MANUAL OF PROCEDURES

FOR

FLEXIBLE PAVEMENT CONSTRUCTION

JANUARY 1996

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1. FOREWORD

The Manual of Procedures for Flexible Pavement Construction is devoted to the inspection requirements for flexible pavement construction and for central plant proportioning and mixing of bituminous paving mixtures. The instructions contained herein define the duties and responsibilities of Department project personnel in the determination of compliance with the provisions of the contract, the measurement of quantities for payment and the documentation of compliance and measurements. In no instance does this manual alter the provisions of the contract.

Throughout this manual, metric (SI) units are used as the primary unit with English units following in parentheses. Metric conversion of English units is generally in accordance with ASTM E 380 and AASHTO guidelines. In some cases, metric conversion has been rounded to a practical value rather than a precise conversion. Industry standard metric values have been adopted where available.

2. INTRODUCTION

The term flexible pavement, used throughout this manual, includes pavement construction composed of bituminous material and aggregate mixtures or various combinations of layers of these mixtures on layers of aggregate base or subbase. Although designs may vary in the combination of these materials, the flexible pavement functions in a definite manner under traffic loads. It is the intent of the design that deflection of the pavement in reaction to wheel loads will not stress the materials to the point of fracture within a reasonable life expectancy of the pavement.

Except for seal coats and other surface treatments, the strength of all flexible pavement layers, including subgrade, is dependent upon the density of the material and the gradation of the particle sizes. In addition, the strength of the subgrade and granular base material is dependent on moisture content, and the strength of bituminous mixtures is dependent on the quantity and viscosity of the bituminous material. While the strength of granular base materials is less affected by moisture content than soil subgrade material, adequate drainage of this material is necessary to prevent saturation of soil subgrade material and loss of subgrade strength.

All flexible pavement courses, except seal coats, are placed loose by means of spreading and leveling equipment and then compacted with compaction equipment. The typical sections or other plan details specify the width and thickness of the individual courses. For granular subbase and base courses, the thickness shown in the plans is the actual compacted thickness to which the course is to be constructed. Normally, the thickness specified for all other courses is to be used to calculate a weight of material to be placed per unit of area.

The purpose of material sampling and testing and construction inspection is to determine that only approved materials are used and that the materials are processed and placed in accordance with all contract provisions. Systematic record keeping is necessary to furnish documented evidence that this has been accomplished. The minimum requirements for the necessary records are stated under the individual items of work covered in this section of the manual.

The administration of the unit price contract also requires the determination of pay quantities. The contract states the method of measurement for each item of work and it is very important that each pay quantity determination be adequately documented.

3. DEFINITIONS AND TERMS

Common words and terms used in this manual or when discussing flexible pavement items are defined in this section. Definitions for other words or terms that may call for clarification in this manual are found in the "Construction and Materials Specifications."

AASHTO - American Association of State Highway and Transportation Officials

AC - See the definition of asphalt cement.

Aggregate - Mineral material, such as sand, gravel, crushed stone, slag or combinations thereof.

Asphalt Cement - A thermoplastic cementing or binding material obtained as a residue in the distillation of petroleum.

Asphalt Concrete - A mixture of aggregate and bituminous material. Some types of asphalt concrete are 402, 404, 446 and 448.

ASTM - American Society of Testing and Materials

Batch Plant - A plant in which dry, hot aggregate and bituminous material are proportioned in fixed or batched quantities into a pugmill (mixer) for mixing. Then the resulting asphalt concrete is either batched directly into a haul truck or stored in a storage bin for later use.

Bitumen - A mixture of hydrocarbons which is the predominant constituent of asphalt cement and tar.

Bituminous Aggregate Base - A type of asphalt concrete which is used as a base course in the construction of a pavement. Two types of bituminous aggregate base are 301 and 302.

Bituminous Concrete - See the definition of asphalt concrete.

Bituminous Material - A material characterized by the presence of bitumen.

Bleeding - The rising of an excess of bituminous material to the surface of a bituminous mixture.

CAS - Construction Administration System, a part of CMS which provides support to all construction administration activities from the time at which a contract has been signed to the time at which the contract has been finalized.

Checking - Short transverse cracks, 25 to 100 mm (1 to 4 inches) in length and 25 to 75 mm (1 to 3 inches) apart, which develop in the asphalt concrete mat during the compaction process.

Choke - Aggregate used for the purpose of filling the surface voids of a coarse aggregate mixture.

CMS - 1. Construction Management System, a set of computer programs developed for the management of construction and testing activities on a project from the time at which a contract has been signed to the time at which the contract has been finalized; or

2. Construction and Material Specifications of the Ohio Department of Transportation; or

3. Cationic medium setting emulsion. See the definition for emulsion.

Coarse Aggregate - Aggregate which is retained on the 4.75 mm (No. 4) sieve.

Compaction - A consolidation or compression of materials resulting in an increase in density of the materials.

Compression Rolls - The compaction load of a steel wheel roller, expressed in kN/m (pounds per inch), which is defined as the weight of the roller divided by the combined width of all the drums on the roller. The compression rolls requirements for rollers are specified in 401.11.

Continuous Plant - A plant in which aggregate and bituminous material are proportioned and mixed in a continuous flow process.

Course - A layer or layers of a given material or mixture placed as a part of the pavement structure.

Cross Section - In the field, elevations taken along a line at right angles to the centerline. On a drawing, a profile of the existing ground at right angles to the centerline. The drawing of an earthwork cross section also shows the shape of the finished excavation or embankment at the same point. A roadway cross section shows the thickness and width of the pavement courses.

Cross-Slope - The transverse slope of the pavement, either crown or superelevation. See Section 8.10.3 for details on checking the cross-slope of a pavement.

Crown - The height of the center of the roadway surface above a straight line drawn between its edges. See Section 8.10.3 for details on checking the crown of a pavement.

Cut Back Asphalt - Asphalt cement which has been rendered fluid by fluxing it with a light volatile petroleum distillate. Upon exposure to atmospheric conditions the volatile distillate evaporates, leaving only the asphalt cement which reverts to its original semi-solid condition.

Cut back asphalts are classified as rapid curing (RC), medium curing (MC), or slow curing (SC).

Degradation - A reduction in aggregate particle size due to breakage and water.

Density - The ratio of the weight of a given material to its volume.

Drum Mix Plant - A continuous production plant in which cold aggregate is proportioned and dried in the first half of a drum and then mixed with bituminous material in the second half of the drum. Then the resulting asphalt concrete is stored in a storage bin for later use.

Elevation - The height as measured from a predetermined point denoted in the plans.

Emulsion - A suspension of extremely small droplets of asphalt or tar in water in the presence of an emulsifying agent, which usually is a type of soap. Upon exposure to atmospheric conditions the water evaporates, leaving only the asphalt cement which has been modified by the emulsifying agent. Emulsions are classified as rapid setting (RS or CRS), medium setting (MS or CMS), or slow setting (SS or CSS). The letter “C” in front of an emulsion type (CRS, CMS, or CSS), denotes a cationic (positively charged) emulsion. If the emulsion type does not start with the letter “C” (RS, MS, or SS), the emulsion is anionic (negatively charged) or non-ionic (neutral charge). If the emulsion type is followed by an “h” (SS-1h, CMS-2h, etc.), the emulsion was made from a harder base asphalt cement.

Fat Spots - See the definition of bleeding.

Fine Aggregate - Aggregate which passes the 4.75 mm (No. 4) sieve.

Flushing - The drawing of bituminous material to the surface of a bituminous mixture, due to the action of traffic.

Gradation - The distribution of particle sizes in an aggregate or bituminous mixture.

Grade - The rate of change of the profile elevations. See Section 8.10.1 for details on checking the grade of a pavement.

Inspector’s Daily Report - A form used by an inspector to document the activities performed by a Contractor. The Inspector Daily Report is Form CMS-1.

JMF - See the definition of job mix formula.

Job Control - Inspection and testing conducted to determine compliance of the materials and work with the contract requirements.

Job Mix Formula - The mix composition of an asphalt concrete approved by the Laboratory. The job mix formula (JMF) of a mix can be obtained from the “BCJMF” screen in the TAS portion of CMS. The JMF number of the mix needs to be known to use the “BCJMF” screen.

Keying - The interlocking of aggregate particles by compaction.

Laboratory - The Office of Materials Management of the Department’s Central Office in Columbus, which is also known as the Central Test Lab.

Marshall Mix Design - Volumetric mix design procedure used to establish the optimum bitumen content for an asphalt concrete. The procedures for designing a mix using the Marshall mix design is contained in 441.02 and the Asphalt Institute Manual Series No. 2.

Mineral Filler - limestone dust, portland cement, or other inert mineral matter. The specifications for mineral filler are contained in 703.07.

NAPA - National Asphalt Pavement Association

NCAT - National Center for Asphalt Technology

Odometer - An instrument used for measuring traveled distance.

Oscillating Wheel - The vertical movement of pneumatic tire roller’s wheels over irregularities in the surface on which the roller is operated, providing a kneading action.

P.E./P.S. Daily Report - A form used by the Engineer or Project supervisor to document the activities performed by a Contractor. The P.E./P.S. Daily Report is Form CMS-2.

PG Binder - An asphalt cement which has been graded by the PG Binder system developed by SHRP. An asphalt cement has to be modified with an additive to meet some of the PG Binder grades. An example of a PG Binder Grade is PG 64-28. Binders graded using the PG Binder system will replace the current viscosity graded system used by the Department.

Placement Rate - The placement of paving materials on the basis of a given weight and area covered. Placement rate is described in detail in Section 8.7.

Plant - The plant where aggregate and bituminous material are mixed together or the plant which produces the aggregate or the bituminous material.

Pneumatic Tire Roller - A roller with 3 to 5 rubber tires mounted on two tandem axles. The wheels that the tires are mounted to oscillate, which means they are capable of moving up and down independently of each other. The pneumatic roller compacts a pavement using the combined force of weight and the kneading action of the oscillating wheels. The specifications for a pneumatic tire roller are contained in 401.11.

Prime Coat - An application of bituminous material made on the surface of a pavement layer for the purpose of binding the surface particles together. The specifications for a prime coat are contained in 408. Prime coats are described in Section 5.

Profile - A line on a drawing which shows elevation of points along a selected route. A profile usually shows both ground elevations and grade-line elevations. See Section 8.10.2 for details on checking the profile of a pavement.

RAP - The abbreviation for reclaimed asphalt pavement, which can be reclaimed asphalt concrete pavement or recycled bituminous aggregate base pavement. The specifications for the use of RAP is contained in 401.031 and 441.03.

Raveling - The loss of aggregate from the surface of a bituminous mixture due to a lack of adequate compaction, segregation of the mixture, high dust content, or a lack of bituminous material for binding the aggregate particle together.

Screed - A rectangular trowel on a bituminous paver used to cut off the bituminous mixture at the desired thickness, to smooth the surface and consolidate the material.

Screenings - This is No. 10 size gravel, stone, or air-cooled slag. The specifications for screenings are contained in 703.10.

Seal Coat - An application of bituminous material and cover aggregate used to protect a pavement course from weathering and wear. The specifications for a seal coat are contained in 409. Seal coats are described in Section 7.

Segregation - The separation of the coarse and fine particle sizes in an aggregate or bituminous mixture.

Shoving - The plastic deformation or displacement in a bituminous mixture in the direction of traffic movement.

SHRP - Strategic Highway Research Program, which was completed in June of 1992, after yielding numerous products including Superpave and PG Binders in the flexible pavement area.

Steel Wheel Roller - A roller which compacts an asphalt concrete with static steel drums. Types of steel wheel rollers are the three wheel roller, tandem roller, trench roller, and vibratory roller.

