastic drums, plastic or fiberglass delineators. No warning lights, signs, flags or other auxiliary devices are allowed on Category I devices. Should any of these attachments be added to a Category I device, the Category I device will be considered a Category II device. Ballast at the base, such as a rubber tire, is an acceptable attachment to Category I devices. The single piece plastic drum refers to the construction of the body of the drum exclusive of a separate base, if any.

(3) Category II Devices:

Category II devices are low-mass traffic control devices that will not cause a significant change in speed of an impacting vehicle. The following traffic control devices will be considered Category II devices: type I, II, and III barricades with or without warning lights; vertical

panels with or without warning lights; signs and sign stand (all types) with or without warning lights and/or flags; drums, other than those listed in Category I, with or without warning lights; and any Category I devices with attached warning lights.

701-2.02 Flashing Arrow Panels:

Flashing arrow panels shall conform to the requirements of the MUTCD and associated ADOT Supplement with the following additions:

Each arrow panel shall have its own independent power source. The power source shall be capable of supplying adequate continuous power for the sign operation over extended periods of time. Fuel capacity shall be such as to provide for at least 12 hours of continuous operation without refueling. Panels may be solar powered with adequate energy source to provide for at least 12 hours of continuous operation without refueling or recharging.

701-2.03 Temporary Concrete Barrier:

Temporary concrete barrier shall be precast sections conforming to the requirements of Signing and Marking Standard Drawing C-3 and Subsections 910-2 and 910-3 of the specifications.

The contractor shall provide, at the preconstruction conference, a certificate of compliance, conforming to the requirements of Subsection 106.05 of the specifications, stating that any temporary concrete barrier to be used on the project conforms to Signing and Marking Standard Drawing C-3. The contractor shall include the project number on the submittal.

701-2.04 Temporary Impact Attenuation Devices:

Temporary impact attenuation devices shall conform to the requirements of Subsections 702-2 and 702-3 of the specifications for the type of device shown on the project plans or as approved by the Engineer.

Temporary Impact attenuation devices shall also meet evaluation criteria for Test Level 3 per NCHRP (National Cooperative Highway Research Program) Report 350, or for Test Level 3 per MASH (AASHTO Manual for Assessing Safety Hardware). The contractor shall provide, at the preconstruction conference, a certificate of compliance, conforming to the requirements of Subsection 106.05 of the specifications, certifying that any temporary impact attenuation devices to be used on the project will meet the above requirement. The contractor shall include the project number on the submittal.

701-2.05 Temporary Pavement Markings:

(A) Temporary Raised Pavement Markers and Chip Seal Pavement Markers:

Temporary Pavement Markers may be Temporary Reflective Markers, Permanent Reflective Markers (used as Temporary) or Non-Reflective Markers, as required on the Project Plans or as approved by the Engineer.

Temporary Pavement Markers shall be in conformance with Standard Drawings M-19 and M-20, and Subsections 706-2 and 706-3 of the specifications, and will be included on a list of pre-approved products maintained by the Department.

Chip Seal Pavement Markers shall conform to Standard Drawing M-20. The Chip Seal marker body and cover shall be manufactured from a polyurethane material conforming to the following requirements:

	Requirement	ASTM Test Method
Specific Gravity (Min.)	1.19	D792
Hardness (Min.)	80A	D2240
Tensile Strength (Min. PSI)	4,600	D412
Ultimate Elongation (Min. %)	330	
Modulus @ 300% PSI	1,000	
Stiffness @ -20 °F (Min. PSI) 70 °F (Min. PSI)	 17,000 900	D1053
Compression Set 22 hrs. @ 70 °C	65	D395
Taber Abrasion; CS 17 wheel, Wt. Loss (mg/1000 cycles)	3	---

Reflective tape shall be metalized polycarbonate microprism retroreflective material with acrylic backing or equal. The tape shall have a minimum reflectance equal to or greater than 1,800 candelas per foot-candle per square foot at 0.10-degree observation and 0-degree entrance angles.

(B) Preformed Pavement Markings:

Preformed Pavement Markings shall be either Type II (Temporary-Removable) or III (Temporary-Nonremovable), as indicated on the project plans or as approved by the Engineer. Preformed Pavement Markings shall be in conformance with the requirements of Section 705 of the specifications and shall be included on a list of pre-approved products maintained by the Department.

701-2.06 Temporary Sign Supports:

Temporary Sign Supports may be wood, steel or aluminum, at the option of the contractor and shall be approved by the Engineer prior to installation. Wood posts shall be Southern Pine, Douglas Fir or other soft wood. Wood posts need not be treated. Embedded posts shall meet the criteria established under NCHRP Report 350 for breakaway sign supports.

Angle braces will not be allowed.

701-2.07 Delineators:

Delineators shall be as shown on the plans and shall be in conformance with the Standard Drawings and Subsection 703-2 of the specifications.

701-2.08 Barricades and Other Channelizing Devices:

Type I barricades having a minimum of 270 square inches of retroreflective area facing traffic, and otherwise conforming to the MUTCD, may be used in lieu of Type II barricades in freeway or other high speed applications, unless specifically excepted in the project plans.

All sheeting for barricades and other channelizing devices shall conform to the requirements of Section 1007 of the specifications.

701-2.09 Drums:

Sheeting type for drums shall conform to the requirements for work zone devices shown in Section 1007 of the specifications.

701-3 Construction Requirements:

701-3.01 General:

The contractor shall provide for the adequate protection of all vehicular and pedestrian traffic and workers through any portion of the work where construction operations interfere with, obstruct, or create a hazard to the movement of traffic.

At the pre-construction conference, the contractor shall provide the Engineer with the name of the contractor's employee who is responsible for implementing, monitoring, and altering, as necessary, the traffic control plan. The Engineer will then advise the local law enforcement agency having jurisdiction, of the names of the contractor's representative and a representative of the Department who will act in a similar capacity. The contractor's designee shall be available at any time to respond to calls involving damage or displacement to barricades,

lights, signs and other devices resulting from vandalism, traffic accident or other causes.

If, at any time, the Engineer determines that sufficient traffic control is not being provided or maintained, the Engineer may order suspension of the work until the proper level of traffic control is achieved. In cases of serious or willful disregard for safety of the public or workers by the contractor, the Engineer may proceed to place the traffic control measures in proper condition and deduct the cost thereof from monies due or becoming due the contractor.

All contractor's personnel, equipment, machinery, tools and supplies shall be kept clear of active traffic lanes, except as necessary for the prosecution of the work. The contractor shall promptly remove any material or debris that is spilled or tracked onto the traveled roadway as a result of the prosecution of the work at no additional cost to the Department. Materials, vehicles and parked equipment shall be kept as far from the traveled way as practical. The contractor shall not park equipment or store materials within 30 feet of the edge of a traveled way unless an adequate barrier is present. Equipment may be parked and materials may be stored in the right-of-way only at locations approved by the Engineer.

Any devices provided under this section which are lost, stolen, destroyed or are deemed unacceptable by the Engineer, while their use is required on the project, shall be replaced by the contractor and, except as hereinafter specified for temporary impact attenuators, at no additional cost to the Department. All such devices shall be replaced by the end of the work shift unless otherwise specified.

The Engineer shall be sole judge as to which signs may require embedded posts, portable stands or another type of support.

701-3.02 Maintenance and Protection of Traffic:

All traffic control devices necessary for the first stage of construction shall be properly placed and in operation before any construction is allowed to start. When work of a progressive nature is involved, such as resurfacing a roadway under traffic, the necessary devices shall be moved concurrently with the advancing operation. The use of temporary devices shall not be extended beyond the anticipated duration of one work shift's production.

All traffic control devices shall be kept clean and free from dirt, mud, and roadway grime. Scratches, rips and tears in reflective sheeting, or loss of fluorescence in fluorescent prismatic sheeting, as determined by the Engineer, shall be promptly corrected by the contractor.

Temporary pavement markings shall be applied in conjunction with changes in the traffic pattern. Placement of new pavement markings and removal of old markings shall be done immediately when the need

for each arises. Temporary markings and devices shall be removed and new roadway marking shall be completed within 24 hours after any changes in traffic pattern unless otherwise directed by the Engineer. Obliteration of the temporary pavement markings shall be in conformance with Subsection 701-3.06 of the specifications.

Types of barricades, supports or devices not specifically described in the MUTCD and associated ADOT Supplement, but which would cause a hazard to traffic if used by the contractor, will not be permitted in the work area. The methods used by a contractor to control traffic when there are no details included in the contract, shall produce a safe condition for travel to the maximum extent possible at all times.

701-3.03 Temporary Concrete Barriers:

Barriers shall be installed in accordance with the details and at the locations shown on the project plans or where directed by the Engineer. Sections of temporary barrier shall be fastened together as shown on the Standard Drawings to form a continuous chain. After placement, each unit shall be moved longitudinally to remove slack in the joints between the units. Where shown on the project plans or directed by the Engineer, the ends of the barrier run shall be flared back or fitted with an impact attenuation device. Attenuation devices shall be installed in accordance with the requirements of Subsection 701-3.04 of the specifications.

Barrier Markers shall be installed as shown on the project plans or standard drawings.

Any unit which has been excessively damaged, as determined by the Engineer, shall not be used. Any unit damaged during or after installation shall be replaced with an undamaged unit by the close of that work shift, at no additional cost to the Department.

Temporary Glare Screen shall be installed on barriers at locations shown on plans, and on barriers used to separate opposing traffic on freeway construction contracts in urban areas. When barrier is used on freeway construction to separate traffic from construction operations, glare screen may be required when construction activity is continuous for at least 1,500 feet adjacent to the active traffic lanes.

Temporary Glare Screen shall be expanded metal or plastic attached to the barrier by a method satisfactory to the Engineer. Temporary Glare Screen shall have the following characteristics:

(A) When hit, the device shall not penetrate the passenger compartment of the errant vehicle or present a hazard to workers and other traffic;

(B) The device shall perform in a predictable manner when hit;

(C) The device shall effectively reduce glare from oncoming vehicle head lights; and

(D) The device shall be resistant to vandalism and vehicle damage, and shall be easy to repair.

701-3.04 Temporary Impact Attenuation Devices:

Energy absorbing terminals be installed at the locations in accordance to the details shown on the project plans and the manufacturer's instructions.

Devices that are damaged by the traveling public shall be repaired within 36 hours by the contractor utilizing a replacement parts package, which shall be on the job site whenever this system is in use. The replacement parts package supplied by the contractor shall be the one recommended by the manufacturer of the attenuation device in use. Upon completion of the work for which energy absorbing terminals are required, all temporary terminals used during the project and the associated replacement parts packages shall be carefully removed and stockpiled by the contractor within the limits of the project at a location specified by the Engineer and shall become the property of the Department.

Sand barrel crash cushions conforming to the requirements of Subsection 702-2.03 of the specifications shall be placed in accordance with the details shown on the project plans.

Crash cushions damaged by the traveling public shall be removed and disposed of by the contractor. New devices shall be furnished and installed by the contractor. The contractor shall repair any damaged installations within 36 hours. Sand barrel crash cushions will remain the property of the contractor upon completion of temporary use unless permanently incorporated into the project.

Upon approval of the Engineer, undamaged attenuation devices, sand barrels or metal type, may be used for permanent installation in accordance with the requirements of Subsections 702-2 and 702-3 of the specifications.

701-3.05 Temporary Pavement Markings (Application and Removal):

(A) General:

Application of temporary pavement markings shall conform to the requirements of Subsection 708-3 of the specifications, the MUTCD and associated ADOT Supplement, and other provisions of these specifications as applicable. Placement of new markings shall be done immediately when the need for each arises, in conjunction with changes in the traffic pattern.

Pavement Markings may be required by the Engineer in lieu of barricades for temporary delineation when the duration of use as shown in the traffic control plan may exceed five days or when lane widths are less than 12 feet.

(B) Raised Pavement Markers:

The adhesive shall be applied uniformly to the cleaned pavement surface and the raised pavement marker shall be placed in the correct position on the adhesive area with the application of pressure as specified by the manufacturer.

(C) Preformed Pavement Markings:

Preformed pavement markings for temporary applications shall be Type II (Temporary-Removable) and III (Temporary-Nonremovable) and shall conform to the requirements of Section 705 of the specifications.

Preformed Pavement Markings, Type II, shall only be used on surfaces or finish pavement courses where eventual removal will be required.

Preformed Pavement Markings, Type III, shall only be used where removal of markings is not required due to obliteration, abandonment or overlaying the pavement surface.

701-3.06 Obliteration of Existing Pavement Markings:

Pavement marking obliteration shall be accomplished by the contractor as indicated on the plans or as directed by the Engineer.

Pavement markings shall be removed to the fullest extent possible from the pavement by any method that does not materially damage the surface, color, or texture of the usable pavement. Abrasive blasting, using air or water, is an acceptable method for removing pavement markings, however, other methods may be approved by the Engineer. Overpainting of markings with paint or asphalt will not be permitted.

Sand or other material deposited on the pavement as a result of removing pavement markings shall be removed as the work progresses. Accumulations of sand or other material, which might interfere with drainage or might constitute conditions adverse to traffic safety, shall be removed by the contractor.

Where blast cleaning is used for the removal of pavement markings or for removal of objectionable material, the residue, including dust, shall be removed immediately after contact between the sand and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation, or by other methods approved by the Engineer. Blast cleaning shall not be used within 12 feet of a lane occupied by public traffic unless a suitable barrier separates traffic from the area being cleaned.

Obliteration or removal of raised pavement markers shall include removal of the marker and adhesive pad, or adhesive pad alone if the marker is missing.

Any damage to the pavement caused by pavement marking removal shall be repaired by methods acceptable to the Engineer. When asphalt slurry is used to repair damage to the pavement caused by pavement marking removal or the obliteration of the marks remaining after the markings have been removed, the asphalt slurry shall be placed parallel to the new direction of travel and shall be at least 2 feet in width.

If obliteration of lead-based striping is necessary, it shall be accomplished by a method that is in compliance with 29 CFR, Lead Exposure in Construction, Interim Final Rule. If lead exposure prevention measures are required, the contractor shall ensure that all contractor personnel, subcontractors, and ADOT personnel present on the job site are notified of the activity and advised of precautions necessary to avoid contamination by lead compounds. The contractor shall submit a lead exposure plan to the Engineer for review at least 48 hours prior to the start of any striping obliteration activities. Payment for additional work to remove lead-based striping shall be in accordance with Subsections 104.02 or 109.04 of the specifications.

701-3.07 Truck-Mounted and Trailer-Mounted Attenuators:

The contractor shall provide trucks and truck-mounted attenuators, or trailer-mounted attenuators and host vehicles, at the locations shown on the project plans and/or as directed by the Engineer.

Attenuators shall meet either NCHRP Report 350, Test Level 3 criteria, or MASH (Manual for Assessing Safety Hardware), Test Level 3 criteria, passing both mandatory and optional tests. The truck and attenuator combination shall only be used in the configuration tested. Either the truck or attenuator shall have a sequential arrow display panel or changeable message board.

Attenuators that require chocking or blocking of the vehicle to meet NCHRP Report 350 or MASH certification shall not be used.

Attenuators shall have rear-mounted, retroreflective chevron stripes and a standard trailer lighting system, including brake lights, turn signals, ICC-bar lights, and two yellow rotating beacons, strobe lights, or LED lights mounted on opposite rear corners of the truck or attenuator approximately 4-1/2 feet above the bottom of the tires. A Type C arrow panel or changeable message board shall be provided and shall be installed in accordance with the NCHRP 350/ MASH Crashworthiness Certification or FHWA Letter of Acceptance. There shall be a minimum of 7 feet from the roadway to the bottom of the panel or board. Frame work shall be an integral part of the truck and be permanently mounted in such a way as to prevent the unit from separating from the truck in the case of a collision.

For each proposed truck-mounted or trailer-mounted attenuator, the contractor shall provide a Certificate of Compliance, in accordance with Subsection 106.05 of the specifications, to the Engineer for approval prior to use. For truck-mounted attenuators, the certificate shall also include the certified weigh bill for the truck, and for trailer-mounted attenuators the certificate shall state the minimum weight for the host vehicle. The certificate shall state that the attenuator meets the specified criteria, and shall clearly state the roll-ahead distance. When trucks require ballasting to comply with NCHRP 350/MASH Crashworthiness Certifications, the contractor shall provide a letter from the owner supplying the attenuator and truck stating that the ballast is in compliance with the manufacturer's recommendations and that it is anchored to the truck frame. The letter shall be on the supplier's official company letterhead and shall include:

(A) The current name, address, and phone number of the supplier of the attenuator;

(B) A statement that the individual signing the letter has the legal authority to bind the supplier;

(C) The name, title and signature of the responsible individual; and

(D) The date of the signature.

A copy of the Certificate of Compliance and if required, the letter regarding ballast shall be kept in the truck cab or host vehicle, available for immediate inspection when requested by the Engineer.

When in use for attenuation, trucks shall be used exclusively for attenuators. When in use for attenuation, such trucks shall not be used to carry or store equipment or devices, secured or unsecured. No modification in configuration or use shall be allowed without a resubmitted certified weigh bill for the Engineer's approval.

Truck-mounted or trailer-mounted attenuators used as shadow vehicles per the MUTCD shall be positioned at a distance greater than the roll-ahead distance in advance of the workers or equipment being protected so that there will be sufficient distance, but not so much that errant vehicles will travel around the shadow vehicle and strike the protected workers and/or equipment.

The contractor shall cease operations when a truck-mounted or trailer-mounted attenuator is damaged. The contractor shall not resume operations until the attenuator has been repaired or replaced, unless authorized by the Engineer.

701-3.08 Changeable Message Board:

Changeable message boards shall be furnished and maintained by the contractor at the locations shown on the plans and as specified by the Engineer. The operations and messages programmed into the board controller shall be as directed by the Engineer. The changeable message board shall be a complete and operational portable unit which shall consist of a wheeled trailer with an adjustable, changeable message board, board message controller and self-contained power supply.

The power supply for the changeable message board shall be a fully independent self-contained trailer-mounted system. The changeable message board power supply shall be battery operated and rechargeable from a solar panel mounted above the changeable message board.

The message characters shall be delineated by either electromagnetically actuated reflective dots or optically enhanced light emitting diode pixels (LED) operating under the control of a digital computer.

The contractor shall submit, at the pre-construction conference, a Certificate of Compliance that the changeable message board to be used on this project shall be as described herein.

The character formation system and components shall conform to the following requirements:

(A) The changeable message board shall be programmable, and shall be capable of displaying a minimum of three lines of message copy, with a minimum of eight characters per line, in various alphanumeric combinations;

(B) The changeable message board matrix configuration shall be 35 dots or pixels per character in a 5 horizontal by 7 vertical arrangement of the dots or pixels;

(C) The dot or pixel size shall be a 2.5-inch high by 1.625-inch wide rectangle (minimum), or equivalent area;

(D) Each character shall be 18 inches in height and 12 inches in width (minimum);

(E) The horizontal character separation shall be 3 inches or more;

(F) Dot color shall be fluorescent yellow upon activation and flat black when not activated. The LED pixels shall emit amber light upon activation and be dark when not activated;

(G) The line separation shall be 5 to 12 inches;

(H) Changeable message boards shall be protected with a clear lexan-type or equivalent shield that shall not interfere with or diminish the visibility of the sign message;

(I) The programmable message board shall be capable of displaying moving arrow patterns as one of the operator-selected programs;

(J) The message board shall also be capable of displaying up to two messages in sequence, with variable timing in a minimum of quarter-second increments;

(K) The message board shall be clearly visible and legible from a distance of 800 feet under both day and night conditions. The dot-matrix board shall have an internal illumination system that shall automatically activate under low light conditions to achieve the visibility requirements. The LED-pixel matrix board shall adjust light output (pulse width modulation) to achieve the visibility requirements; and

(L) The power supply achieved from the battery and solar panel recharging system shall have sufficient capacity to operate the changeable message board for a minimum of 20 days without direct sunshine. The solar panel array shall be capable of recharging the batteries such that 2.5 to 3.5 hours of direct sunshine shall provide for a minimum of one 24-hour period of usage. Additionally, the battery recharging controller shall have an ambient temperature sensing device which will automatically adjust the voltage supplied from the solar panels to the batteries. The sensing device shall ensure that the batteries are properly charged in hot or cold weather and shall provide the sign with sufficient power to operate the sign as specified.

