

Supplement No. 9

to

June 1959 Edition

STANDARD SPECIFICATIONS  
FOR  
CONSTRUCTION  
OF  
AIRPORTS



1964

FEDERAL AVIATION AGENCY

Washington, D.C.

**SUPPLEMENT NO. 2**

**to**

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# **SUPPLEMENT NO. 2 TO JUNE 1959 EDITION OF STANDARD SPECIFICATIONS FOR CON- STRUCTION OF AIRPORTS**

Supplement No. 2, issued as Advisory Circular 150/5370-1, Change 1, contains all changes and additions to the June 1959 Edition of Standard Specifications for Construction of Airports issued subsequent to that date, including Supplement No. 1 dated 1961, and Amendment No. 1 dated September 1962.

## **DIVISION I—GENERAL PROVISIONS**

### **SECTION 10**

#### ***Definition of Terms***

10-17 Federal Specifications—page 2. Delete the last sentence and substitute the following: They may be obtained from General Services Administration Region 3, Federal Supply Service, Printed Materials Supply Division, General Services Regional Office Building, Washington, D.C., 20407.

10-24 MIL Specifications—page 3. Delete the last sentence and substitute the following:

They may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pa., Attention: Code CDS.

10-44 Subgrade—page 4. Delete and substitute the following: The soil which forms the pavement foundation.

10-48 Surfacing—page 5. Delete and substitute the following: The top layer of the pavement.

### **SECTION 20**

#### ***Proposal Requirements and Conditions***

20-25 Preparation of Proposal—page 7. The correct section number should be indicated as 20-05.

### **SECTION 90**

#### ***Contract Requirements***

Delete pages 35 to 37, inclusive, and substitute the following:

All construction contracts entered into by a sponsor with respect to any project involving Federal funds shall contain in addition to such other provisions as may be necessary to insure accomplishment of the work involved in accordance with the Grant Agreement for such project, the following provisions

(or revisions thereof approved in advance by the Administrator) except that contracts for which a minimum wage determination of the Secretary of Labor is not required, need not contain the provisions set forth in subparagraphs 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, and 15.

This regulation in its 17 subparagraphs sets forth 17 mandatory provisions which the sponsor is required to include in all construction contracts except as noted. The provisions are as follows:

(1) *Federal Aid to Airport Program Project.* The work in this contract is included in Federal-aid Airport Project No. ----- which is being undertaken and accomplished by the (insert sponsor's name) in accordance with the terms and conditions of a grant agreement between the (insert sponsor's name) and the United States, under the Federal Airport Act (49 U.S.C. 1101) and Part 151 of the Federal Aviation Regulations (14 CFR Part 151), pursuant to which the United States has offered and agreed to pay a certain percentage of the costs of the project that are determined to be allowable project costs under that Act. Any reference in this contract to the FAA or any representative thereof, or to any rights granted to the FAA or any representative thereof, or the United States, by the contract, shall in no sense make, or be construed as making, the United States a party to this contract.

(2) *Convict Labor.* No convict labor shall be employed under this contract.

(3) *Veterans' Preference.* In the employment of labor (except in executive, administrative, and supervisory positions), preference shall be given to qualified individuals who have served in the military service of the United States (as defined in section 101(1) of the Soldiers' and Sailors' Civil Relief Act of 1940) and have been honorably discharged from such service, except that preference may be given only where that labor is available locally and is qualified to perform the work to which the employment relates.

(4) *Minimum Wages.* (i) All mechanics and laborers employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act [29 CFR Part 3]), the full amounts due at time of payment computed at wage rates not less than those contained in the wage determination decision(s) of the Secretary of Labor which is (are) attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics; and the wage determination decision(s) shall be posted by the contractor at the site of the

work in a prominent place where it (they) can be easily seen by the workers. For the purpose of this clause, contributions made or costs reasonably anticipated under section 1(b) (2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of subparagraph (iv) below. Also for the purpose of this paragraph, regular contributions made or costs incurred for more than a weekly period under plans, funds, or programs, but covering the particular weekly period, are deemed to be constructively made or incurred during such weekly period. (29 CFR 5.5(a) (1) (i))

(ii) Any class of laborers or mechanics which is not listed in the wage determination(s) and which is to be employed under the contract, shall be classified or reclassified conformably to the wage determination(s), and a report of the action taken shall be sent by the (insert sponsor's name) to the FAA for approval and transmittal to the Secretary of Labor. In the event that the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers and mechanics to be used, the question accompanied by the recommendation of the FAA shall be referred to the Secretary of Labor for final determination. (29 CFR 5.5(a) (1) (ii))

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly wage rate and the contractor is obligated to pay a cash equivalent of such a fringe benefit, an hourly cash equivalent thereof shall be established. In the event the interested parties cannot agree upon a cash equivalent of the fringe benefit, the question, accompanied by the recommendation of the FAA shall be referred to the Secretary of Labor for determination. (29 CFR 5.5(a) (1) (iii))

(iv) The contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b) (2) (B) of the Davis-Bacon Act, or any bona fide fringe benefits not expressly listed in section 1(b) (2) of the Davis-Bacon Act or otherwise not listed in the wage determination decision(s) of the Secretary of Labor which is included in this contract, only when the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. Whenever practicable, the contractor should request the Secretary of Labor to make such findings before the making of the contract. In the case of unfunded plans and programs, the Secretary of Labor may require the contractor

to set aside in a separate account assets for the meeting of obligations under the plan or program. (29 CFR 5.5(a)

(1) (iv))

(5) *Withholding: FAA from Sponsor.* Pursuant to the terms of the Grant Agreement between the United States and (insert sponsor's name), relating to Federal-aid Airport Project No. -----, and Part 151 of the Federal Aviation Regulations (14 CFR Part 151), the FAA may withhold or cause to be withheld from the (insert sponsor's name) so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics employed by the contractor or any subcontractor on the work the full amount of wages required by this contract. In the event of failure to pay any laborer or mechanic employed or working on the site of the work all or part of the wages required by this contract, the FAA may, after written notice to the (insert sponsor's name), take such action as may be necessary to cause the suspension of any further payment or advance of funds until such violations have ceased. (29 CFR 5.5(a) (2))

(6) *Withholding: Sponsor from Contractor.* Whether or not payments or advances to the (insert sponsor's name) are either held or suspended by the FAA, the (insert sponsor's name) may withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics employed by the contractor or any subcontractor on the work the full amount of wages required by this contract. If the contractor or any subcontractor fails to pay any laborer or mechanic employed or working on the site of the work any of the wages required by this contract (insert sponsor's name) may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment or advance of funds until the violations cease.

(7) *Payrolls and Basic Records.* (1) Payrolls and basic records relating thereto will be maintained during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records will contain the name and address of each such employee, his correct classification, rates of pay (including rates of contributions or costs anticipated of the types described in section 1(b) (2) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a) (1) (iv) (see subparagraph (iv) of paragraph (4) above), that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b) (2) (B) of the



Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. (29 CFR 5.5(a) (3) (1)).

(ii) The contractor will submit weekly a copy of all payrolls to the (insert sponsor's name) for transmission to the FAA as required by § 151.53(a) of the Federal Aviation Regulations. The copy shall be accompanied by a statement signed by the employer or his agent indicating that the payrolls are correct and complete, that the wage rates contained therein are not less than those determined by the Secretary of Labor and that the classifications set forth for each laborer or mechanic conform with the work he performed. A submission of "Weekly Statement of Compliance" which is required under this contract and the Copeland regulations of the Secretary of Labor (29 CFR, Part 3) and the filing with the initial payroll or any subsequent payroll of a copy of any findings by the Secretary of Labor under 29 CFR 5.5(a) (1)

(iv) shall satisfy this requirement. The prime contractor shall be responsible for the submission of copies of payrolls of all subcontractors. The contractor will make the records required under the labor standards clauses of the contract available for inspection by authorized representatives of the FAA and the Department of Labor, and will permit such representatives to interview employees during working hours on the job. (29 CFR 5.5(a) (3) (ii))

(8) *Apprentices.* Apprentices will be permitted to work as such only when they are registered, individually, under a bona fide apprenticeship program registered with a State apprenticeship agency which is recognized by the Bureau of Apprenticeship and Training, United States Department of Labor; or, if no such recognized agency exists in a State, under a program registered with the Bureau of Apprenticeship and Training, United States Department of Labor. The allowable ratio of apprentices to journeymen in any craft classification shall not be greater than the ratio permitted to the contractor as to his entire work force under the registered program. Any employee listed in a payroll at an apprentice wage rate, who is not registered as above, shall be paid the wage rate determined by the Secretary of Labor for the classification of work he actually performed. The contractor or subcontractor will be required to furnish to the (insert sponsor's name) written evidence of the registration of his program and apprentices as well

as of the appropriate ratios and wage rates, for the area of construction prior to using any apprentices on the contract work. (29 CFR 5.5(a)(4))

(9) *Compliance with Copeland Regulations* (29 CFR Part 3). The contractor shall comply with the Copeland Regulations (29 CFR Part 3) of the Secretary of Labor which are herein incorporated by reference. (29 CFR 5.5(a)(5))

(10) *Overtime requirements.* No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any laborer or mechanic in any workweek in which he is employed on such work to work in excess of eight hours in any calendar day or in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times his basic rate of pay for all hours worked in excess of eight hours in any calendar day or in excess of forty hours in such workweek, as the case may be. (29 CFR 5.5(c)(1))

(11) *Violations; Liability for unpaid wages; liquidated damages.* In the event of any violation of paragraph ----- (insert designation of paragraph of contract corresponding to subparagraph (10) hereof) of this contract, the contractor and any subcontractor responsible therefore shall be liable to any affected employee for his unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed, with respect to each individual laborer or mechanic employed in violation of said paragraph ----- of this contract, in the sum of \$10 for each calendar day on which such employee was required or permitted to work in excess of eight hours or in excess of the standard workweek of forty hours without payment of the overtime wages required by said paragraph ----- of this contract. (29 CFR 5.5(c)(2))

(12) *Withholding for unpaid wages and liquidated damages.* The FAA may withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor, such sums as may administratively be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in paragraph 11 hereof.

(13) *FAA inspection and review.* The contractor shall allow any authorized representative of the FAA to inspect and review any work or materials used in the performance of this contract.

(14) *Subcontracts.* The contractor shall insert in each of his subcontracts the provisions contained in paragraphs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 15 hereof, and

also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

(15) *Contract termination; debarment.* A breach of paragraphs (4) through (14) hereof may be grounds for termination of the contract. A breach of paragraphs 4, 5, 7, 8, 9, and 14 hereof may also be grounds for debarment as provided in 29 CFR 5.6 of the regulations of the Secretary of Labor. (29 CFR 5.5(a)(7))

(16) *Equal Employment Opportunity.* "During the performance of this contract, the contractor agrees as follows:

"(i) The contractor will not discriminate against any employee or applicant for employment because of race, creed, color or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, creed, color or national origin. Such action shall include, but not be limited, to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

"(ii) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

"(iii) The contractor will send to each labor union or representative or workers with which he has a collective bargaining agreement or other contract or understanding a notice, to be provided by the agency contracting officer, advising the said labor union or workers' representative of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

"(iv) The contractor will comply with all provisions of Executive Order 10925 of March 6, 1961, as amended by Executive Order 11114 of June 22, 1963, and of the rules, regulations, and relevant orders of the President's Committee on Equal Employment Opportunity created thereby.

"(v) The contractor will furnish all information and reports required by Executive Order 10925 of March 6, 1961, as amended by Executive Order 11114 of June 22, 1963, and by the rules, regulations, and orders of the said

Committee, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Committee for purposes of investigation to ascertain compliance with such rules, regulations and orders.

"(vi) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be cancelled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or Federally assisted construction contracts in accordance with procedures authorized in Executive Order 10925 of March 6, 1961, as amended by Executive Order 11114 of June 22, 1963, and such other sanctions may be imposed and remedies invoked as provided in the said Executive Order or by rule, regulation, or order of the President's Committee on Equal Employment Opportunity, or as otherwise provided by law.

"(vii) The contractor will include the provisions of paragraphs (i) through (vi) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the President's Committee on Equal Employment Opportunity issued pursuant to Section 303 of Executive Order 10925 of March 6, 1961, as amended by Executive Order 11114 of June 22, 1963, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States."

(17) *Consent to assignment.* The contractor shall obtain the prior written consent of the (insert sponsor's name) to any proposed assignment of any interest in or part of this contract.

## **DIVISION II—PAVING CONSTRUCTION DETAILS**

### **ITEM P-154 SUBBASE COURSE**

154-2.1 Materials—page 54. In Table 1, delete "No. 100" and substitute "No. 200".

## ITEM P-201 BITUMINOUS BASE COURSE

### (Central Plant Hot Mix)

201-2.1 Aggregate—page 60. In the first sentence of the fifth paragraph, delete "No. 8" in both cases and substitute "No. 4".

201-2.3 Bituminous Material—page 61. In the first sentence in the second paragraph, delete "or M 22". In the third sentence of the second paragraph delete "100-120".

201-4.4 Preparation of Bituminous Mixture—page 68. Delete the last sentence of the last paragraph and substitute the following: The mixing shall continue for a time determined necessary by the engineer to coat all particles uniformly. This time is dependent upon the mix design and the type of mixing equipment used. To compute the mixing time in a continuous mixer, the weight of its contents at operating level is divided by the weight of the mixture delivered per second by the mixer.

Mixing time in seconds =  $\frac{\text{Pugmill dead capacity in pound}}{\text{Output in pounds per second}}$

## ITEM P-204 MIXED IN-PLACE BASE COURSE

### (Travel-Plant Method)

204-2.1 Aggregate—page 76. In the first sentence of the fourth paragraph delete "No. 8" in both cases and substitute "No. 4".

204-2.3 Bituminous Material—page 77. To paragraph two, add the following: "Rapid-curing cutback asphalt conforming to AASHO Interim Specification M 81-61I, or subsequent revisions thereof, may be used when available locally."

To Table 1 on page 77, add the following note: If the sample of emulsified asphalt fails to conform to the requirements for modified miscibility, the sample shall be tested for 7-day settlement and for miscibility. If the numerical difference between the average percentages of asphaltic residue in the 7-day settlement test is less than 3 and if the standard miscibility test shows no appreciable coagulation in 2 hours, the requirement for modified miscibility shall be waived.

## ITEM P-209 CRUSHED AGGREGATE BASE COURSE

209-2.1 Aggregate—page 109. In the third sentence of the third paragraph, delete " $\frac{1}{4}$ -inch screen" and substitute "No. 4 mesh sieve".

## ITEM P-216 MIXED IN-PLACE BASE COURSE

216-2.1 Aggregate—page 166. In the first sentence of the third paragraph, delete "No. 8" and substitute "No. 4" in both cases.

**216-2.2 Bituminous Material**—page 166. To paragraph two add the following: "Liquid asphalts conforming to AASHTO Interim Specifications M 81-62I, M 82-62I, or M 141-62I, or subsequent revisions thereof, may be used when available locally."

To Table 1 on page 166, add the following note: If the sample of emulsified asphalt fails to conform to the requirements for modified miscibility, the sample shall be tested for 7-day settlement and for miscibility. If the numerical difference between the average percentages of asphaltic residue in the 7-day settlement test is less than 3 and if the standard miscibility test shows no appreciable coagulation in 2 hours, the requirement for modified miscibility shall be waived.

## **ITEM P-301 SOIL CEMENT BASE COURSE**

Delete the entire Item and substitute the following:

### ***Description***

**301-1.1** This item shall consist of constructing a base course of a minimum of six inches, by uniformly mixing together soil, portland cement, and water; of spreading, shaping, and compacting the mixture in accordance with the requirements of this specification and in conformity with the dimension and typical cross section shown on the plans and to the lines and grades established by the engineer.

Runways, taxiways, or aprons may be built in a series of parallel lanes 20 to 30 feet wide. Unless otherwise specified, longitudinal construction joints shall be formed by temporary 6 x 6-inch wooden side forms, or their equivalent, set firmly to the required grade to permit thorough compaction and finishing operations to proceed along their length. The side forms shall be removed before the adjoining lanes are constructed.

It is the purpose of this specification to so combine cement, soil, and water as to produce a base mixture which can be satisfactorily spread, compacted, and shaped as herein specified and which will have the desired strength and durability.

### ***Materials***

**301-2.1 Materials.** The materials used in this work shall meet the following requirements:

(a) **Portland Cement.** Portland cement shall be a standard brand and shall conform to the latest standard requirements of AASHTO M 85 for the type specified. Air-entrained portland cement shall conform to the latest standard requirements of AASHTO M 134 for the type specified.

Contractors may at their option use bulk cement, subject to approval by the engineer of the apparatus for

handling, weighing, and applying the cement, and subject to the work being done to the entire satisfaction of the engineer in every way.

(b) *Water.* The water for base course shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalies, or vegetable matter; it shall be free from clay or loam. If the water is of questionable quality, it shall be tested in accordance with the requirements of AASHTO T 26.

(c) *Soil.* The soil shall consist of the material existing in the area to be paved, of approved select soil, or of a combination of these materials proportioned as directed. The soil shall be free of roots, sod, weeds, and the soil shall not contain gravel or stone retained on a 3-inch sieve or more than 45 percent retained on a No. 4 sieve.

### ***Laboratory Soil Tests and Quantity of Cement***

**301-3.1 Laboratory Soil Tests.** Prior to base course construction, laboratory tests of soils existing on the airport site, or selected material from other sources proposed for use as base, shall be made to determine the quantity of cement required for satisfactory results. Satisfactory materials for this purpose shall be obtained from an approved source as directed.

Test specimens containing various amounts of cement are to be compacted in accordance with AASHTO T 134, and the optimum moisture for each amount of cement is to be determined. Samples at the optimum moisture for each amount of cement are to be subjected to the wet-dry and the freeze-thaw test in accordance with AASHTO T 135 and T 136, respectively. (The freeze-thaw test may be omitted in locations where there is no frost penetration.)

The weight losses of the specimens subjected to 12 cycles of either the wet-dry or the freeze-thaw should not be more than 14 percent for granular soils, 10 percent for the more plastic granular and silty soils, and 7 percent for clay soils.

The compressive strength of soaked specimens should increase both with age and with increase in cement content.

### ***Construction Methods***

**301-4.1 Weather Limitations.** The soil cement base shall not be mixed or placed while the atmospheric temperature is below 35° F. or when conditions indicate that the temperature may fall below 35° F. within 24 hours or when the weather is foggy or rainy. The temperature requirement may be waived but only when so directed by the engineer.

**301-4.2 Operation at Pits.** All work involved in clearing and stripping pits, including the handling of unstable material encountered, shall be performed by the contractor.

The contractor shall notify the engineer sufficiently in advance of the opening of any designated pit to permit staking of boundaries at the site, and to take elevations and measurements of the ground surface before any material is produced; also to permit the engineer to take samples of the material for tests to determine its quality and gradation, and to prepare a preliminary design of base mixture.

The pits as utilized shall immediately be opened up so as to expose the vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata in order that a uniform material will be secured.

**301-4.3 Equipment.** The soil-cement may be constructed with any machine, combination of machines or equipment that will produce the results meeting the requirements for soil pulverization, cement application, mixing, water application, incorporation of materials, compaction, finishing, and curing as controlled in these specifications.

However, all methods employed in performing the work and all equipment, tools, other plant and machinery used for handling materials and executing any part of the work shall be subject to the approval of the engineer before the work is started, and whenever found unsatisfactory shall be changed and improved as required. All equipment, tools, machinery, and plant used must be maintained in a satisfactory working condition.

Blading equipment shall consist of pneumatic-tired power graders having a blade not less than 10 feet long and a wheel base not less than 15 feet long. The power graders shall have tires of sufficient width to prevent excessive rutting.

**301-4.4 Forms.** When forms are required, they may be of wood or of metal and shall be placed to line and grade as staked by the engineer. Wood forms shall have a thickness of not less than that of a commercial 6-inch timber, shall have a height equal to the compacted depth of the base, and shall be not less than 12 feet in length. All form lumber shall be of good quality timber, straight, well-seasoned, clean, and free from defects which would impair its usefulness. Forms becoming warped, split, worn, or otherwise defective shall be discarded.

Steel forms shall be of a section commonly required for portland cement concrete pavement. They shall be of a depth at least equal to the edge thickness of the work prescribed. They shall be straight and free from warp. The minimum length of section of steel form shall be 10 feet.

When directed by the engineer, side forms will not be required. In such cases, the spreading equipment and supply of base mixture shall be such as will permit the continuous and satisfactory spreading of material for one- or two-



lane construction and compaction to the proper thickness contour as required.