Strike Off - A blade used to cut off material at the desired elevation or thickness.

Superelevation - The difference in elevation between the inside and outside edges of a roadway on a horizontal curve. See Section 8.10.3 for details on checking the superelevation of a pavement.

Superpave - Mix design procedure developed by SHRP, which establishes material properties of an asphalt concrete mix by using a gyratory compactor and other testing equipment developed by SHRP. Superpave will eventually replace the Marshall mix design method.

Surface Texture - A term used to describe the appearance of the surface of a pavement course such as sandy, coarse, open, dense, uniform, etc.

Surface Treatment - See the definitions for seal coat, prime coat, or tack coat.

Tachometer - An instrument for measuring the speed of rotation.

Tack Coat - An application of bituminous material made on a pavement surface for the purpose of bonding the existing course to the overlying course. The specifications for a tack coat are contained in 407. Tack coats are described in Section 6.

Tandem Roller - A steel wheel roller with two drums mounted on tandem axles, which compacts a pavement using the force of the roller's weight. The specifications for a tandem roller are contained in 401.11.

TAS - Testing Administration System, a part of CMS which provides support to all sampling, testing and approval or disapproval of materials used on a project, to the time at which the contract has been finalized.

Three Wheel Roller - A steel wheel roller with three drums, two drums mounted on the rear axle and a smaller drum mounted on the front tandem axle, which compacts a pavement using the force of the roller's weight. The configuration of the drums on a three wheel roller allows it to compact longitudinal joints without interfering with traffic in the adjacent lane. The specifications for a three wheel roller are contained in 401.11.

Tolerance - The allowable limits of variation from a specified measurement.

Transition - The distance in which a change is made gradually from one pavement cross section to another.

Vibratory Roller - A steel wheel roller with one (single drum) or two (double drum) drums, which compacts a pavement using the combined force of weight and the vibration of the drum or drums. The specifications for a vibratory roller are contained in 401.11.

Viscosity - Resistance to flow in a liquid. The higher the viscosity, the greater the resistance to flow. Asphalt cements can be graded by viscosity. An example of a viscosity graded asphalt cement is AC-20.

Yield - The area of a surface covered by a given quantity of material measured in square meters (square yards).

4. MATERIALS INSPECTION, SAMPLING AND TESTING

Control of Material, 106, provides that all materials are to be inspected, tested and in compliance with the specifications prior to incorporation in the work. Minimum requirements for sampling materials are given in 700, Material Details. Samples of materials taken to meet these requirements are called job control samples. Job control samples also include samples taken as judged necessary to determine continued compliance of materials previously approved. These samples always represent a definite quantity of material.

Advance notice by the Contractor of the intended source of supply for specified materials is required to permit sampling and testing of the materials. Evidence of the approval of the materials must be in the Laboratory or a notification of approval given in advance of the Laboratory report by telephone, teletype, or documents identifying a shipment from plant inspected or plant sampled stock.

4.1 Aggregate

Aggregate may be hauled to the paving site from approved stockpiles located at the source, on the project or at some intermediate storage point. In any case it is necessary to maintain sufficient surveillance to assure that loading is from approved stock and that identity of the stockpile is not altered by addition of material or other cause. It also is necessary to inspect the aggregate for uniformity as it is being loaded or placed. When such observations are made, they should be recorded for the project record.

4.2 Aggregate Stockpiling

Two fundamental requirements are included in 703.01 for aggregate stockpiles: separate identity, and freedom from contamination. In addition to these considerations, knowledge of the method used in constructing the stockpile is necessary to have an understanding of the characteristics of the material as it is drawn from the pile for use.

The characteristic of an aggregate most affected by the method of stockpiling is its gradation. The larger size aggregate particles have a tendency to separate from the smaller size particles in parts of the stockpile; this is called segregation. A reduction in aggregate particle size also can occur due to breakage or wear; this is called degradation.

Segregation is more likely to occur in an aggregate having a relatively large particle size range from coarse to fine. The amount of segregation of aggregate particle sizes usually depends on the degree of freedom the aggregate has to flow from one place to another during stockpiling or handling. Usually, segregation is minimized when the stockpiles are formed by placing the aggregate in successive small mounds or layers. Small pockets of segregated aggregate are not objectionable in the stockpile, when re-mixing occurs in the loading and spreading operations, resulting in a uniform appearance. When these pockets are sufficiently large that non-uniform areas can be observed in the material placed on the grade, however, the results are unsatisfactory and corrective measures assuring uniform material in place are required.

Degradation of an aggregate may occur during stockpiling due to the action of hauling and spreading equipment operating on the stockpile. Aggregate particles may be broken into smaller sizes by heavy compressive forces exerted by such equipment: also, excess fine particles may be produced by interparticle abrasion caused by repeated application of these forces. Normally, however, degradation is severe only in the case of very brittle or very soft aggregate particles.

4.3 Liquid Bituminous Materials

The Laboratory maintains a certification program throughout the year with all participating liquid bituminous material producers. Reference should be made to Supplement 1032, regarding forms used for identification of loads from approved stock. Loads arriving without proper identification are not to be used until specification compliance can be determined.

Since liquid bituminous materials may become contaminated and errors in shipment may occur, it is necessary to observe the delivered materials. Where there is a question concerning the quality of the material, the Contractor should be notified and a check sample should be taken.

4.4 Asphalt Concrete

The quality control of an asphalt concrete mix is performed either by the Department, when the acceptance of the mix produced is in accordance with 401.02 (301, 302, 402, 403, 404, etc.), or by the Contractor, when the mix is designed and controlled in accordance with 441 (446, 448, etc.).

4.4.1 Department Quality Control (401.02)

Department quality control is performed by an asphalt concrete plant inspector. The duties of the asphalt concrete plant inspector include all necessary sampling and testing of the materials for the items controlled in accordance with 401.02.

4.4.2 Contractor Quality Control (441)

When asphalt concrete is designed and controlled in accordance with 441, the Contractor is required to provide a laboratory and quality control technician meeting the requirements of Supplement 1041. The duties of the Contractor's quality control technician include all necessary sampling and testing of the materials for the items controlled in accordance with 441. When quality control is performed by the Contractor, the Department monitors the quality control testing. This monitoring program, also known as a quality assurance program, is in accordance with Laboratory policy and may include observing the Contractor's test procedures, testing sister samples of the Contractor's samples, or testing randomly obtained samples.

5. PRIME COAT

Construction requirements for prime coats are included in 408. A bituminous material having low viscosity is required for a prime coat. This material is intended to penetrate a prepared granular surface prior to the placement of a bituminous paving mixture. The purpose is to bind the granular particles together for some depth below the surface.

5.1 Weather and Moisture Limitations

When there is sufficient moisture present in the aggregate to impede the penetration of the bituminous material, or when the atmospheric temperature is below the minimum specified in 408.04, application of the prime coat should not be permitted.

5.2 Equipment

The inspection and approval of the bituminous distributors used to apply the prime coat material is covered in Section 7.2. The spreading of the cover aggregate, when required can be accomplished by any approved method, depending upon the specific job conditions. When sweeping is required, the brooms approved for use should produce a uniform surface without causing damage.

5.3 Preparation of Surface

The surface to be primed should meet all requirements for the particular specification item. Irregularities in excess of specified tolerances must be repaired prior to priming.

5.4 Application of Bituminous Material

The specified application rate for the bituminous material is an estimated rate suitable for average conditions. Open textured surfaces may permit an increase, while dense surfaces may require a reduction in the estimated rate. The application rate should be such that the prime will be absorbed by the material within 24 hours.

The application rate established as satisfactory should be suitable for the remainder of the work. Reference should be made to Section 7.2 for guides in judging distributor spray results and instructions for checking the actual rate of application.

Only bituminous material meeting the requirements of 408.02 are permitted to be used. Loads of bituminous material delivered to the project should carry evidence of approval as defined in Section 4.3. This evidence of approval and the material weight tickets are to be validated at the paving site before the material is used.

5.5 Quantities for Payment

Although the specifications provide for measurement of the bituminous material either by volume or weight conversion, weight conversion is the method normally used. The weighing of the load must be observed and the weight ticket validated by an inspector, or the quantity must be verified by a volumetric check. When loads are received on the project without validation of the weight ticket and it is impractical to have the load reweighed, the quantity of material should be checked using the calibrated volume measuring device on the distributor.

The temperature and the volume of the material are measured and recorded on the Inspector's Daily Report for the project record. While this method is not intended to be used as a substitute for the basic method of measurement by weight, quantity determined by a volumetric check is to be used as the pay quantity when a significant difference is found to exist between this quantity and the one obtained by conversion of the invalidated weight.

Where loads are delivered to storage tanks off the project, special measures may be necessary to maintain prior approval status of the material and it becomes necessary to weigh loads drawn from storage for use on the project.

Any loads partially used should be weighed to determine the quantity used. All weights should be summarized and converted to the nearest liter (gallon) in accordance with current Laboratory policy.

Cover aggregate is only used for the protection of public traffic using the road. Any cover aggregate used is included in the price for the bituminous prime coat.

6. TACK COAT

Construction requirements for tack coats are included in 407.

The tack coat is an application of liquid bituminous material on an existing pavement surface, used as an aid in bonding a new bituminous paving course to the existing pavement surface. Tack coats are specified for most resurfacing work, but also may be employed under special conditions in new construction. Since most resurfacing work is performed with traffic maintained, special attention must be given to traffic control requirements.

6.1 Equipment

The inspection and approval of bituminous distributors used to apply tack coat material are covered under Section 7.2. Mechanical sweepers and other related hand equipment may be of any type that will accomplish the required results.

6.2 Temperature Limitations

The tack coat should not be applied when the surface temperature of the existing pavement is below the minimum placement temperature for the pavement course to be placed. The minimum placement temperatures for pavement courses are specified in 401.05. The surface temperature is to be recorded on the Inspector's Daily Report.

6.3 Preparation of Surface

The preparation of the existing pavement surface for the application of a tack coat is a cleaning operation. All material accumulations on the existing surface which would interfere with the adhesion of the tack coat or with the placing and performance of the bituminous course should be removed. This material includes dust, loose aggregate, soil, leaves and pieces or lumps of other foreign material deposited on the surface. Cleaning may require brooming, handscraping and perhaps power blading of heavy accumulations. Special attention should be given to the edges to assure proper coverage of the full width intended.

The surface must be reasonably dry for the application of cutbacks. However, emulsions may be applied on damp surfaces.

6.4 Application Rates

A field review of the existing pavement surface should be made soon after the award of the contract in order to determine tack coat requirements. Requirements should be determined and transmitted promptly to the Contractor to facilitate job planning. Guides for determining the quantity of tack coat needed are given under the following types of resurfacing:

Bituminous Cold Mix on Existing Bituminous Surface - A tack coat should be applied only on extremely dry or partially disintegrated areas of the existing bituminous surface. This may require spot applications or continuous full or part width applications. For this type of work, the tack coat is of more value as a prime. The nature of the bituminous cold mix is such that a bonding application is not a requirement on a reasonably clean bituminous surface.

Asphalt Concrete Placed on Portland Cement Concrete - A light tack coat application, 0.23 to 0.45 liters per square meter (0.05 to 0.10 gallons per square yard), is always required on existing portland cement concrete pavements.

Asphalt Concrete Placed on Bituminous Cold Mix - Tack coat should be applied to dry and cracked areas of the bituminous cold mix surface. Where bituminous material is visible on the existing surface, the hot asphalt concrete will form a good bond without the tack coat.

Asphalt Concrete Placed on Asphalt Concrete - Normally the existing asphalt concrete surface will be somewhat dry from weathering and a moderate application, 0.45 liters per square meter (0.10 gallons per square yard) or less, should be made. For thin, less than 25 mm (1 inch) single course resurfacing, a uniform light coverage over the entire surface is of particular importance.