When in operation, the changeable message board trailer shall be offset a minimum of 8 feet from the nearest edge of pavement. If the trailer is located behind temporary concrete barrier, a minimum offset of 6 feet will be required. Should the specified shoulder width not be available, a minimum 2-foot offset from the nearest edge of pavement or temporary concrete barrier shall be required. When positioned on the highway, the changeable message board trailer shall be delineated with a minimum of 10 Type II barricades or vertical panels with Type C steady burn lights at a spacing of 10 to 20 feet, or as shown on the approved traffic control plan.

When not in operation, the changeable message board shall be moved a minimum of 30 feet from the edge of pavement.

The changeable message board trailer shall be placed on a level surface and be secured as recommended by the manufacturer and as directed by the Engineer. The contractor shall provide any necessary incidental grading and clearing work required to provide a level surface and clear area for the sign.

701-3.09 Chip Seal Pavement Marker:

Chip Seal Pavement Markers and covers shall be located and placed on the asphaltic concrete prior to any work being started on the chip seal coat, all in a manner as approved by the Engineer.

Immediately after application of the chip seal coat to the roadway pavement, the plastic covers shall be removed, exposing the reflective tape surfaces.

Chip Seal Pavement Markers that are damaged by the contractor shall be replaced by the contractor at no additional cost to the Department.

701-3.10 Sign Sheetings:

Sign sheeting for all temporary work zone signs shall conform to the requirements of Section 1007 of the specifications.

701-3.11 Temporary Removal or Covering of Signs:

Where existing signs are not applicable during construction, they shall be removed or have the affected legends covered in place. Unless otherwise stated in the plans, or if a discrepancy exists, the Engineer will approve the method or methods to be used.

Removed signs shall be properly shipped, stored, and handled in accordance with the manufacturer's recommendations and in a manner approved by the Engineer to assure that such signs will continue to be suitable upon reinstallation.

Where temporary removal of a sign or legend is not practical, the sign face may be covered with an opaque porous cloth or fiber material, folded over the sign edges, and secured at the rear of the sign in such a manner that the sign shall not be damaged.

Tape, hardware, ropes, cables, etc., used to secure the covering material shall not touch, place any pressure on, or damage the sign face.

The covering shall be maintained by the contractor until the Engineer directs reactivation of the sign by removal of the coverings or the contract ends.

The contractor shall restore the signs and legends to their previous conditions, as directed by the Engineer. The contractor shall repair any

damage to the signs or shall replace the damaged signs, as directed by the Engineer when damage is the result of the contractor's operations.

701-3.12 Temporary Sign Supports:

Temporary Sign supports installed in the ground shall be removed at the completion of the project, the post holes filled and compacted, and the immediate area restored to match the surrounding area.

701-3.13 Flagging Services:

Flagging services shall consist of either civilian, local enforcement officers and their vehicles, or DPS (Department of Public Safety) officers and their vehicles. The Engineer will determine the type of flagger needed, and may adjust the relative number of hours of each type of flagger specified in the traffic control plan.

If available, only DPS officers shall be used on Interstate Highways and Urban Freeways. DPS officers shall also be used on other construction projects except when a local law enforcement agency has jurisdiction, in which case a local law enforcement officer and vehicle shall be used.

The contractor shall be responsible to procure civilian flaggers, DPS officers, and local enforcement officers. When procuring DPS officers, the contractor shall contact DPS at least two days, excluding weekends and holidays, before flagging services will be required. Such contact must be made between the hours of 7:00 A.M. and 5:00 P.M. (M.S.T.).

In the event that local enforcement officers or DPS officers are temporarily unable to provide flagging services, the contractor shall ensure that traffic control is maintained and all personnel are protected, either by providing civilian flaggers or through other means as approved by the Engineer. No adjustments to the contract will be allowed for any delays resulting from the unavailability of local enforcement officers or DPS officers.

A DPS or local enforcement officer shall not work more than 12 consecutive hours unless an emergency situation exists which, in the opinion of the Engineer, requires that the officer remain in the capacity of a flagger.

The contractor shall furnish verification to the Engineer that all civilian flaggers have completed a recognized training and certification program. Flaggers certified by the American Traffic Safety Services Association (A.T.S.S.A.) or by the National Safety Council shall be acceptable. Certification through other programs offering flagger training must be approved by the Engineer. Flagger certification must be current. Training and certification shall be required at least once every four years.

701-4 Method of Measurement:

701-4.01 General:

The Department will reimburse the contractor for the work of maintaining and protecting traffic on the basis of unit bid prices for the various Elements of Work. No additional measurement for payment to the contractor will be made for any Elements of Work other than those listed in the bidding schedule.

Elements of Work specified under this subsection which are lost, stolen, destroyed, or are deemed unacceptable by the Engineer, while in use on a project shall be replaced by the contractor and, except as hereinafter specified for temporary impact attenuators, at no additional cost to the Department.

Elements of Work will be measured for payment as follows:

(A) Elements of Work (Complete-in-Place):

The Elements of Work listed herein under Subsection 701-5 of the specifications will be measured for payment upon the satisfactory completion of the initial installation or obliteration. Except as hereinafter specified under Basis of Payment, no subsequent measurements will be made.

(B) Elements of Work (In Use):

The elements of work listed herein under Subsection 701-6 of the specifications will be measured for payment from the time at which the element is put into active use on the project and accepted by the Engineer until such time that the Engineer determines that the element is no longer required.

701-4.02 Relocation of Work Elements:

Following the initial installation of an Element of Work described above, the Engineer may direct the contractor to move the Element of Work from one location and reinstall it at another location. Except as specified elsewhere herein, in Subsection 701-5.01 of the specifications for Temporary Concrete Barrier (Installation and Removal), and Subsection 701-5.02 of the specifications for Temporary Impact Attenuators (Installation and Removal), no measurement for payment will be made for relocation of Work Elements.

When work of a progressive nature is involved, such as resurfacing a road under traffic, or closing a lane or lanes for work to be accomplished during a shift, no measurement for payment will be made for setting up or relocating the necessary traffic control equipment, workers, devices, facilities, signs etc., that are moved concurrently with the advancing operation, or removal at the end of a shift.

701-4.03 Payment Exceptions:

(A) Deficient Elements of Work:

Any deficiencies in the traffic control plan, devices, equipment, services, or other elements of work listed herein under Subsection 701-4.01(B) of the specifications will be brought to the attention of the contractor by the Engineer and all deficiencies shall be corrected before the close of that work shift, unless otherwise specified.

The contractor shall not be paid for those deficient Elements of Work listed herein under Subsection 701-4.01(B) of the specifications unless restored to full usefulness prior to the close of the work shift in which notice of the defect is given, or within the time limits specified in Subsection 701-3 of the specifications. Measurement for payment will not resume until the beginning of the work shift following that work shift in which those elements are restored to usefulness.

(B) Substantial Deficiencies:

For each work day or work shift during which there are, as determined by the Engineer, substantial deficiencies in the contractor's traffic control plan, devices, and/or services, no payment will be made to the contractor for any Element of Work listed herein under Subsection 701-4.01(B) of the specifications.

Measurement for payment will not resume for any Element of Work until the beginning of the work day or work shift following that work day or work shift in which all corrective measures have been performed by the contractor and approved by the Engineer.

In cases of serious or willful disregard for the safety of the public or its employees by the contractor, the Engineer may place the traffic control elements in proper condition and deduct the cost thereof from monies due or becoming due the contractor.

(C) Nondiligent Prosecution of Work:

In the event that the Engineer determines that the contractor's construction operations are not resulting in the diligent prosecution of the work under contract, no payment will be made to the contractor for the Elements of Work listed herein under Subsection 701-4.01(B) of the specifications until such time as the Engineer determines that the contractor is devoting appropriate efforts toward completion of the work. Payment will be suspended effective with the end of the work day or work shift in which written notice is issued to the contractor by the Engineer notifying the contractor of its failure to prosecute the work. Payment will resume with the beginning of the work day or work shift following that work day or work shift in which the Engineer determines that satisfactory efforts are being made by the contractor toward completion of the work. In any case, the contractor shall continue to be

responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

(D) Non-Working Periods:

Measurement for payment of the Elements of Work listed herein under Subsection 701-4.01(B) of the specifications will begin on the day they are installed in place for traffic control and direction. When the elements are not needed for traffic control, they shall be removed or covered and will not be measured unless they are required to stay on site in anticipation of future use or emergency use as determined by the Engineer. Should devices be required on site for these purposes they will be measured and paid for by the unit prices. During non-working periods such as holidays and Sundays, the elements in place and in satisfactory condition will be measured for payment on the day following such downtime. During these non-working periods the contractor shall conduct a minimum of one check per day to verify that the elements are in place and in satisfactory condition.

No payment will be made to the contractor for the Elements of Work listed herein under Subsection 701-4.01(B) of the specifications for non-working periods resulting from a suspension of work that, in the opinion of the Engineer, is due to the fault of the contractor. In any case, the contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

(E) Limitation of Measurement:

Elements of Work listed herein under Subsection 701-4.01(B) of the specifications that are measured on a unit per day basis will be measured for payment for each 24-hour day. Measurement will be based on the maximum number of units of the specific element of work that are in simultaneous use during any given period regardless of the length of time that the elements are in use and regardless of the number of times the elements are relocated.

Measurement will be made after the initial installation and once weekly thereafter for items in continuous use and at any other times changes are made in the use of traffic control elements listed under Subsection 701-4.01(B) of the specifications. The contractor shall notify the Engineer when any changes are made in the use or location of traffic control elements.

(F) Expiration of Contract Time:

No reimbursement will be made to the contractor for the Elements of Work listed herein under Subsection 701-4.01(B) of the specifications when they are required in association with construction work being performed after the expiration of the contract time and all approved extensions.

In any case, the contractor shall continue to be responsible for maintaining all barriers, attenuators, signs, lights and other traffic control devices in proper functioning condition at all times.

701-4.04 Measurement of Work Elements:

Measurement will be made as follows:

(A) Temporary concrete barrier will be measured by the linear foot along the center line of the uppermost surface upon its initial installation (Complete-in-Place), and upon any subsequent relocations, as defined in Subsection 701-5.01 of the specifications. Barrier will be measured by linear foot for each 24-hour day for the "In-Use" condition;

(B) Temporary Impact Attenuators, such as Sand Barrels and Energy Absorbing Terminals, will be measured by the unit for each complete sand barrel array, regardless of the number of barrels, or energy absorbing terminal upon its initial installation (Complete-in-Place) and upon any subsequent re-installations, as defined in Subsection 701-5.02 of the specifications. Temporary Impact Attenuators will be measured by the day for each 24-hour day that a temporary sand barrel array or energy absorbing terminal impact attenuator is in place and functional for the “In-Use” condition;

(C) Truck-Mounted Attenuators, including driver, and Trailer-Mounted Attenuators, including host vehicle and driver, will be measured by the day for each 24-hour day that a truck-mounted or trailer-mounted attenuator and operator are used to protect the work site;

(D) Flashing Arrow Panels will be measured by the day for each 24-hour day that each panel is in place and operating;

(E) Pilot Vehicles, including driver, will be measured by the hour for each approved hour of operation;

(F) Civilian flagging services will be measured by the hour for each hour that a civilian flagger is provided. Flagging services by DPS officers and local enforcement officers will be measured for each hour that a uniformed, off-duty DPS officer or law enforcement officer with vehicle is employed directly by the contractor as a flagger within the project limits, when authorized in advance by the Engineer. Quantities will be rounded to the nearest 0.5 hour;

Civilian, DPS, or local enforcement flagging services and traffic control devices required to permit contractors' traffic to enter safely into normal traffic within the project limits will

be paid under their respective items. Flaggers required by a written local permit agreement will be measured for payment under this item. Additional civilian, DPS, or local enforcement flagging services used within the project limits shall be measured for payment under this item, subject to the approval of the Engineer;

Civilian, DPS, or local enforcement flagging services and traffic control devices used outside the project limits will be measured under their respective items. The Department will pay 50 percent of the unit bid price for such flaggers and traffic control devices used as described in this paragraph, subject to the approval of the Engineer. The project limits are defined as the construction work zone as shown on the approved traffic control plan for the specific section of highway under construction;

(G) Temporary Preformed Markings for Pavement, Types II and III, will be measured in accordance with the requirements of Subsection 705-4 of the specifications;

(H) Obliterate Pavement Marking will be measured in accordance with the requirements of Subsection 708-4 of the specifications;

(I) Changeable Message Boards will be measured by the day for each 24-hour day that the sign is utilized to maintain and control traffic;

(J) Obliterate Pavement Markers will be measured for each unit, Markers and Adhesive pad, or Adhesive pad alone where Markers are missing;

(K) Temporary Delineators and Temporary Pavement Markers will be measured as a unit for each delineator and marker furnished, utilized, and subsequently removed from the project site. No measurement for payment will be made for delineators and markers that are furnished to replace damaged units as specified under Subsection 701-4.01 of the specifications;

(L) Vertical Panels, Barricades (Types II and III), Tubular Markers, Warning Lights (Types A, B, and C), Traffic Cones (28-inch), High-Level Flag Trees, Drums, Embedded Sign Posts, and Portable Sign Stands (Spring-Type and Rigid), will be measured as a unit for each device furnished and subsequently utilized at the project site for each 24-hour day;

Temporary Signs will be measured as Small (less than 10 square feet) and Large (10 square feet or more) regardless

of sheeting type. Temporary Signs will be measured as a unit for each sign furnished and subsequently utilized at the project site for each 24-hour day. Quantities may be determined on a weekly basis for signs in continuous use;

Utilization shall be defined as including those devices ordered to remain on site or covered in accordance with Subsection 701-4.03(D) of the specifications and approved by the Engineer;

(M) Specialty Signs are signs which are required on the job, as determined by the Engineer or shown on project plans, and are not reusable as traffic control signs. Specialty Signs shall contain information which is project and location specific. The sign sheeting shall be orange fluorescent prismatic rigid sheeting unless otherwise specified, and the size, type and legend of the Specialty Signs will be determined by the Engineer, unless specified on the project plans. Specialty Signs will be measured for payment by the square foot, inclusive of borders. Any sign over 20 square feet in area shall be considered a Specialty Sign; and

(N) Obliterate Pavement Legends or Arrows will be measured by each separate symbol, arrow or legend.

701-5 Basis of Payment for Elements of Work (Complete-in-Place):

701-5.01 Temporary Concrete Barrier (Installation and Removal):

Temporary concrete barrier, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the work, complete in place, as specified herein and as shown on the plans, including furnishing, placing, dismantling, and removal. The price bid shall also include any required connection devices, barrier markers, and glare screen.

Fifty percent of the contract unit price for temporary concrete barrier will be paid upon satisfactory installation.

Should it be necessary to dismantle, pick up and relocate a portion of the barrier installation during construction, whether laterally or vertically, that portion of the removed and relocated barrier will be considered a new installation and paid for at 100 percent of the contract unit price.

Fifty percent of the contract unit price will be paid upon final removal.

No payment will be made for portions of the barrier which the contractor can adjust or realign without dismantling and picking up, such cost being

considered as included in the bid price for Temporary Concrete Barrier "Installation and Removal." The Engineer will be the sole judge as to whether devices are to be dismantled, picked up and reinstalled, or are to be adjusted or realigned.

701-5.02 Temporary Impact Attenuators (Installation and Removal):

Temporary Impact Attenuation Devices shall include Sand Barrels and Energy Absorbing Terminals. Temporary Impact Attenuation Devices, measured as provided above, will be paid for at the contract unit price, which price shall be full compensation for the work, complete in place, as specified herein and as shown on the plans, including furnishing the devices with replacement parts, installing, removing and stockpiling the devices.

Fifty percent of the contract unit price for temporary impact attenuators will be paid upon satisfactory installation.

Should it be necessary to dismantle, pick up and reinstall attenuation devices during construction, the work of removing and reinstalling the devices will be considered a new installation and paid for at 100 percent of the contract unit bid price.

Fifty percent of the contract unit price will be paid upon final removal.

The Engineer will be the sole judge as to whether devices are to be dismantled, picked up and reinstalled or are to be adjusted or realigned. No additional payment will be made for devices which are adjusted or realigned, the cost being considered as included in the contract unit price paid for Temporary Impact Attenuator “Installation and Removal.”

Measurement and payment for furnishing materials, equipment and labor and repairing attenuation devices that are damaged by the traveling public will be made in accordance with the requirements of Subsection 109.04 of the specifications.

No measurement or direct payment will be made for furnishing replacement parts and repairing devices damaged by other than the traveling public.

701-5.03 Temporary Preformed Markings for Pavement:

The accepted quantities of Temporary Preformed Markings, measured as provided above, will be paid for at the unit bid price for the type specified, which price shall be full compensation for the work, complete in place, including necessary pavement cleaning, and maintaining Types II and III temporary markings in construction work zones. Installation for accepted quantities shall be considered satisfactory when the markings are installed in conformance with the requirements of the plans.

When the type of temporary preformed marking is not specified, the contractor shall furnish Type II.

Additional reimbursement will be made for replacement of Temporary Markings when the contractor is required by the Engineer to install marking materials on distressed pavements or during adverse weather conditions and subsequent failure occurs. Distressed pavement conditions are defined as alligator cracking, bleeding, or spalling of bituminous pavements and spalling of PCC pavements. Adverse weather conditions are defined as any occurrence where application is required at pavement temperatures less than 50 degrees F or when precipitation occurs within 24 hours before application. The Department will pay for the replacement, where failures occur, at the unit bid price for the items. In the event a second failure occurs when markings have been reapplied on distressed pavements or under weather conditions described above, the Engineer shall determine if conditions require primer, alternate methods of marking, or reapplication of Preformed Markings. Preformed markers and markings will be paid for at the unit bid price. Primers or other methods of markings deemed necessary by the Engineer will be paid for in accordance with the provisions of Subsection 109.04 of the specifications.

701-5.04 Blank:

701-5.05 Obliterate Pavement Marking:

Obliterate Striping, measured as provided above, will be paid for at the unit bid price per linear foot, which price shall be full compensation for the work, complete, including furnishing all labor and equipment required and restoring the pavement surface to a condition acceptable to the Engineer.

The accepted quantities of Arrows, Symbols, or Legends obliterated shall be paid for at the unit bid price for each item.

701-5.06 Temporary Pavement Markers and Chip Seal Pavement Markers:

The accepted quantities of Temporary Pavement Markers and Chip Seal Pavement Markers measured as provided above will be paid for at the unit bid price each, which price shall be full compensation for the work, complete in place, as specified herein and as shown on the plans.

701-5.07 Obliterate Pavement Markers:

Obliterate Pavement Markers will be paid for at the unit bid price each, which price shall be full compensation for the work, complete, including adhesive pad.

701-5.08 Temporary Delineators:

The accepted quantities of Temporary Delineators, measured as provided above, will be paid for at the unit bid price each, which price shall be full compensation for the work, complete, including subsequent removal as specified herein and as shown on the plans.

701-5.09 Specialty Signs:

The accepted quantities of Specialty Signs, measured as provided above, will be paid for at the unit bid price per square foot which price shall be full compensation for the work, complete in place, including manufacturing, delivery to the job site, erection and eventual removal. The price paid shall also include the cost of flags, ballasting, mountings, sign stands, and embedded posts as required.

701-5.10 Temporary Removal or Covering of Signs:

No payment will be made for Temporary Removal or Covering of Signs, including maintenance of storage facilities for the signs or sign legends and the maintenance of sign coverings, the cost being considered as included in the price of contract items.

701-6 Basis of Payment for Elements of Work (In Use):

701-6.01 Quantity Variances:

Payment for variances in quantities shall be in accordance with Subsection 104.02 of the specifications, except that, for decreases in quantities, the following items will be considered as major items:

(A) Temporary Concrete Barrier (In-Use);
(B) Barricades; and
(C) Temporary Signs.

701-6.02 Temporary Concrete Barrier (In Use):

The accepted quantities of Temporary Concrete Barrier, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use of the barrier installation(s), including glare screen, and for furnishing all material, equipment and labor and maintaining, realigning and adjusting the barrier installation(s), as specified herein and as shown on the plans. No payment will be made for barrier not in service, such as, barrier in stockpiled configuration awaiting phase construction change.

There will be no payment for each day that the Engineer determines the barrier traffic reflectors are not in good reflective condition, or for each day that the Engineer determines the barrier is out of alignment.

701-6.03 Channelization Devices:

(A) Vertical Panels, Barricades (Type II), Traffic Cones (28-inch), and Tubular Markers:

The accepted quantities of Vertical Panels, Barricades (Type II), Traffic Cones (28-inch), and Tubular Markers, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

Type I barricades which are substituted for Type II barricades in accordance with Subsection 701-2.08 of the specifications shall be paid for at the unit bid price for Type II barricades.

