4. Examine pavement base, see that required patching and/or pre-leveling is done; make check on paving depths or spread before paving begins.
5. See that paver guide lines are set.
6. Make sure that cold transverse joints are cut back to the vertical before continuing a lane.
7. Check transverse joint for smoothness and appearance.
8. Watch trucks dumping into paver hopper for adverse effect on paver operation.
9. Check temperature of the mixture at time of delivery to the paver and during compaction of the course.
10. Maintain constant inspection of mat behind paver for signs of roughness or non-uniformity of mixture.
11. See that longitudinal and transverse joints are raked and compacted properly.
12. Make frequent checks of the spread yield and depth.
13. Watch rolling operations; see that best rolling sequence is used to fit conditions; watch for excessive speed of rollers. Check and adjust the amplitude and frequency of vibrating rollers.
14. Keep records of truck loads used each day; check with Plant Inspector concerning daily totals.
15. Make sure the job is in good shape before you leave at the end of the day; see that all lights, barricades, etc., are properly placed; see that all signs not required during non-working hours are removed or covered.

401.05 — Records and Reports

The Road Inspector's records should reflect a complete summary of paving operations on the project. These records should include a Road Inspector's diary, load tickets, weather conditions, and the record of loads received with asphalt cement content and location where the load is placed. The Plant Inspector usually files the reports, when required, with the District and Central Offices; however, the Road Inspector must measure the area paved each day and furnish this information to the Plant Inspector, along with the total weight of material placed and numbers of the load tickets when any loads or partial loads have been rejected or wasted. The records of the quantity of material produced and material placed must agree and be properly documented to form an unquestionable basis for pay quantities.

Section 402—Cold Mix Asphalt Pavement

402.01 — General

Asphalt cold mix is a mixture similar to hot asphalt concrete except that the materials are of such a nature that the mixture may be transported, stockpiled, and laid cold. There are many different combinations of materials used in cold asphalt

concrete mixtures; however, all combinations may be classified under two general types: one in which the mineral aggregate is mixed with a liquid asphalt cement (either an emulsion or cutback) bitumen; and another in which asphalt cement, or powdered asphalt, is mixed with the mineral aggregate along with a liquefier, which usually consists of an approved primer and additives such as hydrated lime or water. There are some special kinds of cold asphalt concrete which are patented and hence their use is subject to approval of the patent owner and to the payment of a royalty.

Cold mix asphalt pavement mixture is ordinarily used as a leveling course, surface course, resurfacing course on an existing, but worn surface of another type, and used extensively for patching failures in any pavement surface.

402.02 — Design

As the major portion of mixture is produced by commercial plants set up in a permanent location, the design and plant control is usually performed by the District or Central Office Laboratory personnel. Trial mixes shall be made similar to hot mix trial mixes and the results of these trial mixes should indicate the design mix formula that will produce a mixture with the density and stability specified for the project. The grading of the aggregate and percent asphalt cement shall conform to the requirements of the specifications.

402.03 — Materials

A. Mineral Aggregate. The mineral aggregate shall be of the same nature, graded, and stockpiled as that for hot asphalt concrete, except that when a mineral aggregate has shown poor affinity for asphalt material, its use may be rejected or an approved non-stripping agent must be added to the asphalt material.

B. Asphalt Cement. The liquid asphalt material should be either emulsions or cutbacks and remain fluid at air temperature sufficiently long enough to permit the completion of construction operations. Asphalt cements used with a primer and hydrated lime of water should be of the high penetration, low viscosity type.

402.04 — Plant Operations

The plant operations of asphalt cold mix and hot asphalt concrete are identical except in the drying operation and mixing operations. See Section 401 for details.

The temperature of the mineral aggregate at the mixer must be considerably lower for cold mix. The mixing temperature limits will be set forth in the specifications. These temperature limits must be strictly observed to ensure a mixture that will remain in a workable condition from the time it is mixed until it is incorporated in the pavement. The temperature may be controlled by heating and drying the aggregate and then cooling back to the required temperature; or controlling the heat and rate of

flow of the aggregate through the plant so that the aggregate will arrive at the mixer properly dried and at the specified temperature.