**301-4.5 Preparing Underlying Course.** Before undertaking any other construction operations, the area to be paved shall be graded and shaped as required to construct the base course conforming to the grades, lines, thickness, and typical cross section shown on the plans. When necessary, the soil to be processed shall be so pulverized that, at the completion of moist-mixing, 100 percent by dry weight passes a 1-inch sieve, and a minimum of 80 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves.

**301-4.6 Cement Application, Mixing, and Spreading.** Mixing of the soil, cement, and water shall be accomplished either by the mixed-in-place or the central-plant-mixed method.

No cement or soil-cement mixture shall be spread when the soil or subgrade is frozen or when the air temperature is less than 35° F. in the shade.

The percentage of moisture in the soil, at the time of cement application, shall not exceed the quantity that will permit a uniform and intimate mixture of soil and cement during mixing operations, and it shall not exceed the specified optimum moisture content for the soil-cement mixture.

Any soil and cement mixture that has not been compacted and finished shall not remain undisturbed for more than 30 minutes.

The operations specified in paragraphs 4.6 and 4.7 shall be continuous and completed in daylight within 8 hours.

*Method A. Mixed-in-Place:* The specified quantity of cement shall be spread uniformly on the soil.

Cement that has been displaced shall be replaced before mixing is started. After the cement has been applied, it shall be mixed with the soil. Mixing shall continue until the cement has been sufficiently blended with the soil to prevent the formation of cement balls when water is applied.

Immediately after the soil and cement have been mixed, water shall be incorporated into the mixture. Excessive concentrations of water on or near the surface shall be avoided. A water supply and pressure distributing equipment shall be provided that will assure the application within 3 hours of all mixing water required on the section being processed. After all mixing water has been applied, mixing shall continue until a uniform and intimate mixture of soil, cement, and water has been obtained.

*Method B. Central Plant Mixed:* The soil, cement, and water shall be mixed in a pugmill either of the batch or continuous-flow type. The plant shall be equipped with feeding and metering devices which will add the soil, cement, and

water into the mixer in the specified quantities. Soil and cement shall be mixed sufficiently to prevent cement balls from forming when water is added. Mixing shall continue until a uniform and intimate mixture of soil, cement, and water is obtained.

The mixture shall be hauled to the project in trucks equipped with protective covers. The mixture shall be placed on the moistened subgrade in a uniform layer by an approved spreader or spreaders. Not more than 30 minutes shall elapse between the placement of soil-cement in adjacent lanes except when forms are used. The layer of soil-cement shall be uniform in thickness and surface contour, and in such quantity that the completed base will conform to the required grade and cross-section. Dumping of the mixture in piles or windrows upon the subgrade will not be permitted.

Not more than 60 minutes shall elapse between the start of moist mixing and the start of compaction of soil-cement.

**301-4.7 Compaction.** At the start of compaction the percentage of moisture in the mixture and in unpulverized soil lumps, based on oven-dry weights, shall not be below or more than two percentage points above the specified optimum moisture content, and shall be less than that quantity which will cause the soil-cement mixture to become unstable during compaction and finishing.

The specified optimum moisture content and density shall be determined in the field by a moisture-density test, AASHTO T 134, on representative samples of soil-cement mixture obtained from the area being processed at the time compaction begins.

Prior to the beginning of compaction, the mixture shall be in a loose condition for its full depth. The loose mixture then shall be uniformly compacted to the specified density within 2 hours. During compaction operations, shaping may be required to obtain uniform compaction and required grade and cross-section.

**301-4.8 Finishing.** After compaction, the surface of the soil-cement shall be shaped to the required lines, grades, and cross-section. If necessary during shaping operations, the surface of the base shall be lightly scarified to remove any tire imprints or smooth surfaces left by equipment. The resulting surface shall then be compacted to the specified density. Rolling shall be supplemented by broom-dragging if required.

The moisture content of the surface material must be maintained at not less than its specified optimum moisture content during finishing operations. Surface compaction and finishing shall be done in such a manner as to produce, in not longer than 2 hours, a smooth, dense surface, free of compaction planes, cracks, ridges, or loose material.

Any portion of the soil-cement that has a density of 5 pounds or more below that specified shall be corrected or replaced to meet these specifications.

**301-4.9 Construction Joints.** At the end of each day's run, a transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true transverse vertical face.

The protection provided for construction joints shall be such as to permit the placing, spreading, and compacting of base material without injury to the work previously laid. Where it is necessary to operate or turn any equipment on completed base course, sufficient protection and cover shall be provided to prevent injury to work previously laid. A supply of mats or wooden planks shall be maintained and used as approved and directed by the engineer.

Care shall be exercised to ensure thorough compaction of the base material immediately adjacent to all construction joints. When spreading or compacting base material adjacent to a previously constructed lane, ample care shall be taken to prevent injury to the work already constructed.

**301-4.10 Protection and Curing.** After the base course has been finished as specified herein, it shall be protected against drying for a period of 7 days by the application of bituminous material. The curing material shall be applied as soon as possible, but no later than 24 hours after the completion of finishing operations. The finished soil-cement shall be kept continuously moist until the curing material is placed.

The bituminous material specified shall be uniformly applied to the surface of the completed soil-cement at the rate of approximately 0.2 gallon per square yard with approved heating and distributing equipment. The exact rate and temperature of application to give complete coverage without excessive runoff will be as specified.

At the time the bituminous material is applied the soil-cement surface shall be dense, free of all loose and extraneous material, and shall contain sufficient moisture to prevent penetration of the bituminous material. Water shall be applied in sufficient quantity to fill the surface voids of the soil-cement immediately before the bituminous curing material is applied.

Should it be necessary for construction equipment or other traffic to use the bituminous-covered surface before the bituminous material has dried sufficiently to prevent pick-up, sufficient granular cover shall be applied before such use.

The curing material shall be maintained by the contractor during the 7-day protection period so that all of the soil-cement will be covered effectively during this period.

Finished portions of soil-cement that are traveled by equipment used in constructing an adjoining section shall

be protected to prevent equipment from marring or damaging the completed work.

When the air temperature may be expected to reach the freezing point, sufficient protection from freezing shall be given the soil-cement for 7 days after its construction and until it has hardened.

Other curing materials such as moist straw or hay may be used upon approval.

**301-4.11 Construction Limitations.** When any of the operations after the application of cement are interrupted for more than 30 minutes for any reason, or when the uncompacted soil-cement mixture is wetted by rain so that the average moisture content exceeds the tolerance given, the entire section shall be reconstructed in accordance with this specification. In the event, the uncompacted soil-cement mixture is wetted by rain so that the moisture content exceeds the tolerance above specified, the contractor will be paid for the additional cement which is used in reconstructing the section. All material along longitudinal or transverse construction joints not properly compacted shall be removed and replaced with properly moistened and mixed soil-cement which will be compacted to specified density.

**301-4.12 Surface Tests.** The finished surface shall not vary more than  $\frac{3}{8}$  inch when tested with a 16-foot straight-edge applied parallel with or at right angles to the longitudinal axis of the pavement. Any variations in excess of this tolerance shall be corrected by the contractor, at his own expense, and in a manner satisfactory to the engineer.

**301-4.13 Thickness.** The thickness of the soil-cement base course shall be determined from measurements of cores drilled from the finished base or from thickness measurements at holes drilled in the base for each day's work at intervals of 500 feet or less, and at locations selected by the engineer. The average thickness of the base constructed during 1 day shall be within  $\frac{1}{2}$  inch of the thickness shown on the plans, except that the thickness of any one point may be within  $\frac{3}{4}$  inch of that shown on the plans. Where the average thickness shown by the measurements made in 1 day's construction is not within the tolerance given, the contractor will be required to reconstruct this day's work at his own expense.

**301-4.14 Maintenance.** The contractor shall be required to maintain, at his own expense, the entire base course within the limits of his contract in good condition, satisfactory to the engineer, from the time he first starts work until all the work shall have been completed. Maintenance shall include immediate repairs of any defects that may occur either before or after the cement is applied, which

work shall be done by the contractor at his own expense and repeated as often as may be necessary to keep the area continuously intact. Repairs are to be made in a manner to ensure restoration of a uniform surface and durability of the part repaired. Faulty work must be replaced for the full depth of treatment. Any low areas will be remedied by replacing the material for the full depth of treatment rather than adding a thin layer of soil cement to the completed work.

### ***Method of Measurement***

301-5.1 The yardage of soil cement base course to be paid for shall be the number of square yards of completed and accepted base course.

301-5.2 The amount of portland cement to be paid for shall be the number of barrels of cement actually used as authorized.

### ***Basis of Payment***

301-6.1 Payment shall be made at the contract unit price per square yard for soil-cement base course. This price shall be full compensation for furnishing all materials except portland cement; for all preparation, delivering, placing, and mixing these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

301-6.2 Payment shall be made at the contract unit price per barrel for cement. This price shall be full compensation for furnishing this material; for all delivery, placing, and incorporation of this material; and for all labor, equipment, tools and incidentals necessary to complete the item.

Payment will be made under:

Item P-301-6.1 Soil Cement Base Course—per square yard.

Item P-301-6.2 Portland Cement—per barrel.

## **ITEM P-304 CEMENT TREATED BASE COURSE**

### **(Plant Mixed)**

#### ***Description***

304-1.1 This item shall consist of furnishing, mixing, spreading, shaping, and compacting mineral aggregate, cement and water in accordance with the requirements of this specification and in conformity with the dimensions and typical cross sections shown on the plans and to the lines and grades established by the engineer.

Runway, taxiway, or apron pavements shall be built in a series of parallel lanes 20 to 30 feet wide. Longitudinal construction joints shall be formed by temporary 6 x 6-inch wooden

side forms, or their equivalent, unless otherwise specified, set firmly to the required grade to permit thorough compaction and finishing operations to proceed along their length. The side forms shall be removed before the adjoining lanes are constructed.

### ***Materials***

**304-2.1** The materials used in this work shall meet the following requirements:

(a) *Portland Cement.* Portland cement shall be a standard brand and shall conform to the latest standard requirements of AASHO M 85 for the type specified. Air-entrained portland cement shall conform to the latest standard requirements of AASHO M 134 for the type specified.

Contractors may at their option use bulk cement, subject to approval by the engineer of the apparatus for handling, weighing, and applying the cement, and subject to the work being done to the satisfaction of the engineer.

(b) *Water.* The water for the base course shall be clean, clear, and free from injurious amounts of sewage, oil, acid, strong alkalies, or vegetable matter; and shall be free from clay or silt. If the water is of questionable quality, it shall be tested in accordance with the requirements of AASHO T 26.

(c) *Aggregate.* The aggregate may be either stone or gravel, crushed or uncrushed. The fine aggregate shall be that naturally contained in the base course material. In addition, sand may be used as filler, but shall not exceed 15 percent by weight of the total combined aggregates.

The crushed or uncrushed stone shall consist of hard, durable particles or fragments of stone, free from an excess of flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter, and shall have a percent of wear of not more than 45 at 500 revolutions as determined by AASHO T 96 (Los Angeles Rattler Test).

The crushed or uncrushed gravel shall consist of hard, durable stones, rocks, and boulders of accepted quality, crushed to specified sizes, and shall be free from an excess of flat, elongated, soft or disintegrated pieces, dirt, or other objectionable matter. The method used in the production of crushed gravel shall be such that the finished product shall be as consistent as practicable. If necessary to meet this requirement, or to eliminate an excess of fine particles, the gravel shall be screened before crushing. All stones, rock, and boulders of inferior quality occurring in the pit shall be separated and wasted. The gravel shall have a percent of wear of not more than 45 at 500 revolutions as determined by AASHO T 96 (Los Angeles Rattler Test).

The aggregate shall not show evidence of disintegration nor show a total loss greater than 12 percent when subjected

to five cycles of the sodium sulphate accelerated soundness test using AASHTO T 104.

All material passing the No. 4 mesh sieve produced in the crushing operation of either the stone or gravel shall be incorporated in the base material unless there is an excessive amount which, if included, would not meet the gradation requirements.

The aggregate shall meet the requirements given in the following table, using AASHTO T 11 and T 27.

**TABLE 1—Requirements for Gradation of Aggregate**

Sieve designation (square openings)	Percentage by weight passing sieves		
	A	B	C
2 inches.....	100		
1½ inches.....		100	
1 inch.....	55-85	70-95	100
¾ inch.....	50-80	55-85	70-100
No. 4.....	30-60	30-60	35-65
No. 40.....	10-30	10-30	15-30
No. 200.....	5-15	5-15	5-15

The gradations in the table represent the limits which shall determine suitability of aggregate for use from the sources of supply. The final gradations decided on, within the limits designated in the table, shall be uniformly graded from coarse to fine, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieves, or vice versa.

The amount of the fraction of material passing the No. 200 mesh sieve shall not exceed one-half the fraction passing the No. 40 mesh sieve.

The portion of the base aggregate, including any blended material passing the No. 40 mesh sieve, shall have a liquid limit of not more than 25 and a plasticity index of not more than 6 when tested in accordance with AASHTO T 89, T 90, and T 91.

### **Laboratory Tests and Cement Content**

**304-3.1 Cement Content.** The quantity of cement, approximately 3-6 percent by weight to be used with the aggregate and water, will be determined by tests and will be specified in the special provisions.

**304-3.2 Laboratory Tests.** Specimens of aggregate, cement, and water must develop a compressive strength of at least 750 psi at seven days. The specimens are to be subjected to 12 cycles of the wet-dry and the freeze-thaw tests in accordance with AASHTO T 135 and T 136, respectively. The maximum weight loss of the specimens for either the wet-dry or the freeze-thaw test should be less than 14 percent.

### ***Construction Methods***

**304-4.1 Weather Limitations.** The cement treated base shall not be mixed or placed while the atmospheric temperature is below 35° F. or when conditions indicate that the temperature may fall below 35° F. within 24 hours or when the weather is foggy or rainy. The temperature requirement may be waived but only when so directed by the engineer.

**304-4.2 Operation at Pits.** All work involved in clearing and stripping pits, including the handling of unsuitable material encountered, shall be performed by the contractor. The contractor shall notify the engineer sufficiently in advance of the opening of any designated pit to permit staking of boundaries at the site, and to take elevations and measurements of the ground surface before any material is produced; also to permit the engineer to take samples of the material for tests to determine its quality and gradation, and to prepare a preliminary design of base mixture.

The pits as utilized shall immediately be opened so as to expose the vertical faces of the various strata of acceptable material and, unless otherwise directed, the material shall be secured in successive vertical cuts extending through all the exposed strata to secure a uniform material.

**304-4.3 Equipment.** All methods employed in performing the work and all equipment, tools, other plant and machinery used for handling materials and executing any part of the work shall be subject to the approval of the engineer before the work is started, and whenever found unsatisfactory, shall be changed and improved as required. All equipment, tools, machinery, and plants used must be maintained in a satisfactory working condition.

**304-4.4 Forms.** When forms are required, they may be of wood or of metal and shall be placed to line and grade as staked by the engineer. Wood forms shall have a thickness of not less than that of a commercial 6-inch timber, shall have a height equal to the compacted depth of the base, and shall be not less than 12 feet in length. All form lumber shall be of good quality timber, straight, well-seasoned, clean, and free from defects which would impair its usefulness. Forms becoming warped, split, worn, or otherwise defective shall be discarded.

Steel forms shall be of a section commonly required for portland cement concrete pavement. They shall be of a depth at



least equal to the edge thickness of the work prescribed. They shall be straight and free from warp. The minimum length of section of steel form shall be 10 feet.

When directed by the engineer, side forms will not be required. In such cases, the spreading equipment and supply of base mixture shall be such as will permit the continuous and satisfactory spreading of material for one- or two-lane construction and compaction to the proper thickness and contour as required.

**304-4.5 Preparing Underlying Course.** Before undertaking any other construction operations, the area to be paved shall be graded and shaped as required to construct the base course conforming to the grades, lines, thickness, and typical cross section shown on the plans. Any ruts or soft, yielding places that appear by reason of improper drainage conditions, or hauling, or from any other cause shall be corrected and rolled until firm before any base operations are started. The subgrade shall be firm and able to support, without displacement, the construction equipment and compaction that is specified. The underlying course shall be checked and accepted by the engineer.

Grade control between the edges of the pavement shall be by means of grade stakes, steel pins, or forms placed in lanes parallel to the centerline of the runway, and at intervals sufficiently close that string lines or check boards may be placed between the stakes, pins, or forms.

To protect the subbase and to insure proper drainage, the spreading of the base shall begin along the centerline of the runway or taxiway on a crowned section or on the high side of the pavement with a one-way slope.

#### **304-4.6 Mixing.**

(a) *General Requirements.* Cement treated bases shall be mixed at a central mixing plant by either batch or continuous mixing. The aggregates and cement may be proportioned either by weight or by volume.

The aggregates for the cement treated bases shall be separated into 2 sizes and each size shall be stored separately. One storage bin shall contain aggregate nominally retained on a No. 4 sieve and not more than 15 percent shall be finer than a No. 4 sieve. The other storage bin shall contain aggregate finer than a No. 4 sieve. Additional breakdown in aggregate may be used at the option of the contractor with the approval of the engineer.

In all plants, the water shall be proportioned by weight or volume, and there shall be means by which the engineer may readily verify the amount of water per batch or the rate of flow for continuous mixing. The discharge of the water into the mixer shall not be started before the entrance into the mixer of part of the aggregates. The inside of the mixer shall be kept free from any hardened mix.

In all plants, cement shall be added in such a manner that it is uniformly distributed throughout the aggregates during the mixing operation.

The charge in a batch mixer, or the rate of feed to a continuous mixer, shall not exceed that which will permit complete mixing of all the material. Dead areas in the mixer, in which the material does not move or is not sufficiently agitated, shall be corrected either by a reduction in the volume of material or by other adjustments.

(b) *Batch Mixing.* In addition to the "General Requirements" as provided in Paragraph 304—4.6(a), batch mixing of the materials shall conform to the following requirements:

The mixer shall be equipped with a sufficient number of paddles of a type and arrangement to produce a uniformly mixed batch.

The mixer platform shall be of ample size to provide safe and convenient access to the mixer and other equipment. Mixer and batch box housing shall be provided with hinged gates of ample size to permit ready sampling of the discharge of aggregate from each of the plant bins and of the mixture from each end of the mixer.

The mixer shall be equipped with a timing device which will indicate by a definite audible or visual signal the expiration of the mixing period. The device shall be accurate to within 2 seconds. The plant shall be equipped with a suitable automatic device for counting the number of batches.

The time of mixing a batch shall begin after all ingredients are in the mixer and shall end when the mixer is half emptied. Mixing shall continue until a homogeneous mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced. In general, the time of mixing shall be not less than 30 seconds, except that the time may be reduced when tests indicate that the requirement for cement content and compressive strength is being consistently complied with.

(1) *Weight Proportioning.* When weight proportioning is used the discharge gate on the weigh-box shall be so arranged as to blend the different aggregates as they enter the mixer.

Cement shall be weighed on scales separate and distinct from the aggregate batching scales.

(2) *Volumetric Proportioning.* When volumetric proportioning is used for batch mixing, the volumetric proportioning device for the aggregate shall be equipped with separate bins, adjustable in size, for the various sizes of aggregates. Each bin shall have an accurately controlled gate or other device so designed that each bin shall be completely filled and accurately struck-off in measuring the volume of aggregate to be used in the mix. Means shall be provided for accurately calibrating the amount of material in each measuring bin.

formity in depth and width. If conditions arise where such uniformity in the spreading cannot be obtained, the engineer may require such additional equipment or modification in the spreading procedure as may be necessary to obtain satisfactory results. Spreading equipment shall not be more than 25 feet nor be less than 9 feet in width. Immediately upon completion of the spreading operations, the base material shall be thoroughly compacted. Self-propelled rollers, of either three-wheel or three-axle four-wheel type, weighing not less than 10 tons shall be used; vibratory equipment or other equipment which will produce to the satisfaction of the engineer the required degree of compaction throughout the depth and width of the base may be used in lieu of rollers. Care shall be exercised in routing construction equipment in order to avoid the formation of unnecessary ridges due to wheel tracks or tractor treads. If necessary, the base material after compaction shall be trimmed by means of a self-propelled motor grader to the grade and section shown on the plans. All material loosened in this operation shall be swept from the surface before any further rolling. Finishing operations shall be continued until the surface is true to the specified cross section and will not show a variation of more than  $\frac{3}{8}$  inch from a 16-foot straightedge laid in any location parallel with or at right angles to the longitudinal axis of the pavement.