The unit bid price for barricades includes the cost of ballasting as required.

(B) Barricades (Type III) and High-Level Flag Trees:

The accepted quantities of Barricades (Type III) and High-Level Flag Trees, measured as provided above will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

The unit bid price for barricades includes the cost of ballasting and flags, as required.

When signs are to be mounted on Barricades (Type III) or High-Level Flag Trees, the signs will be paid for as Temporary Signs, Section 701-6.04 of the specifications.

(C) Drums:

The accepted quantities of Drums, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

(D) Warning Lights (Types A, B, and C):

The accepted quantities of Warning Lights (Types A, B, and C), measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

(E) Embedded Sign Posts, Portable Sign Stands (Spring-Type or Rigid) and Portable Sign Posts-Barrier Mounted:

The accepted quantities of Embedded Sign Post, Portable Sign Stands (Spring-Type and Rigid) and Portable Sign Posts-Barrier Mounted, measured as provided above will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

The unit bid price for signs includes the cost of ballasting as required.

701-6.04 Temporary Signs:

The accepted quantities of Temporary Signs, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use and maintenance of each device (in-use), including labor and equipment.

The unit bid price for signs includes the cost of flags and ballasting as required.

No separate payment shall be made for speed plates, distance plates, or other minor sign message boards that are attached to a temporary sign, or temporary sign post, as shown on the plans. If additional signs are attached to those shown on the plans or to existing temporary sign installations, payments will be made as additional temporary signs.

701-6.05 Truck-Mounted Attenuators:

The accepted quantities of truck-mounted attenuators or trailer-mounted attenuators, measured as provided above, will be paid for at the unit bid price for truck-mounted attenuators per day of work site protection, which rate shall be full compensation for the work, complete in place, including, but not limited to, furnishing all materials; equipment; attached arrow panel or changeable message board; and labor (including the operator); and maintaining and repairing the truck and truck-mounted attenuator, or trailer-mounted attenuator and host vehicle, as specified herein and on the project plans. No adjustment to the unit bid price for truck-mounted attenuators will be made when trailer-mounted attenuators are provided, such price being considered as full compensation for the work, as specified herein, regardless of which type of attenuator is used to protect the work site. It shall be the contractor's responsibility to replace any damaged or destroyed parts of the truck-mounted attenuator or trailer-mounted attenuator and host vehicle at no additional cost to the Department.

701-6.06 Flashing-Arrow Panels, and Changeable Message Boards:

The accepted quantity of flashing-arrow panels, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the work, complete in place, including furnishing, operating, maintaining, and relocating the panels on the work site, and providing all necessary labor and equipment.

The accepted quantities of changeable message boards, measured as provided above, will be paid for at the unit bid price per day, which price shall be full compensation for the work, complete in place, including incidental grading; furnishing, operating, maintaining, and relocating the boards on the work site; and providing all necessary labor. Signs, sign stands, Type II barricades, or vertical panels and lights that are used to delineate changeable message boards shall be paid for at the respective unit bid prices.

701-6.07 Pilot Services and Flagging Services:

The accepted quantities of pilot vehicles, measured as provided above, will be paid for at the unit bid price for pilot vehicles with driver, which price shall be full compensation for the work, complete in place including, but not limited to, furnishing and maintaining the vehicle and furnishing the driver. Overtime hours for pilot vehicles will be paid for at the unit bid price for pilot vehicle with driver. No additional payment will be made for overtime hours, the cost being considered as included in the unit bid price.

The accepted quantities of flagging services provided by the local enforcement officers and civilian flaggers, measured as provided in Subsection 701-4.04(F) of the specifications, will be paid for at the unit bid price, which price shall be full compensation for the work, complete in place, including all overhead costs and fringe benefits. Overtime hours for local enforcement officers and civilian flaggers will be paid for at the respective unit bid prices. No additional payment will be made for overtime hours, the cost being considered as included in the unit bid price for local enforcement officers and civilian flaggers.

The accepted quantities of flagging services provided by the DPS officers, measured as provided above, will be paid for at the contract unit price per hour, which price shall be full compensation for the work complete in place. If needed, travel time may be paid on a case by case basis, as evaluated by the Engineer in accordance with the requirements of Subsection 104.02 of the specifications.

701-6.08 Temporary Impact Attenuators (In-Use):

The accepted quantities of temporary impact attenuators, measured as provided above, will be paid for at the unit bid price, which price shall be full compensation for the use of the complete attenuating device and

for furnishing all material, equipment and labor for maintaining, realigning and adjusting the attenuator installation, as specified herein and as shown on the plans. No payment will be made for attenuators not in service, such as attenuator stockpiled for replacement parts or awaiting phase construction change.

SECTION 708 WATERBORNE PAVEMENT MARKINGS:

708-1 Description:

The work under this section shall consist of cleaning and preparing the pavement surface, furnishing all materials and applying white or yellow, water-borne, fast-dry or rapid-dry traffic paint, and reflective glass beads at the locations and in accordance with the details shown on the plans, MUTCD, and associated ADOT Supplement, the requirements of these specifications, or as directed by the Engineer.

708-2 Materials:

708-2.01 Pavement Marking Paint:

(A) General:

All material used in the formulation of the pavement marking paint shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

Only waterborne traffic paint that has been reviewed, evaluated, and approved by the ADOT Product Evaluation Program or equal, prior to the bid opening of each respective project, shall be used.

Copies of the most recent version of the Approved Products List (APL) are available on the internet from the ADOT Research Center through its Product Evaluation Program.

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the specifications shall be submitted along with precertification test results from the ADOT Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer.

(1) Waterborne Pavement Marking Paint: Type I (Standard):

Type I (Standard) waterborne pavement marking paint shall be the traffic paint for long line and short line striping, arrows, symbols, and legends. Type I shall be used:

(a) For temporary traffic control;

(b) At the end of the construction work shift if the roadway is open to traffic over an intermediate layer of pavement while the final lift or layer of pavement has not been placed yet;

(c) As a primer on the final lift or layer of pavement 30 days prior to the application of the durable pavement marking materials; and

(d) During Construction on pavement that will not be resurfaced. Two applications of waterborne paint may be used, allowing 30 to 60 days between applications.

Type I paint shall be capable of performing as specified herein when subjected to high traffic volumes and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

(2) Waterborne Pavement Marking Paint: Type II (High-build):

Type II (High-build) waterborne pavement marking paint shall be used for long line and short line striping, arrows, symbols, and legends. Type II shall be used for temporary traffic control that needs to be in place for at least 180 days, and between two construction seasons.

Type II paint shall be capable of performing as specified herein when subjected to two-season projects, high traffic volumes, and severe wear conditions such as repeated crossing, starting, stopping, and turning movements.

(B) Composition Requirements:

The pavement marking paint shall be a ready-mixed, one component, waterborne traffic line paint of the correct color, to be applied to either asphaltic or Portland cement concrete pavement. The composition of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to produce a pigmented waterborne paint containing all the necessary co-solvents, dispersant, wetting agents, preservatives and all other additives, so that the paint shall retain its viscosity, stability and all of the properties as specified herein.

Lead concentrations shall not exceed 0.009 percent by weight (90 ppm) using test method ASTM D3335.

The manufacturer shall certify that the product contains no detectable concentrations of:

Antimony;
Arsenic;
Cadmium;
Mercury;
Chromium, Inorganic;
Chromium, Hexavalent;
Toluene;
Chlorinated solvents;
Hydrolyzable chlorine derivatives;
Ethylene-based glycol ethers and their acetates; and/or
A carcinogen as defined in 29 CFR 1910.1200.

(C) Manufacturing Formulations:

The manufacturer shall formulate the pavement marking paint in a consistent manner and notify the Engineer of any change of formulation. The formulation of the paint shall be determined by the manufacturer. It will be the manufacturer's responsibility to formulate paint which will meet the quantitative and qualitative requirements of this specification. Any change in the formulation of the paint shall be approved by the Engineer.

(D) Quantitative Requirements of Mixed Paints:

Table 708-1		
	White	**Yellow**
Pigment: Percent by weight, ASTM D3723, Allowable variation from the qualifying sample	± 2.0	± 2.0
Non-Volatile Content/Non-Volatile Vehicle: Percent by weight, ASTM D2369, Allowable variation from the qualifying sample	± 2.0	± 2.0
Viscosity: Krebs Units at 77 ± 1 °F, ASTM D562	70 - 85	70 - 85
Weight per Gallon: Pounds per gallon 77 ± 1 °F, ASTM D1475, Allowable variation from the qualifying sample	± 0.3	± 0.3
Vehicle Composition: Vehicle Infrared Spectra, ASTM D2621, Allowable variation from the qualifying sample	None	None
PH: ASTM E70, Allowable variation from the qualifying sample	± 1.0	± 1.0
Fineness of Dispersion: HEGMAN, minimum, ASTM D121	3.0	3.0
Volatile Organic Compounds: Pounds per gallon of paint, maximum, ASTM D3960 according to 7.1.2.	2.1	2.1
Flash Point: Degrees F., minimum, ASTM D93, Method A	100	100
Dry Time to No Pick Up: With no beads: minutes, maximum, ASTM D711	10	10
Dry Through Time: Minutes, ASTM D1640 except no thumb pressure is used when thumb is rotated 90° on paint film	20	20
Flexibility: ASTM D522, Method B: Flexibility shall be tested per ASTM D522, Method B. Draw down the paint to a wet film thickness of 0.005 inches (0.13mm) on a clean bare cold-rolled steel panel. Air-dry for 24 hours at standard conditions then bake for 5 hours at 221 °F ± 3 °F (105 °C ± 2 °C) and finally condition the panel for 30 minutes at standard conditions. When tested as specified the paint film shall not crack, chip, or flake after the test panel is bent over a ½ inch (13 mm) diameter, cylindrical mandrel.	Pass	Pass

(E) Qualitative Requirements:

(1) Color of Yellow Paint:

The color of the yellow paint shall closely match Federal Standard 595b, Color No. 33538.

(2) Dry Opacity:

Dry opacity for the paint will be determined using a black-white Leneta Chart, Form 2C Opacity, or equal, and a calibrated reflectance meter capable of determining reflectance to the nearest 1 percent. Using a 10 mil gap doctor blade, a film of paint is drawn down, covering both black and white portions of the chart on a vacuum plate. The film shall be allowed to dry 24 hours. After calibrating the meter according to the manufacturer's instructions, measure the reflectance over the white and black portions according to the manufacturer's instructions. Dry Opacity for both white and yellow paint shall be at least 0.90.

(3) Yellowness Index:

Yellowness Index for white paint will be determined as described for dry opacity, only use a 15-mil gap doctor blade to draw down the paint. Calculate the Yellowness Index in accordance with ASTM E313. Yellowness Index for the white paint shall be a maximum of 10.

(4) Reflectance:

Reflectance for both white and yellow paint will be determined using the same 15-mil draw-down film as for the Yellowness Index. For white paint the same sample may be utilized for both the Yellowness Index and Reflectance. Measure the reflectance of the paint film using the reflectance meter according to the manufacturer's instructions. Reflectance for the white paint shall be at least 85. Reflectance for the yellow paint may range from 42 to 59, inclusive.

(5) UV Color Durability:

UV Color Durability shall be determined using a QUV Weatherometer, with Ultra Violet Light and Condensate Exposure according to ASTM G154, for 300 hours total. The repeating cycle shall be four hours UV exposure at 140 degrees F (60 degrees C) followed by four hours condensate exposure at 104 degrees F (40 degrees C). After 300 hours of exposure, the Yellowness Index for white paint shall not exceed 12, and yellow paint shall closely match Federal Standard 595b, Color No. 33538.

(6) Static Heat Stability:

To determine static heat stability for the paint, place 1 pint of paint in a sealed can and heat in an air circulation oven at 120 ± 1 degrees F (49 degrees C) for a period of one week. Remove the paint from the oven and check the viscosity in Krebs Units at 77 ± 1 degrees F (25 degrees C) according to ASTM D562. The viscosity measured shall be in the range from 68 to 90 Krebs Units, inclusive. Also, check for any signs of instability.

(7) Heat-Shear Stability:

To determine heat-shear stability for the paint, 1 pint of the paint is sheared in a Waring Blender at high speed to 150 degrees F (66 degrees C). The blender should have a tight fitting lid taped onto it to minimize volatile loss. When the paint reaches 150 degrees F (66 degrees C), stop the blender, immediately pour the paint into a sample can, and apply a cover to seal the can. Let the paint cool overnight and examine for jelling or other signs of instability. Measure viscosity in Krebs Units at 77 ± 1 degrees F (25 degrees C), according to ASTM D562. The viscosity measured shall be in the range from 68 to 95 Krebs Units, inclusive. If not within the upper limit, run total solids on the sheared paint and adjust solids, if necessary, by adding water to reach the original solids content. If the solids content required adjustment, again check the viscosity of the paint. The viscosity shall be in the range from 68 to 95 Krebs Units, inclusive.

(8) Scrub Resistance:

Scrub Resistance will be determined according to ASTM D2486. Use an appropriate doctor blade to provide a dry film thickness of 3 to 4 mils. Allow the paint to cure for 24 hours. Perform the scrub resistance test at 77 ± 1 degrees F (25 degrees C) and 50 ± 5 percent humidity. Record the number of cycles to remove the paint film. The number of cycles recorded shall be at least 800.

(9) Spraying Properties:

The paint shall be applied, in the field, at a 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II. Both Type I and Type II paint shall show the following properties at ambient temperatures of 50 to 100 degrees F (10 to 38 degrees C) with paint spray temperature of 150 degrees F (66 degrees C), maximum.

For Type I paint, 6 to 10 pounds of Type 1 beads shall be post-applied per gallon of paint. For Type II paint, 10 to 12 pounds of Type 3 beads shall be post-applied per gallon of paint. Beads shall conform to subsection 708-2.02 of the specifications.

(a) For rapid-dry paint applied in a mobile operation and not protected by temporary traffic control, dry to a

no-track condition in 60 seconds or less when the line is crossed over in a passing maneuver with a standard-sized automobile.

(b) For fast-dry paint applied within an established work zone behind temporary traffic control, dry to a no-track condition in five minutes or less when the line is crossed over in a passing maneuver with a standard-sized automobile.

(c) Produce a clean-cut, smooth line with no overspray or puddling.

(d) Paint immediately after application shall accept glass beads so that the spheres shall be embedded into the paint film to a depth of 50 percent of their diameter.

(e) Paint when heated to the temperature necessary to obtain the specified dry time, shall show no evidence of instability such as viscosity increase, jelling, or poor spray application.

(10) Freeze-Thaw Properties:

The paint viscosity or consistency shall not change significantly when the paint is tested for resistance to five cycles of freeze-thaw according to ASTM D2243.

(11) Road Service Rating:

Test stripes of the paint shall be applied transversely across the road, 4 inches in width and approximately 12 feet long at a location approved by the Engineer.

Wet film thickness of the test stripes shall be approximately 15 mils for Type I and 25 mils for Type II paint as determined according to ASTM D4414 and ASTM D713 prior to test stripe application. To aid in obtaining the correct film thickness, a length of roofing paper placed by the side of the road can be used. Place a rigid metal test panel on the roofing paper in the path of a test line. Immediately after the test line is applied by the striper, measure the wet film thickness. If not satisfactory, adjust the spray pressure and repeat until the target wet film thickness is attained. It is important that no glass beads be present that would give a false wet film thickness. When the wet film thickness is correct, apply a test line across a tared metal test panel. After this, apply another test line across a different tared metal test panel, this time also adding the beads. These samples are necessary to determine the initial bead retention.

Glass beads conforming to the requirements of Subsection 708-2.02 of the specifications (moisture proof type) shall be applied after the paint

has been applied, but during the same striping operation at a rate such that the initial bead retention on the test line is at least 6 pounds of beads per gallon of wet paint for Type I paint and at least 10 pounds of beads per gallon of wet paint Type II. The initial bead retention will be determined analytically by the ADOT Construction and Materials Group concurrently with the determination of the dry paint thickness utilizing tared metal test panels. The paint shall accept the glass beads so that the spheres are embedded into the paint film to a depth of 50 percent of their diameter. Test stripes will be observed for a period of 180 days from date of application. Paints will be evaluated for wear according to ASTM D913.

After 180 days of service, on a visual rating scale of 0 to 100 percent, paints shall have a rating of 90 percent or better to be acceptable. All ratings will be taken in the wheel track area. Glass beads shall show no more than a 30 percent loss after 180 days of test. This will be determined by taking close-up, before and after photographs of the paint film and by count determining the average bead loss.

The road service test may be waived at the option of the Engineer or evaluated for a period of time less than 180 days.

(12) Workmanship:

Paint shall be free from foreign materials, such as dirt, sand, fibers from bags, or other material capable of clogging screens, valves, pumps, and other equipment used in a paint striping apparatus.

The paint pigment shall be well ground and properly dispersed in the vehicle. The pigment shall not cake or thicken in the container, and shall not become granular or curdled. Any settlement of pigment in the paint shall result in a thoroughly wetted, soft mass permitting the complete and easy vertical penetration of a paddle. Settled pigment shall be easily redispersed, with minimum resistance to the sidewise manual motion of a paddle across the bottom of the container, to form a smooth uniform product of the proper consistency. If the paint cannot be easily redispersed, due to excessive pigment settlement as described above or due to any other cause, the paint shall be considered unfit for use.

The paint shall retain all specified properties under normal storage conditions for 12 months after acceptance and delivery. The contractor shall be responsible for all costs and transportation charges incurred in replacing paint that is unfit for use. The properties of any replacement paint, as specified herein, shall remain satisfactory for eight months from the date of acceptance and delivery.

(F) Manufacturing Requirements:

(1) Inspection:

The manufacturer of the paint shall furnish the Engineer free access to all parts of the plant involved in the paint manufacture, and shall furnish every reasonable facility for sampling both the paint and the raw materials during the process of manufacturing.

All materials used in formulation shall meet the requirements herein specified. Any materials not specifically covered shall meet the approval of the Engineer.

All manufactured paint shall be prepared at the factory ready for application.

When paint is shipped to a distributor or paint applicator who will store the paint prior to its use, the distributor or paint applicator shall furnish the Engineer free access to all parts of the facility where paint is stored and shall furnish every reasonable facility for sampling the paint.

Paint may also be sampled at the place of storage either at a warehouse or on the site prior to application of the paint. Application of the paint will not be permitted until the paint has been approved by the Engineer. It is the contractor's responsibility to notify the Engineer at least 14 working days prior to any traffic painting operation and to allow access at that time for paint sampling at the storage location.

At least one paint sample shall be obtained from each lot of paint.

Check-samples of finished paint while being applied will be taken at intervals as determined by the Engineer.

(2) Precertification of Pavement Marking Paint :

All tests will be conducted as specified herein.

(a) General:

As described in Subsection 708-2.01(A) of the specifications, the contractor shall provide to the Engineer a Certificate of Compliance from the manufacturer and test results from the Central Laboratory for samples from each batch of material obtained for precertification at the production line of the manufacturer. If the material fails the precertification testing by Central Laboratory, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects. If the material fails the precertification testing by the Central Laboratory, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects.

(b) Precertification Sampling:

Sampling of pavement marking paint for precertification shall be for an active ADOT project. The manufacturer shall provide a 1 pint or 1 quart sample in a metal can of pavement marking paint from each batch of production that will be shipped to an ADOT project. The manufacturer shall ship the composite sample to the Central Laboratory at 1221 N. 21st Avenue Phoenix, AZ 85009, along with a Certificate of Analysis, for precertification testing. The manufacturer shall identify the pavement marking paint with the batch number, the batch quantity, the batch date, the manufacturer's name, and the product name. Such identification shall be shown on the side of the container.

(c) Central Laboratory Precertification Testing Responsibilities:

The Central Laboratory is responsible for coordinating precertification for each batch of pavement marking paint that is to be precertified.

For precertification purposes, pavement marking paint at a minimum will be tested for color, total non-volatile percentage, pigment, non-volatile vehicle, weight per gallon, viscosity, dry time, and dry opacity in accordance with the procedures described in Subsection 708-2.01(D) and 708-2.01(E) of the specifications.

Upon completion of testing, the Central Laboratory will provide the manufacturer with a copy of the test results for each batch tested. Typically, testing will be completed within five working days of receipt of the paint sample. If the material fails the precertification testing, the manufacturer shall not supply any pavement marking paint represented by the failing test results to ADOT projects.