The graded aggregates are proportioned to the mixer according to the design mix formula and dry mixed until they are uniformly distributed. For the liquid asphalt cement type, the asphalt material should then be added and mixed with the aggregate the specified wet mixing period. For the asphalt cement with liquefier type, as soon as dry mixing period is completed the primer, hydrated lime or water, and asphalt cement shall be added and mixed in a manner that will produce a workable cold mix conforming to specification requirements.

The most commonly used hot mix cold lay mixture of the asphalt cement and liquefier type consists of an asphalt cement of low viscosity, an approved primer, and water. The percentages of these materials used in the mixture are determined by the design mix formula within the maximum and minimum limits set forth in the specifications. The sequence of introducing these materials into the mixer, and the length of mixing time, will be such that a uniform and workable mixture that conforms to the specification requirements is delivered to the project.

402.05 — Road Operations

The road operations are the same as for hot asphalt concrete except as discussed below. (See Section 401).

The cold mix, after being uniformly windrowed on the paving surface in the amount to give the required spread, must be thoroughly aerated to reduce the hydrocarbon volatiles and/or moisture content to specified maximum or less before spreading operations begin. As this type of mixture ordinarily produces a dense pavement, there is very little loss in the hydrocarbon volatiles and moisture content after compaction; therefore, if these are not removed to the level specified prior to compaction, they will tend to overfill the voids which in turn may cause the pavement to become unstable. This aerating process may be accomplished by any combination of equipment as described in the road-mix asphalt pavement Section 403. As the aerating process is largely controlled by the weather, the weather limitations set forth in the specifications must be strictly observed.

When the mixture is ready for spreading, it shall be uniformly windrowed, spread, finished, and compacted in the same manner as road-mix asphalt concrete. No succeeding course shall be applied until the surface has been checked and approved by the Project Engineer.

402.06 — Records and Reports

Details as outlined in Section 401.

Section 403 — Road Mix Asphalt Pavement

403.01 — General

The type of base course or surface course known as road-mix or mixed-in-place construction consists of a combination of mineral aggregate and asphalt cement with the mixing performed on the road by means of a traveling mixing plant, travel mixers, or other equipment that will satisfactorily mix the materials directly on the roadbed. This type of pavement, in addition to its use as an original base course or surface course in new construction, is frequently used as a retread mat over an existing but worn surface of another type.

The construction shall consist of one or more courses placed on a prepared foundation.

403.02 — Materials

A. Mineral Aggregates. A wide variety of mineral aggregates may be used for road-mix construction; in fact, almost any gradation and type of material which is predominantly granular in character will serve satisfactorily.

The aggregates used in this type of construction are: (1) aggregates that may be already in place as an integral part of the graded roadbed or as a previously constructed base or surface course of gravel, crushed rock, or other suitable material; (2) if the existing aggregates are deficient in quality or quantity, new aggregate from an outside source may be hauled to the roadbed and blended with the existing aggregate; (3) one aggregate hauled to the roadbed from an outside source; or (4) two or more aggregates hauled from outside sources and blended on the prepared roadbed.

B. Asphalt Materials. The asphalt material for this type of construction must necessarily be a liquid that will remain fluid at air temperature sufficiently long to permit completion of the construction operations. The materials ordinarily used are cutback asphalts, and emulsified asphalts. The type and grade of the material to be used on any project is generally determined by the characteristics of the aggregate, type of road mixing equipment to be used, and climatic conditions. Cutback asphalts may have limited use because of EPA air emission controls.

C. Additives. The only additive to be used in road-mix construction is an approved primer that may be required, or used, at the Contractor's option. In lieu of aerating and drying the aggregate, the Contractor may use an approved primer. The primer shall permit suitable coating of the wet aggregate and shall prevent the asphalt coating from stripping in the presence of free moisture.

403.03 — Equipment

There is a wide variety of mixing equipment, capable of producing a satisfactory mixture, available for use in road-mix construction. The Contractor normally proposes to use equipment that is required by his method of operation. This equipment shall comply with the governing specifications and shall be approved by the Project Engineer, both as to type and working condition, prior to the beginning of construction operations.