6.5 Protection and Control of Traffic

When the contract requires traffic to be maintained, tack coat application should not be allowed to start until the provisions of the traffic maintenance item have been met. Alternate movement of one way traffic must be in operation before the distributor is brought into the starting position. Special attention must be given to the Contractor's operation relative to traffic movement. Every reasonable effort should be made to keep “pick up” of the bituminous material, prior to paving, to a minimum. This may involve tacking in sections and allowing time for curing.

6.6 Application of Bituminous Material

Only bituminous material meeting the requirements of 407.02 are permitted to be used. Loads of bituminous material delivered to the project should carry evidence of approval as defined under Section 4.3. This evidence of approval and the material weight tickets are to be validated at the paving site.

Reference should be made to Section 7.2 for guides in judging distributor spray results and instruction for making record checks of the actual application rate.

The bituminous material should be sprayed uniformly on the pavement surface. If streaking is occurring, the Contractor should be required to adjust the distributor. Streaking is caused by faulty distributor adjustment or operation, resulting in the bituminous material being placed in ridges. Contrary to popular belief, these ridges will not “flow” together. The result is insufficient bituminous material between the ridges to bond the new bituminous paving course to the existing pavement surface.

6.7 Application of Cover Aggregate

Cover aggregate shall only be used in areas where the bituminous material will be exposed to traffic.

If cover aggregate is used, approved cover aggregate is required to be sufficiently dry to permit adhesion of liquid asphalt. When the cover aggregate is placed on an asphalt emulsion tack coat, the aggregate may be moist, but not to the extent that free water drains from the truck bed.

For all types of bituminous materials, the cover aggregate should be placed as close behind the distributor as is practical.

The Contractor is required to apply only the quantity of cover aggregate needed to prevent “pick up” by traffic.

6.8 Quantities for Payment

Reference should be made to Section 5.5 for the method for determining the pay quantity for the tack coat bituminous material. Cover aggregate is included in the bid price for the tack coat.

7. SEAL COAT

Construction requirements for seal coats are included in 409.

The seal coat consists of an application of liquid bituminous material covered by an application of aggregate. It is applied as a surface course on all types of pavements and on paved berms. This course often is termed a surface treatment when applied on a granular material and a seal coat when applied on a hard surface.

As the name implies, the purpose of the seal coat is to seal and protect the underlying course from weathering and from wear by traffic. This protection is provided by the film of bituminous material. The purpose of the cover aggregate is to protect the film from traffic and provide a skid resistant surface. When applied on berms, the cover aggregate provides delineation of the traffic lanes from the berms by a change in surface color and texture.

7.1 Weather and Moisture Limitations

For seal coats, the weather limitations are specified in 409.04.

7.2 Equipment

The following equipment should be checked and approved before it is used on seal coat construction.

7.2.1 Distributors

The requirements for bituminous distributors are included in 407.03. The distributor consists of a truck or truck trailer on which is mounted the following major equipment:

Tank - The tank is an insulated container for the heated bituminous material. It is fitted with heating flues, a thermometer, baffle or surge plates, a manhole and an overflow pipe.

Burners - The burners, one or two in number, are used to heat the material. The burners throw a direct flame into the heating flue which, in turn, transfers heat to the material.

Pump - The pump is used to circulate the material through the tank and spray bar system. When the spray nozzle valves are opened, the pump forces the material through the nozzles.

Spray Bar - Distributors are required to be equipped with full circulating spray bars that prevent clogging by keeping material flowing when not spraying. These are two compartment bars, bars with an inner tube, or bars consisting of two pipes. The spray bar has nozzles, usually mounted 100 mm (4 inches) apart, through which the material is applied to the road surface.

Controls - The controls include a valve system which governs the flow of material, a pump tachometer or a pressure gauge which registers pump output, and an odometer which indicates the distance traveled per minute and total distance traveled.

The inspector should make a general inspection of the distributor to become familiar with the particular equipment and to detect any variance from the specifications that can be observed. In particular, the inspector should have the Contractor demonstrate the use of the required volume measuring device, thermometer and application controls. Work should not be permitted to start if this equipment is unsatisfactory. In addition, the approval of the distributor is based on observation of the operation and check measurements of the actual application rate, performed as described in the following paragraphs.

For large areas, the application rate is determined by the application of a given quantity of bituminous material over a known area. The rate is calculated using the liters (gallons) indicated by the volume indicating device on the distributor, the known length of the distributor run, and the measured width covered. The distributor may be approved only when the measured application rate is within plus or minus 10 percent of required rate. The application rate for small areas, where volume measurement is not practical, may be judged visually.

The operation of the distributor is judged by visual observation. The quantity of material flowing from each nozzle should appear to be uniform. The angle of each “fan” of material with the spray bar should appear to be the same. The particular angle is specified by the manufacturer. The material should be applied uniformly across the width of the spray bar with no visible streaks and with no apparent variations in thickness from the beginning to the end of the run.

While some visible defects in application such as streaking or ridging will not seriously affect performance of prime or tack coats, they cannot be tolerated on seal coat work. This means the inspector must be more particular where seal coats are involved and must approve or prohibit use of a particular distributor accordingly.

The results of the foregoing observations and check tests are recorded for each distributor proposed for use together with a means of identification (license plate or equipment number) and indication of approval or non-approval. This information is entered in the project record as a supplement to the Inspector’s Daily Report.

After the initial inspection, continued approved status of a given distributor is dependent on continued satisfactory results determined visually or by additional checks when deemed advisable.

7.2.2 Rollers

Only pneumatic rollers are permitted for embedding the cover aggregate into the bituminous film, unless a seal coat is placed on new bituminous cold mix, in which case both pneumatic tire and steel rollers are required.

7.2.3 Aggregate Spreaders

The aggregate spreader must be of the revolving drum type and may be a self-contained unit or an attachment for a truck. In this kind of spreader, the aggregate is carried through an adjustable opening by a revolving drum or cylinder extending the full width of the spreader. The spreader must produce a uniform application of aggregate without gaps or ridges at the rate specified.

7.2.4 Brooms

A rotary broom is required to sweep excess cover aggregate from the completed surface. The broom should not dislodge the embedded aggregate during this operation.

7.3 Preparation of the Surface

Before a seal coat is applied on an existing surface, all irregularities in excess of specified tolerances should be corrected and all material accumulations that would interfere with the adhesion of the bituminous material should be removed. Objectionable material includes dust, loose aggregate, soil, leaves, and pieces or lumps of other foreign material. Proper cleaning of the surface requires brooming and may necessitate hand scraping and power blading of heavy accumulations. Special attention should be given to the edges to assure proper coverage of the width intended.

7.4 Application Rates

7.4.1 Bituminous Material

With all other conditions being equal, the application rate of bituminous material is dependent of the average size of the cover aggregate particles. In a good seal coat, the average size particle will be embedded for approximately half its thickness after thorough seating by rolling. When the application rate is too heavy, the particles may become totally embedded, resulting in a flushed or bleeding surface. When the application rate is too light, the particles may not be held with sufficient firmness to resist dislodging forces of traffic, and a loss of cover aggregate will result.

The application rate required to produce proper embedment for a given particle size also may depend upon the porosity, absorption and firmness of the surface to be sealed. The rate specified in the contract may require adjustment depending upon the actual nature of the surface. Considerable judgment is required to determine the proper application rate and avoid undesirable effects of bleeding or raveling.

In order to check the specified application rate, the existing surface conditions should be observed and an application of bituminous material made over a small area. After application of the cover aggregate, the area should be rolled thoroughly to assure maximum embedment of the aggregate particles. The amount of embedment of an average size particle should be observed at several locations. Adjustments should be made in the rate of application of the bituminous material based upon the observed results and the following facts:

1. Little additional embedment will occur under traffic on a hard surface, while considerable additional embedment may be expected to occur on a soft surface. A hard bituminous surface may become soft as the temperature increases, however, and allowances must be made when this condition exists.

2. On a porous surface, application temperature of the bituminous material should be held to the lower side of the specified range (702.00) to keep penetration to a minimum.

3. For a given application rate, flat-shaped particles will require less bituminous material than particles having a rounded or cubical shape.

4. Under rolling and traffic, aggregate particles will be forced into a flat orientation (greatest dimension parallel to the pavement surface).

7.4.2 Cover Aggregate

Cover aggregate should be applied to one layer of aggregate particles. The rate of application is dependent only on the characteristics of the aggregate. It can be determined in advanced by spreading a single dense layer of the actual aggregate to be used on the surface of a given area, and weighing the quantity used. This quantity then is increased by 20 percent and the application rate calculated in kilograms per square meter (pounds per square yard). After this rate of application has been established, it should govern the amount of aggregate used on the remainder of the work.

Application of cover aggregate in excess of requirements for complete coverage is to be avoided. When an excess of material is applied, the particles tend to interlock, interfering with orientation and embedment under the rolling.

7.5 Common Deficiencies and Probable Causes

Deficiencies in seal coat construction often do not show up until the surface has been under traffic for a period of time. It is necessary, therefore, to learn to detect practices during construction which will result in inferior work. An effective way to develop this skill is to observe previous seal coat work, noting deficiencies and determining the probable cause. Following are listed some common deficiencies which occur in seal coat construction and their probable causes:

Streaking - Streaking is caused by faulty distributor adjustment or operation, resulting in the bituminous material being placed in ridges. Contrary to popular belief, these ridges will not “flow” together, particularly when the cover aggregate is applied immediately after the application of bituminous material as it should be. The result is insufficient bituminous material between the ridges to hold the aggregate in place and the aggregate soon will be whipped off by traffic. This leaves only the aggregate which is well bonded in the ridges and produces a streaked appearance.

Loss of Cover Aggregate - This is a serious form of seal coat failure because of the traffic hazard created by the exposure of the slippery film of bituminous material and flying aggregate particles. It may be caused by one or more of the following:

1. Too light an application of the bituminous material
2. Penetration of the bituminous material into the underlying surface
3. Use of an improper grade of bituminous material for existing conditions
4. Delay in spreading the aggregate on the film
5. Excess aggregate application
6. Lack of adequate rolling
7. Use of wet or dirty aggregate
8. Opening the roadway to traffic before adequate curing has taken place

Bleeding - Bleeding is defined as a flushing of bituminous material to the surface, completely or almost completely submerging the cover aggregate. Continuous bleeding simply is the result of too high a rate of application. Spotty bleeding usually is the result of variations in the surface of the existing pavement. Bleeding at connections between distributor loads is the result of an overlap of the previous run.

7.6 Application of Bituminous Material

Only bituminous material meeting the requirements of 409.02 is permitted to be used. Loads of bituminous material delivered to the project should carry evidence of approval as defined in Section 4.3. This evidence of approval and the material weight tickets are to be validated at the paving site before the material is incorporated into the work.

Reference is made to Section 7.2.1 for guides in judging distributor spray results and instructions for making a record of checks of the actual application rate. A uniform application both in the transverse and the longitudinal direction is important particularly in seal coat work. Continued application should not be permitted when visible defects occur. Where it is demonstrated that distributor results are erratic, use of the equipment must be discontinued until the equipment defects are corrected.

7.7 Application of Cover Aggregate

Only aggregate which has been approved is permitted to be used. The weighing of all loads of aggregate must be observed and the weight tickets validated both at the time of weighing and when the material is received at the paving site.

The application of cover aggregate must follow the application of bituminous material closely, regardless of the type of bituminous material used. For this reason, the length of the distributor runs should be regulated to permit the spreader operation to place the aggregate immediately behind the distributor.