Evidence of adulteration or improper formulation shall be cause for rejection.

(d) Packaging:

All shipping containers for paint shall comply with the Department of Transportation Code of Federal Regulations, Hazardous Materials and Regulation Board, Reference 49 CFR. The container and lids shall be lined with a suitable coating so as to prevent attack by the paint or by agents in the air space above the paint. The lining shall not come off the container or lid as skins.

Containers shall be colored white, including lids, and containers shall have an identifying band of the appropriate color around and within the top one third of the container.

All containers shall be properly sealed with suitable gaskets, shall show no evidence of leakage, and shall remain in satisfactory condition for a period of 12 months after delivery to a distributor or paint applicator.

The contractor shall be responsible for all costs and transportation charges incurred in replacing paint and containers.

(e) Labeling:

All containers of paint shall be labeled showing the manufacturer's name, date of manufacture, paint color, product code, manufacturer's batch number, and quantity or weight of paint on both the side of the container and also the lid. Containers shall be clearly labeled Rapid Dry or Fast Dry lead-free Waterborne Type I or Type II Traffic Paints.

All containers of paint shall be labeled to indicate that the contents fully comply with all rules and regulations concerning air pollution control in the State of Arizona, Maricopa County.

The manufacturer of the paint shall be responsible for proper shipping labels with reference to whether the contents are toxic, corrosive, flammable, etc., as outlined in the U.S. Department of Transportation, Hazardous Materials Regulations, Reference 49 CFR.

(f) Unused Paint:

Disposal of unused quantities of traffic paint shall be the responsibility of the contractor and shall meet all applicable Federal regulations for waste disposal. Paint which is saved to be used later shall be packaged as specified and shipped to a storage location. Unused paint shall be identified on the container. Unused paint may be utilized on a future project provided the paint still conforms to all specifications contained herein.

708-2.02 Reflective Glass Beads (Spheres):

(A) General:

The term "glass bead" shall be synonymous with the term "glass sphere" as used herein.

The beads shall be manufactured from glass of a composition designated to be highly resistant to traffic wear and to the effects of weathering.

The glass beads shall be moisture-proof; contain less than 0.25 percent moisture by weight; and be free of trash, dirt, or other deleterious materials.

Beads shall be essentially free of sharp angular particles showing milkiness or surface scoring or scratching. Beads shall be water white in color.

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the specifications shall be submitted.

(B) Physical Requirements:

(1) Gradation:

The gradation for the drop-on beads shall conform to AASHTO M 247 Type 1 and Type 3.

(2) Roundness:

Glass beads shall conform to AASHTO M 247, Type 1 and Type 3. Beads retained on any screen specified in the gradation requirements shall contain at least 80 percent true spheres.

(3) Index of Refraction:

Glass beads shall conform to AASHTO M 247, Type 1 and Type 3.

(4) Specific Gravity:

The specific gravity of the beads shall be in the range 2.40 to 2.60 when tested in accordance with the following procedures:

Place 100 grams in an oven at 230 degrees F (110 degrees C) for one hour.

Remove beads and place in a desiccator until the sample is cool.

Remove approximately 60 grams of beads from the desiccator and weigh the sample accurately.

Pour the beads slowly into a clean 100-milliliter graduated cylinder containing 50 milliliters of isopropyl alcohol. Make certain that air is not entrapped among the beads.

The total volume reading on the graduated cylinder, minus 50, will give the volume of the beads. Calculate the specific gravity as follows:

$$\text{Specific Gravity} = \frac{\text{Weight of the sample}}{\text{Volume of the sample}}$$

(5) Chemical Stability:

Beads which show any tendency toward decomposition, including surface etching, when exposed to atmospheric conditions, moisture, dilute acids, or alkalis or paint film constituents, may be required to demonstrate satisfactory reflectance behavior, prior to acceptance, under such tests as may be prescribed.

(6) Hazardous Constituents:

Each lot shall be tested for heavy metal concentration as specified in the following table, tested by an independent laboratory approved by the Engineer, using EPA Method 3052 and EPA Method 6010B.

Table 708-2	
Heavy Metal	**Concentration**
Arsenic	< 75 ppm
Antimony	< 75 ppm
Lead	< 0.009% by weight (90 ppm)

The manufacturer shall certify that the product contains no detectable concentrations of other hazardous constituents, including:

Cadmium;
Barium;
Mercury;
Chromium, Inorganic;
Chromium, Hexavalent; and/or
A carcinogen as defined in 29 CFR 1910.1200.

(C) Bead Coating:

All glass beads shall have a moisture-proof adhesion enhancing overlay, consisting of a properly formulated material which prevents bead clumping and clogging and promotes proper embedment and adhesion to the applied paint. Water repellent material applied during the process of bead manufacture. The beads so treated shall not absorb moisture in storage and shall remain free of clusters and lumps and shall flow freely from dispensing and testing equipment.

The beads shall conform to AASHTO T 346.

(D) Acceptance of Glass Beads:

(1) Preapproval Sampling of Glass Beads:

Sampling of glass beads shall be for an active ADOT project. For preapproval of glass beads, the Structural Materials Testing Section will obtain a sample from each lot at the striping contractor's yard as requested by the striping contractor. At least a 1 gallon sample taken from a "super sack" shall be sampled for each lot. When sampling a lot consisting of multiple super sacks, no less than four super sacks shall be sampled, and the samples combined to make one sample. A field sample shall consist of at least a 1 gallon sample taken from the striping truck for each lot. Each field sample shall be identified with the manufacturer's lot number. When sampling from the striping truck, the sample shall be obtained from the drop nozzle after 500 feet of striping has been placed. Unless the inspector suspects contamination of the glass beads, no field samples will be required for preapproved lots.

(2) Preapproval Testing of Glass Beads:

Glass beads will be tested in accordance with Subsection 708-2.02(B) and 708-2.02(C) of the specifications for gradation, roundness, refraction, and moisture resistance coating. For each lot of glass beads that is to be preapproved, the Structural Materials Testing Section will perform the sampling and testing. A test report with the lot number will be issued for each project the glass beads are to be used for. Upon completion of testing for preapproval, the Structural Materials Testing Section will provide the striping contractor with a copy of the test results.

For glass beads that have not been preapproved, the Structural Materials Testing Section will test field samples submitted by the project. The issuance of a test report and the maintaining of a log of all lots tested will be completed as described for glass beads tested for preapproval. The Structural Materials Testing Section will immediately notify the project of any failing test results.

708-3 Construction Requirements:

708-3.01 Equipment:

The traffic paint and beads shall be placed on the pavement by a spray-type, self-propelled pavement marking machine except that temporary striping during construction may be placed with other equipment designed for application of paint and beads.

The application equipment to be used on roadway installation shall have, as a minimum, the following characteristic and/or apparatus:

(A) Capable of applying clear-cut lines of the width specified on the project plans;

(B) Equipped with a mechanical device capable of placing a broken reflectorized line with a 10-foot painted segment and a 30-foot gap; and

(C) Equipped with an air-operated glass bead drop-in dispenser controlled by the spray gun mechanism.

A glass bead dispenser which is capable of placing the glass beads into the paint line as the paint is applied to the pavement shall be utilized. This dispenser shall provide satisfactory marking and delineation.

708-3.02 Application:

Pavement markings shall be applied when the pavement surface is dry and the weather is not foggy, rainy, or otherwise adverse to the application of markings. The surface shall be free from excess asphalt or other deleterious substances before traffic paint, beads or primer are

applied. The contractor shall remove dirt, debris, grease, oil, rocks or chips from the pavement surface before applying markings. The method of cleaning the pavement surface and removal of detrimental material is subject to approval by the Engineer and shall include sweeping and the use of high-pressure air spray. The placing of traffic markings shall be done only by personnel who are experienced in this work.

Painting shall not be performed when the atmospheric temperature is below 50 degrees F (10 degrees C) when using waterborne paint, nor when it can be anticipated that the atmospheric temperature will drop below 50 degrees F (10 degrees C) temperature during the drying period. Waterborne paints shall not be applied if rain is expected within one hour of its application, unless otherwise approved by the Engineer. Waterborne paint shall not be heated to a temperature greater than 150 degrees F (66 degrees C) to accelerate drying.

The volume of paint in place shall be determined by measuring the paint tank with a calibrated rod. At the discretion of the Engineer, if the striping machine is equipped with air-atomized spray units (not airless) and paint gauges, the volume of paint may be determined by utilizing said gauges.

The quantity of glass reflectorizing beads in place shall be determined by measuring the glass reflectorizing bead tank with a calibrated rod.

The contractor shall provide the necessary personnel and equipment to divert traffic from the installation area where the work is in progress and during drying time when, in the opinion of the Engineer, such diversion of traffic is necessary.

Painted markings placed below the final surface shall be placed immediately after a change in long-term traffic patterns/configurations, when the need arises, or as directed by the Engineer. On intermediate lifts of overlay projects, painted markings shall consist of at least 4-inch wide by 4-foot long strips of reflective material, placed at 40 foot intervals. In situations involving severe degree of curvature, the Engineer may direct that the length and spacing be adjusted to 2 feet and 20 feet, respectively. These requirements apply to white lane lines separating traffic moving in the same direction and to yellow center lines for two-lane, two-way roadways in areas where passing is permitted. Painted markings shall be placed on each subsequent pavement course.

Curing compound shall be removed from new concrete surfaces before the placement of painted markings.

Tolerances for Placing Paint, Beads, and Primer:

(A) The length of painted segment and gap shall not vary more than 6 inches in a 40-foot cycle;

(B) The finished line shall be smooth, aesthetically acceptable and free from undue waviness;

(C) Painted lines shall be 4, 8, or 12 inches wide as shown on the plans with a tolerance of ± 1/8 inch and shall be placed at a minimum rate of 16 gallons per mile for a solid 4-inch line and 4 gallons per mile for a broken 4-inch line, based on a 10-foot stripe and a 30-foot gap (40-foot cycle aggregate);

(D) Glass reflectorizing beads shall be applied on the wet paint. For Type I paint, 6 to 10 pounds of Type 1 beads shall be post-applied per gallon of paint. And, For Type II paint, 10 to 12 pounds of Type 3 beads shall be post-applied per gallon of paint; and

(E) Wet thickness shall not be less than 15 mils wet film thickness for Type I paint and 25 mils wet film thickness for Type II, unless otherwise shown on the plans.

708-4 Method of Measurement:

Pavement marking paint will be measured by the linear foot along the centerline of the pavement stripe. Skips in dashed lines will not be included in the measurement. Length of pavement markings will be based on a 4-inch wide stripe. Measurement for striping with a plan width greater or less than the basic 4 inches as shown on the plans or directed by the Engineer will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches)} \times \text{Linear Feet}}{4 \text{ (inches)}}$$

Symbols and legends will be measured by each unit applied. Each legend, regardless of the number of letters, will be considered as a single unit.

708-5 Basis of Payment:

Pavement striping of the type specified, measured as provided above, will be paid for at the contract price per linear foot for the total length of painted line applied to the nearest foot, which price shall be full compensation for the work, complete in place, including glass beads, as described and specified herein and on the project plans.

Pavement symbols and legends measured as provided above, will be paid for at the contract price for each painted symbol or legend, which price shall be full compensation for the work, complete in place, including glass beads, as described and specified herein and on the project plans.

SECTION 804 TOPSOIL:

804-1 Description:

The work under this section shall consist of furnishing, hauling and placing topsoil in accordance with the details shown on the project plans and the requirements of these specifications.

804-2 Materials:

When a source of topsoil is not designated, the contractor shall furnish a source in accordance with the requirements of Section 1001 of the specifications. Topsoil from sources furnished by the contractor shall conform to the following requirements:

Prior to hauling any topsoil to the project site, the contractor shall furnish a written soil analysis, prepared by a laboratory approved by the Engineer, for each source of topsoil proposed for use. The soil analysis shall indicate the pH, soluble salts, percent calcium carbonate, exchangeable sodium in percent and parts per million, plasticity index and size gradation. A minimum of three samples per each 10,000 cubic yards, with at least three samples per source, shall be tested. All tests shall be performed in accordance with the following requirements and

test procedures listed in Table 804-1. At the contractor's option, the Engineer will test these topsoil samples. The contractor shall bear the expense of any topsoil testing from proposed sources.

Topsoil shall be fertile, friable soil obtained from well drained arable land which has or is producing healthy crops, grasses or other vegetation. It shall be free draining, non-toxic and capable of sustaining healthy plant growth.

Topsoil shall be reasonably free of subsoil, refuse, roots, heavy clay, clods, noxious weed seeds, phytotoxic materials, coarse sand, large rocks, sticks, brush, litter and other deleterious substances.

A written soil analysis shall be submitted to the Engineer for each source of topsoil proposed for use. The Engineer's approval shall be obtained prior to delivery of topsoil to the project site from each source.

For acceptance purposes, each approximate 20,000 cubic yards of topsoil material delivered from a given source to the project site shall be considered a lot. For each lot of topsoil, six representative samples shall be taken at random locations designated by the Engineer. Topsoil shall be sampled after final placement. Each source of topsoil shall be tested separately. The samples from each lot shall be tested by the Engineer for pH, soluble salts, calcium carbonate, exchangeable sodium in percentage and parts per million, P.I., and gradation in accordance with the test procedures listed in Table 804-1.

The average test result obtained for each characteristic from each lot shall meet the following requirements.

TABLE 804-1

Characteristics	Test Method	Requirement Average of 6 Samples
pH	Arizona Test Method 237	6.0 - 8.3
Soluble Salts: (PPM)	Arizona Test Method 237	2000 Maximum
Calcium Carbonate:	Arizona Test Method 732	8% Maximum
Exchangeable Sodium:	Arizona Test Method 729	5% Maximum
Exchangeable Sodium: (PPM)	Arizona Test Method 729	300 Maximum
P.I.	AASHTO T 90	5 - 20
Gradation: 2 inch 1/2 inch No. 40	Arizona Test Method 201	% Passing 100 85 - 100 35 - 100

If the average test result for a lot fails to meet all the specifications listed above, the material from that lot shall be rejected. In lieu of removal and replacement, the contractor may propose for the Engineer's consideration a method of treatment of the in-place material to obtain specification compliance. Provided the Engineer approves, the topsoil shall be treated at no additional cost to the Department. The lot shall then be resampled and tested for specification compliance by the Engineer.

If the pH of the topsoil for a lot exceeds 8.3, the topsoil shall either be removed and replaced, or be treated as provided for in the preceding paragraph. Any treatment for pH shall be sufficient to obtain an average pH between 6.0 and 8.0, inclusive. The treatment for pH shall follow the recommendations of a recognized soil analyst and shall be subject to the approval of the Engineer. Any treatment for pH shall be at no additional cost to the Department. Additional acceptance testing after treatment for pH will not be required.

804-3 Construction Requirements:

Topsoil shall be spread uniformly on the designated areas to the depths or contours shown on the plans. The contractor shall avoid over-compaction in spreading and shaping operations. Scarification shall be required for over-compacted areas and haul roads. When topsoil is placed over subgrade material as plating, the subgrade shall be scarified or disked to a 6-inch depth prior to placement of the topsoil.

804-4 Method of Measurement:

Topsoil will be measured by the cubic yard.

Topsoil will be measured in its final position, and the volume will be computed by the average end area method or by other methods approved by the Engineer.

804-5 Basis of Payment:

The accepted quantities of topsoil, measured as provided above, will be paid for at the contract unit price per cubic yard, complete in place.

SECTION 805 SEEDING:

805-1 Description:

The work under this section shall consist of furnishing all materials, preparing the soil and applying seed to all areas designated on the project plans or established by the Engineer. Seeding shall be Class I, Class II or Class III, and shall be performed in accordance with the project plans and requirements of these specifications.

805-2 Materials:

805-2.01 General:

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the specifications shall be submitted.

805-2.02 Seed:

The species, strain or origin of seed shall be as designated in the Special Provisions.

No substitution of species, strain or origin of seed will be allowed unless evidence is submitted in writing by the contractor to the Engineer showing that the specified materials are not reasonably available during the contract period. The substitution of species, strains or origins shall be made only with the written approval of the Engineer, prior to making said substitution.

The seed shall be delivered to the project site in standard, sealed, undamaged containers. Each container shall be labeled in accordance with A.R.S. and the U.S. Department of Agriculture rules and regulations under the Federal Seed Act. Labels shall indicate the variety or strain of seed, the percentage of germination, purity and weed content, and the date of analysis which shall not be more than nine months prior to the delivery date.

Legume seed shall be inoculated with appropriate bacteria cultures approved by the Engineer, in accordance with the culture manufacturers' instructions.

805-2.03 Mulch:

(A) General:

The type and application rate of mulch shall be as specified in the Special Provisions.

(B) Manure:

Manure shall be steer manure that has been well composted and unleached, and which has been collected from cattle feeder operations. Manure shall be free of sticks, stones, earth, weed seed, substances injurious or toxic to plant growth and visible amounts of under composted straw or bedding material. Manure shall not contain lumps or any foreign substance that will not pass a 1/2-inch screen and, when specified for lawn use, the material shall be ground or screened so as to pass a 1/4-inch screen.

(C) Peat Humus:

Peat humus shall be natural domestic peat of peat humus from fresh water saturated areas, consisting of sedge, sphagnum or reed peat and shall be of such physical condition that it will pass through a 1/2-inch screen. The humus shall be free of sticks, stones, roots and other objectionable materials.

Peat humus shall have a pH value between 4.0 and 7.5, inclusive, and the minimum organic content shall be 85 percent of the dry weight. The ash content, as determined by igniting a 5 gram sample for 20 hours at a temperature of 900 degrees F, shall not exceed 25 percent by weight.

Peat humus shall be furnished in undamaged commercial bales in an air-dry condition.

(D) Wood Cellulose Fibers:

Natural wood cellulose fiber shall have the property of dispersing readily in water and shall have no toxic effect when combined with seed or other materials. A colored dye which is noninjurious to plant growth may be used. Wood cellulose fiber shall be delivered in undamaged, labeled containers bearing the name of the manufacturer and showing the air-dry water content.

(E) Straw:

Straw shall be from crops of current season as approved by the Engineer and shall be free of noxious weeds, mold or other objectionable material. Straw mulch shall be in an air-dry condition and suitable for placing with mulch blower equipment.

805-2.04 Water:

Water shall be free of oil, acid, salts or other substances which are harmful to plants. The source shall be as approved by the Engineer prior to use.

805-2.05 Tacking Agent:

Tacking agent shall be as specified in the Special Provisions.

805-2.06 Chemical Fertilizer:

Chemical fertilizer shall be a standard commercial fertilizer conforming to the analysis and in the physical form specified in the Special Provisions. Chemical fertilizer shall be furnished in standard containers or bags with the name, weight and guaranteed analysis of the contents clearly marked. When a mixed fertilizer is specified, such as 24-18-2, the first number shall represent the minimum percent of soluble nitrogen,

the second number shall represent the minimum percent of available phosphoric acid and the third number shall represent the minimum percent of water soluble potash.

805-3 Construction Requirements:

805-3.01 General:

Seed shall be of the class and variety specified, and shall be applied at the rate specified in the Special Provisions.

The contractor shall notify the Engineer at least two days prior to commencing seeding operations.

Bermuda seed shall be planted only at times when the daytime atmospheric temperatures are consistently above 90 degrees F and the nighttime atmospheric temperatures are consistently above 60 degrees F.

Seeding operations shall not be performed when wind would prevent uniform application of materials or would carry seeding materials into areas not designated to be seeded.

Preparation of areas for seeding shall be as specified herein and in the Special Provisions.

The equipment and methods used to distribute seeding materials shall be such as to provide an even and uniform application of seed, mulch and/or other materials at the specified rates.

Unless specified otherwise in the Special Provisions, seeding operations shall not be performed on undisturbed soil outside the clearing and grubbing limits of the project or on steep rock cuts.

805-3.02 Classes of Seeding:

(A) Seeding (Class I):

Seeding (Class I) shall consist of furnishing and planting lawn seed.

Immediately before seeding, the surface area shall be raked or otherwise loosened to obtain a smooth friable surface free of earth clods, humps and depressions. Loose stones having a dimension greater than 1 inch and debris brought to the surface during cultivation shall be removed and disposed of by the contractor in a manner approved by the Engineer.

Where indicated on the project plans or specified in the Special Provisions, topsoil shall be placed and allowed to settle for at least one week prior to seeding. The topsoil shall be thoroughly watered at least twice during the settlement period.