It is the intent of this specification to secure the practical maximum weight of dry materials per cubic foot of compacted base material. In no case shall the weight of dry materials per cubic foot be less than 96 percent of the weight per cubic foot, determined by the engineer, as agreeing with the standard density obtainable with the equipment and materials used. The field density shall be determined by methods described in the FAA compaction control tests T 611. The base material shall be compacted immediately after spreading, and not more than 45 minutes shall elapse between the time of spreading and the completion of the final rolling to obtain maximum density as given above.

No equipment or traffic which, in the opinion of the engineer, will damage the base course or the curing material shall be permitted on the finished base course during the 72-hour curing period.

**304-4.8 Construction Joint.** At the end of each day's run a transverse construction joint shall be formed by a header or by cutting back into the compacted material to form a true transverse vertical face. These faces shall be protected by banking damp earth against them or by other approved suitable methods.

The protection provided for construction joints shall be such as to permit the placing, spreading, and compacting of base material without injury to the work previously laid.

When a longitudinal construction joint is required in par-width construction, side forms shall be used or it shall be formed by cutting back into the compacted material to form a true vertical edge. Suitable curing shall be provided for any exposed longitudinal edge.

Care shall be exercised to ensure thorough compaction of the base material immediately adjacent to all construction joints.

**304-4.9 Curing.** Curing material shall be applied to each portion of the finished base within 1 hour after such portion has been compacted and finished. The curing of the base and exposed edges shall be carefully and systematically accomplished in accordance with the following provisions:

As soon as possible after the surface has been finished, it shall be covered with any one of the curing materials hereinafter specified. Where, in the opinion of the engineer, too long a period of time elapses between finishing the base and applying the curing material, and attendant weather conditions cause detrimental drying of the surface, sprinkling of the base may be required before application of the curing material. In sprinkling, care shall be taken that the surface of the base is not damaged. The following materials and methods may be used for curing:

**Bituminous Seal Coats.** The bituminous coats shall consist of a homogenous emulsion made from petroleum asphalt, or of an asphalt cutback, grade RC-1 or RC-2. The asphalt emulsion shall meet the requirements of the Federal Specification contained in the Appendix. The asphalt cutback shall meet the requirements of AASHTO M 81.

The grade of the asphalt and the quantity applied shall be determined by the engineer, but the quantity shall be approximately 0.2 gallon per square yard.

**Impermeable Paper.** The surface of the base shall be wetted and covered with blankets of impermeable paper. The paper for curing shall meet the requirements of ASTM C 171. These blankets shall remain in place for a period of not less than 72 hours. The blankets shall be lapped at least 18 inches, and these laps shall be weighted with a windrow of earth or by other approved methods to form a closed joint. At the edge of the base, the blankets shall be weighted securely with a continuous windrow of earth to provide contact. Blankets may be reused provided they are free from perforations and tears and are kept serviceable with repairs. Any blankets which, in the opinion of the engineer, do not comply with this requirement shall be discarded.

**Wetted Straw.** The surface of the base shall be covered with clean, loose straw applied at the rate of not less than 4 pounds per square yard. Straw covering should be saturated with water as soon as placed and

(c) *Continuous Mixing.* In addition to the "General Requirements" as provided in Paragraph 304-4.6(a), continuous mixing of the materials shall conform to the following requirements:

The correct proportions of each aggregate size introduced into the mixer shall be drawn from the storage bins by a continuous feeder, which will supply the correct amount of aggregate in proportion to the cement, and will be so arranged that the proportion of each aggregate size can be separately adjusted. The fine bin shall be equipped with a vibrating unit which will effectively vibrate the side walls of the bin and prevent any "hang up" of material while the plant is operating. A positive signal system shall be provided to indicate the level of material in each bin and as the level of material in any one bin approaches the strike-off capacity of the feed gate, the device will automatically close down the plant instantly. The plant shall not be permitted to operate unless this automatic signal is in good working condition.

The drive shaft on the aggregate feeder shall be equipped with a revolution counter accurate to 1/100 of a revolution and of sufficient capacity to register the total number of revolutions in a day's run.

The continuous feeder for the aggregate may be mechanically or electrically driven.

Aggregate feeders that are mechanically driven shall be directly connected with the drive on the cement feeder.

Aggregate feeders that are electrically driven shall be actuated from the same circuit that serves the motor driving the cement feeder. An indicating frequency meter, reading to  $\frac{1}{4}$  cycle, shall be installed at a convenient location in the circuit leading to the cement feeder motor. A voltage regulating transformer, controlling the current delivery to a maximum variation of one percent, shall be installed in the circuit leading to aggregate feeders of the vibratory type. At a readily accessible location leading to the aggregate feeders, an indicated voltmeter graduated to 2 volt increments shall be installed. Current for operation of plants equipped with electrically actuated aggregate feeders shall not vary in frequency in excess of one cycle nor in voltage in excess of 10 percent.

All continuous mixing plants shall be equipped with a hopper of at least 20 cubic feet capacity which is divided into as many compartments as there are sizes of aggregate being proportioned. The hopper shall be suspended under the aggregate feeders, on a scale frame, in such a manner that the discharge from each aggregate feeder may be diverted into separate compartments in the hopper when the feeders are in full operation. The full weight of the loaded hopper shall be indicated on a springless dial scale, not

exceeding a 5,000-pound capacity, with 5-pound graduations. Each compartment of the hopper shall be equipped with a gate, so that each size may be withdrawn separately on a conveyor below the hopper, in order that the total weight of each size of aggregate may be determined and representative samples obtained. The material so withdrawn may be returned to storage.

In general, the time of mixing in a continuous mix plant shall not be less than 30 seconds, except that the time may be reduced when tests indicate that the requirement for cement content and compressive strength can be consistently met. To compute the mixing time in a continuous mixer, the weight of its contents at operating level is divided by the weight of the mixture delivered per second by the mixer.

$$\text{Mixing time in seconds} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Output in pounds per second}}$$

**304-4.7 Placing.** The use of mixers having a chute delivery will not be permitted except as approved. In all such cases the arrangement of chutes, baffle plates, etc., shall be such as will ensure the placing of the cement treated base without segregation.

The prepared underlying course shall be free from all ruts and soft, yielding places. The surface, if dry, shall be moistened but not to the extent of producing a muddy condition at the time the base mixture is placed.

Trucks for transporting the mixed base material shall be provided with protective covers. The material shall be spread on the prepared underlying course to such depth that, when thoroughly compacted, it will conform to the grade and dimensions shown on the plans. Not more than 30 minutes shall elapse between the time the base material is mixed and the time it is deposited in place.

The materials shall be spread by a spreader box, self-propelled spreading machine, or other method approved by the engineer. It shall not be placed in piles or windrows. If spreader boxes or other spreading machines are used that do not spread the material the full width of the lane or width being placed in one construction operation, a sufficient number of them shall be provided and operated in staggered formation so as to obtain full width spreading. If, in the opinion of the engineer, full width construction is found to be undesirable because of inadequate equipment, operating difficulties or climatic conditions, the base shall be constructed in partial widths. If the time elapsing between the placing of adjacent partial widths exceeds  $\frac{1}{2}$  hour, a construction joint satisfactory to the engineer shall be provided.

The spreading equipment and methods employed in spreading the base material shall be such as will insure accuracy and uni-

kept saturated for a period of not less than 72 hours from the time applied. Care shall be taken to see that the edges of the base are protected with straw or earth. The straw may be reused when, in the opinion of the engineer, it is in satisfactory condition. Upon completion of the curing period, the straw shall be removed and disposed of as directed by the engineer.

**Wetted Mats.** Blankets made from at least two layers of burlap or from mats of cotton sandwiched between burlap, cotton fabric, or other similar material shall be presaturated with water, applied to the base, and kept saturated for a period of not less than 72 hours. The mats shall be placed so that the entire surface and edges of the slab are completely covered.

**304-4.10 Cold Weather Protection.** During cold weather when the air temperature may be expected to drop below 35° F., a sufficient supply of hay, straw, or other material suitable for covering and protection of previously placed material shall be provided at the site. Any base which has been damaged by freezing, or otherwise, shall be removed and replaced by the contractor at his own expense.

### ***Methods of Measurement***

**304-5.1** The quantity of one course, cement treated base, to be paid for will be determined by measurement of the number of square yards of base actually constructed and accepted by the engineer as complying with the plans and specifications.

**304-5.2** The quantity of portland cement to be paid for will be the number of barrels of cement actually used in the base as authorized by the engineer. One barrel of portland cement shall be considered to weigh 376 pounds.

### ***Basis of Payment***

**304-6.1** Payment shall be made at the contract unit price per square yard for cement treated base course. This price shall be full compensation for furnishing all materials except portland cement; for all preparation, manipulation, and placing these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

**304-6.2** Payment shall be made at the contract unit price per barrel for portland cement. This price shall be full compensation for furnishing this material; for all delivery, placing, and incorporation of this material; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

**Item P-304-6.1** Cement Treated Base Course—per square yard.

**Item P-304-6.2** Portland Cement—per barrel.

## **ITEM P-401 BITUMINOUS SURFACE COURSE**

### **(Central Plant Hot Mix)**

**401-2.1 Aggregate**—page 202. In the first sentence of the seventh paragraph, delete "No. 8" and substitute "No. 4" in both cases.

**401-2.3 Bituminous Material**—page 203. In the first sentence of the second paragraph, delete "or M 22." In the third sentence of the second paragraph, delete "100-120." Delete the last paragraph which begins "Note: . . ."

**401-4.4 Preparation of Bituminous Mixture**—page 210. Delete the last sentence of the last paragraph and substitute the following: The mixing shall continue for a time determined necessary by the engineer to coat all particles uniformly. This time is dependent upon the mix design and the type of mixing equipment used. To compute the mixing time in a continuous mixer, the weight of its contents at operating level is divided by the weight of the mixture delivered per second by the mixer.

$$\text{Mixing time in seconds} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Output in pounds per second}}$$

## **ITEM P-408 BLENDED NATURAL LIMESTONE AND SAND BITUMINOUS SURFACE COURSE**

### **(Central Plant Hot Mix)**

**408-2.2 Bituminous Material**—page 226. In the first sentence of the second paragraph, delete "or M 22." In the third sentence of the second paragraph, delete "100-120."

**408-4.4 Preparation of Bituminous Mixture**—page 231. Delete the last sentence of the last paragraph and substitute the following: The mixing shall continue for a time determined necessary by the engineer to coat all particles uniformly. This time is dependent upon the mix design and the type of equipment used. To compute the mixing time in a continuous mixer, the weight of its contents at operating level is divided by the weight of the mixture delivered per second by the mixer.

$$\text{Mixing time in seconds} = \frac{\text{Pugmill dead capacity in pounds}}{\text{Output in pounds per second}}$$

## **ITEM P-410 ASPHALT CONCRETE SURFACE COURSE**

### **(Liquefier Type)**

**410-2.2 Bituminous Material**—page 240. In the first sentence of the second paragraph, delete "or M 22." In the third sentence of the second paragraph, delete "100-120." Jell



## ITEM P-501 PORTLAND CEMENT CONCRETE PAVEMENT

### (Plain and Reinforced)

**501-2.2 Coarse Aggregate—page 259.** After the second paragraph, add the following: The coarse aggregate shall not show evidence of disintegration nor show a total loss greater than 12 percent when subjected to five cycles of the sodium sulfate soundness test using AASHTO T 104.

**501-2.10 Cover Materials for Curing—page 264.** Delete paragraph "(c) Waterproof Paper" and substitute the following:

(c) *Waterproof Paper or White Polyethylene Sheeting.* The waterproof paper shall conform to the requirements set forth in AASHTO M 139, and the polyethylene sheeting shall conform to the requirements set forth in AASHTO M 171.

(d) Delete "AASHTO M 148, Type 2" and substitute "Interim Federal Specification TT-C-00800, Type 2."

**Delete 501-2.11 Admixtures** in its entirety and substitute the following:

**501-2.11 Admixtures—page 264.** The use of any material added to the concrete mix shall be approved by the engineer. The contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below for the admixtures for which approvals are desired. In addition, the engineer may require the contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests will be made of samples taken by the engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

Pozzolanic admixtures shall be fly ash meeting the requirements of ASTM C350-60T, or raw or calcined natural pozzolans meeting the requirements of ASTM C402-62T.

Air-entraining admixtures shall meet the requirements of AASHTO M 154 or ASTM C260-60T. Air-entraining admixtures shall be added at the mixer in the amount necessary to produce the specified air content. All paving in severe and moderate climate zones shall be air-entrained.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C494-62T, Type A, water-reducing, or Type D, water-reducing and retarding. Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

**501-3.3 Forms and Form Setting—page 265.** Delete the second and third sentences of the first paragraph and substitute the following: For forms 8 inches deep or less, the width of the

base of the form shall be equal to the depth of the form. For forms over 8 inches deep, the width of the base shall be at least 80 percent of the depth of the form.

**501-3.8 Mixing—page 271.** Delete the third sentence of the second paragraph under 3.8(a), and substitute the following: For larger mixers, the mixing time necessary to obtain thorough mixing and uniform consistency is dependent upon the type of equipment used, and shall be determined by the engineer.

**501-3.14 Curing—page 277.** Delete "(b) Paper Curing" and substitute "(b) Paper or White Polyethylene Sheet Curing." Change the first sentence to read:

This method shall consist of blankets of impermeable waterproof paper or white polyethylene sheeting spread over the pavement surface and along the edges and maintained for the curing period designated.

### **ITEM P-602 BITUMINOUS PRIME COAT**

**602-2.1 Materials—page 288.** Add to the last paragraph the following: Medium curing cutback asphalt conforming to AASHO Interim Specification M 82-62I, or subsequent revisions thereof, may be used when available locally.

### **ITEM P-603 BITUMINOUS TACK COAT**

**603-2.1 Bituminous Materials—page 291.** Add to the second paragraph the following: Rapid-curing cutback asphalt conforming to AASHO Interim Specification M 81-62I, or subsequent revisions thereof, may be used when available locally.

### **ITEM P-604 BITUMINOUS SEAL COAT**

**604-2.2 Bituminous Materials—page 296.** To the second paragraph add the following: Rapid-curing cutback asphalt conforming to AASHO Interim Specification M 81-62I, or subsequent revisions thereof, may be used when available locally.

### **ITEM P-605 JOINT SEALING FILLER**

**605-2.1 Joint Sealing Materials—page 301.** Add Types VI and VII to this section as follows: Type VI shall conform to Interim Federal Specification SS-S-00200, Sealing compound, two-component, elastomeric, polymer type, jet-fuel-resistant, cold-applied, concrete paving. Mixing of components and application of the sealer shall be as recommended by the manufacturer.

Type VII shall conform to Federal Specification SS-S-158, Sealing compound; cold-application, ready-mixed liquefier type, for joints in concrete.

**605-3.4—page 303.** Delete the last sentence of this paragraph.

# ITEM P-606 ADHESIVE COMPOUNDS, TWO COMPONENT, FOR SEALING WIRE AND LIGHTS IN PAVEMENT

## Description

606-1.1 This specification covers two types of material; a liquid suitable for sealing electrical wire in saw cuts in pavement, and a paste suitable for embedding light fixtures in the pavement. Both types of material are two-component, and both types shall have the characteristics specified under paragraph 2.3 below.

## Equipment and Materials

### 606-2.1 Applicable Standards—ASTM.

D-149—Tests of Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies.

D-495—Test for High-Voltage, Low-Current Arc Resistance of Solid Electric Insulating Materials.

D-638—Test for Tensile Properties of Plastics (Tentative).

D-1168—Testing Hydrocarbon Waxes Used for Electrical Insulation.

C-192—Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory.

606-2.2 Curing. When mixed and placed in accordance with the manufacturer's directions, the materials shall cure at temperatures above 30° F. without the application of external heat.

606-2.3 Characteristics. When mixed and cured in accordance with the manufacturer's directions, the materials shall have the following properties:

Physical or electrical property	Minimum	Maximum	ASTM method
Tensile.....	1,000 psi.....	-----	D-638
Elongation.....	8 percent.....	-----	D-638
Coef. of cub.exp.- cm <sup>3</sup> /cm <sup>3</sup> /° C.	$0.90 \times 10^{-3}$ .....	$1.20 \times 10^{-3}$ .....	D-1168
Coef. of lin.exp.cm cm/° C.	$0.30 \times 10^{-3}$ .....	$0.40 \times 10^{-3}$ .....	D-1168
Dielectric strength, short time test.	350 volts/ mil.	-----	D-149
Arc resistance.....	125 secs.....	-----	D-495
Adhesion to steel.....	1,300 psi.....	-----	
Adhesion to port- land cement con- crete.	300 psi.....	-----	

**606-2.4 Storage.** The adhesive components should not be stored at temperatures over 85° F.

**606-2.5 Caution.** Avoid prolonged or repeated contact with skin. In case of contact, wash with soap and flush with water. If taken internally, call doctor. Keep away from heat or flame. Avoid vapor. Use in well ventilated areas. Keep in cool place. Keep away from children.

### ***Sampling, Inspection, and Test Procedures***

**606-3.1 Tests for tensile strength and elongation** shall be conducted in accordance with ASTM D-638.

**606-3.2 Tests for coefficients of linear and cubical expansion** shall be conducted in accordance with ASTM D-1168, Method B, except that mercury shall be used instead of glycerine. The test specimen(s) shall be mixed in the proportions specified by the manufacturer, and cured in a glass tube approximately 2'' long by  $\frac{3}{8}$ '' in diameter. The interior of the tube shall be precoated with a silicone mold release agent. The hardened sample shall be removed from the tube and aged at room temperature for one week before conducting the test. The test temperature range shall be from 1.6° to 60° C.

**606-3.3 Test for Dielectric Strength.** Test for dielectric strength shall be conducted in accordance with ASTM D-149.

**606-3.4 Test for Arc Resistance.** Test for arc resistance shall be conducted in accordance with ASTM D-495.

**606-3.5 Test for Adhesion to Steel.** The ends to two smooth, clean steel specimens of convenient size (1'' x 1'' x 6'' would be satisfactory) are bonded together with adhesive mixture and allowed to cure for at least 12 hours at room temperature, and then tested to failure on a Riehle (or similar) tensile tester. Thickness of adhesive 0'',  $\frac{1}{8}$ '', and  $\frac{1}{4}$ '' shall be tested. A thickness of 0'' means just enough to wet and form an adhesive bond between the test specimens.

**606-3.6 Adhesion to Portland Cement Concrete.**

**(a) Concrete Test Block Preparation.** The aggregate shall be as shown in Table 1.

The coarse aggregate shall consist of crushed rock having a water absorption of not more than 1.5 percent. The fine aggregate shall consist of crushed sand manufactured from the same parent rock as the coarse aggregate. The concrete shall have a water-cement ratio of 5.5 gallons of water per bag of cement, a cement factor of 6 (plus or minus 0.5) bags of cement per cubic yard of concrete, and a slump of 2½ inches, plus or minus ½ inch. The ratio of fine aggregate to total aggregate shall be approximately 40 percent by solid volume. The air content shall be 5.0 percent, plus or minus 0.5 percent, and shall be obtained by the addition to the batch of an air-entraining admixture such as vinsol resin. The mold shall be of metal and shall be provided with a metal base plate. Means shall be provided for securing the base plate to the mold. The assembled

**TABLE 1—Aggregate for Bond Test Blocks**

Type	Sieve size	Percent passing
Coarse aggregate-----	¾ inch.....	97 to 100.
	½ inch.....	63 to 69.
	¼ inch.....	30 to 36.
	No. 4.....	0 to 3.
	No. 8.....	82 to 88.
	No. 16.....	60 to 70.
	No. 30.....	40 to 50.
	No. 50.....	16 to 26.
	No. 100.....	5 to 9.

mold and base plate shall be watertight and shall be oiled with mineral oil before use. The inside measurement of the mold shall be such that several 1" x 2" x 3" test blocks can be cut from the specimen with a concrete saw having a diamond edge. The concrete shall be prepared and cured in accordance with ASTM C-192.

(b) *Bond Test.* Two clean, dry test blocks shall be bonded together on the 1" x 3" sawed face with the adhesive mixture and allowed to cure for not less than 12 hours at room temperature, and tested to failure in a Riehle (or similar) tensile tester. Thickness of 0", ⅛" and ¼" shall be tested. A thickness of 0" means just enough to wet and form an adhesive bond between the test specimens.