The aggregate must be sufficiently free from dust and moisture to permit immediate adhesion of the bituminous material. For all bituminous materials, except those treated with a coating agent, or emulsions, the aggregate should be relatively dry. When a treated bituminous material is used, the aggregate may have some surface moisture, but not so much as to prevent proper adhesion. In the case where an emulsion is used, the aggregate may be wet, but not so wet that water drains from the truck bed during the spreading operation.

7.8 Rolling

Rolling of the seal coat cover aggregate is required to begin immediately behind the aggregate spreader. This is to assure that the aggregate particles will be embedded in the bituminous material and worked into a stable position while the bituminous material is fresh and will adhere to the aggregate.

Specifications require a minimum of four complete roller coverages of the cover aggregate. Each coverage consists of two one-way trips or passes of the roller over a given area. While making these coverages, the speed of the roller must be slow enough to avoid displacing or dislodging the aggregate particles from the bituminous material.

7.9 Protection of Completed Work

The completed seal coat construction should be protected from both construction and public traffic until the bituminous material has cured sufficiently to prevent dislodging of the embedded aggregate. Under normal conditions a new seal coat will not be harmed when subjected to immediate traffic if the speed of the traffic is kept low. In the event of rain on a fresh seal coat, however, the curing of the bituminous material may be delayed by the presence of water, and traffic should be kept off of the pavement until the curing has been completed.

The excess cover aggregate should be removed from the pavement by light brooming. This should be done as soon as practical after the work has been completed, but not before sufficient curing has taken place to prevent dislodging the embedded aggregate particles.

7.10 Quantities for Payment

Reference should be made to Section 5.5 for methods to be used in determining the pay quantity for the bituminous material used in the seal coat construction. Determination of the pay quantity for the cover aggregate is made by summarizing the validated aggregate weight tickets and converting the total weight of material used to the nearest cubic meter (cubic yard), using conversion factors specified in 409.09. The quantity approved for payment should not exceed the quantity required as determined by calculation using the approved application rate.

8. ASPHALT CONCRETE

General requirements for mix production and for the construction of asphalt concrete pavement courses are included in 401 or 441, depending on the contract item designation. Specification requirements for the specific pavement courses are found in the specifications under the contract item designation.

Asphalt concrete is a mixture of aggregate and bituminous material. The bituminous material used in these mixtures has a relatively high viscosity at normal temperatures. Because of this, it is necessary to heat the aggregate and bituminous material to permit mixing, placing and compacting.

Asphalt concrete may be used in new construction as the entire pavement structure or it may be used in conjunction with other materials in a layered pavement structure. Extensive use of asphalt concrete also is made for rehabilitating existing pavements by resurfacing or widening and resurfacing. Asphalt concrete is adaptable particularly to this type of work, where disruption of normal traffic flow must be kept to a minimum. Although written with reference to new construction, the instructions contained herein also apply to rehabilitation construction.

Asphalt concrete mixtures are produced in a central proportioning and mixing plant. At the plant, aggregate is dried and heated to the mixing temperature and mixed with the specified bituminous material. On completion of mixing, the mixture is discharged directly into trucks or conveyed to a surge bin from which trucks are loaded for transport to the project.

Asphalt concrete is placed by use of various types of mechanical spreaders or by hand methods. After it is placed, the mixture must be compacted, using the proper compaction equipment, before it cools and becomes unworkable.

8.1 Equipment

8.1.1 Spreading Equipment

The type of equipment considered suitable for spreading asphalt concrete will depend on the particular paving operation to be performed, mainline, widening, berm, intersections, and whether the pavement course to be placed is base, intermediate or surface. For this reason, spreading equipment requirements in 401.10 are stated in general terms and the approval of the equipment proposed for use by the Contractor is based on the Contractor's capability to obtain specified results as determined by the Engineer. The basic types of spreaders found in current practice are described in the following paragraphs:

Floating Screed Bituminous Paver - The standard bituminous paver has long been accepted for placing all courses of asphalt concrete. The standard bituminous paver consists of a tractor with a receiving hopper, a conveying and distributing system, and a floating screed. The screed essentially is a rectangular trowel which floats on the surface of the bituminous mixture. The screed is pulled by the tractor by means of two shafts or arms hinged to each side of the tractor. The thickness of the material placed is regulated by adjusting the angle of the screed with respect to the arms. This adjustment causes the screed to rise or descend until a condition of equilibrium is reached. Vibrating or tamping devices on the screed unit are used to maintain a uniform flow of mixture under the screed. A heating system is provided to bring the screed to operating temperature at the beginning of work and to maintain proper screed temperature in cool weather.

The paver must have an automatic control system which maintains the screed in a constant position relative to grade, profile, and cross slope references. These references must be capable of controlling the screed position reasonably independent of irregularities in the underlying surface and the paver operation.

When paving in excess of the nominal paver width, only a screed extension, other than a strike-off, shall be used when matching a previously placed pavement course. Strike-off plates or extensions may be used on adjacent berm areas.

Off-Set Blade Strike-Off Spreader - Spreading equipment having a hopper from which material is conveyed to a side mounted blade strike-off is used for placing asphalt concrete for pavement widening, berm paving and in other applications where a relatively narrow width is to be placed. The tractor to which the hopper is attached operates on the surface adjacent to the area being paved. The blade is attached to the tractor and is adjustable as to width, elevation and cross slope.

Motor Grader - The standard motor grader, when properly equipped to contain the material within the required width, is used to place asphalt concrete satisfactory in patching, spot leveling and in crown correction work.

The approval of spreading equipment of any of the types described above for use on asphalt concrete construction should be based mainly on observation of the quality of previous work completed and current performance. The following items should be observed when considering approval:

1. Equipment must have sufficient size, power, and stability to receive the asphalt concrete material without erratic operation.

2. Equipment must be capable of placing the material accurately in regard to line and grade.

3. Asphalt concrete must be fed uniformly across the width of the screed or strike-off without surges which produce corresponding roughness in the finished surface.

4. Asphalt concrete mixture behind the screed or strike-off must have a uniform appearance across the full width of the course.

It is the Contractor's responsibility to make any necessary adjustments in the spreader operation. The inspector, however, should be familiar with the working of the spreader, the effect of wear on spreader operation, and the effect of various spreader adjustments on the placing operation.

8.1.2 Compaction Equipment

The compaction of asphalt concrete is governed by 401.14 or 446.05, depending on the specified contract item designation. Two types of rollers, steel wheel and pneumatic tire, are specified for use and the requirements for the rollers are found in 401.11.

All rollers proposed for use in the compaction of asphalt concrete material should be inspected for compliance with the specifications before paving begins. The Contractor is required to furnish the inspector all necessary information concerning roller weights, tire pressure and wheel loads, and average contact area and contact pressure.

Approval of specialized equipment proposed for compaction in areas inaccessible to the specified rollers should be based on obtaining equal results.

8.2 Mixture Production Inspection

8.2.1 Initial Plant Inspection and Mix Design

Preliminary to the production of any asphalt concrete, the mixing plant proposed for use by the Contractor must be inspected and approved by personnel from the Laboratory.

The composition limits for any asphalt concrete mixture established in accordance with 401.02, are established by the Laboratory prior to the start of production. The mixture composition data for the specific contract item is transmitted from the Laboratory to the plant inspector. The job mix constants included in this data are not to be changed by the plant inspector without prior approval by the Laboratory.

The composition limits for any asphalt concrete mixture established in accordance with 441, are determined by a mix design process (usually a Marshall mix design) performed by the Contractor and approved by the Laboratory.

8.2.2 Plant Production Inspection (401.02)

If the asphalt concrete is being accepted in accordance with 401.02, the Department will have a plant inspector at the plant. During production of the asphalt concrete, the duties of the plant inspector include testing of the materials used in the mixture, observing the plant operation, and testing of the mixture produced. If informed by the field inspector that the mixture being placed is unsatisfactory, the plant inspector should make such adjustments in the mixture proportions or take such action as necessary.

8.2.3 Field Inspection

The inspector assigned to the placing of asphalt concrete should observe closely the placing of the initial production of each type of mixture for indications of deficiencies in the mixture composition. Important mixture characteristics to be observed are:

> **Aggregate Gradation -** The coated aggregate particles should appear to be uniformly graded in size from coarse to fine.
>
> **Mixture Consistency** - The mixture should have sufficient cohesion to remain mounded in the vehicle during hauling, but should flow freely from the vehicle when the load is dumped.
>
> **Stability** - The mixture should have sufficient stability for compaction without excessive displacement.
>
> **Bitumen Content** - The mixture should contain enough bitumen to bind the aggregate particles together as the mixture is compacted without producing a glazed or flushed appearance.

If the mixture appears to be deficient in any of the above respects, the condition should be discussed with the plant inspector (401.02 quality control) or the Contractor (441 quality control), and noted on the Inspector's Daily Report.

As the placing of the asphalt concrete progresses, the inspector should continue to observe the mixture being delivered to the spreader since irregularities in proportioning, mixing and temperature control may occur. The results of such irregularities may not be detected at the plant and an unsatisfactory load of asphalt concrete may arrive at the spreader.

Mixture in the hauling vehicle that obviously is out of specification limits must be rejected in borderline cases. The material may be placed with acceptance based on the appearance of the material under the action of the compaction equipment. If the mixture is unsatisfactory, it must be removed and replaced with acceptable material. When the field inspector rejects a load of material, this action should be recorded on the plant ticket form, along with the reason for rejection. Also, the Department's plant inspector or Contractor's quality control technician should be informed of the quantity of the material rejected and the reasons for rejection.

Observance of the following mixture characteristics can be an aid in determining the asphalt concrete delivered to the project is acceptable or should be rejected.

Temperature - Variations in the temperature of the loads of asphalt concrete often can be detected simply by comparative observation and then substantiated by actual temperature measurement. In extreme cases, a hot load will give off a blue smoke while a cold load will be partially congealed and will not flow freely. By close observation of the flow of the asphalt concrete from the truck bed into the spreader hopper, the inspector can learn to judge the temperature of the material quite accurately.

Mixture Proportions - Excessive fluctuations in bitumen content, changes in the proportion of the coarse and fine aggregate, and non-uniform mixing can be detected by comparative observation. This includes observation of the material as it flows into the hopper and of the surface texture as the material is spread and rolled. The arrival of a load of asphalt concrete in a flattened condition, rather than peaked or mounded, may indicate the presence of an excess of bituminous material, although this condition also may be the result of excess moisture.

Moisture - Variations in the moisture content of the aggregate fed to the plant or an erratic production rate may result in an excess of moisture in the asphalt concrete mixture. This may cause slumped or flattened loads, accompanied by considerable bubbling or steaming of the mixture. In extreme cases, the bituminous material may separate from the aggregate and collect in a film over the surface of the load. This condition is unacceptable and is sufficient cause for rejection of the load. The presence of excess moisture also may cause streaks of excess bituminous material to appear as the mixture is spread. These streaks should be eliminated immediately by remixing the material, using a rake, and the plant inspector notified of this condition.

Contamination - An asphalt concrete mixture can become unsatisfactory due to contamination of the bituminous material, the aggregate, or the mixture itself. Contamination of the bituminous material, either in shipment of in storage at the plant, usually has the most serious effects. Contamination of the bituminous material may remain undetected until a quantity of mix is produced, at which time a marked change in the odor, consistency, or appearance of the mixture in the truck or in the spreader hopper would be an indication that such contamination has occurred. When these changes are noted, the mixture should be observed carefully as it is being placed and compacted. If the mixture is unusually soft and unstable or tends to flush, the material should be considered unsatisfactory and must be removed and replaced with acceptable material.