A. Mixers. The three principal types of travel mixers used in road-mix construction are: (1) the travel plant mixer that receives the aggregate into a hopper from trucks, mixes it with asphalt material and spreads the mixture—all in one pass of the machine; (2) the travel plant mixer that takes the aggregate from a windrow, mixes it with asphalt material and deposits the mixture behind the mixer in a windrow; (3) the rotary pulverizer-type mixer with transverse shafts that mix the asphalt material and aggregate with resolving tines under a hood.

The mixing mechanism of the mixer should be examined daily for excessive wear and broken or defective parts. The pressure pump and meter that delivers the liquid asphalt material from the tank truck to the spray bar on the travel mixers (1) and (2) above should be accurately calibrated to deliver the percentage of asphalt material specified for the mixture.

B. Distributor. The distributor that is used to apply the liquid asphalt material when the mixer is not equipped to do so shall be of the type and be so equipped as to conform to the specifications. The distributor must be kept clean and in good working condition so as to deliver an accurately measured quantity of asphalt cement material at the specified rate and temperature.

C. Motor Graders. The motor grader(s) shall be of the size and type necessary to adequately mix the needed quantities of materials on the roadway and shall be in good working condition. The blade must be reasonably sharp and the control unit should be capable of holding the blade to an established line and grade.

D. Rollers. The rollers shall be of size and type specified for the project. On pneumatic-tired rollers, all tires must be of equal size and equally inflated. Tire pressures and the loading of the roller may be varied to give the ground contact pressures that are desirable for that particular mixture. Steel-wheel rollers should be checked for excessive play in the steering and driving mechanisms, flat spots on wheels, and spray bars operating properly with wetting mats in satisfactory condition.

E. Haul Trucks. Haul trucks that are used to transport aggregates from other sources to the roadbed should be in good operating condition, uniform in capacity,

and capable of dumping into a spreader box, windrow sizer, or hopper. When aggregate is measured by volume, all trucks shall be accurately measured and numbered and these measurements and numbers recorded in the project records.

F. Scales. Truck scales of the type and size specified for the project shall be finished and installed by the Contractor. A commercial scale mechanic should supervise the installation and perform the initial check on the accuracy of the scales. Periodic checks for accuracy, during construction, shall be performed by the Project Engineer in accordance with specification requirements.

G. Miscellaneous Equipment. In addition to the equipment listed above, other equipment, such as asphalt storage tanks, asphalt heaters, water trucks, disk harrows, tractors, power brooms, windrow sizers, and other auxiliary equipment, may be required for use on the project.

403.04 — Construction Operations

A. Traffic Control. Traffic control should be thoroughly discussed at the pre-construction conference. At this time, definite traffic control procedures should be established that provide maximum safety for workers and the traveling public, and with the least interruption of the work. All traffic control devices and procedures used to direct traffic through the construction area should be in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD) and of the type shown on the plans and approved by the Department.

If traffic is to be carried on an unpaved shoulder during paving operations, adequate measures should be taken to prevent blowing dust from becoming a traffic hazard. On a pavement-widening project, the open trench is an unusually dangerous traffic hazard and this edge should be properly signed and delineated at all times.

B. Weather. Weather limitations as to temperature and closed seasons for this type of construction shall be in accordance with the specifications. The weather should be hot and dry to facilitate the evaporation of moisture and volatiles from the mixture. Extra manipulations of the mixture will be required to remove the moisture and volatiles in cool and humid conditions. Work shall be suspended during wet weather.

C. Preparation of Base and Aggregate. When aggregate in the existing road surface is to be used in the asphalt mixture, the surface should first be scarified lightly and bladed to the correct grade and cross section. If no new aggregate is to be added, the reshaped surface should then be scarified to the depth necessary to provide the required amount of material. The loosened material should then be bladed aside and the understratum shaped to the profile and cross section of the proposed finished surface. Next the understratum shall be scarified, bladed,

watered, and rolled to the density specified or until a satisfactory foundation for the mat is prepared. After curing, a prime coat should be applied, as required by the contract provisions.