### ***Method of Measurement***

606-4.1 The adhesive compound to be paid for shall be either the pounds or gallons of adhesive as specified, in place, complete and accepted. When required in the installation of an in-runway lighting system or portion thereof, no measurement will be made for direct payment of adhesive, as the cost of furnishing and installing shall be considered as a subsidiary obligation in the completion of the installation.

### ***Basis of Payment***

606-5.1 Payment shall be made, where applicable, at the contract unit price per pound or per gallon for the adhesive. This price shall be full compensation for furnishing all materials; for all preparation, delivering, and application of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-606-5.1 Adhesive Compound-per pound or per gallon.

## ITEM P-609 BITUMINOUS SURFACE TREATMENT

609-2.2 Bituminous Materials—page 306. In the second paragraph add the following: Rapid-curing cutback asphalt conforming to AASHTO Interim Specification M 81-62I, or subsequent revisions thereof, may be used when available locally.

In the second sentence of the third paragraph, delete "between 150 and 225" and substitute "120-150 or 200-300."

## ITEM P-625 TAR EMULSION PROTECTIVE SEAL COAT

(for Bituminous Pavements)

625—Delete in entirety and substitute the following:

### *Description*

625-1.1 This item shall consist of an application of coal-tar pitch emulsion seal coat, with or without mineral aggregate, applied on an existing, previously prepared bituminous-wearing course in accordance with these specifications for the areas shown on the plans or as designated by the engineer.

625-1.2 Quantities and Composition of Materials Per Square Yard. The approximate amounts and composition of materials per square yard for the seal coat shall be as provided in Table 1. The exact amounts to be used shall be determined by the engineer.

TABLE 1—Quantities and Composition of Materials

Type of seal	Method of application	Application rates	
		Emulsion <sup>1</sup> gal./sq. yd.	Sand lbs./gal. emulsion
Emulsion (only).	Distributor or hand...	First application: 0.10-0.15. Second application: 0.08-0.12. Total 2 coats: 0.20-0.26.	----- ----- -----
Sand slurry.....	Distributor or hand...	Prime coat: 0.075- 0.10. First application: 0.10-0.15. Second application: 0.10-0.15.	----- 4-6 5-7
Sand slurry.....	Spreader box (Prime coat by distributor or hand).	Prime coat: 0.075- 0.10. Single application: 0.25-0.50 <sup>2</sup> .	----- 5-7

<sup>1</sup> Undiluted coal-tar pitch emulsion.

<sup>2</sup> Approximate application rate for 1/4 to 1/2 inch thickness.

## **Materials**

**625-2.1 Mineral Aggregate.** The mineral aggregate shall be either a natural or manufactured product and shall be composed of clean, hard, durable, uncoated particles, free from lumps of clay and all organic matter. The mineral aggregate shall meet the gradation given in Table 2. The test for gradation shall be made using AASHTO T 27.

**TABLE 2—Requirements for Gradation of Aggregate**

Sieve designation (square openings)	Percentage by weight passing sieves
No. 16.....	100
No. 20.....	85-100
No. 30.....	15-85
No. 40.....	2-15
No. 100.....	0-2

The moisture content of the mineral aggregate at the time of batching shall be such that the material will readily flow into the batching box for correct measurement.

**625-2.2 Bituminous Material.** The bituminous material shall be a coal-tar pitch emulsion prepared from a high temperature coal-tar pitch conforming to the requirements of Federal Specification R-T-143. Oil and water gas tars shall not be used even though they comply with R-T-143. The coal-tar pitch emulsion shall conform to all requirements of Interim Federal Specification R-P-00355 prior to winterization, and shall be homogeneous showing no signs of separation or coagulation of components that cannot be overcome by moderate stirring.

**625-2.3 Water.** The water used for mixing and dampening the pavements shall be clear fresh water having a temperature of 50° F. or higher. The amount of water added to the coal-tar pitch emulsion or to the coal-tar pitch emulsion sand slurry shall not exceed 10 percent of the coal-tar pitch emulsion.

## **Construction Methods**

**625-3.1 Weather Limitations.** The tar emulsion seal coat shall not be applied when the weather is foggy, when rain threatens, nor when the atmospheric or pavement temperature is below 50° F., unless otherwise directed by the engineer.

**625-3.2 Equipment and Tools.** All methods employed in performing the work and all equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the engineer before the work is started; and whenever found unsatisfactory shall be changed and improved as required. All equipment, tools, machinery, and containers used must be kept clean and maintained in a satisfactory condition.

Pressure distributors used for the application of the tar emulsion shall be self-propelled, equipped with pneumatic tires, and capable of applying 0.08 to 1.0 gallon per square yard of tar emulsion over the required width of application. Distributors shall be equipped with removable manhole covers, tachometers, pressure gauges, and volume measuring devices.

Mixing or agitating equipment furnished shall be either a portable power mixer or a tank type power mixer. A portable mixer for use in drums shall have sufficient power and impeller blades shaped to thoroughly mix and pull the material upward from the bottom of the drum. Mixing in tanks may be done in round-bottom tanks equipped with a power driven mixer of sufficient capacity to maintain the mineral content of the emulsion in complete suspension.

Suitable types and sizes of pumping equipment shall be available for pumping water and handling or applying the emulsion. Water will be needed to flush or dampen the pavement surface or to clean equipment. When compressed air spray equipment is used for application of the emulsion, heavy-duty air compressors shall be furnished.

Mixing machines for preparing the slurry may be central plant mixers, a transit mixer, or any type mixer, approved by the engineer, capable of producing a uniform mixture of emulsion and aggregate.

When a transit mixer or other type mixer is used for preparing the slurry, the slurry may be applied by means of a spreader box into which the slurry is conveyed by means of a chute. The spreader box shall consist of a rectangular frame 10 feet or more in width and not less than 8 feet long, equipped for towing, and with a squeegee screed across the inside of the box about three-quarters toward the rear, adjustable for thickness of application and crown of pavement. The squeegee on the spreader box may be neoprene rubber belting,  $\frac{1}{2}$ -inch thick and 6 to 8 inches in width, held vertically across the width of the box (preferably with 4 inches of "free rubber" for aggregate flexibility), and anchored to an adjustable frame. The front and sides of the box shall be lined with  $\frac{1}{4}$  inch thick belting to prevent slurry leakage and assure proper spreading. The slurry box shall be equipped with wheels in order



that it may be raised off the pavement and quickly towed into position for use on adjacent lanes.

A suitable spray type applicator or distributor approved by the engineer may be used for applying the slurry. Such equipment shall be equipped with an agitator to keep the slurry uniformly mixed before and during application and so designed to uniformly spread the slurry on the pavement surface at the specified rates of application.

Other tools or equipment shall be provided as required, such as brushes, hand squeegees, hose equipment, aggregate batchers, sand spreaders, tank trucks, water distributors and flushers, power sweepers, power blowers, barricades, etc.

**625-3.3 Preparation of Pavement Surface.** Bituminous pavement surfaces which have been softened by petroleum derivatives or have failed due to any other cause shall be removed to the full depth of the damage and replaced with new bituminous concrete similar to that of the existing pavement. Areas of the pavement surface to be treated shall be in a firm consolidated condition and sufficiently cured so that there is no concentration of oils on the surface. This can usually be determined by pouring water on the surface to be treated. If the water, after standing for a short period, picks up a film of oil, the surface is not sufficiently cured for the application of the emulsion. (A 30-day minimum should normally be allowed for curing of new bituminous pavements.)

**625-3.4 Cleaning Existing Surface.** Prior to placing the seal coat, the surface of the pavement shall be clean and free from dust, dirt, or other loose foreign matter, grease, oil, or any type of objectionable surface film. When directed by the engineer, the existing surface shall be swept with hand brooms or with power sweepers or cleaned with a power blower. When required, pavement shall be flushed with a fire hose, if hydrants are convenient, or with a water flushing truck. To remove accumulations of oil or grease, some sections may require cleaning with a strong caustic solution. The residue from this treatment shall be flushed and washed with pressure streams of water taking extreme care that all caustic is removed from the surface; otherwise, the emulsion will not cure properly. If this does not provide a water-break free surface, the affected areas shall be removed and replaced with new pavement. All large cracks shall be cleaned by removing accumulated dirt or any vegetation and by blowing out with compressed air. Cracks larger than  $\frac{1}{16}$ " shall be routed out to  $\frac{3}{8}$ " and poured with a suitable joint sealer before the emulsion is applied.

All painted stripes or markers on the bituminous surface to be treated shall be removed.

After the pavement surface has been thoroughly cleaned, it shall be flushed with water to provide a damp surface, free from standing water, for the application of the seal coat.

Areas which are to receive a sand slurry seal shall be primed with undiluted emulsion at the rate of 0.075 to 0.10 gallon per square yard. The primed area shall be allowed to dry thoroughly, and in no case shall the curing period be less than 4 hours.

**625-3.5 Application of Emulsion.** After the pavement surface has been inspected and approved by the engineer, the emulsion shall be applied over the dampened pavement, free from standing water, in two coatings in accordance with the method prescribed in subparagraph (a) *Hand Method*, or (b) *Distributor or Applicator*. Due to the settling that may take place in transit, the emulsion shall be thoroughly agitated before using by power mixers so that a homogeneous consistency is assured for proper and uniform application.

(a) *Hand Method.* The emulsion shall be applied in two coats in the amounts per square yard as stated in Table 1. The undiluted material shall be poured in strips on the pavement and spread with a squeegee or brush, smoothing out with a brush. This procedure shall be continued until the entire area is covered. The first coat shall be allowed to dry or cure sufficiently to prevent pickup before the second coat is applied. When spreading the second coat, it shall be spread crosswise to the placing of the first coat when practicable.

(b) *Distributor or Applicator.* When applied by distributor or approved type of applicator, the emulsion shall be applied uniformly to the surface of the pavement at the prescribed pressures and in the amounts per square yard as stated in Table 1. The emulsion shall be thoroughly mixed before use. When it is necessary to dilute the emulsion in order to aid proper application, the emulsion may be diluted with the minimum amount of clean, fresh water necessary to produce the desired application, but not exceeding 10 percent. The rate of application of the diluted emulsion shall be increased to provide the amount of undiluted emulsion specified in Table 1.

The first application shall be cured sufficiently to drive over without damage before the second application is applied. When conditions permit, the second application shall be spread crosswise to the first application. During the application, surfaces of adjacent structures shall be protected in such a manner as to prevent being spattered or marred. Areas inaccessible to the distributor may be applied by the hand method.

**625-3.6 Application of Sand Slurry.** When the emulsion and aggregate are blended, the material shall be premixed to produce a slurry seal coat. The quantities of materials to be combined in each batch shall be in accordance with the proportions shown in Table 1. Slurry not diluted with water shall be applied at the rates specified. When necessary to dilute the slurry in order to aid proper application at the correct rate, the emulsion may be diluted with the minimum amount of water necessary to produce a workable mixture, but not exceeding 10 percent. The rate of application of the diluted emulsion shall be increased to provide the amount of undiluted emulsion specified in Table 1.

Before application the materials shall be proportioned accurately and mixed by suitable mixing equipment. The emulsion and the water are first charged into the mixer and blended into desired consistency, then the aggregate shall be added at a slow and uniform rate while the mixing is continued until the batch aggregate is incorporated. After all the constituents are in the mixer, the mixing shall continue for approximately 5 minutes or as much longer as may be necessary. The mixing shall produce a smooth, free flowing, homogeneous mixture of a uniform consistency. Mixing shall be continuous from the time the bitumen is placed into the mixer until the slurry is applied by distributor truck or poured into the spreading equipment. During the entire mixing process, no breaking, segregating, or hardening of the emulsion; nor balling, lumping, or swelling of the aggregate will be permitted. When transit mixers are used, the drum shall be rotated at its slowest possible speed.

The application of the slurry shall be either by hand methods using rubber squeegees for spreading, by spreader boxes, or distributor equipment, as specified in paragraph 3.2, or by any other suitable method approved by the engineer. The slurry shall be applied at a uniform rate to provide the desired amount. When spreader boxes are used, the seal coat shall be applied in one application. Care shall be taken not to overload the box with slurry, but a sufficient quantity shall be maintained to supply a feed against the full width of the squeegee.

The surface of the pavement shall be dampened (but free of standing water) immediately before each application of the seal coat is applied. Each application shall be allowed to dry thoroughly, and in no case shall the curing period be less than 4 hours.

When, in the opinion of the engineer certain areas will be subjected to intensive fuel or oil spillage, a final application of straight emulsion may be made at the rate of 0.075 to 0.10 gallon per square yard.

**625-3.7 Curing.** The applied emulsion seal coat shall be allowed to cure for a period of not less than 24 hours, during which time all traffic shall be excluded from the area that has been sealed.

**625-3.8 Handling.** The emulsion shall be continuously circulated or agitated from the time it has been mixed until its application on the pavement surface. The distributor or applicator, pumps, and all tools shall be maintained in satisfactory working condition. Spray bar nozzles, pumps, or other equipment can be cleaned with coal-tar toluene or xylene.

**625-3.9 Emulsion Material Contractor's Responsibility.** Samples of the emulsion that the contractor proposes to use, together with a statement as to its source, must be submitted and approval obtained before use of such material begins. The contractor shall furnish manufacturer's certification that each consignment of the emulsion shipped for the work meets the requirements of Interim Federal Specification R-P-00355. The report shall be delivered to the engineer. The manufacturer's certification for the emulsion shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing of samples of the emulsion as received for use on the project.

#### *Method of Measurement*

**625-4.1** The unit of measurement of coal-tar pitch emulsion shall be the U.S. gallon. The gallonage to be paid for shall be the number of gallons of undiluted emulsion used as ordered in the accepted work.

**625-4.2** The unit of measurement of the mineral aggregate shall be the ton. The tonnage to be paid for shall be the number of tons of mineral aggregate used as ordered in the accepted work.

#### *Basis of Payment*

**625-5.1** Payment shall be made at the contract unit price per gallon for coal-tar pitch emulsion, and at the contract unit price per ton for mineral aggregate. These prices shall be full compensation for furnishing all materials; for all preparation, mixing, and applying these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment shall be made under:

Item P-625-5.1 Coal-Tar Pitch Emulsion—per gallon.

Item P-625-5.1 Mineral Aggregate—per ton.

### **ITEM P-626 ASPHALTIC EMULSION SLURRY SEAL COAT**

#### *Description*

**626-1.1** This item shall consist of an application of an emulsified asphalt, aggregate, and water slurry, applied on an exist-

ing, previously prepared bituminous wearing course in accordance with these specifications and/or as directed by the engineer for those areas shown on the plans or designated by the engineer.

### **Materials**

**626-2.1 Mineral Aggregate.** The mineral aggregate shall meet the gradation given in Table 1. The test for gradation shall be made using AASHTO T 27.

**TABLE 1—Requirements for Gradation of Aggregate**

Sieve designation (square openings)	Percentage by weight passing sieves
No. 8.....	100
No. 16.....	55-85
No. 30.....	35-60
No. 50.....	20-45
No. 100.....	10-30
No. 200.....	7-15

The final gradation decided on within the limits designated in the table shall not vary from the low limit on one sieve to the high limit on adjacent sieves, or vice versa.

The mineral aggregate shall consist of sound and durable plaster sand and/or crushed stone and rock dust, and shall be free from dirt, organic matter, clay balls or films, dust, or other objectionable matter. The aggregate shall contain no free water and shall be nonplastic as determined by AASHTO T 91.

Care shall be exercised to prevent segregation of the aggregate in storage and handling; if segregation occurs, the material shall be reblended prior to mixing to reduce segregation to the minimum.

The aggregate shall be mixed with the designated emulsion and subjected to AASHTO T 182 Stripping Test. As determined visually, the total area of the aggregate on which the bituminous film is retained shall be 95 percent or more. If stripping occurs, the aggregate shall be rejected or treated with the proper antistripping agent to meet this requirement.

**626-2.2 Filler.** If filler, in addition to that naturally present in the aggregate, is necessary, it shall be nonplastic inert material such as portland cement, limestone dust, or other suitable material, and shall meet the requirements of AASHTO M 17.

**626-2.3 Bituminous Material.** The bituminous material shall be an emulsified asphalt conforming to Federal Specification SS-A-674 (Type SS-1, SS-1h, SS-K, or SS-Kh).

**626-2.4 Tack Coat.** A tack coat of emulsified asphalt diluted in the ratio of one part emulsion to three parts water shall be applied at the rate of from 0.05 to 0.15 gallon per square yard.

**626-2.5 Water.** The water shall be free from foreign matter. Soft or softened water is preferable.

### ***Construction Methods***

**626-3.1 Weather Limitations.** The asphaltic emulsion slurry seal coat shall not be applied when the weather is foggy, when rain threatens, or when atmospheric or pavement temperature is below 60° F., unless otherwise directed by the engineer.

**626-3.2 Equipment and Tools.** All methods employed in performing the work and all equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the engineer before the work is started; and whenever found unsatisfactory shall be changed and improved as required. All equipment, tools, machinery, and containers used must be kept clean and maintained in a satisfactory condition.

Pressure distributors used for application of the diluted asphaltic emulsion tack coat shall be self-propelled, equipped with pneumatic tires, and capable of uniformly applying 0.05 to 0.15 gallon per square yard of the diluted emulsion over the required width of application. Distributors shall be equipped with removable manhole cover, tachometers, pressure gauges, and volume measuring devices.

Mixing machines for preparing the slurry may be central plant mixers, transit mixers, or any mixer approved by the engineer capable of producing a uniform mixture of emulsion and aggregate.

The spreader box used for application of the slurry shall consist of a rectangular frame 10 feet or more in width and not less than 8 feet long, equipped for towing, and with a squeegee screed across the inside of the box about three-quarter toward the rear, adjustable for thickness of application and crown of pavement. The squeegee may be two plies of neoprene rubber belting, 1/2-inch thick and 6 to 8 inches in width, anchored vertically to an adjustable frame across the full width of the box, preferably with 4 inches of "free rubber" for flexibility. The front and sides of the box shall be lined with 1/4-inch thick belting to prevent slurry leakage and assure proper spreading. The spreader box construction may be modified at the discretion of the engineer.

Other tools or equipment shall be provided as required, such as brushes, hand squeegees, hose equipment, aggregate batchers, tank trucks, water distributors and flushers, power sweepers, power blowers, barricades, etc.

**626-3.3 Cleaning Existing Surface.** Prior to placing the tack coat and slurry seal coat, the surface of the pavement shall be clean and free from dust, dirt, or other loose foreign matter,

grease, oil, or any type of objectionable surface film. When directed by the engineer, the existing surface shall be swept with hand brooms or with power sweepers or cleaned with a power blower. When required, the pavement shall be flushed with pressure streams of water. It may be necessary to clean the pavement with a strong caustic solution; in which case the residue from this treatment shall be flushed and washed with pressure streams of water taking extreme care that all caustic is removed from the surface.

Any painted stripes or markers on the bituminous surface to be treated shall be removed before applying the tack coat.

During prolonged periods of dry weather, the surface shall be dampened with a light fog spray of water just prior to the application of the tack coat.

**626-3.4 Application of Bituminous Tack Coat.** The application of the diluted asphaltic emulsion tack coat shall be made by means of a pressure distributor of approved type, and shall be made at the pressure and in the amounts as directed by the engineer. The tack coat should be allowed to cure before the slurry seal is applied, but should not be left so long that it loses all tackiness or becomes dusty or dirty. In general, the tack coat should precede the slurry by 4 to 24 hours.

**626-3.5 Composition of Slurry Mix.** The slurry shall contain from 18 percent to 25 percent by weight of emulsion based on the dry weight of the aggregate. The desired percentage of emulsion, as well as the quantity of additional water required for proper consistency, shall be determined by the engineer.

**626-3.6 Mixing of the Slurry.** The slurry mixture shall be prepared by charging the mixer with material in the properly measured proportions specified in Section 3.5 and in the following order:

- (a) Water.
- (b) Aggregate, added evenly and slowly.
- (c) Emulsified asphalt.

When a mineral filler is required to obtain the desired gradation, this material shall be added very slowly to the other aggregate prior to the addition of the emulsified asphalt in order to obtain an even distribution of this material throughout the mix. For the initial batches, 25 percent or less of the water content determined by trial may be withheld until all ingredients are thoroughly mixed. Additional water shall then be added and mixing continued to produce a smooth, free-flowing, homogeneous mixture of a consistency similar to butter-milk. During the entire mixing process, no breaking, segregating, or hardening of the emulsion; nor balling, lumping, or swelling of the aggregate will be permitted.