Contamination of small portions of the asphalt concrete mixture may occur due to bed hoist leakage, or spillage of fuel or lubricants, or foreign matter on the surface. These areas should be corrected by removing the contaminated material and replacing it with acceptable material.

8.3 Weather Limitations

Paving operations must not be permitted when the surface temperature of the existing pavement at the site is below the minimum specified in 401.05. Air temperature requirements for surface courses and courses paved directly on an aggregate base, subbase or subgrade are also specified in 401.05.
Surface temperature measurements should be taken using the following procedures:

1. When taking a reading in the sun, place the thermometer on the pavement and then shade that area with a clipboard, cardboard, or other available shading material. Then take the temperature reading after approximately 3 minutes. It is not the intent to shade the area to allow it to cool, but to protect the thermometer from obtaining a false reading due to direct exposure to the sun.

2. The surface temperature should not be taken under the only shade tree or at the only sunny (unshaded) spot on the project. The surface temperature should be taken at a representative area.

3. The surface temperature should be taken in the lane to be paved and not the adjacent berm.

4. On portland cement concrete pavements where flexible repairs have been performed, the surface temperature of the portland cement concrete will be the governing temperature.

5. A new surface temperature should be taken when the existing pavement surface material changes (asphalt concrete to portland cement concrete or portland cement concrete to asphalt concrete) to assure the new surface meets the minimum temperature specification. If it does not meet, paving operations shall be discontinued until the surface reaches specification temperature or paving operations may be moved to a different area of the project where the surface meets minimum specification temperature.

The placing of thin surface courses at temperatures near this limit may require the Contractor to employ special precautions to produce a satisfactory surface. These precautions include avoiding paver stops, keeping the rollers close to the paver, and providing proper insulation for the truck hauling the material.

In the event of rain, the paving operation must be stopped. It is the inspector's responsibility to order paving operations to be halted and the Contractor's responsibility to stop plant production. A load of material in the process of being dumped into the paver may be placed, with the requirement that the rollers follow closely behind the paver and a construction joint be formed at the end of the run. Loads waiting to be dumped, however, must not be allowed to be placed. The material in the waiting trucks will retain sufficient heat for proper placing and compacting for an hour or more, and water can be kept from accumulating on the covers of the trucks and draining into the bituminous mixture by raising the truck beds slightly. These loads may be placed when conditions improve and the surface being paved is reasonably dry and in an acceptable condition.

8.4 Hauling

Included in the specifications (401.09) are the requirements concerning the condition of the vehicles used to haul asphalt concrete mixtures and the distance the mixture may be transported.

The inspector should check the trucks for compliance with the specifications as they arrive at the paving site. In particular, the inspector should observe the following:

1. The bed cover is in good condition.

2. Small portions of the load are not isolated from the mass on projections such as extensions over cabs.

3. The load is discharged evenly, without surging in the spreader hopper and without jogging the vehicle when it is in contact with the spreader.

4. As the bed is raised, it does not come in contact with the rigid parts of the spreader.

5. Uniform contact is maintained when the truck is pushed by the spreader during unloading.

6. Excess coating material is not being used.

7. Diesel fuel is not being used as a coating material.

8. When insulation is required, check to see that all trucks are properly insulated and permit only approved trucks to be loaded.

The inspector should notify the Contractor when deficiencies are found. When corrections are not satisfactory and difficulties persist, the vehicle in question should be removed from the project.

8.5 Preparation of the Surface

8.5.1 Cleaning the Surface

The surface on which an asphalt concrete course is to be placed must be free from accumulations of materials that would contaminate the mixture, prevent bonding or interfere with placing operations. The surface of the existing pavement should be inspected before the paving operation begins and should be cleaned of all foreign material, in accordance with 401.12. The surface also should be checked a short distance in front of the paver to assure that the surface has not become contaminated during the construction operation.

8.5.2 Maintenance of Previously Constructed Surfaces

Prior to placing asphalt concrete on a pavement course constructed under the contract, the condition of this previously approved work should be observed. Where the approved subgrade or pavement course has become loosened, rutted or otherwise defective, the deficiency must be corrected before the placing of a subsequent course is permitted. Hauling of materials over an asphalt concrete base course, for example, may cause cracking when there is not a sufficient pavement to carry such loads or where excessive deflection occurs over soft areas developed in the subgrade. Where cracking of the pavement occurs, in such a case, the strength due to slab action is destroyed and the affected material must be removed and replaced after correcting the cause of the failure.

8.5.3 Coating of Vertical Faces

The specifications require all vertical faces, with which the asphalt concrete will come in contact, to be coated with bituminous material of a type specified in 401.03. The purpose of this requirement is to provide some additional bituminous material to improve the bond of the asphalt concrete to other structures, such as gutters, curbs, catch basins and all existing pavements. Because of the small quantity of material involved, the approval of the bituminous material to be used for this purpose may be based on field inspection, and the results of this inspection recorded on the Inspector’s Daily Report, with the material identified as to type, grade, manufacturer, and use.

8.5.4 Correcting Existing Surface Irregularities

In contracts which include rehabilitation of the existing pavement by resurfacing, a quantity of asphalt concrete usually is provided in the plans for making spot corrections or for placing a continuous intermediate course in order to correct the cross-slope and profile of the existing pavement, as directed by the Engineer. The placing of this corrective material should be controlled closely to assure that the best possible riding quality is obtained in the completed pavement.

Spot corrections, when provided for in the plans, are made to correct irregularities in the existing pavement which would not, due to their magnitude, be corrected satisfactorily during the placing of the overlaying intermediate or surface course. Deficiencies in the surface which require spot correction should be located and the Contractor notified by the Engineer of the required corrective measures. In making these spot corrections, the mixture should be placed and compacted alternately, until the profile and cross-slope conforms to the surrounding pavement. Interior edges of these patches may be irregular, but outside edges must conform to the specified edge alignment. All spot corrective work must be completed, to the satisfaction of the Engineer, before the intermediate or surface course is permitted to be placed.

An intermediate course of asphalt concrete, when specified, is used to correct minor irregularities in the existing pavement surface. As mentioned above, spot correction may be needed prior to placing of the intermediate course since this course cannot be expected to cover or correct major deficiencies. The paver used to place the intermediate course has a self-leveling action which tends to correct these small irregularities. In addition to this action, automatic control of the paver screed is used to compensate for these irregularities. The inspection should observe closely the placing of the intermediate course to assure that all deficiencies have been corrected satisfactorily. For intermediate courses where the profile or cross-slope is not specified on the plans, the profile of the new course should provide for a smooth riding surface, and the cross-slope should be uniform on all tangent sections and should vary uniformly in transition sections into superelevated sections. For an intermediate course where the profile or cross-slope is specified, the new course should conform to the required profile and cross-slope, within the specified limits. The procedure for checking the profile and cross-slope is given in Section 8.10.

8.6 Checking Spreading Methods

The inspection of the spreading of the asphalt concrete primarily consists of observing the methods and practices being employed by the Contractor. It is the responsibility of the inspector to assure that these methods are producing the intended results and to require any corrective measures necessary in the event that unsatisfactory results are obtained. Regardless of the method of placing used, mechanical or hand, the following conditions should be checked closely:

Uniformity of the mixture and any evidence or segregation

Surface texture of the mixture

Temperature of the mixture

Edge alignment of the material

The inspector should observe the spreading operation for any signs of segregation of the mixture. The accumulation of coarse aggregate in pockets across the width of the spread mixture is undesirable and particularly so when these pockets occur along the edges. Methods or practices causing segregation must not be permitted to continue.

Hand placing and leveling tend to segregate the mixture by working the coarse aggregate particles to the surface. Surface courses placed by hand must be given particular attention because of appearance and the fact that the segregated areas are very susceptible to raveling. Only a dense, uniform surface texture is acceptable. Since an unsatisfactory surface texture may not be evident until after a pass of the roller, the inspector must insist that workers and material are available during rolling of hand-placed areas to make any needed correction. Segregated areas should be corrected by placing additional material and raking out the coarse particles, leaving the fine particles to form a dense surface.

Disturbance of the spreader operation, due to bumping of the spreader by the hauling vehicle or uneven flow of material into the spreader hopper, can cause irregularities in the surface being placed. The hauling vehicle should come in contact with the spreader with as little shock as possible and, if the hauling vehicle is pushed by the spreader during unloading, a constant contact pressure should be maintained in order to avoid jerking of the spreader. The asphalt concrete should flow uniformly from the truck into the hopper with the quantity in the hopper being maintained at a uniform level. Sudden surges of material affect the position of the strike off, causing surface irregularities.

The mixture should have a uniform appearance across the width placed. Streaks of differing texture and pulling or tearing of the mixture generally indicate the need for adjustments to the spreader screed or strike off, or that differential wear has occurred in these parts. This also may be due, however, to low temperature or to mix deficiencies as discussed in Section 8.2.3.

The placing of asphalt concrete mixtures, particularly in a thin surface course susceptible to rapid loss of heat, must be accomplished in such a manner that compaction can follow before the mixture cools below a workable temperature. This is important especially in small areas where the mixture is placed by hand. In these areas, heating of the underlying surface with torches or radiant heaters is helpful in reducing the loss of heat from the mixture to this surface. Although not a recommended practice, heat also can be applied to the material being placed in order to maintain the mixture at a workable temperature. This practice must be controlled carefully to prevent damage to the mixture. Any mixture that cools before it can be compacted properly must be removed and replaced.

8.7 Control of Quantity Placed

The specifications require placing of asphalt concrete on the basis of weight per unit of area. For a given course, this rate, in kilograms per square meter (pounds per square yard), is calculated using the course thickness shown on the plan in millimeters (inches) multiplied by the applicable conversion factor established in accordance with 401.17. In 401.17, the conversion factor is established by the Laboratory when a mix design is available for the project or if no mix design is available, the conversion factor is listed in the table in 401.17. Depending on the conversion factor used, the required placement rate, in kilograms per square meter (pounds per square yard), is calculated as follows:

Conversion Factor Established by the Laboratory - When a conversion factor is established by the Laboratory, it is the unit weight of the mix, which has no units. The unit weight of a mix can be obtained from the “BCJMF” screen in the TAS portion of CMS. You will need to know the JMF number of the mix to use the “BCJMF” screen.

To establish the required placement rate, this conversion factor (unit weight) is multiplied by 1.0 kilograms per square meter per millimeter (46.8 pounds per square yard per inch) and multiplied by the course thickness, in millimeters (inches). So the placement rate, in kilograms per square meter (pounds per square yard), is:

Metric:

conversion factor × 1.0 kg/m^2/mm × thickness (mm)

English:

conversion factor × 46.8 pounds / square yard / inch × thickness (inches)

This rate should be rounded off to the nearest kilogram per square meter (pound per square yard) for control purposes.

Conversion Factor from Table in 401.17 - When a conversion factor is obtained from the table in 401.17, it is in kilograms per cubic meter (pounds per cubic yard). To establish the required placement rate, this conversion factor is divided by 1000 millimeters per meter (36 inches per yard) and multiplied by the course thickness. So the placement rate, in kilograms per square meter (pounds per square yard), is:

Metric:

conversion factor ÷ 1000 mm/m × thickness (mm)

English:

conversion factor ÷ 36 inches/yard × thickness (inches)

This rate should be rounded off to the nearest kilogram per square meter (pound per square yard) for control purposes.