When new aggregate is to be blended with material from the existing road surface, the process is the same as in the previous case except that following the scarifying of the reshaped roadbed to the required depth the new aggregate should be spread over the loosened existing aggregate in the required amount. The two types of aggregate should then be thoroughly blended by travel mixer or harrowing and blading after which all the aggregate should be bladed to the side and the understratum prepared as a foundation, as in the previous case.

When all new aggregate is to be used in the mixture, it is only necessary to shape and compact the existing road surface to receive the mat and apply a prime coat if specified. When more than one new aggregate is to be used, they should be placed on the prepared surface in the required quantity and blended as in the previous case. Usually, one material is windrowed and spread to the width desired and then one or more new aggregates added on to this aggregate until the required quantity of material is in place and ready for blending operations. If the construction is a retread mat over an existing hard-surface pavement, some patching of the pavement may be necessary and the application of a tack coat will be desirable.

D. Applying Asphalt and Mixing. The aggregate, whether new, blended, or salvaged from the existing road, should be bladed into a windrow along the center or one side of the roadbed. The cross-sectional area should then be measured, the volume computed, and the quantity of asphalt cement required determined. Immediately prior to applying asphalt cement, the aggregate should be checked for moisture. The maximum allowable surface moisture content of the aggregate is normally 2 percent, except where emulsified asphalts are used. If the aggregate is wet, the aggregate should be turned by blades, disk harrows, rotary travel mixer, or otherwise aerated until the moisture content is reduced to 2 percent or as specified. When the aerating process is prolonged and impedes construction progress, the Contractor may elect to use, with the permission of the Project Engineer, an approved additive that will permit suitable coating of the aggregate in the presence of free moisture and shall prevent the asphalt cement coating from stripping.

If the traveling plant method of mixing is to be used, the aggregate should be left in the windrow from which it will be picked up by the machine, fed continuously through the plant, mixed with asphalt cement, and redeposited in a windrow behind the machine ready for aerating, spreading, and compacting. In the mixing machine the desired proportions are obtained automatically through devices which measure both the aggregate and the asphalt cement. The combined materials flow into the mixing chamber where they are processed to uniformity and forced out the rear in a continuous stream by the twin pugmill-type mixer. Another travel plant method of mixing is to receive the aggregate in a hopper from the haul trucks, feed from this hopper continuously through the plant, mix with asphalt cement and deposit behind the machine to the grade and cross section prescribed for that course.

When the mixing is to be performed on the roadbed rather than by a traveling plant, the windrowed aggregate should be spread smoothly and uniformly over part of the roadbed to a width convenient for application of liquid asphalt bitumen. The asphalt material should then be sprayed over the aggregate in two or three separate applications, each approximately one-third the total amount required. Each application should be followed immediately by partial mixing with blades, disk harrows, rotary travel mixer, or other suitable equipment until as little free asphalt material as possible is left. The intervals between the applications depend upon the results of the partial mixing.

After the third application of liquid asphalt and partial mixing is completed, the entire mass should be windrowed and then bladed alternately from one side of the roadbed to the other, or otherwise manipulated by means which will produce equivalent results, until all particles of aggregate are coated with the asphalt cement material and the whole mass has a uniform color. During mixing, attention should be paid to the vertical and horizontal angles of the mold board of the motor grader; this board should be adjusted so that a complete rolling action of the material is obtained when the windrow is manipulated. Also, during the mixing, aerating and spreading operations to follow, care should be taken to avoid cutting into the underlying foundation or contaminating the mixture with earth or other extraneous matter. When specified, the mixing process shall be confined to part of the width or area of the road so as to allow traffic to pass.

Either method of mixing will produce satisfactory results, but the traveling plant method has the following advantages over manipulating the materials on the roadbed: (1) more accurate control of liquid asphalt content is possible; (2) heavier grades of asphalt cement can be used; (3) a more uniform thickness can be obtained; (4) delays caused by inclement weather will be of shorter duration; and (5) the likelihood of partially mixed material getting wet is eliminated.

If, when the mixing process has been substantially completed, the mixture shows an excess, deficiency, or uneven distribution of asphalt cement material, the unsatisfactory condition must be corrected, and then remixed.

If, for some reason, mixing operations are not completed before the end of the day's work or if the operation is interrupted by weather or other conditions, all loose material shall be bladed into a windrow, whether mixing is completed or not, and shall be retained in a windrow until operations are resumed.