Seed shall be uniformly applied in two directions at right angles to each other with one-half the specified application rate applied in each direction.

Immediately after seeding, the area shall be uniformly covered with screened manure at the rate of 1 cubic yard per 1,000 square feet and then watered until the ground is wet to a minimum depth of 2 inches.

Hydroseeding (hydraulic seeding), using 1,500 pounds of wood cellulose fiber per acre, will be an acceptable alternate for planting and mulching Seeding (Class I).

Machines used for hydroseeding shall be approved types capable of continuous agitation of the slurry mixture during the seeding operation. Pump pressure shall be such as to maintain a continuous nonfluctuating spray capable of reaching the extremities of the seeding area with the pump unit located on the roadbed. The sprayer shall be equipped to use the proper type of nozzles to obtain a uniform application on the various slopes at the distance to be covered.

The seed, fertilizer, mulch, tacking agent (when required) and water shall be combined in the proportions of the various materials as provided in the Special Provisions and allowed to mix a minimum of five minutes prior to starting the application of the slurry. Seed shall be applied within 30 minutes after mixing with water.

Hydroseeding which is deposited on adjacent trees and shrubs, roadways, in drain ditches, on structures and upon any areas where seeding is not specified or which is placed in excessive depths on seeding areas shall be removed.

Seeding areas flooded or eroded as a result of irrigation shall be repaired, reseeded and refertilized by the contractor, at no expense to the Department.

(B) Seeding (Class II):

Seeding (Class II) shall consist of furnishing and planting range grass seed, flower seed and/or shrub seed, including mulch.

Where equipment can operate, the area to be seeded shall be prepared by disking, harrowing or by other approved methods of loosening the surface soil to the depth specified in the Special Provisions. On slopes too steep for equipment to operate, the area shall be prepared by hand raking to the specified depth. On sloping areas, all disking, harrowing and raking shall be directional along the contours of the areas involved. Loose stones having a dimension greater than 4 inches which are brought to the surface during cultivation shall be removed and disposed of in an approved manner prior to grading and seeding. All areas which are eroded shall be restored to the specified condition, grade and slope as directed prior to seeding.

On cut and fill slopes the operations shall be conducted in such a manner as to form minor ridges thereon to assist in retarding erosion and favor germination of the seed.

Care shall be taken during the seeding operations to prevent damage to existing trees and shrubs in the seeding area in accordance with the requirements of Subsection 107.11 of the specifications. Seed shall be drilled, broadcast or otherwise planted in the manner and at the rate specified in the Special Provisions.

The type of mulch, and the manner and rate of application shall be as specified in the Special Provisions.

Mulch material which is placed upon trees and shrubs, roadways, structures and upon any areas where mulching is not specified or which is placed in excessive depths on mulching areas shall be removed as directed. Mulch materials which are deposited in a matted condition shall be loosened and uniformly spread, to the specified depth, over the mulching areas.

During seeding and mulching operations, care shall be exercised to prevent drift and displacement of materials. Any unevenness in materials shall be immediately corrected by the contractor.

Mulch shall be immediately affixed by crimping and tacking after application. The Engineer shall determine which areas are not conducive to anchoring by crimping and will direct the contractor to anchor such mulch by tacking only. No mulch shall be applied to seeding areas which can not be crimped and/or tacked by the end of each day. Any drifting or displacement of mulch before crimping and/or tacking shall be corrected by the contractor, at no additional cost to the Department.

If a tacking agent is specified in order to bind the mulch in place, the type, rate and manner of application shall be as specified in the Special Provisions. Prior to the application of a tacking agent, protective covering shall be placed on all structures and objects where stains would be objectionable. All necessary precautions shall be taken to protect the traveling public and vehicles from damage due to drifting spray.

Unless otherwise specified in the Special Provisions, Class II seeding areas shall not be watered after planting.

(C) Seeding (Class III):

Seeding (Class III) shall consist of furnishing and planting range grass seed, flower seed and/or shrub seed, all without mulching.

Seeding (Class III) shall conform to the requirements specified under Subsection 805-3.02(B) of the specifications, except that mulching will not be required.

Unless otherwise specified in the Special Provisions, Class III seeded areas shall not be watered after planting.

805-3.03 Preservation of Seeded Areas:

The contractor shall protect seeded areas from damage by traffic or construction equipment. Surfaces which are eroded or otherwise damaged following seeding and prior to final acceptance shall be repaired by regrading, reseeding and remulching as directed by the Engineer.

805-4 Method of Measurement:

Seeding (Class I) will be measured by the square foot of ground surface measured to the nearest 1,000 square feet seeded or as a single complete unit of work.

Seeding (Class II) and Seeding (Class III) will be measured by the acre of ground surface seeded or as a single complete unit of work.

805-5 Basis of Payment:

The accepted quantities of seeding, measured as provided above, will be paid for at the contract price for the pay unit specified in the bidding schedule, complete in place.

No direct measurement or payment will be made for the preservation or repairs of seeded areas.

SECTION 810 EROSION CONTROL AND POLLUTION PREVENTION:

810-1 Description:

The work under this section shall include furnishing, installing, maintaining, removing and disposing of temporary erosion control measures such as silt fences, check dams, straw barriers, and other erosion control devices or methods as shown in the Storm Water Pollution Prevention Plan (SWPPP) and in the Special Provisions.

The work shall also include furnishing, installing, and maintaining permanent erosion control measures such as pipe inlet and outlet protection, cut and fill slope transitions, headwall and wingwall treatments, and other permanent erosion control devices or methods as shown in the SWPPP.

810-1.01 Erosion Controls:

Erosion controls, both temporary and permanent, shall be installed in accordance with phasing provisions in the approved SWPPP and coordinated with the related construction.

All work specified in this subsection will be temporary for use during construction, unless designated otherwise.

The contractor shall be responsible for maintaining all erosion and pollution control devices in proper functioning condition at all times.

When deficiencies in the erosion control devices or other elements of work listed herein are noted by inspection or other observation, specified corrections shall be made by the contractor by the end of the day or work shift, or as directed by the Engineer.

Work specified herein which is lost, destroyed, or deemed unacceptable by the Engineer as a result of the contractor's operations shall be replaced by the contractor at no additional cost to the Department. Work specified herein which is lost or destroyed as a result of natural events, such as excessive rainfall, shall be replaced by the contractor and be paid for in accordance with the requirements of Subsection 109.04 of the specifications.

In cases of serious or willful disregard for the protection of the waters of the U.S. and/or natural surroundings by the contractor, the Engineer will immediately notify the contractor of such non-compliance. If the contractor fails to remedy the situation within 24 hours after receipt of such notice, the Engineer may immediately place the erosion and/or other pollution control elements in proper condition and deduct the cost thereof from moneys due the contractor.

810-1.02 Other-Pollutants Controls:

The work shall include implementing controls to eliminate the discharge of pollutants, such as fuels, lubricants, bitumens, dust palliatives, raw sewage, wash water, and other harmful materials; into storm and other off-site waters. The work shall include the implementation of spill prevention and material management controls and practices to prevent the release or washoff of pollutants. These controls and practices shall be specified in the SWPPP and shall include storage procedures for chemicals and construction materials, disposal and cleanup procedures, the contractor's plans for handling of potential pollutants, and other pollution prevention measures as required.

Handling procedures for potential pollutants shall also be included in the contractor's "good housekeeping" practices, as specified in Subsection 104.09 of the Special Provisions.

810-2 Materials:

810-2.01 Silt Fence:

Material requirements for silt fences, including posts, wire support fencing, and fasteners, shall be in accordance with Section 915 of the specifications. Geotextile fabric shall conform to the requirements of Subsections 1014-1 and 1014-8 of the specifications, except that the filter cloth shall be woven polypropylene, and the fabric Apparent Opening Size shall be between numbers 20 and 50 U.S. Standard sieve sizes, when tested in accordance with ASTM D4751.

810-2.02 Compost Stabilization:

Compost stabilization shall consist of composted organic vegetative materials stabilized with a tacking agent and used for erosion control.

Compost material shall be dark brown in color with the parent material composted and no longer visible. The structure shall be a mixture of fine and medium size particles and humus crumbs. The maximum particle size shall be within the capacity of the contractor’s equipment for application to the constructed slopes. The odor shall be that of rich humus with no ammonia or anaerobic odors.

Compost shall also meet the following requirements:

COMPOST MATERIAL	
Cation Exchange Capacity (CEC)	Greater than 50 meq/100g
Carbon: Nitrogen Ratio	Less than 20:1
PH (of extract)	6 – 8.5
Organic Matter Content	Greater than 25%
Total Nitrogen (not added)	Greater than 1%
Humic Acid	Greater than 5%
Maturity Index	Greater than 50% on Maturity Index at a 10:1 ratio
Stability	Less than 100 mb 02/Kg compost dry solids – hour

Prior to furnishing on the project, compost mulch samples shall be tested for the specified microbiological and nutrient conditions, including maturity and stability, by a testing laboratory approved for testing of organic materials. Certified laboratory test results shall be submitted to the Engineer for approval.

Tacking agent shall be a naturally occurring organic compound and be non toxic. It shall be a product typically used for binding soil and mulch in seeding or erosion control operations. Approved types shall consist of mucilage or gum by dry weight as active ingredient obtained from guar or plantago. The tacking agent shall be labeled indicating the type and mucilage purity.

The contractor shall have the tacking agent swell volume tested by an approved testing laboratory using the USP method. The standard swell volume shall be considered at 30 milliliters per gram. Material shall have a swell volume of at least 24 milliliters per gram. Certified laboratory test results shall be furnished to the Engineer for each shipment of homogenous consistency to be used on project areas or as directed by the Engineer. Tacking agent rates shall be adjusted to compensate for swell volume variation. Material tested with lesser volume shall have the tacking agent rate increased by the same percentage of decrease in swell volume from the standard 30 milliliters per gram. Material tested with greater volume may reduce tacking agent rates by the same percentage of increase in swell volume from the standard 30 milliliters per gram. Tacking agent shall be pure material without other starches, bentonite, or other compounds that would alter the swell volume test results of mucilage, or the effectiveness of the tacking.

810-2.03 Riprap and Rock Mulch:

Riprap for cut and fill transitions designated on the plans shall be angular in shape and shall conform to the requirements of Section 913 of the specifications. Unless otherwise specified, riprap for cut and fill transitions shall conform to gradation A or B in the table below, as designated on the project plans.

Sieve Size		Percent Passing
Gradation A	Gradation B	
6 inch	12 inch	90 - 100
4.24 inch	9 inch	70 - 85
3 inch	6 inch	30 - 50
2 inch	4 inch	5 - 15
1 inch	2 inch	0 - 5

Rock mulch for pipe inlet and outlet protection, headwall and wingwall treatment, and rock check dams shall be angular in shape and shall conform to the requirements of Section 803 of the specifications. Rock mulch shall be in accordance with gradation C below, unless otherwise specified. Section 803 of the specifications requirements for use of pre-emergent herbicide and for post-placement watering of rock mulch shall not apply to rock mulch applied under Section 810 of the specifications.

Gradation C Rock Mulch (fractured/crushed rocks in angular shape)	
Sieve Size	Percent Passing
3.75 inch	100
2.5 inch	50 - 75
2 inch	30 - 50
1 inch	10 - 20

810-2.04 Sand Bags:

Sand bags, when filled, shall measure approximately 24 inches long by 16 inches wide by 4 inches thick. Bags shall be manufactured from polypropylene, polyethylene, or polyamide woven fabric with the following characteristics:

Unit Weight, Minimum, oz. per sq. yd.	4
Mullen Burst Strength:, Exceeding, psi	300
Ultraviolet Stability, Exceeding, %	70

Material used to fill sand bags shall be clean sand or a clean sandy soil free of silt, as approved by the Engineer.

810-2.05 Erosion Control Blankets:

(A) General:

Erosion control blankets shall consist of temporary, degradable, rolled erosion-control products of short-term or extended-term duration, composed of natural fibers mechanically or structurally bound together with natural or polymer netting to form a continuous matrix.

Erosion control blankets of short-term duration shall have a minimum one-year degradation period for both the netting and fibers, and be composed of 100 percent virgin aspen excelsior wood fibers or 100 percent agricultural straw. Extended-term erosion control blankets shall

have a minimum two-year degradation period for the netting and fibers, and be composed of heavy-duty excelsior blankets, or a mix of 70 percent straw and 30 percent coconut fibers, or 100 percent coconut fibers. Heavy-duty excelsior blankets used in the extended-term category shall have a minimum weight of 0.7 pounds per square yard. All other types of blankets, whether for short-term or extended-term use, shall have a minimum weight of 0.5 pounds per square yard.

Fibers for short-term erosion control blankets shall be encased top and bottom with photodegradable polypropylene or 100-percent biodegradable natural organic fiber netting, as specified on the plans. Should the plans not specify type of netting for short-term blankets, fibers shall be encased with photodegradable polypropylene. Fibers for extended-term blankets shall be encased within either a heavy duty UV-stabilized top netting (black) and bottom netting (green), or two UV-stabilized nettings (black). All netting for extended-term blankets shall be photodegradable polypropylene.

Erosion control blankets shall also conform to the following requirements:

Property	Test Method	Short-Term Duration	Extend-Term Duration
Minimum mass per unit area (ounces/sq. yd.)	ASTM D6475	8	8*
Minimum Thickness** (inches)	ASTM D5199	0.25	0.25
Minimum Tensile Strength (lbs./ft) ***	ASTM D5035	75x75	100x100

Notes:

*Heavy duty blankets shall have a minimum mass per unit area of 11 ounces per square yard.
**Numerical value represents total thickness of blanket, including netting.
***Numerical value represents minimum average test result in either direction.

The contractor shall provide Certificates of Analysis, in accordance with Subsection 106.05 of the specifications, for all erosion control blankets.

Fiber color shall be natural unless otherwise specified in the special provisions.

Fibers shall be free of weed seed, and shall be locked in place to form a mat of consistent thickness. Erosion control blankets using straw shall conform to the requirements of Subsection 810-2.05(B) of the specifications. Fibers shall remain evenly distributed over the entire area of the blanket after being placed on the slope.

Erosion control blankets shall be furnished in 4-foot to 8-foot wide rolls, and shall be wrapped with suitable material to protect against moisture and extensive ultraviolet exposure prior to placement.

Each roll shall be labeled to provide sufficient identification for quality control purposes.

Staples shall be U-shaped, 11 gauge steel wire, and shall be 1 inch wide by 6 inches long or 2 inches wide by 8 inches long.

(B) Straw Certification:

All wheat straw shall be free from noxious weeds in compliance with the standards and procedures of the Arizona Crop Improvement Association (ACIA) or the North American Weed Management Association (NAWMA). The contractor shall provide documentation that the product containing wheat straw was manufactured solely from straw certified as free of noxious weeds by the ACIA or NAWMA. Such certification shall be provided to the Engineer prior to delivery of the products to the project site. Products using wheat straw without such certification will not be acceptable.

810-2.06 Sediment Logs, Sediment Wattles, and Fiber Rolls:

(A) General:

Sediment logs, sediment wattles, and fiber rolls shall be manufactured or constructed rolls of fiber matrix, secured with netting, and used for the purpose of controlling erosion by slowing high flow water velocity and trapping silt sediments. Netting for fiber rolls and sediment wattles shall have a minimum durability of one year after installation, and shall be tightly secured at each end of the individual rolls. All wheat straw used in sediment logs, sediment wattles, and fiber rolls shall comply with the requirements of Subsection 810-2.05(B) of the specifications.

The unit weight for wattles and fiber rolls shall be 0.144 pounds per inch of diameter per linear foot. Sediment log unit weight shall be 0.167 pounds per inch of diameter per linear foot. The minimum weight per linear foot for sediment logs, wattles, and fiber rolls shall be determined by multiplying the specified diameter of the device by the appropriate unit weight, in pounds per inch of diameter per linear foot, as specified above.

Netting at each end of sediment logs and wattles shall be secured with metal clips or knotted ends to assure fiber containment.

(B) Sediment Logs:

Sediment logs shall be constructed of 100 percent curled-fiber aspen wood excelsior with interlocking barbs, and with 80 percent (±10 percent) of the fiber at least 6 inches in length. Netting shall consist of

long-term degradable, open weave, plastic or natural fiber containment mesh, with a maximum 1-inch by 1-inch grid. Sediment logs may also be filled with compost conforming to the requirements of Subsection 810-2.02 of the specifications. Mesh shall be photodegradable or biodegradable with a life expectancy of 12 to 24 months. Sediment logs shall be twenty inches in diameter. Unless approved by the Engineer, sediment logs shall be 10 feet (±10 percent) in length.

(C) Sediment Wattles:

Sediment wattles shall be manufactured rolls composed of weed-free, 100-percent agricultural wheat or rice straw, or excelsior wood fiber, encased in a tube of long-term photodegradable plastic or biodegradable natural fiber netting with a maximum 1-inch by 1-inch grid. Sediment wattles shall have nominal diameters of 9, 12, or 18 inches, with lengths from 7 to 25 feet, as specified on the plans. Fibers shall be evenly distributed throughout the wattle.

Wattles composed of wheat straw shall conform to the requirements of Subsection 810-2.05(B) of the specifications. Wheat straw wattles without the specified certification will not be acceptable.

(D) Fiber Rolls:

Fiber rolls shall be constructed from heavyweight manufactured blankets consisting of wood excelsior, straw, or coconut fibers, or any combination of such fibers, mechanically or structurally bound together with natural or polymer netting to form a continuous matrix. Blankets used to construct fiber rolls shall be between 6.5 and 8 feet wide by approximately 50 feet long. Wood excelsior blankets shall have 80 percent of its fibers equal to or greater than 6 inches. Blankets used to construct the fiber rolls shall have photodegradable plastic or biodegradable natural netting, with a maximum 1-inch by 1-inch grid, on at least one side.

Fiber rolls containing any amount of wheat straw shall conform to the requirements of Subsection 810-2.05(B) of the specifications. Fiber rolls with wheat straw that are not certified as specified herein will not be acceptable.

The contractor shall produce fiber rolls by rolling the blankets along their width to produce 50-foot lengths, and securing the rolls with jute twine spaced at 6.5-foot intervals along the roll for the full length and at 6 inches from each end. If shown on the plans or directed by the Engineer, the contractor shall cut the blankets before rolling to produce completed fiber roll lengths of between 14 and 50 feet. The nominal diameter of the finished rolls shall be 9, 12, or 18 inches, as specified on the plans. Overlapping of more than one blanket may be required to achieve larger diameters. When overlapping is required, the end of one blanket shall overlap 6 inches onto the end of the next blanket prior to rolling.

810-2.07 Sediment Control Berms:

Sediment control berms shall consist of soil obtained from within the project limits, or compost, or both, as called for on the plans.

Compost and tacking agent used in sediment control berms shall conform to the material requirements of Subsection 810-2.02 of the specifications.

810-3 Construction Requirements:

The contractor shall implement the SWPPP throughout the project, as specified in Subsection 104.09 of the Special Provisions.

Erosion control features shall be temporary or permanent, as designated herein. Temporary erosion control features specified for removal at the end of the project shall become the property of the contractor, unless designated by the Engineer to be left for permanent use.

810-3.01 Silt Fences:

Installation and maintenance requirements for silt fences shall be accordance with Section 915 of the specifications, unless otherwise specified.

810-3.02 Compost Stabilization:

Compost stabilization shall be applied as shown on the plans or as directed by the Engineer.

810-3.03 Riprap and Rock Mulch:

Riprap used in cut and fill transitions; and rock mulch treatments for pipe inlets and outlets, headwalls and wingwalls, and rock check dams; shall be installed in accordance with the project plans and details or as directed by the Engineer.

Rock shall be installed so as to conform to and completely cover the treatment area shown on the plans with a uniform, cohesive rock unit. The rock shall not impede flow into the treatment area and shall be feathered at the outflow.

Accumulated debris shall be removed and disposed of by the contractor after each rain storm, or as directed by the Engineer.

Pipe treatments, headwall and wingwall treatments, and cut and fill transitions are permanent project features which shall remain in continuous service after installation and project completion.

Rock check dams shall remain in service until the seeding work commences or until they are no longer needed, as approved by the Engineer. When use of a rock check dam is discontinued, the materials shall be removed and wasted on site in a manner that will not impede designed drainage flows, as approved by the Engineer.

810-3.04 Sand Bags:

The work shall include furnishing sand bags and sand, preparing the filled bags, and installing filled sand bags where shown on the plans or as approved by the Engineer.