**626-3.7 Application of Slurry Seal Coat.** Care shall be taken not to overload the spreader box, which shall be towed at a slow and uniform rate not exceeding 5 miles per hour. The

action of the squeegee in the spreader box shall be such as to permit free flow of the slurry into all surface voids and cracks. A sufficient amount of slurry shall be fed to the box to keep a full supply against the full width of the squeegee. The mixture shall not be permitted to overflow the front or sides of the spreader box. The slurry mixture shall be applied at a rate of 4 to 8 pounds of aggregate per square yard. (This is equivalent to approximately  $\frac{1}{8}$  to  $\frac{1}{4}$  inch thickness.) Adjacent lanes, except for lanes in which two or more boxes are used in tandem in placing the slurry, shall not be sealed until at least 2 hours have elapsed between the placing of one lane and that of the adjacent lane. Adjacent lanes shall be lapped at the edges a minimum dimension which will provide complete sealing at the overlap.

**NOTE:** When sealing extremely short lanes, the waiting period may be omitted if the adjacent lane can be sealed before the emulsion in the previously sealed lane has broken and started to cure.

The fresh mix shall be protected by barricades and markers and permitted to dry for 4 to 24 hours depending on weather conditions.

In areas where the spreader box cannot be used, the slurry shall be applied by means of hand squeegees. Any joints and/or cracks that are not filled by the slurry mixture shall be corrected by use of hand squeegees. Upon completion of the work, the seal coat shall have no holes, bare spots, or cracks through which liquids or foreign matter could penetrate to the underlying pavement. The finished surface shall present a smooth and uniform appearance satisfactory to the engineer. All wasted and unused material and all debris shall be removed from the site prior to final acceptance.

**626-3.8 Emulsion Material Contractor's Responsibility.** Samples of the emulsion that the contractor proposes to use, together with a statement as to its source, must be submitted and approval obtained before use of such material begins. The contractor shall furnish a manufacturer's certified report for each consignment of the emulsion shipped for the work. The report shall be delivered to the engineer. The manufacturer's certified report for the emulsion shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing of the samples of the emulsion as received for use on the project.

### ***Method of Measurement***

**626-4.1** The unit of measurement of the emulsified asphalt shall be the gallon or ton. The gallonage or tonnage to be paid for shall be the number of gallons or tons of emulsified asphalt used as ordered for the accepted work. Gallonage shall be determined by measuring the material at a temperature of 60° F.



or by converting the gallonage measured at other temperature to gallonage at 60° F. in accordance with the "Temperature—Volume Corrections for Asphalt Emulsion" (Table 5), in the appendix of the Federal Aviation Agency publication, "Standard Specifications for Construction of Airports", dated June 1959.

626-4.2 The unit of measurement of the mineral aggregate shall be the ton. The tonnage to be paid for shall be the number of tons of dry mineral aggregate used as ordered in the accepted work.

### ***Basis of Payment***

626-5.1 Payment shall be made at the contract unit price per gallon or ton for the emulsified asphalt, and at the contract unit price per ton for mineral aggregate. These prices shall be full compensation for furnishing all materials; for all preparation, mixing, and applying these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment shall be made under:

- Item P-626-5.1 Emulsified Asphalt for Tack Coat—per gallon or ton (undiluted).
- Item P-626-5.1 Emulsified Asphalt for Slurry Seal Coat—per gallon or ton (undiluted).
- Item P-626-5.1 Mineral Aggregate—per ton.

## **DIVISION III—FENCING**

### **ITEM F-160 WIRE FENCE WITH WOOD POSTS**

#### **(Classes A and B Fences)**

Delete 160-2.1 (b) through (d), page 337, and substitute the following:

(b) *Barbed Wire (Zinc-Coated)*. Zinc-coated barbed wire shall be 2-strand twisted No. 12½ ASW gauge galvanized steel wire with 4-point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall conform to Federal Specification RR-F-221, Type A, Grade 3. The barbs shall be spaced approximately 4 inches apart.

(c) *Barbed Wire (Copper-Covered)*. Copper-covered steel barbed wire shall conform to Federal Specification RR-F-221, Type D.

(d) *Barbed Wire (Aluminum-Coated)*. Aluminum-coated steel barbed wire shall be 2-strand twisted No. 12½ ASW gauge aluminum-coated steel wire. The 4-point barbs of No. 14 ASW gauge aluminum-coated steel wire shall be spaced approximately 5 inches apart. The steel wire shall have a minimum tensile strength of 80,000 pounds per square inch, and the aluminum coating shall have a minimum weight of .30 ounce per square foot of wire surface

on the No. 12½ ASW gauge line wire and .25 ounce per square foot of wire surface on the No. 14 ASW gauge barbs.

(e) *Bracing Wire (Zinc-Coated)*. Wire used for cable for bracing shall be No. 9 smooth galvanized soft wire. Delete 160-2.2(a), page 338, and substitute the following:

160-2.2 Gates. (a) Gates shall be constructed of galvanized steel tubing and of the size as shown on the plans conforming to Federal Specification RR-F-183.

## **ITEM F-161 WIRE FENCE WITH STEEL POSTS**

### **(Classes C and D Fences)**

Delete 161-2.1 (b) through (d)—page 344, and substitute the following:

(b) *Barbed Wire (Zinc-Coated)*. Zinc-coated barbed wire shall be 2-strand twisted No. 12½ ASW gauge galvanized steel wire with 4-point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall conform to Federal Specification RR-F-221, Type A, Grade 3. The barbs shall be spaced approximately 4 inches apart.

(c) *Barbed Wire (Copper-Covered)*. Copper-covered steel barbed wire shall conform to Federal Specification RR-F-221, Type D.

(d) *Barbed Wire (Aluminum-Coated)*. Aluminum-coated steel barbed wire shall be 2-strand twisted No. 12½ ASW gauge aluminum-coated steel wire. The 4-point barbs of No. 14 ASW gauge aluminum-coated steel wire shall be spaced approximately 5 inches apart. The steel wire shall have a minimum tensile strength of 80,000 pounds per square inch, and the aluminum coating shall have a minimum weight of .30 ounce per square foot of wire surface on the No. 12½ ASW gauge line wire and .25 ounce per square foot of wire surface on the No. 14 ASW gauge barbs.

(e) *Bracing Wire (Zinc-Coated)*. Wire used for cable for bracing shall be No. 9 smooth galvanized soft wire.

Delete 161-2.2, 161-2.3, 161-2.4, 161-2.5, and 161-2.6 and substitute the following:

161-2.2 Fence Posts, Gates, Rails, Braces, and Accessories. These items, when specified, shall conform to the requirements of Federal Specification RR-F-183 and shall be zinc coated. Change 161-2.7 to 161-2.3.

## **ITEM F-162 CHAIN-LINK FENCES**

### **(Class E)**

Delete 162-2.1 through 162-2.13—pages 349 to 352, and substitute the following:

162-2.1 Fabric. The chain-link fence fabric shall be of the following types, as specified:

**Type A—Zinc coated.**

**Type B—Copper covered.**

**Type C—Aluminum coated.**

**Type D—Aluminum alloy.**

The chain-link fence fabric for Types A, C, and D shall conform to the requirements of AASHO M 181.

The chain-link fence fabric for Type B shall conform to the requirements of Federal Specification RR-F-191.

**162-2.2 Barbed Wire.** All wires shall be spaced as shown on the plans.

(a) *Barbed Wire (Zinc-Coated).* Zinc-coated barbed wire shall be 2-strand twisted No. 12½ ASW gauge galvanized steel wire with 4-point barbs of No. 14 ASW gauge galvanized steel wire. All wire shall conform to Federal Specification RR-F-221, Type A, Grade 3. The barbs shall be spaced approximately 4 inches apart.

(b) *Barbed Wire (Copper-Covered).* Copper-covered steel barbed wire shall conform to Federal Specification RR-F-221, Type D.

(c) *Barbed Wire (Aluminum-Coated).* Aluminum-coated steel barbed wire shall be 2-strand twisted No. 12½ ASW gauge aluminum-coated steel wire. The 4-point barbs of No. 14 ASW gauge aluminum-coated steel wire shall be spaced approximately 5 inches apart. The steel wire shall have a minimum tensile strength of 80,000 pounds per square inch, and the aluminum coating shall have a minimum weight of .30 ounce per square foot of wire surface on the No. 12½ ASW gauge line wire and .25 ounce per square foot of wire surface on the No. 14 ASW gauge barbs.

**162-2.3 Fence Posts, Post Tops and Extensions, Rails, Gates, Braces, Stretcher Bars, and Clips.** These items, when specified, shall conform to the requirements of Federal Specification RR-F-183. When these items are furnished for use in conjunction with zinc-coated steel fabric, aluminum-coated steel fabric, or copper-covered steel fabric, they shall be of zinc-coated steel. When these items are furnished for use in conjunction with aluminum alloy fabric, they shall be of aluminum alloy conforming to the requirements of AASHO M 181.

**162-2.4 Wire Ties and Tension Wire.** Wire fabric ties, wire ties, and tension wire furnished for use in conjunction with a given type of fabric shall be of the same material identified with the fabric type. Zinc-coated steel wire, aluminum-coated steel wire, and aluminum alloy wire shall conform to requirements of AASHO M 181. Copper-covered wire shall be of the same quality as the barbed wire with respect to the copper covering specified in Federal Specification RR-F-221, Type D, and the base metal shall be steel wire conforming to the requirements of Federal Specification RR-F-183.

**162-2.5 Miscellaneous Fittings and Hardware.** Miscellaneous fittings and hardware shall be of design standard with the manufacturer. Miscellaneous fittings and hardware furnished for use with other than aluminum alloy fabric shall be zinc-coated steel, wrought iron, or malleable iron, and shall be equal to the materials specified in Federal Specification RR-F-183. When furnished for use in conjunction with aluminum alloy fabric, miscellaneous fittings and hardware shall conform to the requirements of AASHTO M 181.

**162-2.6 Welding.** Structural members of gates which are in contact shall be fully welded by a method that will procure a continuous weld on all sides and faces of joints at exposed edges. Surplus welding material shall be removed.

**162-2.7 Concrete.** Concrete shall be 1-2½-5 mix of approved materials, placed in accordance with Item P-610.

## **DIVISION IV—DRAINAGE**

### **DRAINAGE PIPE**

The following Item D-701, "Pipe for Storm Sewers and Culverts", combines and revises the material of items formerly identified as D-701, D-702, and D-703.

#### **ITEM D-701 PIPE FOR STORM SEWERS AND CULVERTS**

##### *Description*

**701-1.1** This item shall consist of pipe of the types, classes, sizes, and dimensions required on the plans, furnished and installed at such places as are designated on the plans and profiles, or by the engineer, in accordance with these specifications and in conformity with the lines and grades given.

The item shall include the bid price per linear foot of pipe in place, the cost of common excavation and backfill, the cost of furnishing and installing all trench bracing, all fittings required to complete the pipe drain as shown on the plans, and the material for and the making of all joints, including all connections to existing drainage pipe and structures.

##### *Materials*

**701-2.1 General.** The pipe shall be of the type called for on the plans or in the proposal, and shall be in accordance with the following appropriate requirements. When the plans or proposals permit a choice of pipe, the contractor shall indicate in the bid the type proposed to be furnished.

When harmful concentrations of petroleum fuels are wasted to the piping, use should not be made of pipe involving bituminous products in its coating and/or paving, nor should pipe joint-

ing be made with material, such as rubber, that would also be adversely effected in this case.

**701-2.2 Vitrified Clay Pipe.** Vitrified clay pipe shall conform to the requirements of AASHTO M 65; or the appropriate ASTM C 13, C 261, C 462 for standard strength pipe, and ASTM C 200, C 278, C 463 for extra strength pipe.

**701-2.3 Concrete Sewer Pipe.** Concrete sewer pipe, standard, nonreinforced, shall conform to the requirements of AASHTO M 86 or ASTM C 14.

**701-2.4 Concrete Culvert and Sewer Pipe.** Concrete culvert and sewer pipe, reinforced, shall conform to the requirements of AASHTO M 170 or ASTM C 76.

**701-2.5 Corrugated Steel Pipe.** Corrugated steel pipe shall conform to the requirements of AASHTO M 36.

**701-2.6 Corrugated Aluminum Alloy Pipe.** Corrugated aluminum alloy pipe shall conform to the requirements of AASHTO M 196.

**701-2.7 Bituminous-Coated Corrugated Steel Culvert Pipe.** Bituminous-coated corrugated steel culvert pipe shall conform to the requirements of AASHTO M 36, and in addition shall be coated with an asphalt cement that will meet the following requirements:

(a) *Type 1—Coated Pipe.* The pipe shall be coated uniformly, inside and out, to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

(b) *Type 2—Coated and Paved Pipe.* The pipe shall be coated as required for Type 1 pipe. In addition, bituminous material shall be applied in such a manner that a smooth pavement will be formed in the invert (bottom of pipe when installed) and the corrugations will be filled for one-quarter of the circumference of the pipe. The pavement, except where the upper edges intersect the corrugations, shall have a minimum thickness of  $\frac{1}{8}$  inch, measured on the crests of the corrugations.

(c) *Type 3—Coated and Smooth Lined Pipe.* The pipe shall be uniformly coated on the outside as required for Type 1 pipe. In addition, the pipe shall be paved on the inside for the entire periphery. The bituminous paving material shall be applied in such a manner that a smooth interior will be formed throughout with all corrugations filled, all rivets and metal sheet edges covered with bituminous paving. The paving over the crest of the corrugations shall be 0.125 inch in thickness. The rivets shall be placed in the crests of the outside corrugations. The pipe shall be joined in such a manner that the flow line will be uniform and smooth.

(d) *Bituminous Material.* The tests on the bituminous coating and paving shall be made on samples secured from pipe delivered to, or about to be delivered to, the project.

The asphalt cement shall be not less than 99.5 percent soluble in carbon disulphide (AASHO T 44). The loss on heating the material to 325° F. shall not exceed 1 percent (AASHO T 47). The penetration of the residue from loss on heating, compared with the penetration of same sample before heating, shall be not less than 85 percent (AASHO T 49). The asphalt cement shall adhere to the metal tenaciously, shall not chip off in handling, and shall protect the pipe from deterioration, as evidenced by meeting the following tests successfully:

1. *Shock Test.* The ability of coated pipe to withstand handling in cold weather is indicated by successfully passing the following shock test:

*Apparatus.*—The apparatus for the shock test shall consist essentially of a rigid metal anvil or base plate not less than  $\frac{1}{2}$ -inch thick and resting on a solid foundation, and a hammer weighing 2,000 grams arranged to fall freely in suitable guides against a plunger weighing 1,000 grams and sliding freely in a vertical sleeve. The lower end of the plunger shall be hemispherically shaped, with a radius of  $\frac{1}{2}$  inch. The hammer shall be held in its guide by a trip mechanism at a distance of  $5\frac{1}{8}$  inches above the plunger. Split molds for preparing the specimens shall be made of brass with the surfaces amalgamated to prevent sticking and held together by slip rings pressed on the slightly tapered outside surfaces.

*Procedure.*—Four test specimens shall be prepared in the form of discs  $\frac{3}{8}$ -inch thick and  $1\frac{1}{4}$  inches in diameter. Approximately 4 ounces of the material sample shall be heated over a low flame until it becomes fluid, then poured into a mold or molds. Care must be exercised to melt the sample at the lowest possible temperature. The sample shall be stirred thoroughly until it is homogeneous and free from air bubbles when poured into the molds. The material may be poured in one  $1\frac{1}{4}$ -inch diameter cylinder of such length that the four test specimens may be cut from it, using a wire cutter. Two of the samples used in the shock test may be used later to prepare samples for the flow test.

The four specimens shall be cooled in a brine of ice and salt at a temperature of 30° F. for a period of at least 1 hour. The samples shall then be removed one at a time and quickly placed on the anvil of the test apparatus and centered under the plunger. The hammer shall then be tripped from a height of  $5\frac{1}{8}$  inches. Not more than 8 seconds shall elapse from the time each specimen is removed from the brine until the hammer strikes the plunger.

For material to be acceptable, not more than one of the four test specimens shall show a crack. If it is difficult to determine visually whether a specimen has cracked, it may be removed from the test apparatus and bent slightly.

**2. Flow Test.** The ability of the coating on the pipe to remain in place and not flow or sag at summer temperatures is indicated by successfully meeting the following flow test:

**Apparatus.**—The apparatus for the flow test shall consist of a corrugated brass plate 0.03-inch thick, 8 inches long, and 4 inches wide, with corrugations running the long way of the plate and a metal support to hold the plate on a 45° angle with the horizontal. The corrugations shall have a crest-to-crest dimension of  $\frac{5}{8}$  inch and a depth of  $\frac{3}{16}$  inch. A line shall be scribed 6 inches from the lower edge. Split molds shall be similar to those specified above for the shock test.

**Procedure.**—Two test specimens in the form of cylinders, each  $\frac{3}{8}$  inch in diameter and  $\frac{3}{4}$  inch in length, shall be obtained by pouring the excess molten bitumen from the shock test into the amalgamated brass molds. Each specimen shall be placed in a corrugation of the corrugated slide (slide to be on the 45° slope) so that the lower end of each specimen will rest exactly along a line scribed 6 inches from the bottom edge of the slide. The test apparatus, with the specimens in place, shall then be placed in an oven maintained at 150° ( $\pm 2^\circ$ ) F. After 4 hours, it shall be removed and allowed to cool to room temperature. The distance from the bottom of the corrugated plate to the lower edge of each test specimen, subtracted from 6 inches, determines the amount of sag or flow. To be acceptable, the flow must not exceed  $\frac{1}{4}$  inch for either of the two specimens.

**3. Imperviousness Test.** The asphalt cement shall be impervious to liquids as indicated by passing the following test: 25-percent solution of sulphuric acid, or a 25-percent solution of sodium hydroxide, or a saturated salt solution (such as sodium chloride) shall be held in the valley of a corrugation for a period of 48 hours, during which time no loosening or separation of the bituminous material from the galvanizing shall have taken place.

**701-2.8 Asbestos-Bonded Corrugated Steel Culvert Pipe.** Asbestos-bonded corrugated steel culvert pipe shall be fabricated from asbestos-bonded sheets, the base metal of which shall conform to the requirements of AASHTO M 36. Both sides of the metal sheets shall be coated with a layer of asbestos fibers applied by pressing a sheet of asbestos fiber into the

molten metallic bonding medium. Immediately after the metallic bond has solidified, the asbestos fibers shall be thoroughly impregnated with a bituminous saturant. The finished sheets shall be a first-class commercial quality, free from blisters and uncoated spots. After the asbestos-bonded sheets have been fabricated into culvert sections, a bituminous coating shall be applied uniformly, inside and out, to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

**701-2.9 Asbestos-Cement Sewer Pipe.** Asbestos-cement sewer pipe shall conform to the requirements of Federal Specification SS-P-331.

**701-2.10 Bituminous Fiber Drain and Sewer Pipe and Fittings.** Bituminous fiber drain and sewer pipe and fittings shall conform to the requirements of AASHTO M 158.

**701-2.11 Mortar.** Mortar for pipe joints and connections to other drainage structures shall be composed of 1 part by volume of portland cement and 2 parts of mortar sand. The portland cement shall conform to the requirements of ASTM C 150, Type 1. The sand shall conform to the requirements of AASHTO M 45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15 percent of the weight of cement used. The hydrated lime shall meet the requirements of the ASTM C 6.

**701-2.12 Concrete.** Concrete for pipe cradles shall conform to the requirements of Item P-610.

**701-2.13 Oakum Packing.** Oakum packing for joints in bell-and-spigot pipe shall conform to the requirements of Federal Specification HH-P-117.

**701-2.14 Rubber Gasket Joints.** Rubber-type gaskets for concrete nonpressure pipe shall conform to the requirements of ASTM C 443.

If the gaskets are to be exposed to petroleum products, a swelling test based on Methods 6001 and 6211 of Federal Standard No. 601 shall be used. When the latter method is used with No. 3 oil for 70 hours at 212° F, the swelling shall not exceed 100 percent by volume. (Gaskets shall meet the low-temperature flexibility requirements of Federal Specification HH-G-156.)

**701-2.15 Composition Gasket Joints.** Factory fabricated jointing connections, using materials having resilient properties, on vitrified clay pipe shall conform to the requirements of ASTM C 425.