In order to construct courses for uniform thickness in new full-depth or base-widening construction, the Contractor is required to maintain the calculated rate of placing within a specified tolerance. This rate of placing should be checked by the inspector, using the plant ticket forms, which must accompany each load of material, and the area covered by a given number of loads. The area to be used for the check should not be greater than 150 m (500 feet) in length and should be measured from the start of a full load of asphalt concrete to the end of a full load. The results of these checks should be recorded on Form C-146 or the Inspector's Daily Report. If Form C-146 is not being used or is not available, a suggested format for the check is:

Location of Test Section	____________________________	
Plan Thickness	_________	mm (inches)
Required Placement Rate (A)	_________	kg/m^2 (pounds/square yard)
Specification Tolerances (A ± 5%)	_________	kg/m^2 (pounds/square yard)
to	_________	kg/m^2 (pounds/square yard)
Length of Test Section (B)	_________	m (yards)
Width of Test Section (C)	_________	m (yards)
Area of Test Section (B × C = D)	_________	m^2 (square yards)
Total Weight Placed (E)	_________	kg (pounds)
Actual Placement Rate (E ÷ D)	_________	kg/m^2 (pounds/square yard)

When variations greater than plus or minus 5 percent of the required rate are detected, the inspector should require the Contractor to adjust the spreader accordingly, and immediately check the rate at the new setting.

Depending on the nature of the material being placed and quality of the placing operation, one to four placement rate checks per day normally will represent the material placed with a given spreader. When the work involves a series of small areas, the use of partial loads at each location makes the weight check impractical. In such cases, the inspector should determine that at least plan thickness is being obtained.

The placing of asphalt concrete should be closely controlled and kept as near as possible at the specified rate. Even for a well controlled operation, however, both positive and negative variations will occur and are to be expected. The Contractor should not place the material at a rate greater than that required since this would result in an overrun of plan quantity for which the Contractor would not be paid. As stated in 401.17 Method of Measurement, the pay quantity is limited to the total weight of the item placed, converted to cubic meters (cubic yards), with no payment made for the quantity of material placed which exceeds that calculated from plan lines and dimensions.

C-146 (7/95)

OHIO DEPARTMENT OF TRANSPORTATION
BITUMINOUS CONCRETE INSPECTION

Project No. ______________________ County, Route, Section ______________________
Item No. ______________________ Description ______________________
Reference No. ______________________ Contractor ______________________
Weather and Temperature ______________________
Existing Surface Condition ______________________

Beginning Ticket No.	Ending Ticket No.	Station Location From	Station Location To	Lane	Plan Quantity	Used Quantity	Pay Quantity	Measured Width	Mix Temperature	Remarks

Conversion Factor __________ kg/m^3 (pounds/cubic yard)
Required Placement Rate (A) __________ kg/m^2 (pounds/square yard)
Specification Tolerances (A ± 5%) __________ to __________ kg/m^2 (pounds/square yard)

	Test 1	Test 2	Test 3	Test 4	
Location of Test Section					
Plan Thickness					mm (inches)
Length of Test Section (B)					m (yards)
Width of Test Section (C)					m (yards)
Area of Test Section (B x C)					m^2 (square yards)
Total Weight Placed (E)					kg (pounds)
Average Weight Placed per Area (E ÷ D)					kg/m^2 (pounds/square yard)

Action Taken ______________________

Signed ______________________ Date ______________________
DOT - 1501

8.8 Compaction

The compaction of asphalt concrete mixes is currently governed by one of two types of specifications. A method specification is used by the majority of our asphalt concrete specifications (301, 302, 402, 403, 404, 448, etc.), while a few specifications are governed by a density acceptance specification in accordance with 446.05.

8.8.1 Compaction (Method)

This section pertains to the compaction of all asphalt concrete mixes, except for asphalt concrete mixes accepted in accordance with 446.05. Compaction of mixes accepted in accordance with 446.05 is described in Section 8.8.2. Compaction of an asphalt concrete mixture using the method specification is obtained by using the rollers and methods specified in 401.11 and 401.14.

The number and type of rollers proposed for use by the Contractor should be checked for compliance with 401.11 and as the work progresses the rate of placement should be checked to assure that it does not exceed the combined capacity of the rollers in use. If the rate of placement does exceed the roller capacity, the Contractor must either reduce the rate of placement or use additional rollers.

For compacting base mixtures, the specifications require at least one steel and one Type 1 pneumatic tire roller. This requirement must be met even though the placing rate may indicate the need for only one roller. The intent is to assure that each layer of base mixture will be subjected to the traffic conditioning effects of pneumatic tire rolling while the mixture has sufficient retained heat to respond without fracturing.

8.8.2 Compaction (446.05 Acceptance)

This section pertains to the compaction of asphalt concrete mixes accepted in accordance with 446.05. Compaction of all other mixes is described in Section 8.8.1.

Compaction of an asphalt concrete mixture accepted in accordance with 446.05 is obtained by using rollers meeting the minimum requirements specified in 401.11. Since the Contractor is responsible for choosing the roller train and obtaining density in accordance with 446.05, the maximum roller capacities specified in 401.11 and all but the last four paragraphs of 401.14 are waived.

8.8.3 General Compaction Inspection

This section pertains to the compaction of asphalt concrete mixes using either the method specification (described in Section 8.8.1) or the 446.05 acceptance specification (described in Section 8.8.2). The inspector should refer to the last four paragraphs of 401.14, to review the common part of both compaction specifications.

The optimum conditions for compaction are present immediately behind the spreader and the greatest increase in density per roller pass occurs in this area. It is important, therefore, that the initial or breakdown roller follow the spreader as closely as possible. When an intermediate roller is being used, it should follow the initial roller closely in order to accomplish the required overlapping coverage. The timing of the final rolling, required for removal of any roller marks, is dependent upon the condition of the mixture. Regardless of their position in the compaction sequence, however, the rollers should be in continuous operation during the spreading process except for necessary stops for fuel and water. The specified roller pattern should be repeated uniformly, without abrupt stops or changes in direction, and the reversing points at the end of the roller runs should be staggered to reduce the possibility of forming transverse bumps.

If a longitudinal joint is being made, it shall be rolled first, before the rest of the asphalt concrete.

The inspector must not hesitate to require correction of any defects which appear during the compaction operation, particularly during the construction of surface courses. Deficiencies can be corrected with better results and with less effort during the compaction operation, while the mixture is still hot, than after final compaction and cooling of the mixture.

8.9 Joints

8.9.1 Longitudinal Joints

Proper longitudinal joint construction requires the loose asphalt concrete material to be “set up” above the adjacent material to permit proper compaction. This height must be sufficient to permit full compaction of the material being placed before the weight of the roller begins to be carried on the adjacent construction. It is important that this height is maintained uniformly, particularly on surface courses where raveling of an unsound joint is likely to occur. This uniformity can be accomplished by continuous manual control or by automatic control of the strike off height.

There are no special requirements for forming the longitudinal joint. The inspector should observe the edge line of all courses against which a joint will be constructed, however. Excessive deviations of the edge line from a straight line is unacceptable and trimming of the edge is required before the adjacent material is placed. With a good edge and proper control of the placing operation, little or no hand work normally is needed to form a good longitudinal joint. The presence of irregularities in the edge line may require continuous hand raking, however. On surface courses, the inspector must be sure that the hand raking process does not produce an irregular surface texture.

The specified time limit for making a longitudinal joint in the surface course when traffic is maintained is intended to reduce distortion and sealing over of the exposed face. When the Contractor fails to meet this requirement due to unforeseen conditions such as weather or equipment failure, the joint face should be inspected and special precautions taken to assure that a dense well bonded joint still can be constructed. Trimming of the joint face may be necessary in some cases.

Coating the face of the longitudinal joint is required for all surface courses or any course which is open to traffic more than 30 days, as specified in 401.15.

8.9.2 Transverse Joints

Transverse joints occur at the end of work each day and when the pacing operation is interrupted. When placing the last load of asphalt concrete for the day, the paver should move forward until all material is spread, leaving an irregular end which should be squared off by hand to form the joint. This joint edge should be compacted thoroughly, with the rollers passing over the edge even though this may cause some rounding or even displacement of the material in the process.

When the paving operation resumes, the point where the rounding or other departure from the profile begins should be located, and the paving operation continued from that location in order to assure a smooth transition from one section to the other. In some cases, trimming the joint face may be necessary. The joint face should be coated in accordance with 401.15 and 404.15. The Contractor is required to have workers and hot material available during construction of the joint, until alternate rolling, straightedging, and addition of material produce a uniform profile. Paving operations should not be permitted to continue until a satisfactory joint has been obtained.

8.10 Checking Pavement Tolerances

8.10.1 Checking Line

In new construction, asphalt concrete mixtures are placed on top of a prepared subgrade, subbase, or base course. The placing must be controlled accurately so that the new pavement will conform to the required plan lines. For this purpose, line and grade stakes are set by the Contractor prior to the paving operation. Using the line stakes as a reference, a guide or string line is set. This string line, fixed as necessary to furnish a straight line or smooth transition or curve, is followed by the spreader during the placing operation. The line may be set as desired by the Contractor, but must provide adequate means of control of the spreader to allow the asphalt concrete to be placed to the correct longitudinal alignment.

In a resurfacing operation, a guide or string line also is used to control the alignment of the spreader during paving. When line stakes are not set for this type of construction, another reference must be established for setting the string line. If the edge of the existing pavement is straight and uniform, it may be used as the required reference. If the edge is unsatisfactory for this purpose, the reference should be established as directed by the Engineer. As for new construction, the guide line must provide adequate means for longitudinal control of the spreader to assure that the asphalt concrete will be placed to the specified alignment.

8.10.2 Checking Profile

For all new construction and some rehabilitation construction, the required profile grade and pavement elevations are given in the plans. Where a profile grade is not specified for rehabilitation construction, the profile of the finished pavement surface is dependent upon the corrected profile of the existing pavement surface. The methods for correcting the profile of the existing surface are given in Section 8.5.

For construction where a profile grade is specified, the Contractor is required to set grade stakes in order to provide a reference for control of the elevation and grade at which the asphalt concrete is placed. These grade stakes should be set at intervals of not more than 15 m (50 feet) on tangents and not more than 7.5 m (25 feet) on vertical curves and transition lengths of superelevated curves. The stakes should be placed on both sides of the pavement to permit easy checking of the grade and intermediate stakes should be provided as needed in areas of greater than normal width.

The specifications require the profile of the completed pavement to be parallel to the specified profile within a specified tolerance. The tolerance is specified in 401.16. The change in pavement elevation between stations may be obtained by methods such as profile levels or differences in rod readings. Prior to placing the surface course, the Contractor is required to check the profile of the preceding course and submit a tabulation of the results to the Engineer for approval. The results should be tabulated in a convenient form, listing the following:

Station

Pavement elevation change

Plan elevation change

Difference between the changes

The Contractor's profile check should be evaluated by the Engineer. Approval of the profile and permission to place the surface course should be based on satisfactory completion of any corrective work needed for compliance with the profile requirement. The approved profile check should then be made a part of the project record.

8.10.3 Checking Cross-Slope

For all new construction and some rehabilitation construction, the required cross, or transverse, slope of the asphalt concrete pavement is given either as crown or superelevation in the plans. Where a cross-slope is not specified for rehabilitation construction, the cross-slope of the finished pavement is dependent upon the corrected cross-slope of the existing pavement surface. The methods for correcting the cross-slope of the existing pavement are given in Section 8.5.

For construction where cross-slope is specified, the specifications require the pavement to be constructed to the specified cross-slope within a given tolerance. The cross-slope of the pavement course being placed should be checked by the Contractor during the spreading operation. The inspector should observe this checking regularly to assure that the pavement course is being constructed substantially within the specified cross-slope limits.

Particular attention should be given to the checking of the cross-slope on the asphalt concrete course preceding the surface course. Where observation of the Contractor's checking or additional checking by the inspector reveals substantial deviations from the specified limits, corrections must be made to bring the asphalt concrete course within the specified cross-slope limits before the surface course is permitted to be placed.