Sand bags in the vicinity of curbs and catch basins shall be installed to 2 inches below the height of the adjacent curb to allow drainage into the catch basin. When sediment depth behind the sand bags reaches 3 inches, the sediment shall be removed and disposed of in accordance with local, state, and federal laws and permit requirements.

Sand bag features shall remain in service until disturbed areas have been stabilized, as directed by the Engineer.

When the use of a sand bag feature is discontinued, all materials shall be removed and become the property of the contractor. During removal, all sediment shall be disposed of, and the area restored to a finished condition as shown on the plans, or as directed by the Engineer.

810-3.05 Erosion Control Blankets:

(A) General:

Erosion control blankets shall be installed in accordance with the project plans and details, or as directed by the Engineer in accordance with the manufacturer's instructions.

For slope installations short-term duration blankets, as specified in Subsection 810-2.05 of the specifications, shall be used for slopes from 4:1 (horizontal to vertical) to 2:1. Extended-term blankets shall be used for slopes steeper than 2:1. For channel installations erosion control blankets shall conform to the requirements for extended-term duration.

The contractor shall coordinate with the blanket supplier for a qualified representative of the blanket supplier to be present at the job site at the start of installation to provide technical assistance as needed.

(B) Slope Installations:

Erosion control blankets shall be oriented in vertical strips and anchored with 6-inch long staples in cohesive soil and 8-inch long staples in non-cohesive soil. A 2-to-5 inch overlap, or as required by the manufacturer, shall be required for side seams. A 6-inch overlap, shingle-style, shall

be required for blanket ends. The distribution of staples shall be as recommended by the manufacturer. A 6-inch deep by 6-inch wide trench shall be located at the top of the slope. The erosion control blankets shall be stapled to the bottom of the trench with staples spaced 6 inches apart across the width of the blanket. The trench shall then be backfilled and compacted.

(C) Channel Installations:

For channel installations, erosion control blankets shall be installed parallel to the flow of water. The first blanket shall be centered longitudinally in mid-channel and anchored with staples, as recommended by the manufacturer. Subsequent blankets shall follow from channel center outward.

The distribution of staples shall be as recommended by the manufacturer.

Successive lengths of erosion control blankets shall be overlapped a minimum of 6 inches with the upstream end on top. Staple the overlap across the end of the overlapping lengths with staples spaced 6 inches apart.

A 6-inch deep by 6-inch wide trench shall be located at the upstream and top of side slope terminations of the blankets. The erosion control blankets shall be stapled to the bottom of the trench, with staples spaced 6 inches apart across the width of the blanket. The trench shall be backfilled and compacted.

810-3.06 Sediment Logs, Sediment Wattles, and Fiber Rolls:

(A) Sediment Logs:

Sediment logs shall be installed in channel bottoms, around catch basins, as check dams, or on slopes, as shown on the plans or as directed by the Engineer in accordance with the manufacturer's instructions. Sediment logs shall be secured with 1-inch by 1-inch by 46-inch hardwood stakes placed with a maximum spacing of 2 feet on center, or as shown on the plans. Each stake shall be intertwined with the netting on the downstream side of the log and driven approximately 2 feet below finished grade. Unless otherwise specified, soil shall be tamped against the upstream side of the log to assure that storm water is forced to flow through the log rather than under it.

Sediment logs installed in drainage channel bottoms shall be perpendicular to the flow of the water, and shall continue up the channel side slope 2 feet above the high water flow line. Spacing of the logs shall be as specified in the plans.

When sediment logs are used to construct check dams, the logs placed on the ground shall be buried 4 to 6 inches deep as shown on plans.

Logs placed on slopes shall be installed in a 2 inch deep by 5 inch wide anchor trench. The ends of adjacent logs shall be abutted tightly together so that water cannot undermine the logs.

(B) Sediment Wattles:

Sediment wattles shall be installed on slopes as shown on the plans, and in accordance with the manufacturer's instructions, or as directed by the Engineer. Sediment wattles shall be secured with wooden stakes as shown on the plans. The ends of adjacent wattles shall be abutted tightly together.

(C) Fiber Rolls:

Fiber rolls shall be installed on slopes as shown on the plans, and in accordance with the manufacturer's instructions, or as directed by the Engineer. If no spacing is shown on the plans, fiber rolls shall be placed as specified in the table below. Fiber rolls shall be installed in a 2-inch deep by 5-inch wide anchor trench. Fiber rolls shall be secured with wooden stakes having a 3/4-inch by 3/4-inch minimum cross-sectional dimension and 3-foot minimum length, or as shown on the plans. Each stake shall be driven through the center of the finished fiber roll, spaced a maximum of 3 feet apart, and driven approximately 2 feet into the ground. The ends of adjacent rolls shall be abutted together.

Fiber Roll Spacing Table	
Slope (Horizontal to Vertical)	**Spacing (feet)**
Less than 6:1	50
6:1 to 4:1	25
Greater than 4:1 and less than 2:1	17
2:1 to less than 1:1	10
1:1 and greater	5

810-3.07 Sediment Control Berms:

Sediment control berms shall be installed as shown on the plans. The berm shall be considered a temporary erosion control protection measure. As directed by the Engineer, the contractor shall remove segments of the berm within areas that have been successfully re-vegetated prior to allowing traffic operations.

810-4 Method of Measurement:

Silt Fence will be measured in accordance with Subsection 915-5 of the specifications.

Compost stabilization will be measured by the cubic yard of applied and tacked compost material.

Pipe Inlet/Outlet Treatment, Headwall and Wingwall Treatment, and Rock Check Dams will be measured per cubic yard of rock mulch. Cut and Fill Transitions will be measured per cubic yard of riprap.

Sand bags will be measured per each filled sand bag placed into service.

Erosion control blankets will be measured by the square yard of total ground area covered.

Sediment logs, sediment wattles, and fiber rolls will be measured by the linear foot.

Sediment control berms will be measured by the linear foot along the center line of the berm, parallel to the ground surface.

810-5 Basis of Payment:

Silt Fence will be paid for in accordance with Subsection 915-6 of the specifications, except that no separate measurement and payment will be made for removal of sediment, the cost being considered a part of contract items.

The accepted quantity of rock check dams, measured as provided above, will be paid for at the contract unit price per cubic yard of rock mulch, which price shall be full compensation for the work, complete in place, including all excavation; preparation; and furnishing, installing, maintaining, final removal, and disposal or dispersion, including returning the area to a natural condition, as approved by the Engineer.

The accepted quantity of Pipe Inlet/Outlet Treatment, measured as provided above, will be paid for at the contract unit price per cubic yard of rock mulch, which price shall be full compensation for the work, complete in place, including all excavation; preparation; and furnishing, installing, and maintaining of Pipe Inlet/Outlet Treatment, as approved by the Engineer.

The accepted quantity of Headwall and Wingwall Treatment, measured as provided above, will be paid for at the contract unit price per cubic yard of rock mulch, which price shall be full compensation for the work, complete in place, including all excavation; preparation; and furnishing, installing, and maintaining of Headwall and Wingwall Treatment, as approved by the Engineer.

The accepted quantity of Cut and Fill Transitions, measured as provided above, will be paid for at the contract unit price per cubic yard of riprap, which price shall be full compensation for the work, complete in place, including all excavation; preparation; and furnishing, installing, and maintaining of Cut and Fill Transitions, as approved by the Engineer.

The accepted quantities of sand bags, measured as provided above, will be paid for at the contract unit price per each sand bag, which price

shall be full compensation for the work, complete in place, including all excavation; preparation; and furnishing, installing, maintaining, final removal, and disposal of temporary sand bags, including returning the area to a natural condition, as approved by the Engineer. No separate measurement and payment will be made for removal of sediment, the cost being considered a part of contract items.

The accepted quantities of erosion control blankets, measured as provided above, will be paid for at the contract unit price per square yard, which price shall be full compensation for the work, complete in place, including all excavation and preparation; and furnishing, installing, and maintaining the erosion control blankets, as approved by the Engineer. Such unit bid price shall be considered full compensation for either short-term or extended-term blankets. No additional payment will be made for technical assistance provided by representatives of the blanket supplier, the cost being considered as included in the unit bid price.

The accepted quantities of sediment logs, sediment wattles, and fiber rolls, measured as provided above, will be paid for at the contract unit price per linear foot, which price shall be full compensation for all labor, including excavation, preparation, and installation, and all materials, tools, stakes, equipment, and incidentals necessary for furnishing and installing the devices, complete in place, as approved by the Engineer. No additional payment will be made for sediment logs used as check dams, the cost being considered as included in the unit bid price paid for sediment logs.

The accepted quantities of compost stabilization, measured as provided above, will be paid for at the contract unit price per cubic yard of compost material applied and tacked, as directed by the Engineer. Such price shall be full compensation for the work, complete in place, including all materials, preparation, installation, tacking, maintenance, and removal of the compost-stabilization area.

The accepted quantities of sediment control berms, measured as provided above, will be paid for at the contract unit price per linear foot, regardless of the type of material used. Such price shall be full compensation for the work, complete in place, including all materials, preparation, compaction, installation, and maintenance, and removal of the sediment control berm.

No additional measurement or payment will be made for temporary features subsequently designated by the Engineer as permanent, the cost being considered as included in the unit bid price.

No additional measurement or payment will be made for associated earthwork, ground preparation, overlapping, stakes, silt and debris removal and disposal, or maintenance, the cost being considered as included in the unit bid price.

SECTION 1005 BITUMINOUS MATERIALS:

1005-1 General Requirements:

Bituminous materials shall conform, when tested in accordance with the tests hereinafter enumerated, to the following requirements, as applicable, for the types and grades designated and used.

Certificates of Compliance conforming to the requirements of Subsection 106.05 of the specifications shall be submitted.

1005-2 Sampling of Bituminous Material:

Sampling of bituminous material shall conform to the requirements of Arizona Test Method 103. Samples shall be taken by the contractor and witnessed by the Engineer. The point of sampling and the number of samples will be specified by the Engineer.

The contractor shall provide convenient facilities for obtaining accurate samples of bituminous material.

1005-3 Bituminous Material Requirements:

1005-3.01 Asphalt Cement:

Asphalt cement shall be a performance grade (PG) asphalt binder conforming to the requirements of AASHTO M 320. The pressure aging temperature shall be as specified below:

PG Asphalt Binder	Pressure Aging Temperature
PG 76-XX or PG 70-XX	110 ºC
PG 64-XX, PG 58-XX, or PG 52-XX	100 ºC

If PG 76-22 TR+ asphalt binder is used, it shall conform to the requirements of Table 1005-1a.

If PG 70-22 TR+ asphalt binder is used, it shall conform to the requirements of Table 1005-1b.

If PG 64-28 TR+ asphalt binder is used, it shall conform to the requirements of Table 1005-1c.

If, during asphaltic concrete production, it is determined by testing that asphalt cement fails to meet the requirements for the specified grade, the asphaltic concrete represented by the corresponding test results shall be evaluated for acceptance. Should the asphaltic concrete be allowed to remain in place, the contract unit price for asphalt cement will be adjusted by the percentage shown in Table 1005-1. Should the asphalt cement be in reject status, the contractor may, within 15 days of receiving notice of the reject status of the asphalt cement, supply an engineering analysis of the expected performance of the asphaltic concrete in which the asphalt cement is incorporated. The engineering analysis shall detail any proposed corrective action and the anticipated effect of such corrective action on the performance. Within three working days, the Engineer will determine whether or not to accept the contractor's proposal. If the proposal is rejected, the asphaltic concrete shall be removed and replaced with asphaltic concrete meeting the requirements of the applicable specifications at no additional expense to the Department. If the contractor's proposal is accepted, the asphaltic concrete shall remain in place at the applicable percent of contract unit price allowed, and any necessary corrective action shall be performed at no additional cost to the Department.

1005-3.02 Liquid Asphalt:

Liquid asphalt shall conform to the requirements of AASHTO M 82, Cut-back Asphalt (Medium Curing Type).

Adjustments in the contract unit price, in accordance with the requirements of Table 1005-2, will be made for quantities of material represented by the corresponding test results.

1005-3.03 Emulsified Asphalt:

Emulsified asphalt shall conform to the requirements of Table 1005-3 for Anionic Rapid Set (RS-1, RS-2), Anionic Slow Set (SS-1), Cationic Rapid Set (CRS-1, CRS-2) and Cationic Slow Set (CSS-1).

Polymerized Cationic Rapid Set (CRS-2P) emulsified asphalt shall conform to the requirements of Table 1005-3a.

Polymerized High Float (HFE-150P) and (HFE-300P) emulsified asphalt shall conform to the requirements of Table 1005-3b.

Emulsified asphalts shall be homogeneous. If emulsified asphalt has separated, it shall be thoroughly mixed to ensure homogeneity. If emulsified asphalt has separated due to freezing, it shall not be used. Emulsified asphalt shall not be used after 30 days from delivery.

The contract unit price will be adjusted, to the nearest cent, for quantities of emulsified asphalt which do not meet the specified minimum percent residue. The adjusted contract unit price will be determined by the following:

$$\begin{bmatrix}\text{Adjusted Contract}\\ \text{Unit Price}\end{bmatrix} = \frac{\begin{bmatrix}\text{Percent Residue}\\ \text{From Testing}\end{bmatrix}}{\begin{bmatrix}\text{Specified Minimum}\\ \text{Percent Residue}\end{bmatrix}} \times \left[\text{Contract Unit Price}\right]$$

1005-3.04 Emulsified Asphalt (Special Type):

Emulsified asphalt (special type) shall consist of Type SS-1 or CSS-1 diluted with water to provide an asphalt content not less than 26 percent. The water used shall be potable. The material shall not be diluted in the field.

1005-3.05 Recycling Agents:

Recycling agents shall conform to the requirements of Table 1005-4.

1005-3.06 Emulsified Recycling Agents:

Emulsified recycling agents shall conform to the requirements of Table 1005-5.

The contract unit price will be adjusted, to the nearest cent, for quantities of emulsified recycling agent which do not meet the specified minimum percent residue. The adjusted contract unit price will be determined by the following:

$$\begin{bmatrix}\text{Adjusted Contract}\\ \text{Unit Price}\end{bmatrix} = \frac{\begin{bmatrix}\text{Percent Residue}\\ \text{From Testing}\end{bmatrix}}{\begin{bmatrix}\text{Specified Minimum}\\ \text{Percent Residue}\end{bmatrix}} \times \left[\text{Contract Unit Price}\right]$$

1005-3.07 Other Requirements:

Other requirements for bituminous materials shall conform to the requirements of Table 1005-6.

TABLE 1005-1
ASPHALT BINDER ADJUSTMENT TABLE

Test Property	AASHTO Test Method	Test Result	Percent of Contract Unit Price Allowed
Dynamic Shear of Original Binder: G*/Sin δ, kPa	T 315	≥ 1.00 0.90-0.99 0.70-0.89 < 0.70	100 95 85 70 (1)
Dynamic Shear of RTFO Binder: G*/Sin δ, kPa	T 315	≥ 2.20 2.00-2.19 1.60-1.99 < 1.60	100 95 85 70 (1)
Dynamic Shear of PAV Binder: G*Sin δ, kPa	T 315	≤ 5000 5001-5500 5501-7000 7001-8000 > 8000	100 95 85 75 65 (1)
Creep Stiffness of PAV Binder: S, Mpa	T 313	≤ 300 301-330 331-450 451-600 > 600	100 95 85 75 65 (1)
m-value at 60 sec.	T 313	≥ 0.300 0.270-0.299 0.230-0.269 < 0.230	100 95 80 65 (1)

Notes:

(1) Reject Status: The pay adjustment applies if allowed to remain in place.

(2) Specified properties in AASHTO M 320 for flash point, viscosity at 135 °C, and mass loss are not considered performance related. Specification deficiencies for these properties shall be cause for a work stoppage until specification properties are met, but will not be cause for a pay adjustment.

(3) Should the bituminous material be deficient on more than one property, the pay adjustment will be the greatest reduction to the contract unit price specified considering individual test results.

(4) The information presented in this table does not apply to asphalt cement used for tack coats.

TABLE 1005-1a
PG 76-22 TR+ ASPHALT BINDER

Test Property	Test Method	Requirement	Test Result	Percent of Contract Unit Price Allowed
Solubility in Trichloroethylene, %, minimum	ASTM D2042	97.5	-----	-----
Softening Point, ºC, minimum	AASHTO T 53	60	≥ 60 57-59 < 57	100 85 70 (1)
Elastic Recovery, @ 10 ºC, %, minimum	AASHTO T 301	55	≥ 55 50-54 < 50	100 85 70 (1)
Phase Angle (δ), @ 76 ºC @ 10 rad/sec, degrees, maximum	AASHTO T 315	75	≤ 75 76-83 > 83	100 85 65 (1)

Notes:

(1) Reject Status: The pay adjustment applies if allowed to remain in place.

(2) PG 76-22 TR+ asphalt binder shall contain a minimum of 8 percent crumb rubber and a minimum of 2 percent SBS (styrene-butadiene-styrene) polymer.

(3) PG 76-22 TR+ asphalt binder shall conform to the requirements of AASHTO M 320 and, in addition, shall meet the requirements specified above.

(4) Table 1005-1 will also apply for PG 76-22 TR+ asphalt binder.

(5) Should the bituminous material be deficient on more than one of the properties listed in Tables 1005-1 and 1005-1a, the pay adjustment will be the greatest reduction to the contract unit price specified considering individual test results.

(6) The pressure aging temperature for PG 76-22 TR+ asphalt binder shall be 110 ºC.

(7) The crumb rubber shall be derived from processing whole scrap tires or shredded tire materials. The tires from which the crumb rubber is produced shall be taken from automobiles, trucks, or other equipment owned and operated in the United States. The processing shall not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above ground.

TABLE 1005-1b
PG 70-22 TR+ ASPHALT BINDER

Test Property	Test Method	Requirement	Test Result	Percent of Contract Unit Price Allowed
Solubility in Trichloroethylene, %, minimum	ASTM D2042	97.5	-----	-----
Softening Point, ºC, minimum	AASHTO T 53	54	≥ 54 51 - 53 < 51	100 85 70 (1)
Elastic Recovery, @ 10 ºC, %, minimum	AASHTO T 301	55	≥ 55 50-54 < 50	100 85 70 (1)
Phase Angle (δ), @ 70 ºC @ 10 rad/sec, degrees, maximum	AASHTO T 315	75	≤ 75 76-83 > 83	100 85 65 (1)

Notes:

(1) Reject Status: The pay adjustment applies if allowed to remain in place.

(2) PG 70-22 TR+ asphalt binder shall contain a minimum of 8 percent crumb rubber and a minimum of 2 percent SBS (styrene-butadiene-styrene) polymer.

(3) PG 70-22 TR+ asphalt binder shall conform to the requirements of AASHTO M 320 and, in addition, shall meet the requirements specified above.

(4) Table 1005-1 will also apply for PG 70-22 TR+ asphalt binder.

(5) Should the bituminous material be deficient on more than one of the properties listed in Tables 1005-1 and 1005-1b, the pay adjustment will be the greatest reduction to the contract unit price specified considering individual test results.

(6) The pressure aging temperature for PG 70-22 TR+ asphalt binder shall be 110 °C.

(7) The crumb rubber shall be derived from processing whole scrap tires or shredded tire materials. The tires from which the crumb rubber is produced shall be taken from automobiles, trucks, or other equipment owned and operated in the United States. The processing shall not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above ground.

TABLE 1005-1c
PG 64-28 TR+ ASPHALT BINDER

Test Property	Test Method	Requirement	Test Result	Percent of Contract Unit Price Allowed
Solubility in Trichloroethylene, %, minimum	ASTM D2042	97.5	-----	-----
Softening Point, ºC, minimum	AASHTO T 53	50	≥ 50 47 - 49 < 47	100 85 70 (1)
Elastic Recovery, @ 10 ºC, %, minimum	AASHTO T 301	55	≥ 55 50-54 < 50	100 85 70 (1)
Phase Angle (δ), @ 64 ºC @ 10 rad/sec, degrees, maximum	AASHTO T 315	75	≤ 75 76-83 > 83	100 85 65 (1)

Notes:

(1) Reject Status: The pay adjustment applies if allowed to remain in place.

(2) PG 64-28 TR+ asphalt binder shall contain a minimum of 8% crumb rubber and a minimum of 2 percent SBS (styrene-butadiene-styrene) polymer.

(3) PG 64-28 TR+ asphalt binder shall conform to the requirements of AASHTO M 320 and, in addition, shall meet the requirements specified above.