If the gaskets are to be exposed to petroleum products, a swelling test based on Methods 6001 and 6211 of Federal Standard No. 601 shall be used. When the latter method is used with No. 3 oil for 70 hours at 212° F., the swelling shall not exceed 100 percent by volume. (Gaskets shall meet the low-temperature flexibility requirements of Federal Specification HH-G-156.)



neer and compacted to the density of the surrounding earth material as determined by the FAA compaction control tests T 611.

When directed, unstable soil shall be removed for the full width of the trench and replaced with sand or with approved granular material. The engineer shall determine the depth of removal of unstable soil and the amount of backfill necessary. The backfill shall be compacted and shaped to a firm but slightly yielding condition to form the bed for the pipe. When not specified in the special provisions, the cost of removing unstable soil and replacing it with approved material shall be covered by a supplemental agreement for the cubic yards of excavation and the cubic yards of approved material.

The depth of cut shown on the plans is from the surface grade to the invert of the pipeline. In case the depth of cut is changed from that shown on the plans, the change shall not exceed 6 inches without a revision in the contract unit price per linear foot of pipe. However, if the depth of cut is changed more than 6 inches, compensation or deduction of work involved, whether increased or decreased, shall be provided for in a supplemental agreement.

The minimum width of the trench at the top of the pipe, when placed, shall be a width which will permit the proper construction of joints and compaction of backfill around the pipe, but shall be at least equal to the outside diameter of the pipe plus 6 inches on each side of the pipe. The trench shall be excavated accurately to the established line so that at least a 6-inch space will exist between the side of the trench and the side of the pipe. The sides of the trench shall be vertical, unless otherwise approved by the engineer. The maximum allowable width of the trench shall not exceed 12 inches on each side of the pipe when placed, unless otherwise approved by the engineer.

The bed for the pipe shall be so shaped that at least the lower quarter of the pipe circumference shall be in continuous contact with the bottom of the trench.

The contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation; also, as required for safety and to conform to governing laws. The bracing, sheathing, or shoring shall not be removed in one operation but shall be done in successive stages as determined by the engineer to prevent overloading of the pipe during backfilling operations. The cost of the bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot for the pipe.

**701-3.3 Cradles.** When the engineer finds the bottom of the trench to be an insufficient foundation for the pipe, he shall determine the locations and dimensions of the necessary cradles to properly support the pipe. The design details for the cradles shall be as shown on the plans.

**701-2.16 Joint-Sealing Compound.** Joint-sealing compound used in filling joints of bell and spigot sewer pipe shall conform to the requirements of Federal Specification SS-S-169.

### ***Construction Methods***

**701-3.1 Equipment.** All equipment necessary and required for the proper construction of storm sewers and culverts shall be on the project, in first-class working condition, and shall have been approved by the engineer before construction is permitted to start.

The contractor shall provide appropriate hoisting equipment to handle the pipe, in unloading and placing it in its final position, without damage to the pipe.

The contractor shall provide such hand tampers and pneumatic tampers to obtain the compaction of the pipe bed and the backfill as specified.

**701-3.2 Excavation.** (a) *Common.* The contractor shall do all common excavation to the depth shown on the plans. Common excavation shall consist of all excavation not included under rock excavation.

(b) *Rock.* The contractor shall do all rock excavation to the specified depth shown on the plans plus the required additional depth for bedding. Rock excavation shall consist of the removal of boulders and detached rock,  $\frac{1}{2}$  cubic yard in volume or greater, and of all rock in place in ledges or masses which can be removed only by the use of bars and sledges or by blasting.

Where rock, rocky or gravelly soil, hardpan, or other unyielding foundation material is encountered in trench excavation, the pipe shall be bedded in accordance with the requirements of one of the classes of bedding, but with the following additions: The hard unyielding material shall be excavated below the elevation of the bottom of the pipe or pipe bell for a depth of at least 8 inches or  $\frac{1}{2}$  inch for each foot of fill over the top of the pipe, whichever is greater, but not more than  $\frac{3}{4}$  of the nominal diameter of the pipe. The cushion shall consist of a fine compressive material, such as silty clay or loam, lightly compacted, and shaped as required for the specified class of bedding. The cost of furnishing and placing the cushion material shall be included in the bid price per cubic yard for rock excavation. Before any rock is removed, the engineer shall have the opportunity to obtain the necessary data to determine the yardage to be used for payment. The bottom of the trench shall be excavated to a horizontal section as far as practicable.

(c) *General.* Excavated material not required or acceptable for backfill shall be disposed of by the contractor as directed by the engineer. Common excavation shall not be carried below the required depth; but when it is, the trench shall be backfilled at the contractor's expense with material approved by the engi-

**701-34 Laying and Installing Pipe.** (a) *Clay Pipe and Concrete Pipe.* The contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to line and grade, as staked by the engineer. The contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

The engineer shall inspect all pipe before it is laid, and reject any section that is damaged by handling or is found to be defective to a degree which will materially affect the function and service of the pipe.

The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bell shall be laid upgrade. If tongue and groove pipe is used, the grooved end shall be laid upgrade.

The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. The pipe shall be protected from water during placing and until the mortar in the joints has thoroughly set.

When bell and spigot pipes are used, spaces for the pipe bells shall be dug in the pipe subgrade to accommodate the bells. These spaces shall be deep enough to ensure that the bells do not bear the load of the pipe; they shall not be excessively wide in relation to the longitudinal direction of the trench. When the pipes are laid, the barrel of each section of pipe shall be in contact with the quadrant shaped bedding throughout its full length, exclusive of the bell, to support the entire load of the pipe.

Pipe shall not be laid on frozen ground.

When placing concrete pipe constructed with elliptical reinforcing, the pipe shall be oriented in accordance with the manufacturer's markings of top or bottom.

The upgrade end of pipelines not terminating in a structure shall be plugged with a cap or plug approved by the engineer.

Pipe which is not true in alignment, or which shows any settlement after laying, shall be taken up and relaid without extra compensation.

The contractor shall provide, as may be necessary, for the temporary diversion of stream flow in order to permit the installation of the pipe under dry conditions.

(b) *Corrugated Metal Pipe.* Corrugated metal pipe shall be laid with the separate sections joined firmly together, with coupling bands described in AASHTO M 36, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands which is not protected thoroughly by galvanizing, shall be coated with a suitable asphalt paint.

Proper facilities shall be provided for lowering the pipe when it is to be placed in a trench. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its length. Any pipe which is not in true alignment, or which shows any undue settlement after being laid or is

damaged, shall be taken up and relaid or replaced without extra compensation.

During installation, the asphalt-protected pipe shall be handled without damaging the asphalt coating. The pipe shall be placed so that the element of the cylindrical pipe constituting the centerline of the paved section shall coincide with the flow line of the culvert or sewer. Sections of paved pipe shall be laid so that the flow line is smooth and continuous across joints.

Any breaks in the bitumen or treatment of the pipe shall be repaired with the type and kind of bitumen used in coating the pipe originally.

Where strutting of round pipe is shown on the plans, the vertical diameter shall be increased 5 percent by means of suitable jacks applied after the entire length of the culvert has been placed in the prepared bedding and before any fill is placed. The 5-percent increase shall be uniform for the full length of the culvert except that, when so indicated on the plans, it may be reduced gradually under the embankment side slopes to zero at the culvert ends. The pipe shall be maintained in this shape by means of sills and struts or by horizontal ties in accordance with details shown on the plans.

Ties and struts shall be left in place until the embankment is completed and compacted, unless otherwise directed by the engineer.

Timber struts should not be used on asphalt coated or paved invert pipe.

Pipe shall not be laid on frozen ground.

**701-3.5 Mortar.** Mortar shall be mixed in a ratio of 1 part by volume of portland cement and 2 parts by volume of sand. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15 percent of the weight of the cement used. The mortar shall be of the desired consistency for calking and filling the joints of the pipe or for calking and filling between the pipe and the drainage structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar will not be permitted.

**701-3.6 Pipe Joints.** Pipe joints for clay or concrete pipe may be of the bell and spigot type or the tongue and groove type unless one type is specified by the engineer.

One of the following methods of jointing pipe shall be used: (a) portland cement mortar, (b) portland cement grout, (c) rubber gasket, (d) composition gasket, (e) bituminous jointing compound used with or without oakum or jute, as prescribed below, or by a combination of these types unless one type or combination is specified in the special provisions.

(a) *Cement Mortar Joints.* (1) *Bell and Spigot Pipe.* The first pipe shall be bedded to the established grade line, placing the bell end upstream. The interior surface of the bell shall be carefully cleaned with a wet brush, and the lower portion of the bell filled with mortar to such a depth as to bring the

inner surfaces of the abutting pipe flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into the bell so that the sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with a sufficient amount of additional mortar. The cement mortar shall be protected from rapid drying from exposure to sun or wind by suitable covering such as damp burlap kept moist for at least 24 hours. If the mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint should be wrapped or bandaged with cheesecloth to hold the mortar in place.

(2) *Tongue and Groove Pipe.* The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the second pipe. The grooved end of the first pipe shall be carefully cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned carefully with a wet brush, and while in a horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall then be inserted in the grooved end of the first pipe until mortar is squeezed out on the interior and exterior surfaces. Sufficient mortar shall be used to completely fill the joint and to form a bead on the outside. The cement mortar shall be protected from rapid drying from exposure to sun or wind by suitable covering such as a damp burlap kept moist for at least 24 hours. If the mortar is not sufficiently stiff to prevent appreciable slump before setting, some method shall be provided to hold the mortar in place.

(b) *Cement Grout Joints.* (1) *Bell and Spigot Pipe.* The pipe shall be bedded and installed as described in (a) (1) above with the exception of placing mortar. Suitable means shall be furnished for centering the spigot into the bell. The joint shall be sealed with cement grout poured or pumped into diaper bands. Diaper bands shall be made from a suitable fabric of sufficiently close weave to prevent the loss of cement from the grout, but shall not be waterproof. The longitudinal edges of the bands shall be rolled and hemmed in a manner to contain a steel wire or strap along each edge. The width of the band shall be such that it will tie back of the bell and yet extend over the joint. The length shall extend to at least 90 percent of the outside diameter of the pipe, but the steel wires or straps shall be of sufficient extra length so the ends can be twisted or fastened together at the top of the pipe to hold the diaper tight against the pipe. After securing the band, an inspection shall be made to ensure that the band is positioned completely around the pipe and that the joint is covered. The fabric of the band shall be dipped in cement mortar before placing, but the fabric

shall not be dry nor the mortar set before pouring the joint. The cement grout shall consist of the same materials as specified for mortar, but shall contain sufficient water to maintain a freely pouring consistency. The grout shall be poured between the band and the pipe through the openings in the diaper at the top of the pipe. The pouring of grout shall alternate from side to side of the pipe, and successive pourings shall fill the joint in almost equal lifts on each side. Care shall be exercised to seal the joint at the bottom of the pipe. The diaper shall be left in place. No backfilling shall be done until the joints have been inspected and approved.

(2) *Tongue and Groove Pipe.* The pipe shall be bedded and installed as described in (a) (2) above with the exception of placing the mortar. Suitable means shall be furnished for centering the tongue into the groove. The joint shall be sealed with cement grout poured or pumped into diaper bands. The bands shall meet the requirements as described in (b) (1) above. The diaper band shall be approximately 8 inches in width and shall be placed symmetrically over the joint. The sealing of the joint shall meet the requirements as given in (b) (1) above. No backfilling shall be done until the joints have been inspected and approved.

(c) *Rubber Gasket Joints.* The gasket shall be installed in accordance with the manufacturer's instructions.

(d) *Composition Gasket Joints.* The gasket shall be installed in accordance with the manufacturer's instructions.

(e) *Joint-Sealing Compound.* Joint-sealing compound, hot-pour, mineral-filled, shall be used in filling joints of bell and spigot sewer pipe. The bell and spigot pipe shall be installed and centered so that the annular space is uniform. This annular space shall be calked with oakum joint packing, and then shall be sealed with a joint compound conforming to the requirements of Federal Specification SS-S-169. The oakum shall be packed into the joint so as to leave a space, measured from the end of the bell, for pouring the compound. The space shall be at least 1 inch for pipes 15 inches or less in diameter, shall be at least 1½ inches for pipes 18 to 24 inches in diameter, and shall be at least 2 inches for pipes larger than 24 inches in diameter. When the jointing is made with pipe in its final position, a suitable joint runner previously coated to facilitate removal shall be placed around the pipe, leaving an opening at the top of the runner. The joint shall be poured until completely filled with the compound; the pouring shall be made as rapidly as possible without entrapping air. After the compound has cooled and set, the runner may be removed. The joint shall be inspected for unfilled spaces or unsatisfactory jointing. Alternate joints may be poured before the pipe is lowered into the trench. In this case, the joint shall be poured with the pipe in a vertical position without the use of the runner. The compound shall be thoroughly set before the pipe is moved. When previously jointed,

the pipe shall be handled carefully so as not to move or deform the jointing.

**701-3.7 Backfilling.** All trenches and excavations shall be backfilled in a reasonable time after the pipes are installed, unless other protection of the pipe is directed. The backfill material shall be selected material from excavation, or borrow; and that which is placed at the sides of the pipe and 1 foot over the top shall be material which can be readily compacted. It shall not contain stone which will be retained on a 3-inch sieve, frozen lumps, chunks of highly plastic clay, or any other material which is objectionable in the opinion of the engineer. The material shall be moistened or dried, if necessary, to be compacted by the method in use. Backfill material shall be approved by the engineer. Special care shall be taken in placing the backfill. Great care shall be used to obtain thorough compaction under the haunches and along the sides to the top of the pipe.

The backfill shall be placed in loose layers not exceeding 6 inches in depth under and around the pipe, and not exceeding 8 inches over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the engineer, until the trench is completely filled and brought to the elevation as directed. Backfilling shall be done in such manner as to avoid injurious top or side pressures on the pipe.

In embankments and for other areas outside of pavements, the fill shall be compacted at each side of the pipe for a lateral distance equal to twice the outside diameter or 12 feet, whichever is less, and carried up to an elevation at least 1 foot above the top of the pipe. The backfill shall be compacted to the density required for embankments in unpaved areas under Item P-2. Under paved areas, the subgrade and any backfill shall be compacted to the density as required for embankments for paved areas under Item P-152.

Movement of construction machinery over a culvert shall be at the contractor's risk. Any pipe damaged thereby shall be replaced at the expense of the contractor.

**701-3.8 Connections.** Where the plans call for connections to existing or proposed structures, these connections shall be watertight and so made that a smooth uniform flow line will be maintained throughout the drainage system.

**701-3.9 Cleaning and Restoration of Site.** After the backfill is completed, the contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the engineer. Except for paved areas of the airport, the contractor shall restore all disturbed areas to their original condition. After all work is completed, the contractor shall remove all tools and other equipment used by him, leaving the entire site clean, clear, and in good condition.

Performance of the work described in this section is not payable directly, but shall be considered as a subsidiary obligation of the contractor, covered under the contract unit price for the pipe.

**701-3.10 Inspection.** Prior to final approval of the drainage system, the engineer, accompanied by the contractor's representative, shall make a thorough inspection, by an appropriate method, of the entire installation. Any indication of defects in material or workmanship, or obstruction to flow in the pipe system, shall be further investigated and corrected as necessary. Defects due to the contractor's negligence shall be corrected by the contractor without additional compensation, and as directed by the engineer.

### *Method of Measurement*

**701-4.1** The footage of pipe to be paid for shall be the number of linear feet of pipe in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure, to end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

**701-4.2** The volume of concrete for pipe cradles to be paid for shall be the number of cubic yards of concrete complete in place and accepted; determined from the dimensions shown on the plans, or as ordered by the engineer.

**701-4.3** Rock required to be removed shall be computed by the cubic yard for the specified width of the trench and to a depth of 4 inches below the bed of the pipe. No payment will be made for the cushion material placed for the bed of the pipe, or for additional backfill material.

### *Basis of Payment*

**701-5.1** Payment shall be made at the contract unit price per linear foot for each kind of pipe of the type, class, and size designated; at the contract unit price per cubic yard of concrete for pipe cradles; and at the contract unit price per cubic yard for rock excavation. These prices shall be full compensation for furnishing all materials; for all preparation and excavation for installing these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

*Payment will be made under:*

Item D-701-5.1----Inch Standard Strength Clay Pipe—per linear foot.

Item D-701-5.1----Inch Extra Strength Clay Pipe—per linear foot.

Item D-701-5.1----Inch Standard Nonreinforced Concrete Sewer Pipe—per linear foot.

Item D-701-5.1----Inch Standard Reinforced Concrete Sewer Pipe—per linear foot.



- Item D-701-5.1.....Inch Standard Strength Reinforced Concrete Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Extra Strength Reinforced Concrete Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Asbestos Cement, Sewer, Nonpressure, Pipe—per linear foot.
- Item D-701-5.1.....Inch Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Corrugated Aluminum Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Bituminous-Coated Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Bituminous-Coated Paved Invert Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Asphalt Coated and Smooth Lined Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Asbestos-Bonded Asphalt Coated Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Asbestos-Bonded Asphalt Coated with Paved Invert Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Asbestos-Bonded Asphalt Coated and Smooth Lined Corrugated Steel Culvert Pipe—per linear foot.
- Item D-701-5.1.....Inch Bituminized-Fiber Sewer Pipe—per linear foot.
- Item D-701-5.1 Concrete for Pipe Cradles—per cubic yard.
- Item D-701-5.1 Rock Excavation—per cubic yard.

## **ITEM D-702 CONCRETE PIPE FOR STORM SEWERS AND CULVERTS**

Delete this Item. See Item D-701.

## **ITEM D-703 CORRUGATED METAL PIPE, GALVANIZED, OR GALVANIZED AND BITUMINOUS COATED, FOR STORM SEWERS AND CULVERTS**

Delete this Item. See Item D-701.

## **ITEM D-705 PIPE UNDERDRAINS FOR AIRPORTS**

Delete the entire Item and substitute the following:

### ***Description***

705-1.1 This item shall consist of pipe underdrains of the types, classes, sizes, and dimensions required on the plans, furnished and installed at such places as are desig-

nated on the plans and profiles, or by the engineer, in accordance with these specifications and in conformity with the lines and grades given.

The item shall include in the bid price per linear foot of pipe in place, the cost of excavation, the cost of furnishing and installing all trench bracing, all fittings required to complete the underdrain as shown on the plans, and the material for the making of all joints, including all connections to existing drainage pipes and structures.

The bid price per linear foot of pipe shall include all backfill made with earth excavated from the immediate trench. When a granular backfill, as called for on the plans or as ordered by the engineer, is used to replace material excavated from the trench, it shall be bid and paid for separately as porous backfill No. 1 and/or No. 2, per cubic yard in place and compacted.

### ***Materials***

**705-2.1 General.** The pipe shall be of the type called for on the plans or in the proposal, and shall be in accordance with the following appropriate requirements. When the plans or the proposals permit a choice of pipe, the contractors shall indicate in the bid the type proposed to be furnished.

**705-2.2 Vitrified Clay Cradle Invert Pipe.** Vitrified clay cradle invert pipe shall meet the requirements of AASHTO M 65.

**705-2.3 Perforated Vitrified Clay Pipe.** Perforated vitrified clay pipe shall conform to the requirements of AASHTO M 65, except that nothing in the specifications shall exclude the use of plain and perforated clay pipe equipped with approved type joint fasteners. The latter fasteners shall be capable of maintaining the alignment of the pipe and securing a taut but elastic joint between the sections of pipe when laid. Fasteners may consist of wire clips or other devices which will produce a joint as heretofore specified. If wire fasteners are supplied, they shall be constructed of not thinner than No. 9 hard drawn or oil tempered steel wire, meeting the requirements of ASTM A 227 or A 229. Other devices used to join the lengths of pipe shall produce a joint having characteristics equal to those provided by the above described wire fasteners.

Wire or other metal fastening devices shall be coated with a japanned enamel or other rust preventative as may be approved.

The finished fastener shall withstand 25 cycles of alternating loading and unloading using a stressing force of 125 pounds, and the permanent set resulting from this test shall be less than 5 percent, based on the original length of the fastener.

**705-2.4 Perforated Concrete Pipe.** Perforated concrete pipe shall conform to the requirements of AASHTO M 173 or ASTM C 444.

**705-2.5 Porous Concrete Pipe.** Porous concrete pipe shall conform to the requirements of AASHTO M 176.

**705-2.6 Perforated Corrugated Metal Pipe.** (a) *Perforated Corrugated Steel Pipe.* Perforated corrugated steel pipe shall conform to the requirements of AASHTO M 136. If the pipe is required to be coated, it shall meet the requirements of Item D-701, Section 2.7. When perforated corrugated steel pipe is required to be coated, the perforations shall not be stopped up, but shall present full openings.