8.10.4 Checking Surface Smoothness

The required smoothness of asphalt concrete pavement courses is specified in terms of an allowable tolerance from the testing edge of a 3.0 m (10 foot) straightedge. Checking of the course being placed should be done by the Contractor and observed by the inspector. The frequency of checking will depend on the nature of the work being done. When the paving operation is progressing uniformly, no checks of the smoothness need be made. When a transverse joint is being made, when erratic spreader operation occurs, or when hand placing is required in construction of a transverse joint, the surface smoothness should be checked closely.

The completed surface course will be checked in accordance with 401.16. Acceptable methods for the correction of irregularities indicated by the check method used are given in Section 8.11.

8.11 Special Requirements for Surface Course

8.11.1 Construction Requirements

The surface course of an asphalt concrete pavement must be placed within ten days following the placing of the intermediate course. Where circumstances prevent the placing of the surface course within the required time limit, the Engineer may extend the limit provided that a light tack coat is applied to the intermediate course at the Contractor's expense, before the surface course is placed. Such action should be made a part of the project records. The application of the tack coat should be required when necessary to provide adequate bonding on the surface course to the intermediate course. Inadequate bonding of the two courses results in shoving of the surface course, usually accompanied by tearing of the surface, during compaction.

Where the surface course has been damaged due to inadequate bonding, it must be removed and a tack coat applied before the surface placing is continued.

On projects where traffic is maintained, the longitudinal joints between adjacent lanes of a surface course pavement must be completed within 24 hours. Where this time limit is exceeded, the joint should be inspected, and if the joint appears to be excessively rounded or displaced, necessary corrections should be made as provided in Section 8.9. This action should be recorded in the project records.

Traffic should not be permitted on a completed surface course until the mixture has cooled sufficiently to prevent glazing or the drawing of bituminous material to the surface of the pavement due to tire action.

Where the completed surface course is placed directly against an adjacent curb face, the surface course should be sealed along the gutter line. When sealing is required, the operation should be inspected and the use of an excessive quantity of bituminous material or sloppy application should not be permitted. Only the quantity of bituminous material necessary to fill the surface voids should be used. The material should be applied at a uniform rate, approximately 100 mm (4 inches) in width. The bituminous material used for the seal shall be asphalt cement. Because of the small quantity of material involved, the approval of the bituminous material to be used for this purpose may be based on field inspection, and the results of the inspection recorded on the Inspector’s Daily Report, with the material identified as to grade, manufacturer and use.

8.11.2 Correction of Surface Course

The specifications require irregularities and defects to be corrected in a manner satisfactory to the Engineer. The following methods will produce satisfactory results when the work is properly performed by sufficiently skilled workers.

In general, heat may be applied to aid in the removal of surface course material only when the affected area will be covered with new material. When heat is applied, the adjacent material which will remain in place must be shielded from the heat to avoid permanent damage.

Where removal of defective material is required, the limits of removal should be defined by cutting or sawing to neat lines. After the defective material has been removed, the area and the edges should be given a uniform coating of tack coat material. The replacement material should then be placed and compacted to conform to the surface of the surrounding material.

Minor segregated areas in which there is insufficient fine aggregate at the surface can be corrected by a squeegee application of a commercial sealer containing bituminous material of the same type as was used in the mixture. An emulsion of the bituminous material along with added fine aggregate also is effective. Careful use of the squeegee is necessary to fill the surface voids without leaving a surplus of the sealer on the surface.

Where additional surface course mixture must be added to correct a low area in the surface, the limits of the area requiring correction should be defined by cutting or sawing to neat lines followed by removal of material as necessary to permit replacement at not less than 12.5 mm (0.5 inch) thickness. The surface of the area to be corrected and the face of the butt joint should be given a coating of tack coat material. The replacement mixture should then be placed and compacted as required to effect the needed correction.

Where material must be removed to correct high areas in the surface, satisfactory correction often can be accomplished by using a surface grinder or a cutter planer. Removal and replacement of the surface course and a portion of the underlying material may be necessary in extreme cases.

8.12 Acceptance Sampling

While the acceptance of material produced in accordance with 401.02 (301, 302, 402, 403, 404, etc.) is based on tests performed by the plant inspector (see Section 8.2.2), the acceptance of other specifications (446, 448, etc.) are based on acceptance samples obtained in the field. These acceptance samples are obtained by the Contractor at random locations determined by the Engineer.

8.12.1 Plate Sampling

The frequency of obtaining a plate sample is specified in 448.05. The procedures for determining the location of a plate sample and obtaining the sample is specified in 448.05 and Supplement 1035.

After a plate sample is obtained, it should be packaged and identified in accordance with current District or Laboratory policy. The sample should be shipped to the District lab as soon as possible.

Samples obtained by plate sampling are tested to determine the gradation and bitumen content of the asphalt concrete mix.

8.12.2 Core Sampling

The frequency of obtaining a core sample and the procedures for determining the location and obtaining the sample is specified in 446.05.

After a core sample is obtained, it should be packaged and identified in accordance with current District or Laboratory policy. The sample should be shipped to the District lab as soon as possible. Care should be taken not to damage the core by dropping it, throwing it or exposing it to excessive heat.

Samples obtained by core sampling are tested to determine the density of the asphalt concrete mix after it has been compacted by the rollers.

8.12.3 Hopper Sampling

Hopper samples are obtained in lieu of plate samples when the asphalt concrete course being placed is less than 32 mm (1.25 inch). The frequency of obtaining a hopper sample is specified in 448.05. The procedures for determining the location of a hopper sample and obtaining the sample is specified in 448.05 and Supplement 1035.

After a hopper sample is obtained, it should be packaged and identified in accordance with current District or Laboratory policy. The sample should be shipped to the District lab as soon as possible. Samples obtained by hopper sampling are tested to determine the gradation and bitumen content of the asphalt concrete mix.

8.12.4 Cutting Pavement Samples

Cut pavement samples are obtained when additional tests need to be made on the finished asphalt concrete pavement. The most common use of cut pavement samples are samples obtained in accordance with 448.08 or 448.09.

The location of a cut pavement sample is selected in a random manner, as specified in 448.05 and Supplemental 1035. The cut pavement sample should be 305 mm × 305 mm (12 inches × 12 inches). If the cut pavement sample breaks while it is being removed from the pavement, care should be taken to obtain all of the pieces.

After a cut pavement sample is obtained, it should be packaged and identified in accordance with current District or Laboratory policy. The sample should be shipped to the District lab as soon as possible. Most District labs are not able to test cut pavement samples, so the District will forward the sample to the Laboratory for testing.

Cut pavement samples are usually tested to determine the gradation and bitumen content of the asphalt concrete mix.

8.13 Quantities for Payment

8.13.1 Summarizing Quantities

Each load of asphalt concrete delivered to the project and accepted for placement must be accompanied by a plant ticket form approved by the Laboratory. When the load is accepted at the paving site, the paving inspector records the placement location and validates the ticket in the space provided.

A daily summary by item and location should be made of the weight of asphalt concrete placed.

When the placement of asphalt concrete items has been completed, a final summary of the weight placed must be made for use in the determination of the pay quantity for each item. The final summary should be broken down by separate pavement areas. In general, separate pavement areas are defined as separate contract parts, separate participation codes, physically separate roadways and pavement areas having differing design sections. The total weight summarized is converted to cubic meters (cubic yards) using the applicable conversion factor.

8.13.2 Converting to Cubic Meters (Cubic Yards)

After the total weight of a pavement area has been determined, it needs to be converted to cubic meters (cubic yards) using the applicable conversion factor established in accordance with 401.17. In 401.17, the conversion factor is established by the Laboratory when a mix design is available for the project or if no mix design is available, the conversion factor is listed in the table in 401.17. Depending on the conversion factor used, the total weight of a pavement area can be converted to cubic meters (cubic yards) as follows:

Conversion Factor Established by the Laboratory - When a conversion factor is established by the Laboratory, it is the unit weight of the mix, which has no units. The unit weight of a mix can be obtained from the “BCJMF” screen in the TAS portion of CMS. You will need to know the JMF number of the mix to use the “BCJMF” screen.

To convert the total weight of a pavement area to cubic meters (cubic yards), the total weight in kilograms (pounds) is divided by the conversion factor (unit weight) and is then divided by 1000 kilograms per cubic meter (1684.8 pounds per cubic yard). So the total weight converted to cubic meters (cubic yards) is:

Metric:

total weight (kg) ÷ conversion factor ÷ 1000 kg/m^3

English:

total weight (pounds) ÷ conversion factor ÷ 1684.8 pounds / cubic yard

This volume should be rounded off to the nearest cubic meter (cubic yard).

Conversion Factor from Table in 401.17 - When a conversion factor is obtained from the table in 401.17, it is in kilograms per cubic meter (pounds per cubic yard). To convert the total weight of a pavement area to cubic meters (cubic yards), the total weight in kilograms (pounds) is divided by the conversion factor. So the total weight converted to cubic meters (cubic yards) is:

Metric:

total weight (kg) ÷ conversion factor

English:

total weight (pounds) ÷ conversion factor

This volume should be rounded off to the nearest cubic meter (cubic yard).

8.13.3 Pay Quantity - New Construction

Where asphalt concrete is placed on a subgrade, subbase or base constructed under the contract, the plan depth is uniform and the pay quantity is the quantity placed providing it does not exceed the quantity calculated using plan lines and dimensions. Quantities placed in excess of

the plan quantity are not eligible for payment.
However, where a pavement area consists of more than one item, an excess in the quantity of one item may be transferred to offset a deficiency in the quantity of another item with payment for the transferred quantity being made at the lower unit bid price. Such transfer of quantities should not be made from the summary for one separate pavement area to that of another. Separate pavement areas are defined as separate contract parts, separate participation codes, physically separate roadways and pavement areas having differing design sections.

No transfer should be made to offset a deficiency in the quantity of a surface course item.

8.13.4 Pay Quantity - Minor Rehabilitation

Where one to two courses of asphalt concrete is placed on an existing pavement for the correction of the profile and cross section, the depth is variable and the pay quantity is the quantity placed as directed by the Engineer in accordance with the intent of the plans. Placement rate checks, as described in Section 8.7, should be used to verify the Contractor is meeting the intent of the plans.

8.13.5 Pay Quantity - Major Rehabilitation

Where multiple courses (three or more) of asphalt concrete are placed as part of a major rehabilitation of a pavement section, part of the asphalt concrete will be used for the correction of the profile and cross section of the rehabilitated pavement, as described in Section 8.13.4, and the rest of the asphalt concrete will be placed at a uniform depth, as described in Section 8.13.3.

For the course(s) used to correct the profile and cross section, the pay quantity is the quantity placed as directed by the Engineer in accordance with the intent of the plans. Once the Engineer has determined the profile and cross section has been corrected, the rest of the courses should have a uniform depth and the pay quantity is the quantity placed providing it does not exceed the quantity calculated using plan lines and dimensions, in accordance with Section 8.13.3.

9. BITUMINOUS COLD MIX

Construction requirements for bituminous cold mix are specified in 405.

Bituminous cold mix is a mixture of aggregate and bituminous material produced in a mixing plant. A coarse aggregate is used without fine aggregate. The bituminous material used has a viscosity that will permit mixing and placing often without heating the aggregate.

Since fine aggregate is not used in bituminous cold mix, there are rather large voids in the compacted mixture. The voids on the surface are filled by an application of fine aggregate. This is called a choke application. Usually, the plans also provide a seal coat to further seal the surface.

Bituminous cold mix may be produced in a central proportioning and mixing plant or in a travel plant which proportions, mixes, and places the mixture in one unit.