(4) Table 1005-1 will also apply for PG 64-28 TR+ asphalt binder.

(5) Should the bituminous material be deficient on more than one of the properties listed in Tables 1005-1 and 1005-1c, the pay adjustment will be the greatest reduction to the contract unit price specified considering individual test results.

(6) The pressure aging temperature for PG 64-28 TR+ asphalt binder shall be 100 °C.

(7) The crumb rubber shall be derived from processing whole scrap tires or shredded tire materials. The tires from which the crumb rubber is produced shall be taken from automobiles, trucks, or other equipment owned and operated in the United States. The processing shall not produce, as a waste product, casings or other round tire material that can hold water when stored or disposed of above ground.

TABLE 1005-2		
MC LIQUID ASPHALT PAY ADJUSTMENT TABLE		
Grade	**Kinematic Viscosity (AASHTO T 201): Centistokes, Deviations**	**Percent of Contract Unit Price Allowed**
70	70 - 140	100
	63 - 69 or 141 - 154	90
	52 - 62 or 155 - 175	75
	Less than 52 or greater than 175	60 (1)
250	250 - 500	100
	225 - 249 or 501 - 550	90
	187 - 224 or 551 - 625	75
	Less than 187 or greater than 625	60 (1)
800	800 - 1600	100
	720 - 799 or 1601 - 1760	90
	600 - 719 or 1761 - 2000	75
	Less than 600 or greater than 2000	60 (1)
3000	3000 - 6000	100
	2700 - 2999 or 6001 - 6600	90
	2250 - 2699 or 6601 - 7500	75
	Less than 2250 or greater than 7500	60 (1)

Note:

(1) Reject Status: The pay adjustment applies if allowed to remain in place.

(2) Since volatile solvents utilized in the manufacture of MC Liquid Asphalt may volatilize in varying amounts during transporting, handling, and storage operations, whenever such Liquid Asphalts are used for prime coats or curing seals, deviations from the maximum specification limits greater than those listed may be permitted when justified. In such cases, when material is allowed to remain in place, 60 percent of the contract unit price is allowed.

TABLE 1005-3
EMULSIFIED ASPHALTS

Tests on Emulsion	Test Method (1)	Requirement					
		RS-1	CRS-1	RS-2	CRS-2	SS-1	CSS-1
Viscosity: Saybolt Furol, seconds, range 77 °F 122 °F	T 59	20-100	20-100	50-400	50-400	20-100	20-100
Settlement: 5 days, %, maximum	T 59	5	5	5	5	5	5
Sieve: Retained on No. 20, %, maximum	T 59(2)	0.10	0.10	0.10		0.10	0.10
Particle Charge	T 59		Pos.		Pos.		Pos. (3)
Demulsiability: 35 mL, 0.02 N calcium chloride %, minimum	T 59	60		60			
Classification: Uncoated particles, %, minimum	Arizona Test Method 502				55		
Residue: (4) Residue, %, minimum (5)		55	60	63	65	57	57

Notes:

(1) T 59 is AASHTO.

(2) Distilled water shall be used. Two percent sodium oleate solution will not be accepted.

(3) If the Particle Charge Test result is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

(4) Residue will be obtained in accordance with the requirements of Arizona Test Method 504 and shall conform to all the requirements of AASHTO M 320 for PG 64-16, except that for CRS-2 the dynamic shear ($G^*/\sin\delta$) on the original residue shall be a minimum of 1.00 kPa and a maximum of 1.50 kPa.

(5) Residue by evaporation may be determined in accordance with the requirements of Arizona Test Method 512; however, in case of dispute, AASHTO T 59 will be used.

TABLE 1005-3a
POLYMERIZED CATIONIC RAPID SET (CRS-2P) EMULSIFIED ASPHALT (1)

Tests on Emulsion:	**Test Method**	**Requirement**
Viscosity, Saybolt Furol seconds @ 50 ºC (122 ºF), range	AASHTO T 59	100-400
Storage Stability, 24 hours, % maximum	AASHTO T 59	1
Demulsibilty, 35 mL of 0.8% DSS, % minimum	AASHTO T 59	40
Particle Charge Test	AASHTO T 59	Positive
Sieve Test, retained on 850 µm (No. 20), % maximum	AASHTO T 59	0.10
Residue from Distillation to 176.7 ºC (350 ºF), % minimum	AASHTO T 59	66
Oil Distillate to 176.7 ºC (350 ºF), Volume of Emulsion, % maximum	AASHTO T 59	0.5
Tests on Residue from Distillation:		
Penetration, 25 ºC (77 ºF), 100 grams, 5 seconds, range in 0.1 mm	AASHTO T 49	40-100
Ductility, 4 ºC (39.2 ºF), 10 mm/minute, cm, minimum	AASHTO T 51	35
Elastic Recovery by means of Ductilometer, 25 ºC (77 ºF), % minimum	AASHTO T 301 (2)	55

Notes:

(1) The introduction of polymer shall occur before emulsification.

(2) Testing shall be performed on residue by distillation, not on residue by oven evaporation.

TABLE 1005-3b
POLYMERIZED HIGH FLOAT EMULSIFIED ASPHALT (1)

Tests on Emulsion:	Test Method	Requirement	
		HFE-150P	HFE-300P
Viscosity, Saybolt Furol seconds @ 50 ºC (122 ºF), range	AASHTO T 59	50-400	50-400
Sieve test, retained on 850 µm (No. 20), % maximum	AASHTO 59 (2)	0.10	0.10
Storage Stability, 24 hours, % maximum	AASHTO T 59	1	1
Residue from Distillation to 204.4 ºC (400 ºF), % minimum	AASHTO T 59	65	65
Oil Distillate to 176.7 ºC (350 ºF), Volume of Emulsion, % maximum	AASHTO T 59	7.0	7.0
Tests on Residue from Distillation:			
Penetration, 25 ºC (77 ºF), 100 grams, 5 seconds, range in 0.1 mm	AASHTO T 49	150-300	300 +
Float Test at 60 ºC (140 ºF), seconds, minimum	AASHTO T 50	1200	1200
Ductility, 25 ºC (77 ºF), 5 cm/minute, cm, minimum	AASHTO T 51	100	N/A
Elastic Recovery by means of Ductilometer, 4 ºC (39.2 ºF), % minimum	AASHTO T 301 (3)	25	25

Notes:

(1) The introduction of polymer shall occur before emulsification.

(2) Distilled water shall be used. Two percent sodium oleate solution will not be accepted.

(3) Testing shall be performed on residue by distillation. Testing on residue by oven evaporation will not be accepted.

TABLE 1005-4
RECYCLING AGENTS

Tests On Recycling Agent	Test Method	Requirement							
		RA-1		RA-5		RA-25		RA-75	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity: 140°F, centistokes	AASHTO T 201	100	200	200	800	1000	4000	5000	10000
Flash Point: Cleveland Open Cup, °F, minimum	AASHTO T 48	340		375		425		450	
Saturate by weight: %	ASTM D2007		30		30		30		30
Test on Residue: Weight Change, %	AASHTO T 240		6.5		4		3		2
Viscosity Ratio: (1)			3		3		3		3

Notes:

(1) Viscosity Ratio:

$$\frac{\text{Viscosity of residue at 140 °F, centistokes}}{\text{Viscosity of recycling agent at 140 °F, centistokes}}$$

TABLE 1005-5
EMULSIFIED RECYCLING AGENTS

Tests on Emulsified Recycling Agent	AASHTO Test Method Except as Shown	Requirement			
		ERA-1	ERA-5	ERA-25	ERA-75
Viscosity: Saybolt Furol, 77 °F, seconds range	T 59	15 - 40	15 - 100	15 - 100	15 - 100
Miscibility	T 59	Passes	Passes	Passes	Passes
Sieve Test: %, maximum	T 59 (1)	0.10	0.10	0.10	0.10
Particle Charge	T 59	Positive	Positive	Positive	Positive
Residue: (2) Residue, %, minimum (3)		60	60	60	60

Notes:

(1) Distilled water shall be used. Two percent sodium oleate solution will not be accepted.

(2) Residue will be obtained in accordance with the requirements of Arizona Test Method 504 and shall conform to the requirements specified in Table 1005-4.

(3) Residue by evaporation may be determined in accordance with the requirements of Arizona Test Method 512; however, in case of dispute, AASHTO T 59 will be used.

TABLE 1005-6
OTHER REQUIREMENTS

Grade of Asphalt Specification Designation	Range of Temperatures for Application by Spraying, °F (Not applicable for Plant Mixing)	Range of Aggregate Temperatures for Plant Mixing, °F	Basis of Conversion, Average Gallons Per Ton at 60 °F
Paving Asphalt	275 - 400	------	
PG 76-XX			232
PG 70-XX			233
PG 64-XX			235
PG 58-XX			236
PG 52-XX			238
PG 76-22 TR+			229
PG 70-22 TR+			230
PG 64-28 TR+			231
Liquid Asphalt			
MC-70	105 - 175	90 - 155	253
MC-250	140 - 225	125 - 200	249
MC-800	175 - 225	160 - 225	245
MC-3000	215 - 290	200 - 260	241
Emulsified Asphalt		-----	240
RS-1	70 - 140		
CRS-1	125 - 185		
RS-2	125 - 185		
CRS-2	125 - 185		
CRS-2P	125 - 185 (1)		
SS-1	70 - 160		
CSS-1	70 - 160		
HFE-150P	-----		
HFE-300P	-----		
Emulsified Asphalt (Special Type)	70 - 160	-----	240
Recycling Agent (RA-1, RA-5, RA-25, RA-75)	-----	-----	240
Emulsified Recycling Agent (ERA-1, ERA-5, ERA-25, ERA-75)	70 - 160	-----	240

Note:

(1) Or as directed by the Engineer.

SECTION 1010 DRAINAGE PIPE:

1010-1 General Requirements:

Certificates of Compliance shall be furnished in accordance with the requirements of Subsection 106.05 of the specifications.

1010-2 Metal Pipe:

1010-2.01 Corrugated Metal Pipe:

Type 1A pipe, as specified in AASHTO M 36, Section 4.1.2, may be used if the shell thickness meets or exceeds the thickness specified on the plans for Type 1 pipe.

Metallic coated (zinc or aluminum) corrugated iron or steel culverts, underdrains, and spiral rib corrugated steel pipe shall conform to the requirements of AASHTO M 36, except as otherwise noted herein.

Polymer precoated, metallic coated (zinc or aluminum) corrugated steel culverts and underdrains shall conform to the requirements of AASHTO M 245, except as otherwise noted herein.

Bituminous coated corrugated metal (metallic coated steel or aluminum) culverts and underdrains shall conform to the requirements of AASHTO M 190.

Aluminum alloy corrugated metal pipe shall conform to the requirements of AASHTO M 196.

The types of bituminous coating and the type of precoated sheets to be used will be specified on the project plans. In lieu of the Type A bituminous coating, the pipe shall be coated either in the field or at the plant on the outside surface only in accordance with the requirements of AASHTO M 243. Either asphalt mastic or tar base material shall be used.

Coupling bands shall conform to the requirements of AASHTO M 36, M 245 and M 196, except that the use of bands with projections (dimples) will be limited to connection of new pipe to existing in-place pipe. Bands of special design that engage factory reformed ends of corrugated metal pipe may be used.

Bolts and nuts for all types of coupling bands shall conform to the requirements of ASTM F568.

Coupling band connection hardware consisting of nuts, bolts, rods, bars, and rivets shall be either galvanized after fabrication by the hot-dip process in accordance with the requirements of ASTM A153 or coated by the electroplating process in accordance with the requirements of ASTM B633 or ASTM B766. Components of bolted assemblies shall be galvanized in accordance with ASTM A153 separately before assembly. Special sections, such as elbows and prefabricated end sections shall conform to the applicable requirements of AASHTO M 36, M 190, M 196 and M 245.

Gaskets for all water-resistant joints shall be a continuous band or strip, at least 7 inches wide and 1/2 inch thick. Rubber for the gaskets shall

conform to the requirements of ASTM D1056 for the "2A" closed cell expanded grades.

Watertight joints shall use "O"-ring gaskets. The “O”-ring gasket shall conform to the diameter dimensions specified in AASHTO M 36, Section 9.3, and conform to the technical requirements of AASHTO M 198. Watertight joints may be used when water-resistant joints are specified.

1010-2.02 Spiral Rib Metal Pipe:

Spiral rib metal pipe shall conform to the requirements specified under Subsection 1010-2.01 of the specifications for corrugated metal pipe, except as modified herein:

(A) Fabrication:

Ribbed steel pipe shall be fabricated with a continuous helical lock seam in accordance with AASHTO M 36, Type 1R or corrugation in accordance with AASHTO M 196, Type 1R. Aluminum rib pipe shall be manufactured in accordance with AASHTO M 196, Type 1R.

Each pipe end shall be fabricated with a minimum of two annular rerolled corrugations for the purposes of joining pipes together with band couplers.

(B) Coatings:

The types of coatings and the type of precoated sheets to be used shall be as specified on the project plans.

(C) Coupling Bands:

Coupling bands for spiral ribbed steel pipe shall be rerolled bands manufactured from 0.064 inch thick metallic-coated steel conforming to the requirements specified under Subsection 1010-2.01 of the specifications and shall be two-piece for pipe greater than 48 inches in diameter.

Coupling bands shall be a minimum of 10-1/2 inches wide, formed with two corrugations that are spaced to provide nesting in the second corrugation of each pipe end and shall be drawn together by a minimum of two 1/2 inch diameter galvanized bolts through the uses of a bar and strap suitably welded to the band. Bands may be drawn together by other means, such as angles, as approved by the Engineer.

(D) Fittings:

Fittings for ribbed steel pipe shall conform to the requirements for corrugated steel pipe fittings specified in Subsection 1010-2.01 of the specifications, except the material shall be ribbed steel.

(E) Miscellaneous:

All spiral rib manhole risers 24 inches in diameter or greater shall be reinforced with a rolled 3 inch by 3 inch by 1/4 inch angle or as approved by the Engineer.

Pipe thickness for spiral rib pipe shall be specified in the pipe summary, but shall not be less than that listed in the following tables:

SPIRAL RIB METALLIC COATED STEEL PIPE		
Pipe Diameter, Inches	**Minimum Thickness, gage**	**Corrugation Rib Size, Inches**
18 - 60	16	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2
66 - 78	14	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2
84 - 102	12	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2

SPIRAL RIB ALUMINUM PIPE		
Pipe Diameter, Inches	**Minimum Thickness, Gage**	**Corrugation Rib Size, Inches**
18 - 42	16	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2
48 - 54	14	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2
60 - 72	12	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2
78 - 84	10	3/4 by 3/4 by 7-1/2, or 3/4 by 1 by 11-1/2

1010-2.03 Concrete-Lined Corrugated Metal Pipe:

(A) Corrugated Metal Pipe:

Corrugated metal pipe, coupling bands and fittings for concrete-lined pipe shall conform to the requirements of AASHTO M 36 for the specified sectional dimensions and metallic coatings. Aluminized coating shall conform to AASHTO M 274.

Pipe shall be full circle and shall be fabricated with helical corrugations.

Pipe thickness shall be as specified in the pipe summary, but shall not be less than that listed in the following table:

Pipe Diameter, Inches	Minimum Thickness, Inches (Gage)	Corrugation Rib Size, Inches
12 - 48	0.064 (16)	2-2/3 by 1/2
54 - 72	0.064 (16)	2-2/3 by 1/2 3 by 1 5 by 1
78 - 84	0.079 (14)	2-2/3 by 1/2 3 by 1 5 by 1
90 - 102	0.109 (12)	2-2/3 by 1/2 3 by 1 5 by 1
108 - 120	0.138 (10)	3 by 1 5 by 1

Each pipe end shall be fabricated with a minimum of two annular rerolled corrugations for purposes of joining pipes together with band couplers.

Pipe shall be joined with rerolled bands made from the same material as the pipe. The bands shall be a minimum of 16 gage (0.064 inches) thick. Bands shall be two-piece for pipe greater than 48 inches in diameter.

Coupling bands shall be a minimum of 10-1/2 inches wide, formed with two corrugations that are spaced to provide nesting in the second corrugation of each pipe end and shall be drawn together by a minimum of two 1/2 inch diameter galvanized bolts through the use of a bar and strap suitably welded to the band. Bands may be drawn together by other means, such as angles, as approved by the Engineer.

When watertight joints are specified, "O" ring gaskets will be required. "O" ring gaskets shall be per ASTM C361 Section 5.9 and shall be placed in the first corrugation of each pipe end and shall be compressed by tightening the coupling band, in accordance with the manufacturer's installation instructions.

(B) Concrete Lining:

(1) Composition:

Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregating lining.

(2) Cement:

Portland cement shall be in accordance with Subsection 1006-2.01 of the specifications.

(3) Aggregate:

Aggregates shall conform to AASHTO M 6, except that the requirements for gradation and uniformity of gradation shall not apply.

(4) Mixture:

The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogeneous concrete mixture of such quality that the pipe will conform to the design requirements of this specification. In no case, however, shall the proportions of Portland cement plus pozzolanic admixture be less than 470 pounds per cubic yard of concrete.

(5) Lining:

The lining shall have a minimum thickness of 3/8 inch above the crest of the corrugations and shall be applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogeneous non-segregated lining throughout. The lining shall be applied in a two-course application and shall be mechanically troweled by the lining machine as the unit moves through the pipe. The trowel attachment shall be such that the pressure applied to the lining will be uniform and shall produce a lining that has a uniform thickness and a consistent troweled finish. The vertical diameter anywhere inside the pipe must be 95 percent of the nominal diameter less acceptable tolerances as stated in AASHTO M 36. Pipe not meeting these tolerances will be rejected.

(C) Experience:

The manufacturer shall certify in writing that it has successfully manufactured and furnished corrugated steel pipe with a concrete lining per these specifications on a minimum of 15 previous projects of a storm sewer nature.

1010-3 Slotted Pipe:

Slotted pipe shall conform to the applicable requirements of AASHTO M 36. It shall be the grate slot or angle slot type. Pipe shall be helically or annular corrugated.

Grate assemblies shall be fabricated from steel conforming to the requirements of either ASTM A36 or A576 and shall be galvanized in accordance with the requirements of ASTM A123. The method of manufacture shall relieve all strain and prevent distortion of the pipe.

When a lockseam joint is used, slotted drain pipe shall be placed in a clamping device and cut the entire length prior to placement of the grate. The grate must be continuous and full depth. The grate shall be welded

continuously to the pipe with a 3/16 inch fillet weld from end to end on both sides.

Bolts and nuts shall be steel conforming to the requirements of ASTM F568 and shall be galvanized in accordance with the requirements of ASTM A123.

The butyl rubber joint sealant material shall be an extruded strip or bead compounded from a nondrying, nontoxic, synthetic resin base with butyl rubber and inorganic extenders and be 100 percent solid material with no shrinkage. The sealant material shall have sufficient adhesion so that the strip or bead will adhere to galvanized steel and be soft enough to allow cold flow when compressed during connection of the pipe sections. The sealant material shall not flow or sag at temperatures up to 180 degrees F nor become brittle, crack or lose adhesion at temperatures as low as -30 degrees F and shall contain no migrating components that could leach out or produce any chemical reaction with galvanized steel. The sealant material shall be furnished in 5/8 inch by 1 inch strips or in 1 inch diameter beads on 1 inch wide release paper and wound into rolls.

An alternative joint sealant or sealing method that will provide a watertight joint may be used if approved by the Engineer.

Grout shall consist of Portland cement, aggregate, and water. It may also contain supplementary cementitious material. Portland cement, aggregate, water, and supplementary cementitious material shall conform to the requirements of Section 1006 of the specifications. If approved by the Engineer, chemical admixtures may be used. Chemical admixtures shall conform to the requirements of Subsection 1006-2.04 of the specifications, except no admixtures containing chlorides or nitrates shall be used. Air-entraining admixtures, conforming to the requirements of Subsection 1006-2.04 of the specifications, will be required for grout placed at elevations of 3,000 feet or above.

The grout shall meet the requirements given in the table below.

Minimum Cementitious Material Content: Lbs per CY (See Note 1)	**Maximum Water/Cementitious Material Ratio (w/cm): Lb./Lb.**	**Slump: Inches** (See Note 2)	**Air Content: Percent** (See Note 3)
850	0.60	9 ± 2	0 – 8

Notes:

(1) A maximum of 25 percent of the cementitious material, by weight, may consist of an approved Class F fly ash, conforming to the requirements of ASTM C618.