(b) *Perforated Corrugated Aluminum Pipe.* Perforated corrugated aluminum pipe shall conform to the requirements of AASHTO Interim Specification M 197-621.

**705-2.7 Perforated Bituminized-Fiber Pipe.** Perforated bituminized-fiber pipe shall conform to the requirements of AASHTO M 177.

**705-2.8 Perforated Asbestos-Cement Pipe.** Perforated asbestos-cement pipe shall conform to the requirements of AASHTO M 189.

**705-2.9 Mortar.** Mortar for pipe connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of mortar sand. The portland cement shall conform to the requirements of ASTM C 150, Type 1. The sand shall conform to the requirements of AASHTO M 45. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 15 percent of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C 6.

**705-2.10 Porous Backfill.** Porous backfill shall be free of clay, humus, or other objectionable matter, and shall also conform to particle size specified.

Sieve designation (square openings)	Percentage by weight passing sieves	
	Porous material No. 1	Porous material No. 2
1 1/4 inches.....		100
1 inch.....		90-100
3/4 inch.....	100	25-60
No. 4.....	95-100	5-40
No. 8.....		0-20
No. 16.....	45-80	
No. 50.....	10-30	
No. 100.....	0-10	

When two courses of porous backfill are called for in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

### ***Construction Methods***

**705-3.1 Equipment.** All equipment necessary and required for the proper construction of pipe underdrains shall be on the project, in first-class working condition, and shall have been approved by the engineer before construction is permitted to start.

The contractor shall provide hand tampers and pneumatic tampers to obtain the compaction of the pipe bed and backfill as specified.

**705-3.2 Excavation.** The contractor shall do all necessary excavation to the depth shown on the plans. The excavation shall be unclassified and shall be performed regardless of the material encountered.

When rock or noncushioning material is encountered in trench excavation, a cushion at least 4 inches thick shall be placed between the rock and the bottom of the pipe. The cushion shall consist of clean sand or equivalent granular material. The cost of furnishing and placing the cushion material shall be included in the bid price per linear foot of pipe. When rock is encountered, the bottom of the trench shall be excavated to a horizontal section as far as is practicable.

Excavated material not required or acceptable for backfill shall be disposed of by the contractor as directed by the engineer. The excavation shall not be carried below the required depth; when this is done, the trench shall be backfilled at the contractor's expense, with material approved by the engineer, and compacted to the density of the surrounding earth material, as determined by the FAA compaction control tests T 611.

The depth of cut shown on the plans is from the surface grade to the invert of the pipeline. In case the depth of cut is changed from that shown on the plans, the change shall not exceed 6 inches without a revision in the contract unit price per linear foot of pipe. However, if the depth of cut is changed more than 6 inches, compensation or deduction of work involved, whether increased or decreased, shall be provided for in a supplemental agreement.

The minimum width of the trench at the top of the pipe, when placed, shall be a width which will permit the proper construction of joints and compaction of backfill around the pipe, but shall be at least equal to the outside diameter of the pipe plus 6 inches on each side of the pipe.

the bed for the pipe shall be so shaped that at least lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell shall be excavated accurately to size to clear the bell so the barrel supports the entire weight of the pipe.

The contractor shall do such trench bracing, sheathing, shoring as necessary to perform and protect the excavation also, as required for safety and to conform to government laws. Unless otherwise provided, the bracing, sheathing or shoring shall be removed by the contractor after completion of the backfill to at least 12 inches over the top of the pipe. The sheathing or shoring shall be pulled out as the granular backfill is placed and compacted to avoid unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot for the pipe.

**6-3.3 Laying and Installing Pipe.** (a) *Clay or Concrete Types of Pipe.* The contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to line and grade, as staked by the engineer. The contractor's facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

The engineer shall inspect all pipe before it is laid, and reject any section that is damaged by handling or is found to be defective to a degree which will materially affect the installation and service of the pipe.

The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bells shall be laid upgrade. If flange and groove pipe is used, the groove end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless otherwise shown on the plans. The pipe shall be properly and accurately set to line and grade so that the exterior will be smooth and uniform. Pipe shall not be laid in frozen ground.

Pipe which is not true in alignment, or which shows excessive settlement after laying, shall be taken up and relaid without extra compensation.

(b) *Metal, Fiber, or Asbestos Cement Types of Pipe.* Metal pipe shall be laid with the separate sections bolted firmly together with bands, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands which is not protected thoroughly by galvanizing shall be protected with a suitable asphaltum paint.

The sections of bituminized-fiber pipe shall be securely bolted together with suitable fittings. When the fiber

couplings are tapered, they shall provide a tight, close fit.

The sections of asbestos-cement pipe shall be secured and fastened together with suitable couplings. The use of plastic couplings with asbestos cement underdrains shall provide a permanently tight joint.

Proper facilities shall be provided for lowering the pipe when it is to be placed in a trench. The pipe shall be laid carefully and true to lines and grades on a bed which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any settlement after being laid or is damaged, shall be removed, up and relaid or replaced without extra compensation.

During installation, the asphalt protected pipe shall be handled without damaging the asphalt coating. In case of breaks in the bitumen or treatment of the pipe shall be refilled with the type and kind of bitumen used in coating the pipe originally. Perforated pipe shall be placed with perforations down unless otherwise indicated on the plans. Pipe shall not be laid on frozen ground.

(c) *All Types of Pipe.* The upgrade end of pipe not terminating in a structure, shall be plugged with a plug or plug approved by the engineer.

Unless otherwise shown on the plans, a 4-inch bed of granular backfill material shall be spread in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required or shown on the plans. The pipe shall be laid true to line and grade with tight-fitting joints. The joints shall be sealed as specified under Item D-70. The backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipe structures shall be made as required and in a satisfactory manner. If no connections are made with other pipe structures, the outlets shall be protected and constructed as shown on the plans.

**705-3.4 Mortar.** Mortar shall be mixed in a ratio of 1 part by volume of portland cement and 2 parts by volume of sand. The mortar shall be of the desired consistency for calking and filling the joints of the pipe, and for making connections to other pipes or to structures. Mortar shall not be used within 45 minutes after water has been added and shall be discarded. Retempering of mortar will not be permitted.

**705-3.5 Joints in Clay or Concrete Pipe.** When open or partly closed joints are required or specified, they shall be constructed as indicated on the plans. The pipe shall be laid with the ends fitted together as designed. If

and spligot pipe is used, hemp, oakum, or mortar, or whichever is specified, shall be placed along the inside bottom quarter of the bell to center the following section of pipe.

The open or partly open joints shall be surrounded with granular material meeting requirements of porous backfill No. 2, or as indicated on the plans. This backfill shall be placed in such a manner that its thickness will be not less than 8 inches nor more than 6 inches, unless otherwise shown on the plans.

When the original material excavated from the trench is impervious, commercial concrete sand or granular material meeting requirements of porous backfill No. 1 shall surround porous backfill No. 2, as shown on the plans or as directed by the engineer.

When the original material excavated from the trench is pervious and suitable, it will be used as backfill in lieu of porous backfill No. 1, when indicated on the plans or as directed by the engineer.

**705-3.6 Backfilling.** (a) *Earth.* All trenches and excavations shall be backfilled in a reasonable time after the pipes are installed, unless other protection of the pipe is directed. The backfill material shall be selected material from excavation, or borrow; and that which is placed within a nominal diameter distance at the sides of the pipe and 1 foot over the top shall be material which can be readily compacted. It shall not contain stone which will be retained on a 3-inch sieve, frozen lumps, chunks of highly plastic clay, or any other material which is objectionable in the opinion of the engineer. The material shall be moistened or dried, if necessary, to be compacted by the method in use. Backfill material shall be approved by the engineer. Special care shall be taken in placing the backfill. Great care shall be used to obtain thorough compaction under the haunches and along the sides to the top of the pipe.

The backfill shall be placed in loose layers not exceeding 6 inches in depth under and around the pipe, and not exceeding 8 inches over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the engineer, until the trench is completely filled and brought to the elevation as directed. Backfilling shall be done in such a manner as to avoid injurious top or side pressures on the pipe.

In embankments, and for other areas outside of pavements, the backfill shall be compacted to the density as required for embankments in unpaved areas under Item P-152. Under paved areas, the subgrade and any backfill shall be compacted to the density as required for embankments for paved areas under Item P-152.

(b) *Granular Material.* When granular backfill is required, its placement in the trench and about the pipe shall be as shown on the plans. Special care shall be taken in placing the backfill. The granular backfill shall not contain a damaging amount of foreign matter, nor shall earth from the sides of the trench or from the windrow be allowed to filter into the backfill. When required by the engineer, a template shall be used to properly place and keep separate the two sizes of backfill. The backfill shall be placed in loose layers not exceeding 6 inches in depth, and compacted by hand and pneumatic tampers to the requirements as given for earth backfill. Backfilling shall be done in such a manner as to avoid injurious top or side pressure on the pipe to cause damage or displacement. The granular backfill shall be made to the elevation of the trench, as shown on the plans.

When perforated pipe or cradle invert pipe is specified, granular backfill material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans. If the original material excavated from the trench is pervious and suitable, it shall be used in lieu of porous backfill No. 1.

When porous backfill is to be placed in paved or adjacent areas prior to the completion of grading or subgrade operations, the backfill material shall be placed immediately after laying the pipe. The depth of this granular backfill so placed shall be not less than 12 inches in depth, measured from the top of the underdrain. During subsequent construction operations, this minimum backfill of 12 inches of depth shall not be disturbed until such time as the underdrains are to be completed. When the underdrains are to be completed, the unsuitable material shall be removed until the porous backfill is exposed. That part of the porous backfill which contains objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any such unsuitable material shall be borne by the contractor.

Whenever a granular subbase blanket course is to be used under pavements, and extends several feet beyond edge of paving to outside edge of underdrain trench, the granular backfill material over the underdrains will be placed in the trench up to an elevation of 2 inches above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the contractor shall blade this excess trench backfill from top of the trench onto the adjacent subgrade where it can be incorporated into the granular subbase blanket course. Any unsuitable material which remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide



clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

**705-3.7 Connections.** Where the plans call for connections to existing or proposed pipe or structures, these connections shall be watertight and so made that a smooth uniform flow line will be obtained throughout the drainage system.

**705-3.8 Cleaning and Restoration of Site.** After the backfill is completed, the contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the engineer. Except for paved areas of the airport, the contractor shall restore all disturbed areas to their original condition.

After all work is completed, the contractor shall remove all tools and other equipment used by him, leaving the entire site free, clear, and in good condition.

Performance of the work described in this section is not payable directly, but shall be considered as a subsidiary obligation of the contractor, covered under the contract unit price for the underdrain.

### ***Method of Measurement***

**705-4.1** The footage of pipe to be paid for shall be the number of linear feet of pipe underdrains in place, completed, and approved; measured along the centerline of the pipe from end or inside face of structure, to end or inside face of structure, whichever is applicable. The several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured.

**705-4.2** The yardage of porous backfill to be paid for shall be the number of cubic yards of porous backfill No. 1 or No. 2, complete in place and accepted; determined from the dimensions given on the plans by typical trench sections indicating the placement of porous backfill, or dimensions ordered by the engineer.

### ***Basis of Payment***

**705-5.1** Payment shall be made at the contract unit price per linear foot for pipe underdrains of the type, class and size designated; at the contract unit price per cubic yard for porous backfill No. 1; and at the contract unit price per cubic yard for porous backfill No. 2. These prices shall be full compensation for furnishing all materials; for all preparation, hauling, and installing these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

- Item D-705-5.1-----Inch Standard Strength Clay Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Standard Strength Clay Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Cradle Invert Clay Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Standard Nonreinforced Concrete Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Standard Nonreinforced Concreted Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Porous Concrete Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Corrugated Steel Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Corrugated Aluminum Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Bituminous Coated Corrugated Steel Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Bituminized-Fiber Pipe Underdrain—per linear foot.
- Item D-705-5.1-----Inch Perforated Asbestos-Cement Pipe Underdrain—per linear foot.
- Item D-705-5.1 Porous Backfill No. 1—per cubic yard.
- Item D-705-5.1 Porous Backfill No. 2—per cubic yard.

#### ITEM D-706 CORRUGATED METAL PIPE ARCHES

Pages 393 and 394. Change headings on top of both pages from "Corregated" to "Corrugated".

706-2.1 Corrugated Metal Pipe Arches—page 392. First paragraph, last sentence, delete "shown in Table 1" and add "of AASHTO M 190".

Delete the remaining parts of 706-2.1.

706-2.2 Bituminous Coating or Paving—page 393. Second sentence, delete "paragraph 703-2.3" and add "AASHTO M 190".

706-2.3 Asbestos-Bonded Corrugated Metal Pipe Arches—page 393. First paragraph, second sentence, delete "703-2.4" and add "701-2.8".

Second paragraph, second sentence, delete "paragraphs 703-2.3 and 706-2.2" and add "AASHTO M 190".

706-3.1 General—page 393. First paragraph, delete "paragraphs 703-3.1 to 703-3.8, inclusive" and add "the appropriate parts of Item D-701, Section 3, Construction Methods."

## **DIVISION VI—LIGHTING INSTALLATION**

Add the following as the first paragraph on page 482.

**General.** Wherever reference is made in any item of Division VI to prior approval of equipment and materials covered by FAA specifications as listed in "Approved Airport Lighting Equipment," the publication is identified as Advisory Circular No. 150/5345-1 "Approved Airport Lighting Equipment." This publication contains a current listing of L-800 series specifications together with their advisory circular number when appropriate. This advisory circular should be used, when needed, as a cross reference to identify the specific L-800 series specification with the assigned advisory circular number.

### **ITEM L-103 INSTALLATION OF AIRPORT BEACON TOWERS**

**103-2.2 Tower—page 493.** Delete the entire section and substitute:

**103-2.2 Tower.** The steel beacon tower shall conform to one of the following:

(a) Specification MIL-T-8637, "Tower and Extension; Aerial Navigation Beacon," of the height specified on the proposal, less wind cone bracket. (Heights of 51, 62, 75, 91, 108, 129, and 152 feet are standard.)

(b) FAA Airport "51-Foot" tubular beacon tower, or an approved equal, of the type specified on the proposal or shown on the plans.

**103-2.4 Down Conductor—page 493.** Delete: "No. 2/0 B&S gauge" in this paragraph and substitute "No. 6 AWG."

**103-3.2 Excavation and Fill—page 494.** At the end of the section, add the following paragraph:

The concrete footing for tubular beacon towers shall be in accordance with the manufacturer's recommendations. Portions of the footing in the topsoil layer shall not be included in the footing height.

**103-3.3 Erection—page 495.** At the end of the section, insert the following paragraph:

Tubular beacon towers shall be erected in accordance with the manufacturer's recommendations. The safety cable shall be located on the side of the tower adjacent to the driveway or most accessible approach to the tower.

### **ITEM L-107 INSTALLATION OF AIRPORT 8-FOOT AND 12-FOOT WIND CONES**

**107-3.5 Ground Connection and Ground Rod—page 500.** Delete: "No. 2/0 B&S gauge" in this paragraph and substitute "No. 6 AWG."

## ITEM L-108 INSTALLATION OF UNDERGROUND CABLE FOR AIRPORTS

**108-2.1 General**—page 502. Add the following subparagraph at the end of this section :

(c) This specification does not apply to the installation of cable for low intensity airport lighting systems.

**108-2.2 Cable**—page 502. Delete the following: "*Type A*—Single and multiple conductor cable with 600 or 3000-volt performance type insulation with an overall neoprene jacket"; and substitute "*Type A*—Single and multiple conductor cable with 600-volt performance type insulation with an overall neoprene jacket."

Insert the following paragraphs before the last paragraph of this section: If telephone control cable is specified, copper shielded, polyethylene insulated and jacketed, No. 19 AWG telephone cable conforming to the United States Department of Agriculture, Rural Electrification Administration (REA) Bulletin 345-14, *REA Specification for Fully Color-Coded, Polyethylene Insulated, Double Polyethylene-Jacketed Telephone Cables for Direct Burial*, shall be used.

Where counterpoise conductors are to be installed and where soil conditions would adversely affect bare copper wire, thermoplastic wire conforming to Federal Specification J-C-129, Type TW, Class I, 600-volt, may be used.

**108-2.4 Splices**—page 503. Delete the entire section and substitute :

**108-2.4 Cable Connections.** In-line connections of underground primary cables shall be of the type called for on the plans or in the proposal, and shall be one of the following types. When the plans or the proposal permit a choice of connection type, the contractor shall indicate in the bid the type proposed to be furnished.

(a) *The Cast Splice.* A cast splice, employing a plastic mold and using epoxy resin for potting the splice, manufactured by Minnesota Mining and Manufacturing Company, "Scotchcast" Kit No. 82-A, is approved. This means of splicing is the only type approved for telephone control cable.

(b) *The Vulcanized Splice.* A vulcanized splice employing Joy Manufacturing Company's Vulcanizing Kit No. X-1604-8 is approved for field vulcanized splices. The proper molds for various cable sizes shall be used.

(c) *The Field-Attached Plug-In Splice.* Figure 14 of Specification L-823, employing connector kits, is approved for field attachment to single conductor cable.

(d) *The Factory-Molded Plug-In Splice.* Specification L-823 connectors, factory-molded to individual conductors, are approved.

(e) *The Taped Splice.* Taped splice employing field-applied plastic tape equal to the Minnesota Mining and

Manufacturing Company Scotch Electrical Tape No. 88 is approved.

In all the above cases, connections of cable conductors shall be made using crimp connectors utilizing a crimping tool designed for the specific connector. No. 19 AWG telephone control wires may be connected by means of wrapped and soldered splices or a method approved by the engineer.

**108-3.1 General—page 503.** Change the entire section to read as follows:

**108-3.1 General.** The contractor shall install the specified cable at the approximate locations indicated on the airport lighting layout plans. The engineer shall indicate specific locations.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual insulating transformers. The contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections, unless authorized in writing by the engineer or shown on the plans.

**108-3.2 Installation in Duct or Conduit—page 503.** In the second paragraph, delete "splices" and substitute "connections."

**108-3.4 Installation in Trenches—page 505.** In the first sentence of the last paragraph, change "of all splices" to "of all connections."

**108-3.7 Cable Markers—page 506.** Delete last paragraph and substitute the following:

The location of each underground cable connection, except at lighting units or insulating transformers, shall be marked by a concrete marker slab placed above the connection. The contractor shall impress the word "SPlice" on each slab. He also shall impress additional circuit identification symbols on each slab if so desired by the engineer.

**108-3.8 Splicing—page 506.** Delete the entire section and substitute:

**108-3.8 Connections.** Connections shall be of the type shown on the plans, and shall be made as follows:

(a) *Cast Splices.* These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured in accordance with manufacturer's instructions and to the satisfaction of the engineer.

(b) *Vulcanized Splices.* These shall be made by using crimp connectors for joining conductors. The splice shall be made, using compounds furnished by the manufacturer, in accordance with his instructions and to the satisfaction of the engineer.

(c) *Field-Attached Plug-In Splices.* These shall be assembled in accordance with manufacturer's instructions.

These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least  $1\frac{1}{2}$  inches each side of the joint.

(d) *Factory-Molded Plug-In Splices.* These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least  $1\frac{1}{2}$  inches each side of the joint.

(e) *Taped Splices.* These shall be made in the following appropriate manner:

1. Bring the cables to their final position and cut so that conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with  $\frac{1}{4}$ -inch on each side of connector. Use a sharp knife to pencil insulation and jacket at approximately the same angle as a pencil point, taking care to avoid nicking the bare conductors. The copper conductors shall be thoroughly cleaned. Join conductors by inserting equidistance into the compression connector sleeve. Crimp conductors firmly in place with a crimping tool specifically designed for the connector used. Test crimped connection by pulling on cable to assure that both ends of conductors are firmly fastened in place. Clean the entire surface of the cable over which insulating tape will be placed. Ensure that all wax is removed from the cable jacket by wiping outward from bare conductors toward outer jacket. Apply vinyl pressure sensitive tape one-half lapped, beginning over bare conductor. Care should be taken not to overtension the tape. Continue buildup of one-half lapped tape to  $1\frac{1}{2}$  times cable diameter over the entire length of splice, with ends tapered a distance of approximately one inch over the original jacket. Do not use glyptol or lacquer over vinyl tape as they react as a solvent to the tape. Do not vulcanize or use Scotchcast kit material over vinyl tape splices. No further cable covering or splice boxes are required. All splicing shall be performed only by experienced cable splicers regularly engaged in this type of work.