E. Laying, Compacting, and Finishing. Before the mixed material is spread on the road for compacting and finishing, it should be checked for moisture content and for the quantity of the volatile portion of the asphalt material remaining in the mixture. If the moisture content exceeds the maximum allowable for aggregate under the contract provisions, the mixture should be aerated sufficiently by manipulation to remove the excess water.

The volatile portion of the asphalt material serves no useful purpose after the mixture has been prepared and placed, and it must be partially removed if the

asphalt cement is to develop the natural cementing properties of which it is capable and the mixture stability expected. Dissipation of the volatile material after the mixture has been compacted is a very slow process; consequently, the volatile substance should be eliminated as far as possible before compaction begins. This should be accomplished by continued manipulation until the mixture is just sufficiently workable to permit satisfactory placing.

When the mixture is ready for placing, the windrowed mixture should be moved to one side of the centerline. Approximately one-half of the windrowed material then is split from this windrow and the spreading process begins with the blade carrying this windrow across the centerline to the edge and back to the remaining half of windrowed material. The remaining material is then bladed to the other edge and back. Sufficient material should be left to continue across the centerline to the first edge and then back across the centerline to the second edge completing the laying operation. A pneumatic roller, of the size and type specified, should begin rolling right behind the motor grader on the first spreading pass and should continue to roll until the blading has been completed. This will compact the mixture from the bottom up, mostly eliminating grader tire marks from the surface. The finish rolling should be completed by a steel-wheel roller of the size and type specified. Any loose material that will not compact should be wasted over the side. As a part of the final finishing, the edges should be trimmed to neat lines and the surface straightedged in accordance with the governing specifications.

After one course has been compacted and cured, other courses, as required by the plans, may be placed on it. This operation should be repeated as many times as necessary to bring the road to the cross section and grade shown on the plans.

No uncompacted mixture should be allowed to remain spread on the roadbed overnight or until resumption of operations following suspensions due to weather or other conditions. To avoid contamination, increase in moisture content, or damage by traffic, such loose material should be bladed into a windrow at the end of each day's work and at the beginning of any interruption and retained in a windrow until operations are resumed.

403.05 — Records and Reports

Project records should reflect a complete summary of materials incorporated and construction operations performed on the project and, with proper documentation, form an unquestionable basis for pay quantities. These records should include project diaries, tests performed on materials by project personnel, by District and Central Office personnel, materials received, measurements of materials used on the project, and final plans.

Tests reports and progress reports should be filed, as required, with the District and Central Offices. These reports should reflect the quality and quantity of materials being incorporated in the work.

Section 404 — Tack Coat

404.01 — General

This section will deal with the type of construction contained in Section 404 of the AASHTO *Guide Specifications for Highway Construction*.

It must be assumed that the proper quantities of asphalt material to be used have been established. It is further assumed that during construction, proper adjustments will be made in the quantities due to permissible, slight variations which occur in the materials and which were not considered in the original determination. A uniform application of asphalt material is extremely important in order to achieve the desired results.

404.02 — Descriptions

Tack Coat. A tack coat consists of applying a liquid asphalt material, usually at a specified rate per square yard, upon the existing pavement surface to ensure a thorough bond between the old and new courses. Tack coats are used primarily in connection with the higher types of asphalt concrete pavements.

404.03 — Design and Materials

Prior to use, all materials must be inspected and tested for compliance with the requirements of the specifications.

404.04 — Equipment

See Section 406.04 for the applicable equipment.

404.05 — Road Operations

Surface Cleaning. The existing surface must be cleaned just prior to the applying of the asphalt material. All foreign materials such as paper and mud should be removed and the entire surface should be thoroughly broomed to remove dirt and dust.

Traffic Control. Traffic control should be thoroughly discussed at the preconstruction conference. At this time, definite traffic control procedures should be established that provide maximum safety for the workers and the traveling public, and with the least interruption of the work. All traffic control devices and procedures used to direct traffic through the construction area should be in accordance with the *Manual on Uniform Traffic Control Devices* (MUTCD) and of the type shown on the plans and approved by the Department.