(2) The consistency of the grout shall be as approved by the Engineer.

(3) For placement of grout at elevations of 3,000 feet or above, the air content shall be a minimum of 4 percent and a maximum of 8 percent.

The aggregate shall consist of fine aggregate; however, at the option of the contractor, No. 8 coarse aggregate may be used in the grout. If No. 8 coarse aggregate is used, the volume shall be a maximum of 35 percent of the total aggregate volume.

For plant-mixed grout, the proportioning, mixing, and placing shall be in accordance with the applicable requirements in Section 1006 of the specifications.

For on-site mixing, grout that has been mixed more than one hour shall not be used.

Re-tempering of grout will not be permitted.

1010-4 Structural Plate Pipe:

Structural plate (steel) for pipe, pipe-arches and arches and the accessories for connecting the plates shall conform to the requirements of AASHTO M 167.

Structural plate (aluminum alloy) for pipe, pipe arches and arches and the accessories for connecting the plates shall conform to the requirements of AASHTO M 219.

When specified on the project plans or in the Special Provisions, structural plates (steel) and structural plates (aluminum alloy) shall be bituminous coated in accordance with the requirements of AASHTO M 243. Unless otherwise specified, the coating shall be applied to the outside only.

Concrete for footings, bottom slabs on paved inverts, and rings on struts shall conform to the requirements of Section 1006 of the specifications for the strength and class specified on the project plans.

Steel bars, wire, wire fabric, anchor bolts, and structural steel shall conform to the requirements of Section 1003 or 1004 of the specifications, as applicable.

1010-5 Nestable Steel Pipe:

Nestable corrugated steel pipe shall conform to the requirements of AASHTO M 36, except that the pipe shall be fabricated in two separate semi-circular sections. The two sections shall be firmly joined together in accordance with the requirements of Military Specification MIL-P-236. At the option of the contractor, the longitudinal joint of the nestable pipe sections shall be either Type I, flanged, or Type II, notched, as specified in MIL-P-236.

1010-6 Reinforced Concrete Pipe:

Reinforced concrete pipe (circular) shall conform to the requirements of AASHTO M 242 for the D-load specified.

Reinforced concrete pipe (circular) shall conform to the requirements of AASHTO M 170 for the class of pipe specified.

Reinforced concrete pipe (elliptical) shall conform to the requirements of AASHTO M 207 for the class of pipe specified.

Reinforced concrete pipe (arch) shall conform to the requirements of AASHTO M 206 for the class of pipe specified.

The contractor shall furnish the Engineer a copy of the pipe design when the standard AASHTO tables are exceeded.

Precast, reinforced concrete flared end sections shall conform to the requirements of the previously cited specifications to the extent to which they apply. The area of steel reinforcement per linear foot of the flared end section shall be at least equal to the minimum steel requirement for the reinforcement in that portion of the flared end section which abuts the pipe.

Gaskets for reinforced concrete pipe (circular) joints shall conform to the requirements of AASHTO M 198 for tongue and groove ends, or AASHTO M 315 for bell and spigot types with groove or shoulder ends.

Mortar used to join reinforced concrete pipe shall be composed by volume of one part Portland cement, two parts fine aggregate, one-fifth part hydrated lime and sufficient water to provide a plastic mixture.

Cement and water shall conform to the requirements of Section 1006 of the specifications.

Fine aggregate shall conform to the grading requirements of ASTM C144. Hydrated lime shall conform to the requirements of ASTM C207, Type N. The lime shall be considered as an addition to and not as replacement for any cement.

1010-7 Nonreinforced Concrete Pipe:

Nonreinforced concrete pipe shall conform to the requirements of AASHTO M 86 for the class of pipe specified.

Gaskets and mortar used to join nonreinforced concrete pipe shall conform to the requirements hereinbefore specified under Subsection 1010-6 of the specifications.

1010-8 Thermoplastic Pipe:

Thermoplastic pipe includes corrugated high density polyethylene plastic pipe and corrugated polypropylene plastic pipe.

Corrugated high density polyethylene plastic pipe, fittings, couplings and ends, where specified, shall conform to the requirements of AASHTO M 252 for pipe sizes less than 12 inches in diameter and AASHTO M 294 for pipe sizes 12 to 60 inches in diameter.

Corrugated polypropylene plastic pipe and fittings for pipe sizes 12 to 60 inches in diameter shall conform to the requirements of AASHTO M 330 (Type C or S) and ASTM F2881.

Non-perforated pipe shall have either water resistant or watertight joints, as specified on the project plans. Watertight joints may substitute or be used when water resistant joints are required.

Water resistant joints shall be watertight according to the requirements of ASTM D3212, except that the internal water pressure test shall be conducted at 2.0 pounds per square inch, during which the joint leakage shall not exceed 200 gallons per inch of diameter per mile of pipe per day.

Watertight joints shall be watertight according to the requirements of ASTM D3212.

Tracer wire or tape, which is to be placed in the trench with the corrugated high density polyethylene plastic pipe, or corrugated polypropylene plastic pipe as an aid in location after burial, shall conform to the requirements of Subsection 104.15(B) of the specifications.

1010-9 Steel Reinforced Thermoplastic Pipe:

Steel reinforced thermoplastic pipe includes steel reinforced high density thermoplastic ribbed pipe.

Steel reinforced high density thermoplastic ribbed pipe and fittings shall conform to the requirements of ASTM F2562.

Non-perforated pipe shall have either water resistant or watertight joints, as specified on the project plans. Watertight joints may substitute or be used when water resistant joints are required.

Water resistant joints shall be watertight according to the requirements of ASTM D3212, except that the internal water pressure test shall be conducted at 2.0 pounds per square inch, during which the joint leakage shall not exceed 200 gallons per inch of diameter per mile of pipe per day.

Watertight joints shall be watertight according to the requirements of ASTM D3212.

1010-10 Metal Safety End Sections:

Metal safety end sections shall conform to the applicable requirements of AASHTO M 36.

Bolts and nuts shall be steel conforming to the requirements of ASTM A307 and shall be galvanized in accordance with the requirements of ASTM A153.

Safety and longitudinal bars shall be fabricated using schedule 40 galvanized pipe. All bars shall be galvanized after fabrication in accordance with the requirements of ASTM A123. Components of bolted assemblies shall be galvanized after fabrication in accordance with the requirements of ASTM A153 separately before assembly.

SECTION 1014 GEOSYNTHETICS:

1014-1 General Requirements:

The contractor shall submit a Certificate of Compliance, conforming to the requirements of Subsection 106.05 of the specifications, to the Engineer upon delivery of geosynthetic material for use on the project. If the delivered materials have not been evaluated and preapproved as noted below, a Certificate of Analysis shall be submitted to the Engineer along with supporting documentation before the material may be considered for use on the project. Each geosynthetic material lot or shipment must be approved by the Engineer before the materials can be incorporated in the work.

Certificates of Analysis, conforming to the requirements of Subsection 106.05 of the specifications, shall be submitted. Samples of geosynthetic materials may be requested by the Engineer and shall be obtained and submitted for testing in accordance with the requirements of the ADOT Materials Quality Assurance Program (Appendix C – Sampling Guide Schedule). When requested by the Engineer, samples shall be submitted to the ADOT Structural Materials Section for testing.

Geosynthetic materials, including eligible biaxial geogrid, must be on the DataMine list for geotextiles and geosynthetics on the National Transportation Product Evaluation Program (NTPEP) website. The product line evaluation report from NTPEP shall be provided to the Engineer prior to use on the project.

Fibers, yarns, and filaments used in the manufacture of geotextile fabric, and the threads used in joining by sewing, shall consist of long-chain synthetic polymers, composed at least 95 percent, by weight, of polyolefins or polyesters. They shall be formed into a stable network such that the filaments or yarns retain their dimensional stability relative to each other, including selvages.

Geosynthetic materials shall be furnished in protective covers capable of protecting the materials from harmful environmental conditions such as ultraviolet rays, abrasion, extreme heat, and water. Storage of the

materials shall be in a manner that prevents damage, contamination, or deterioration.

Geotextile fabric shall be resistant to chemical attack, rot, and mildew, and shall have no tears or defects which will adversely alter its physical properties.

All numeric values in the following tables, except for apparent opening size (AOS), represent minimum average roll values (MARV) in the weaker principal direction. Numeric values for (AOS) represent maximum average roll values.

Woven slit film geosynthetics will not be allowed for use in Subsections 1014-5, 1014-6, 1014-7, and 1014-9 of the specifications.

1014-2 Pavement Fabric:

The pavement fabric shall be specifically designed for the designated pavement application, as a waterproofing and stress relieving membrane between two successive asphalt layers.

The width of the fabric shall be appropriate for the proposed construction. Pavement fabric shall meet the requirements of the following table:

Pavement Fabric Requirements		
Property	**Requirement**	**Test Method**
Mass per unit area: oz./sq. yd.	4.0	ASTM D5261
Grab strength: lb.	100	ASTM D4632
Ultimate Elongation: %	≥ 50	ASTM D4632
Melting point: degrees F	300	ASTM D276
Asphalt Retention: gal./sq. yd.	(Notes 1 and 2)	ASTM D6140

Notes:

(1) Asphalt is required to saturate paving fabric only. Asphalt retention must be provided in the manufacturer certification. Value does not indicate the asphalt application rate required for construction.

(2) Product asphalt retention property must meet the MARV value provided by the manufacturer certification.

1014-3 Geogrid:

Geogrid reinforcement material for roadway base applications shall be a bi-axial polymer grid structure, specifically fabricated for use as a base reinforcement. The width of the geogrid shall be approximately 13 feet or as appropriate for the proposed construction. The geogrid shall be one of the following structure types:

(A) A structure comprised of punched and drawn polypropylene sheet to form a grid; or

(B) A structure comprised of polypropylene extruded to form a grid.

(C) A structure comprised of polypropylene integrally formed by extruding then stretching longitudinally and transversely to form a grid.

The geogrid material shall additionally conform to the requirements shown in the table below:

Geogrid Requirements			
Property	**Requirement**		**Test Method**
	MD (Note 2)	**XMD** (Note 3)	
Average Aperture Size: inch	0.8 – 1.5	0.8 – 1.5	I.D. Calipered (Note 1)
Rib Thickness: inch	0.05	0.05	ASTM D1777
Tensile Strength: lb./ft. At 2% Strain At 5% Strain Ultimate Tensile Strength	 410 810 1,310	 620 1,340 1,970	ASTM D6637
Flexural Rigidity: mg-cm	750,000		ASTM D7748
Junction Efficiency: %	93		ASTM D7737
Resistance to UV Degradation: %	100		ASTM D4355

Notes:

(1) Maximum inside dimension in each principal direction measured by calipers.

(2) MD: Machine direction which is along roll length.

(3) XMD: Cross machine direction which is across the roll width.

1014-4 Separation Geotextile Fabric:

The physical requirements for the separation fabric will be determined by the survivability rating called out for the fabric in the Special Provisions or as shown on the project plans. Requirements for each survivability rating are listed herein and in Subsections 1014-4.01, 1014-4.02, and 1014-4.03 of the specifications.

Separation geotextile fabric shall meet the following requirements:

Property	Non-Woven	Test Method
Permittivity: sec^{-1}	0.5	ASTM D4491
Apparent opening size: U.S. Standard sieve size	No. 70	ASTM D4751

1014-4.01 Low Survivability Fabric:

Low survivability fabric shall additionally meet the following requirements:

Low Survivability Separation Fabric Requirements		
Property	**Non-Woven** **Elongation ≥50%** (Note 1)	**Test Method**
Grab strength: lb.	112	ASTM D4632
Tear strength: lb.	40	ASTM D4533
Puncture Strength: lb.	223	ASTM D6241
Ultraviolet Stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Note: (1) As measured in accordance with ASTM D4632.		

1014-4.02 Moderate Survivability Fabric:

Moderate survivability fabric shall additionally meet the following requirements:

Moderate Survivability Fabric Requirements		
Property	**Non-Woven** **Elongation ≥50%** (Note 1)	**Test Method**
Grab strength: lb.	157	ASTM D4632
Tear strength: lb.	56	ASTM D4533
Puncture strength: lb.	309	ASTM D6241
Ultraviolet stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Notes: (1) As measured in accordance with ASTM D4632. (2) The required MARV tear strength for woven monofilament geotextiles is 56 lb.		

1014-4.03 High Survivability Fabric:

High survivability fabric shall additionally meet the following requirements:

High Survivability Fabric Requirements		
Property	**Non-Woven** **Elongation ≥50%** (Note 1)	**Test Method**
Grab strength: lb.	202	ASTM D4632
Tear strength: lb.	79	ASTM D4533
Puncture strength: lb.	433	ASTM D6241
Ultraviolet stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Note: (1) As measured in accordance with ASTM D4632.		

1014-5 Bank Protection Fabric:

Bank protection fabric shall meet the following requirements:

Bank Protection Fabric Requirements		
Property	**Non-Woven** **Elongation ≥50%** (Note 1)	**Test Method**
Grab strength: lb.	202	ASTM D4632
Tear strength: lb.	79	ASTM D4533
Puncture strength: lb.	433	ASTM D6241
Ultraviolet stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Permittivity: sec^{-1}	0.7	ASTM D4491
Apparent opening size: U.S. Standard sieve size	No. 70	ASTM D4751
Note: (1) As measured in accordance with ASTM D4632.		

1014-6 Geocomposite Wall Drain System:

The geocomposite wall drain system shall be of composite construction, consisting of a supporting structure of drainage core material and a geotextile filter fabric permanently bonded to the core material on one side only. The geocomposite shall be resistant to commonly encountered chemicals and hydrocarbons, and resistant to ultraviolet exposure.

1014-6.01 Geocomposite Wall Drain Core:

The geocomposite wall drain core material shall consist of a preformed, stable, polymer plastic material with a cuspated, nippled, or geonet structure. The drainage core shall provide support for and shall be bonded to the geotextile filter fabric at intervals not exceeding 1-1/8 inches in any direction. Its preformed structure shall be perforated to allow water to flow freely to the weep hole drainage outlets. If not

perforated during manufacture, the core shall be perforated in the field at the weep hole drainage outlet locations. The core shall have at least 14 square inches per square foot of flat area in contact with the geotextile fabric to support the fabric. The core material shall additionally conform to the following physical requirements:

Geocomposite Wall Drain Core Requirements		
Property	**Requirement** (Note 1)	**Test Method**
Thickness with Fabric: inch	0.23	ASTM D1777
Compressive Strength: psf	6,000	ASTM D1621
Transmissivity; Gradient = 1.0, Normal Stress = 5000 psf, gpm/ft.	4.0	ASTM D4716
Note: (1) All numeric values represent minimum values.		

The geocomposite core shall be connected to outlet pipes or weep holes as shown on the plans. These fittings shall allow entry of water from the core, but shall not allow intrusion of backfill material into the core.

1014-6.02 Geocomposite Wall Drain Fabric:

The geocomposite wall drain fabric shall be laminated onto or adhere to the side of the drainage core which will face the backfill. Geocomposite wall drain fabric shall meet the requirements of Subsection 1014-9 of the specifications. A minimum 3-inch wide flap of fabric shall extend beyond both longitudinal edges of the geocomposite core. The fabric shall cover the full length of the core.

1014-7 Geocomposite Edge Drain System:

The geocomposite edge drain system shall be of composite construction, consisting of a supporting rectangular structure of drainage core material wrapped with a geotextile filter fabric. The fabric shall surround and be attached to the core material in a manner which does not restrict the flow capacity of the core material. The geocomposite edge drain system shall be resistant to commonly encountered chemicals and hydrocarbons, and resistant to ultraviolet exposure.

1014-7.01 Geocomposite Edge Drain Core:

The geocomposite edge drain core material shall consist of a preformed, stable, polymer plastic material with a cuspated, nippled, ridged, slotted, and/or perforated structure. The drainage core shall provide support for and may be bonded to the geotextile filter fabric. Its preformed structure shall be perforated to allow water to flow freely to the weep hole drainage outlets. If not perforated during manufacture, the core shall be perforated in the field at the weep hole drainage outlet locations unless otherwise approved by the Engineer. The core shall have at least

14 square inches of flat area in contact with the geotextile fabric to support the fabric per square foot. The core material shall additionally conform to the following physical requirements:

Geocomposite Edge Drain Core Requirements		
Property	**Requirement** (Note 1)	**Test Method**
Thickness Wrapped with Fabric: inch	0.75	ASTM D1777
Compressive Strength: psf	6,000	ASTM D1621
Transmissivity; Fabric Wrapped Core, Gradient = 0.1, Normal Stress = 1440 psf, gpm/ft.	4.0	ASTM D4716, (Note 2)
Width: ft.	1.0 (Note 3)	Measured

Notes:

(1) All values represent minimum values.

(2) Use a full width panel, if possible, testing flow on the side which may be placed against the soil to be drained.

(3) Minimum width normally required, but shall be the minimum width specified on the plans, if that is greater.

1014-7.02 Geocomposite Edge Drain Fabric:

The geocomposite edge drain fabric shall completely wrap around the drainage core material in a snug manner and may be permanently bonded to the core. Geocomposite edge drain fabric shall meet the requirements of Subsection 1014-9 of the specifications.

1014-7.03 Outlet Pipes:

The outlet pipe for the edge drain outlet lateral shall be rigid, 4-inch in diameter, Schedule 40 PVC pipe conforming to the requirements of ASTM D1785. The open end of the outlet pipe conduit shall be connected into either a drainage structure or a concrete pad drain in accordance with the details shown on the plans.

1014-8 Temporary Silt Fence Fabric:

Temporary silt fence fabric shall contain a stabilizer or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat.

The edges of the fabric shall be finished to prevent the outer yarn from pulling away from the fabric. The fabric shall be free of defects or flaws which significantly affect its physical or filtering properties. The fabric shall have a minimum width of 36 inches. Sheets of fabric may be bonded together. No deviation from any physical requirements will be permitted due to the presence of the seam.

The fabric may be manufactured with pockets for posts, hems with cord or with posts preattached using staples or button head nails.

During periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering which will protect the cloth from sunlight, mud, dust, and debris.

The fabric shall not be exposed to temperatures greater than 160 degrees F.

Temporary silt fence fabric shall additionally meet the following requirements:

Temporary Silt Fence Requirements			
Property	**Supported Silt Fence** (Note 1)	**Unsupported Silt Fence** **Woven** **Elongation <50%** (Note 2)	**Test Method**
Maximum post spacing: ft.	8	6.5	-
Grab Strength: lb. MD (Note 3) and XMD (Note 4)	124	124	ASTM D4632
Permittivity: sec^{-1}	0.05		ASTM D4491
Apparent Opening Size: U.S. Standard sieve size	No. 30		ASTM D4751
Ultraviolet Stability (retained strength):	≥ 70% after 500 hours exposure		ASTM D4355

Notes:

(1) Silt fence support shall consist of 14-gauge steel wire with a maximum mesh spacing of 6 inches by 6 inches or prefabricated polymeric mesh with a minimum strength of 200 lb./ft. x 200 lb./ft. per ASTM D6637.

(2) As measured in accordance with ASTM D4632.

(3) MD: Machine direction which is along roll length.

(4) XMD: Cross machine direction which is across the roll width.

1014-9 Drainage Fabric:

Drainage fabric shall meet the following requirements:

Drainage Fabric Requirements		
Property	**Non-Woven** **Elongation ≥50%** (Note 1)	**Test Method**
Grab strength: lb.	157	ASTM D4632
Tear strength: lb.	56	ASTM D4533
Puncture strength: lb.	309	ASTM D6241
Ultraviolet stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Permittivity: sec^{-1}	0.5	ASTM D4491
Apparent opening size: U.S. Standard sieve size	No. 70	ASTM D4751
Note: (1) As measured in accordance with ASTM D4632.		

1014-10 Stabilization Fabric:

Stabilization fabric shall meet the following requirements:

Stabilization Fabric Requirements		
Property	**Woven** **Elongation <50%** (Note 1)	**Test Method**
Grab strength: lb.	315	ASTM D4632
Tear strength: lb.	112	ASTM D4533
Puncture strength: lb.	618	ASTM D6241
Ultraviolet stability (retained strength):	≥ 50% after 500 hours exposure	ASTM D4355
Permittivity: sec^{-1}	0.05	ASTM D4491
Apparent opening size: U.S. Standard sieve size	No. 40	ASTM D4751
Note: (1) As measured in accordance with ASTM D4632.		

INDEX

A

B

C

D

E

F

G

H

I

J

L

M

N

O

P

Q

R

S

T

U

V

W