Bituminous cold mix may be used in new construction, in salvaging existing pavements by resurfacing or widening and resurfacing, and in shoulder paving. It also may be used as patching material for all types of pavements. The mixture often is stored for extended periods for use as patching material as needed.

9.1 Equipment

9.1.1 Mixing Plant

Requirements for mixing plants for use in the production of bituminous cold mix are specified in 405.04 in which reference is made to general requirements for asphalt concrete mixing plants. Travel plant requirements apply specifically to bituminous cold mix, while some of the central plant requirements apply only to asphalt concrete (hot mix).

Preliminary inspection and approval of the proposed mixing plant normally is done by a District specialist.

9.1.2 Spreading Equipment

Except for the travel plant, the type of spreading equipment considered suitable for spreading bituminous cold mix is the same as described in Section 8.1.1 for asphalt concrete. The travel plant utilizes an adjustable blade type strike-off, the blade of which is supported at each end on runners which provide a smoothing, leveling effect.

9.1.3 Compaction Equipment

The rollers to be used for compacting bituminous cold mix are specified in 405.11. All rollers proposed for use by the Contractor should be inspected for compliance with specification requirements before paving begins. The Contractor is required to furnish all required information concerning roller weights, tire pressure and wheel loads.

9.2 Weather Limitations

Paving operations must not be approved unless weather conditions are within the limitations in 405.05.

Weather conditions can affect the mixing and coating, and the curing of the bituminous material after the bituminous cold mix is placed and compacted. The effect on mixing and coating is included in Section 9.3. As for the curing of the bituminous material, weather conditions affect the rate of evaporation or dissipation of the liquefying component of the bituminous material. With all the types of bituminous materials used, some curing must take place in order for the compacted mixture to resist the deteriorating effects caused by traffic and, in case of rain, the accumulation of water in the mixture.

9.3 Mixture Production Inspection

9.3.1 Preparation of Bituminous Material

The table in 702.00 lists the grades of bituminous materials and the temperature ranges for mixing. The temperature of the bituminous material must be within the specified range at the time it is proportioned into the mixer. Heating of the bituminous material to a temperature above the specified range in an attempt to improve the coating of aggregate that is too cold or too wet is not effective and must not be permitted.

When the plans include a choice of bituminous material viscosity grades, a lower viscosity grade should be used under cooler conditions and a higher viscosity grade under warmer conditions.

9.3.2 Preparation of Aggregate

The quantity of moisture on the surface of the aggregate particles and the temperature of the aggregate greatly affects mixing and coating efficiency. With colder aggregate, greater mixing time and effort is needed to equal the results that would be obtained if the aggregate were warmer. The presence of moisture on the surface of the aggregate particles reduces the adhesion of cut-back asphalts which is necessary to cause coating of the aggregate particles as they are stirred and tumbled in the mixer. An approved coating agent may be added to cut-back asphalts to improve adhesion and coating. Some moisture on the surface of the aggregate particles often aids mixing and coating when an emulsified bituminous material is used. This is because the emulsion consists of minute globules of asphalt suspended in water containing an emulsifying agent.

Unless the aggregate is processed through a dryer, special stockpiling methods usually are necessary to assure a continuous, uniform supply of aggregate that is sufficiently dry to coat satisfactorily in the mixer. The coarse aggregate exposed at the surface of a stockpile dries quickly and may be warmed to some extent. The air dried aggregate is selectively loaded from exposed sides or from the top layer of a flattened stockpile.

In no case should the temperature of the aggregate be less than the minimum temperature specified in 405.07 as it is proportioned into the mixer.

9.3.3 Mix Proportions

Mix proportions, bituminous material and aggregate, usually are specified in the plans. Although these proportions are based on experience, there is some variation in the aggregate within a given type (gravel, limestone, or slag) and some adjustment may be desirable to produce a mixture with good stability and durability. Using any of the aggregates specified in 405.02, the proper quantity of bituminous material will produce a thick coating on each aggregate particle and the mix will stick together well, before and after compaction.

If mix proportions are not specified in the plans, trial mixes should be made preferably in a laboratory to establish proportions for the project.

Caution is required when evaluating mix proportions during full scale production. Failure of the bituminous material to properly coat the aggregate may be due to the aggregate being too cold or too wet rather than due to insufficient bituminous material. Also, when the aggregate has been processed through a dryer, a tendency for the bituminous material to drain from the aggregate may be due to the aggregate being too hot rather than due to an excess of bituminous material.

9.3.4 Mixing

Inspection of the mixing operation in bituminous cold mix production includes the proportioning of the aggregate and the bituminous material as well as the mixing of these two ingredients.

In a central batch type plant, the aggregate for a batch is drawn from a bin into an aggregate weigh box and then discharged into the mixer. The bituminous material for a batch may be pumped from either storage into a bituminous material weigh bucket and then discharged into the mixer or it may be pumped from storage through an indicating meter into the mixer. The accuracy of the proportioning is checked by testing the batch scales using test weights. The accuracy of the indicating meter is checked by weighing, in a test container, a quantity of bituminous material indicated by the meter.

In a continuous type plant, either a central or a travel plant, the aggregate in a bin is metered through an adjustable feeder into the inlet end of the mixer. A positive displacement type pump, coupled with the aggregate feeder drive, delivers a proportional quantity of bituminous material form storage to the mixer where it is sprayed on the aggregate. The mixer paddles are arranged so the mixture is moved continuously from the inlet end to the discharged end as mixing and coating is caused to take place. Calibration of the aggregate feeder and the bituminous material pump settings is necessary prior to the start of production. The accuracy of the proportioning is checked periodically in the same manner.

The proportioning of materials should be observed regularly to assure that specified proportions are maintained. Depending on the type of mixing plant, this would include observing batch scales and a periodic comparison of the quantity of bituminous material used with the quantity of aggregate used. Proportioning should be sufficiently accurate that no variation is apparent from visual inspection as the work progresses.

Acceptance of the mixture with regard to the mixing of the aggregate and bituminous material and to the coating of the aggregate particles is based on visual inspection. The bituminous material should appear to be thoroughly and uniformly distributed within a quantity of the mixture. Thorough coating of each particle of aggregate should be expected. While complete coating of each particle is desirable, the presence of some uncoated spots is acceptable. As a general rule not less than 75 percent of the surface of each aggregate particle should be coated with bituminous material at the time the mixture is spread on the pavement.

When coating of the aggregate is not satisfactory it can be improved by the measures noted in Sections 9.3.1 and 9.3.2. In addition the mixing time can be increased. In a batch mixer this simply means holding the batch in the mixer a longer period of time. In a continuous mixer the mixing effect is increased by increasing the depth of mixture in the mixer. This is done by raising the dam at the discharge end of the mixer or by adjusting the pitch of the mixer paddles to retard the rate of flow through the mixer.

The mixture should be observed regularly and where mixing and coating is found to be unacceptable the work should not continue without satisfactory corrective measures by the Contractor.

The net weight of each load of mixture produced in a central mix plant must be measured either by means of a truck scale or automatic recording batch scales. The weighing operations are observed by an inspector who then validated a load ticket for each load to be delivered to the project. The required data on the load ticket for use in controlling spreading and for establishing pay quantities is given in Section 9.5.1.

9.4 Spreading

The Contractor is required to spread bituminous cold mix in reasonably close conformance with the lines, grades, quantity per square meter (square yard), and typical sections specified or established by the Engineer.

The quantity to be spread per square meter (square yard) usually is specified in the plans in terms of cubic meters (cubic yards) of aggregate per square meter (square yard) of a pavement surface. For control of spreading, the cubic meter (cubic yard) rate is converted to kilograms (pounds) of aggregate per square meter (square yard) using the conversion factors in 405.17. The inspector should check the actual rate of spreading regularly and maintain a running total of aggregate spread and area covered to assure conformance with plan requirements.

A guideline for the spreader operator to follow is necessary for proper control of alignment. The Contractor sets a string line to control mainline paving and uses the pavement edge to control shoulder paving. In the case of new construction, the string line is set from layout stakes. In the case of resurfacing, it is the intent of the plans to follow the existing pavement alignment and the Engineer should establish control points along the existing centerline from which the Contractor can set a string line.

The cross-slope of the pavement is shown on the typical sections for new construction. For resurfacing, the cross-slope often is not shown and the Engineer must designate the desired cross-slope so the Contractor can adjust the spreader accordingly. This should not be less than a slope of 0.0156 (15.6 mm/m (0.0156 feet per feet)) on normal tangent sections. When the existing superelevation on curves is satisfactory, the resurfacing should smooth out any irregularities. When the superelevation on curves is not satisfactory, adjustment of the cross-slope of the resurfacing through the curves should be consistent with the geometries of the alignment and the traffic speed.

Correction of profile irregularities often is desirable during the resurfacing of existing pavements. For spot profile correction methods, reference is made to Section 8.5.4.

9.5 Choke Application

The choke aggregate is applied by means of a mechanical spreader after the mixture has been compacted by the initial roller coverage. The choke aggregate is rolled into the surface voids during the final rolling of the mixture. The rate of application of choke aggregate should be adjusted as necessary to fill the surface voids with little or no excess loose aggregate on the surface.

When a penetration choke is specified on the plans, a choke application is made, as above, then within a specified time period an application of bituminous material is made and covered by a second choke application. The second choke application is rolled until the aggregate is embedded tightly in the surface voids.

Loose choke aggregate that accumulates in piles or in windows must be redistributed over the surface prior to placing either a seal coat or a penetration choke.

9.6 Compaction

Satisfactory compaction of bituminous cold mix will be obtained using the rollers and methods specified in 405.11 and 405.14. As the work progresses, the rate of spreading should be checked to assure that it does not exceed the combined capacity of the rollers in use.

During the compaction operation it is intended that the aggregate particles will be worked into a stable position and tightly interlocked before curing of the bituminous material takes place.

9.7 Quantities for Payment

9.7.1 Central Plant Mix

Each load of central plant mixed bituminous cold mix delivered to the paving site and accepted for placement must be accompanied by a load ticket validated by the inspector at the plant.

Where truck scales are used, the following data is tabulated on each load ticket:

Gross Weight (truck and mixture)

Tare Weight (truck)

Net Weight (mixture)

Total Weight of Bituminous Material

Total Weight of Aggregate

Where automatic batch weight recording equipment is used, only the net weights of mixture, aggregate, and bituminous material are tabulated on each load ticket.

When each load is accepted at the paving site, the paving inspector validates the load ticket and retains it for the project record.

9.7.2 Travel Plant Mix

Each load of aggregate delivered to the travel plant and accepted for mixing must be accompanied by a load ticket validated by the inspector at the scale location. The paving inspector validates the load ticket and retains it for the project record.

9.7.3 Bituminous Material

Each load of bituminous material delivered to the paving site either for transfer to a travel plant or for a distributor spray application must be accompanied by the validated load weight ticket. When the entire load is accepted and used in the work, the inspector validates the load ticket and retains it for the project record. When the entire load is not used in the work, the quantity used must be determined by weighing the partial load remaining. After recording this weight thereon, the inspector validates the original load ticket and retains is for the project record.

The specifications also provide in 109 for the measurement of bituminous material by volume in calibrated tanks. This method requires an accurate temperature measurement to be made and recorded when the volume is measured. The measured volume then is converted to the pay volume at a specified temperature as provided in 109.

9.7.4 Summarizing Quantities for Payment

A daily summary of aggregate and bituminous material used in the work should be made by item and location.

The final summary of pay quantities should be broken down by separate pavement areas or contract parts. Bituminous material weights are converted to volume to the nearest gallon for payment in accordance with 109 and aggregate weights are converted to volume to the nearest cubic meter (cubic yard) for payment in accordance with the conversion factors in 405.17. The summaries along with validated load tickets are a part of the project record documenting the quantities presented for payment.