2. If shielded cable is used, prepare cable as for regular taped splice, except that the neoprene jacket shall be split and rolled back a distance of not less than 2 inches from the beginning of the penciled portion. Carefully unwrap the shielding tape from that portion where jacket has been removed. Proceed with taped splice, as described above, bringing tape in as close as possible to the end of the unwrapped portion of the shielding tape. Build up

vinyl tape to a diameter equal to insulation thickness. This ends step one of the splice. Rewrap shielding tape, maintaining as near as possible the original lap. Over the replaced shielding tape and over the taped splice, wrap a fine flat shielding braid and spot solder at each end to the cable shielding tape. Reroll the jackets over the shielding tapes and cover with at least two wraps of vinyl tape, extending over the entire splice to a distance of two inches beyond the split jackets.

The above-described splice is for a straight-through splice with continuity of shielding.

3. If shielded cable is to be spliced to transformer pig-tail leads, a form of stress cone shall be formed on the shielded cable side as follows:

Split jacket on shielded cable and roll back, unwrap shielding tape, and build up splice with tape to  $1\frac{1}{2}$  times insulation thickness tapering back smoothly to end of unwrapped shielding.

Rewrap shielding tape, bringing it up to the thickest part of the splice. Using minimum No. 14 AWG standard bare copper wire, open the stranding at the end, bind the individual strands around end of shielding tape and spot solder to shielding tape. Roll jacket back over shielding tape and cover with at least two wraps of tape over entire splice with ground wire extending through the wrap. A sufficient length of this wire shall be used to allow for a connection to be made to similar wire from shielded cable on the continuing primary circuit on other side of the transformer. The stranded bare copper wire used to "bridge" the gap in cable shielding across the transformer primary connections shall also be securely bonded to the metal transformer base or metal mounting stake.

108-5.1 Page 509. Delete the first paragraph and substitute the following:

108-5.1 Payment shall be made at the contract unit price for trenching; cable and bare counterpoise wire installed in trench or duct in place by the contractor and accepted by the engineer. This price shall be full compensation for furnishing all materials; for all preparation and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete this item.

## **ITEM L-109 INSTALLATION OF AIRPORT TRANSFORMER VAULT AND VAULT EQUIPMENT**

109-1.1 Page 510. Delete first and second sentences and substitute:

This item shall consist of an airport transformer vault or a prefabricated metal housing constructed and installed in accordance with this specification at the location and

in conformity with the dimensions and design shown on the plans. This work shall also include the installation of conduits in floor and foundation, painting and lighting of the vault or metal housing, and the furnishing of all incidentals necessary to produce a completed unit.

**Page 510.** Delete title "Vault" and substitute "Vault and Prefabricated Metal Housing."

**109-2.8 Vault Lighting—page 511.** Delete entire section and substitute:

**109-2.8 Lighting.** Vault or metal housing fixtures shall be of a vapor proof type.

**109-2.10 Switches—page 511.** Delete entire section and substitute:

**109-2.10 Switches.** Vault or metal housing light switches shall be single pole switches.

**Page 511.** Delete title "Vault Equipment" and substitute "Vault and Prefabricated Metal Housing Equipment."

**109-2.20 FAA Approved Equipment—page 512.** Delete the following specifications: "L-814, L-815, L-817, L-826, L-832, and L-836"; and add the following specifications:

**L-841—Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.**

**L-846—Specification for L-846 Electrical Wire for Lighting Circuits To Be Installed in Airport Pavements.**

**L-847—Specification for L-847 Circuit Selector Switch, 5000 Volt 20 Ampere.**

**109-2.22 Wire and Cable—page 513.** Delete first sentence and substitute: Wire and cable shall conform to Specification L-824 for rubber insulated, neoprene covered wire (0 to 5,000 volts). Type RH or RW rubber insulated fibrous covered wire (0 to 5,000 volts) shall conform to Federal Specification J-C-103. Thermoplastic insulated wire (0 to 600 volts) shall conform to Specification L-846 or Federal Specification J-C-129, Type TW, Class 1.

**109-2.22** At the end of subparagraph (a) insert:

If telephone control cable is specified, copper shielded, polyethylene insulated and jacketed No. 19 AWG telephone cable conforming to the United States Department of Agriculture, Rural Electrification Administration (REA) Bulletin 345-14 shall be used.

**Page 513—Delete title "Construction of Vault" and substitute "Construction of Vault and Prefabricated Metal Housing."**

**109-3.1 General—page 513.** Delete entire section and substitute:

**109-3.1 General.** The contractor shall construct the transformer vault or prefabricated metal housing at the location indicated on the plans. The vault or metal housing



shall be the type shown on the plans. Vault construction shall be reinforced concrete, concrete masonry, or brick wall as specified. The metal housing shall be a prefabricated equipment enclosure to be supplied in the size specified. The mounting pad or floor details, installation methods, and equipment placement are shown on the plans.

The contractor shall clear, grade, and seed the area around the vault or metal housing for a minimum distance of 10 feet on all sides. The slope shall be not less than  $\frac{1}{2}$  inch per foot away from the vault or metal housing in all directions.

**109-3.7 Doors—page 516.** Insert at the end of the section: "and/or local electrical codes."

**Page 516.** Delete title "Installation of Vault Equipment" and substitute "Installation of Equipment in Vault or Prefabricated Metal Housing."

**109-3.12 Switchgear and Panels—page 517.** Add to last sentence, "in masonry or concrete vaults."

**109-4.2 Page 520.** Delete entire section and substitute:

The quantity of prefabricated metal housings to be paid for under this item shall consist of the number of housings constructed in place and accepted as a complete unit.

**109-4.3** The quantity of vault or prefabricated metal housing equipment to be paid for under this item shall consist of all equipment installed, and connected as a complete unit, ready for operation and accepted.

**109-5.1 Page 520.** Delete first sentence and substitute:

Payment shall be made at the contract unit price for each completed and accepted vault or prefabricated metal housing equipment installation.

**109-5.1 Page 520.** Add to second paragraph:

**Item L-109-5.1 Construction of Prefabricated Metal Housing and Foundation in Place—per unit.**

**Item L-109-5.1 Installation of Prefabricated Metal Housing Equipment in Place—per unit.**

## **ITEM L-110 INSTALLATION OF AIRPORT UNDER-GROUND ELECTRICAL DUCT**

Add new Item 110-2.7—page 521 as follows:

**110-2.7 Plastic Conduit.** Plastic conduit and fittings shall conform to the requirements of Interim Federal Specification L-C-00740 (GSA-FSS) and shall be one of the following as specified in the proposal:

(a) *Type I*—Suitable for underground use either directly in the earth or encased in concrete.

(b) *Type II*—Suitable for either above ground or underground use.

## ITEM L-112 INSTALLATION OF AIRPORT WIND TEE

**112-3.7 Ground Connection and Ground Rod**—page 528. Delete "No. 2/0 B&S gauge" in this paragraph and substitute "No. 6 AWG".

## ITEM L-114 INSTALLATION OF MEDIUM INTENSITY RUNWAY AND TAXIWAY LIGHTS WITH BASE MOUNTING

**114-1.1 Page 530.** In the second line, delete "or multiple."

**114-2.2 Lights**—page 530. In the last paragraph, delete "cone".

**114-2.3 Insulating Transformers**—page 530. Delete the entire section and substitute:

**114-2.3 Insulating Transformers.** Insulating transformers shall conform to the following specification:

L-833, "Individual Lamp Series-to-Series Type. Insulating Transformer for 600 Volt or 3,000 Volt Series Circuits," (30-45 Watt).

**114-2.5 Tapes**—page 531. Change "Tape No. 33" to "Tape No. 88".

**114-3.4 Identification Number**—page 531. In subparagraph (a) delete "cone or". Also delete subparagraph (b) and substitute:

(b) A noncorrosive metal disc of a 2-inch minimum diameter with numbers permanently stamped or cut shall be installed under the head of a base plate bolt.

**114-3.6 Cable Connections**—page 532. Delete the entire section and substitute:

**114-3.6 Cable Connections.** In making cable connections to the lights, the contractor shall pull cables into each light base and shall leave sufficient slack cable inside the base to permit connections to be made above ground.

Cable connections shall be made to the transformer or fixture by one of the following methods:

(a) *Direct Connection.* The transformer primary lead connectors shall be plugged directly into mating connectors of *Field-Attached or Factory-Molded Plug-In Splices* on the supply cables, whichever is called for on the plans. The splices shall be attached to the supply cables as specified in Item L-108.

(b) *Pigtail Splicing Lead Connection.* When the plans specify that pigtail splicing leads are to be supplied with the transformers, the pigtail leads shall be connected to the supply cable by means of either a *Cast Splice*, a *Vulcanized Splice*, or a *Taped Splice*, whichever is called for on the plans. The splices shall be made as specified in Item L-108.

The joint where the transformer mating connectors come together shall be wrapped with at least two layers

of plastic tape, one-half lapped, extending at least 1½ inches each side of the joint.

(c) *Neutral Connection.* An insulated or bare neutral wire may be used when a neutral connection is required. It shall be connected to the junction box as described in the manufacturer's installation instructions.

114-3.7 Assembling the Unit—page 533. Delete the last sentence.

## ITEM L-116 INSTALLATION OF MEDIUM INTENSITY RUNWAY AND TAXIWAY LIGHTS WITH STAKE MOUNTING

116-2.2 Lights—page 534. In the last paragraph, delete "cone."

116-2.3 Insulating Transformers—page 534. Delete the entire section and substitute:

116-2.3 Insulating Transformers. Insulating transformers shall conform to the following specification:

L-833, "Individual Lamp Series-to-Series Type Insulating Transformer for 600 Volt or 3,000 Volt Series Circuits," (30-45 Watt).

116-2.4 Tape—page 535. Change "Tape No. 33" to "Tape No. 88."

116-3.2 Transformer and Junction Box Installation—page 535. In the seventh line, subparagraph (b), substitute "(c)" for "(d)."

116-3.5 Assembling the Unit—page 536. Delete last sentence.

116-3.6 Cable Connections—page 536. Delete the entire section and substitute:

116-3.6 Cable Connections. Underground cable will be installed between the units as a separate item under Item L-108, "Installation of Underground Cable for Airports." The contractor shall connect this cable to the transformer. The connection to the underground cable supply shall be made by one of the following methods:

(a) *Direct Connection.* The transformer primary lead connectors shall be plugged directly into mating connectors of *Field-Attached or Factory-Molded Plug-In Splices* on the supply cables, whichever is called for on the plans. The splices shall be attached to the supply cables as specified in Item L-108.

(b) *Pigtail Splicing Lead Connection.* When the plans specify that pigtail splicing leads are to be supplied with the transformers, the pigtail leads shall be connected to the supply cable by means of either a *Cast Splice*, a *Vulcanized Splice*, or a *Taped Splice*, whichever is called for on the plans. The splices shall be made as specified in Item L-108.

The joint where the transformer mating connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least 1½ inches each side of the joint.

(c) *Neutral Connection.* An insulated or bare neutral wire may be used when a neutral connection is required. It shall be connected to the junction box as described in the manufacturer's installation instructions.

(d) *Junction Box Connections.* The junction box shall be furnished with watertight bushings. The underground supply cable shall be brought through the bushings and internal connections shall be made as recommended by the manufacturer. The contractor shall ascertain that the rubber bushing inserts are of the correct size for the underground cable. The use of incorrect sizes shall not be permitted. After the cable is connected, the bushings shall be drawn up tightly on the jacket of the cable. The access cover and gasket of the junction box shall be brushed clean and assembled in accordance with the manufacturer's installation instructions.

**116-3.8 Identification Numbers—page 537.** Delete subparagraphs (a) and (b) and substitute:

(a) Numbers shall be stenciled on the runway side of the fixture.

(b) A noncorrosive tag shall be fastened to the fixture.

## **ITEM L-120 INSTALLATION OF INTERNALLY LIGHTED TAXI GUIDANCE SIGNS**

**120-2.3 Insulating Transformers—page 543.** Delete the entire section and substitute:

**120-2.3 Insulating Transformers.** Insulating Transformers shall conform to one of the following specifications:

(a) Specification L-833, "Individual Lamp Series-to-Series Type Insulating Transformer for 600 Volt or 3,000 Volt Series Circuits," (30-45 Watt).

(b) Specification L-834, "Individual Lamp Series-to-Series Type Insulating Transformer for 5,000 Volt Series Circuit," (100-watt and 200-watt).

**120-3.6 Cable Connections—page 545.** Delete the entire section and substitute:

**120-3.6 Cable Connections.** In making cable connections to the taxi signs, the contractor shall pull the underground supply cables into each light base leaving sufficient slack cable inside the base to permit all connections to be made above ground. The specific supply circuit used shall be as shown on the construction plans and specifications. Cable connections for the different types of supply circuits shall be made as follows:

(a) *Direct Connection.* The transformer primary lead connectors shall be plugged directly into mating connectors of *Field-Attached or Factory-Molded Plug-In Splices* on the supply cables, whichever is called for on the plans. The splices shall be attached to the supply cables as specified in Item L-108.

(b) *Pigtail Splicing Lead Connection.* When the plans specify that pigtail splicing leads are to be supplied with the transformers, the pigtail leads shall be connected to the supply cable by means of either a *Cast Splice*, a *Vulcanized Splice*, or a *Taped Splice*, whichever is called for on the plans. The splices shall be made as specified in Item L-108.

The joint where the transformer mating connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least 1½ inches each side of the joint.

(c) *Neutral Connection.* An insulated or bare neutral wire may be used when a neutral connection is required. It shall be connected to the junction box as described in the manufacturer's installation instructions.

(d) *120/240-Volt Multiple Circuits.* For 120/240-volt multiple circuits, insulating transformers will not be used. For such installations a cable connector conforming to Figure 1c of Specification L-823, "Plug and Receptacle, Cable Connectors," and equipped with a two-conductor pigtail lead with a minimum length of 24 inches shall be used for connecting to the power supply cable. One conductor shall be "T" spliced to the hot side of the incoming supply cable and the other conductor shall be "T" spliced to the neutral side of the incoming supply circuit. Normally, the neutral wire will be a bare conductor and the hot side will always be an insulated conductor.

"T" splices shall be made in accordance with the following instructions:

The overall jacket shall be removed for a distance of 6 inches from the pigtail end of the two-conductor cord attached to the Figure 1c rubber receptacle. The insulation on each of these two conductors shall then be removed for a distance of 3 inches and the bare copper wire thoroughly cleaned. Next, the jacket and insulation shall be removed from a section of the insulated underground supply cable by pencilling jacket and insulation so as to leave one-half inch of the bare conductor exposed. One of the bare lead wires of the cord shall be tightly wrapped around the bare section of the supply feeder and a soldered connection made. Plastic electrical tape, one-half lapped, shall be applied over the bare wires. Proceed to continuously

build up tape over entire "T" section to  $1\frac{1}{2}$  times cable diameter. The tape should be applied with ends tapered a distance of approximately one inch over the original jackets of cable and cord. Care should be taken to seal with tape the area where the two conductors emerge from the overall jacket of the cord. The other lead wire of the cord shall be wrapped around the neutral conductor of the supply circuit and firmly soldered. A wrapping of tape shall be applied over this joint to give added mechanical protection. Do not use glyptol or lacquer over vinyl plastic tape as they react as a solvent to the tape.

## **ITEM L-121 INSTALLATION OF HIGH INTENSITY RUNWAY LIGHTS**

**121-1.1** Page 548. In the second line, delete "or multiple."

**121-2.2** High Intensity Runway Lights—page 548. Delete the entire section and substitute:

**121-2.2** High Intensity Runway Lights. The high intensity runway lights shall conform to the requirements of the following specification:

L-819, "Specification for L-819 Fixed Focus Bidirectional High Intensity Runway Light."

Each unit shall be furnished complete with a lens assembly of the color specified in the proposal, fixture, mounting assembly, base, and a transformer.

**121-2.3** Insulating Transformers—page 548. Delete the entire section and substitute:

**121-2.3** Insulating Transformers. Insulating transformers shall conform to one of the following specifications:

(a) L-834, "Individual Lamp Series-to-Series Type Insulating Transformer for 5,000-Volt Series Circuit," (Type II) 6.6/6.6 Amperes-200 Watt.

(b) L-844, "Individual Lamp Series-to-Series Type Insulating Transformer for 5,000-Volt Series Circuit 20/6.6 Ampere 200 Watt."

**121-2.5** Tapes—page 549. Change "Tape No. 33" to "Tape No. 88".

**121-3.6** Cable Connections—page 550. Delete entire section and substitute:

**121-3.6** Cable Connections. In making cable connections to the lights, the contractor shall pull cables into each light base and shall leave sufficient slack cable inside the base to permit connections to be made above ground.

Cable connections shall be made to the transformer or fixture by one of the following methods:

(a) *Direct Connection.* The transformer primary lead connectors shall be plugged directly into mating con-

nectors of *Field-Attached or Factory-Molded Plug-In Splices* on the supply cables, whichever is called for on the plans. The splices shall be attached to the supply cables as specified in Item L-108.

(b) *Pigtail Splicing Lead Connection.* When the plans specify that pigtail splicing leads are to be supplied with the transformers, the pigtail leads shall be connected to the supply cable by means of either a *Cast Splice*, a *Vulcanized Splice*, or a *Taped Splice*, whichever is called for on the plans. The splices shall be made as specified in Item L-108.

The joint where the transformer mating connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least 1½ inches each side of the joint.

121-3.7 *Assembling the Unit*—page 551. Delete the last sentence.

## **ITEM L-122 INSTALLATION OF AIRPORT LOW INTENSITY LIGHTING SYSTEM**

### ***Description***

122-1.1 This item consists of low intensity runway or taxiway lights, stake mounted, and a beacon for small airports, furnished and installed in accordance with this specification at the locations and in conformity with the dimensions, design, and details shown on the plans. This item shall also include all necessary wire and cable installation, the testing of the installation, and all incidentals necessary to place the system in operation to the satisfaction of the engineer.

### ***Equipment and Materials***

122-2.1 *General.* (a) Airport lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Agency, Airports Service, Washington, D.C., 20553, and shall be listed in Advisory Circular No. 150/5345-1, "Approved Airport Lighting Equipment."

(b) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when so requested by the engineer.

122-2.2 *Low Intensity Lights.* The lights shall conform to "Specification for L-840 Low Intensity Runway, Landing Strip and Taxiway Light." Each unit shall be furnished with a lens of the color specified in the proposal and on the plans. A 15-watt, 115-125 volt, 15 T7N lamp shall be installed in each unit.

122-2.3 *Beacon.* The beacon shall conform to "Specification for L-801 Beacon for Small Airports," and shall be furnished with two 500-watt lamps.

This item shall include a mounting platform and/or a booster transformer, if stipulated on the plans.

**122-2.4 Wire and Cable.** The wire and cable shall be of the type shown on the plans, and shall conform to the following requirements:

(a) *Cable for Direct Burial.* Phase wire shall be No. 10 AWG, 600-volt cable conforming to FAA Specification L-824, Type A. Neutral wire shall be either No. 10 AWG, 600-volt cable conforming to FAA Specification L-824, Type A; No. 10 AWG, 600-volt, thermoplastic insulated wire conforming to Federal Specification J-C-129, Type TW, Class 1; or No. 6 AWG stranded bare copper wire conforming to ASTM Specification B3 and B8.

(b) *Interior Wiring.* Interior wiring shall be of the type shown on the plans and in conformance with local electrical codes and/or the National Electrical Code.

**122-2.5 Power Supply and Control Equipment.** Circuit breakers, safety switches, booster transformers, photoelectric control switches, etc., shall be of the type shown on the plans and shall conform to applicable provisions of local electrical codes and/or the National Electrical Code.

### ***Construction Methods***

**122-3.1 Low Intensity Lights.** The lights shall be installed as shown on the plans and in conformance with the manufacturer's installation instructions.

**122-3.2 Beacon.** The beacon shall be installed as shown on the plans and in conformance with the manufacturer's installation instructions.

**122-3.3 Wiring and Power Supply Equipment.** All wiring and power supply equipment shall be installed as shown on the plans and in conformance with local electrical codes and/or the National Electrical Code.

All buried wire shall be installed at least six inches below grade and surrounded by earth or sand which contains no sharp particles nor any particles large enough to be retained on a  $\frac{1}{4}$ -inch sieve. Backfill shall be placed in layers no more than six inches thick. The final layer of backfill shall be thoroughly compacted to the satisfaction of the engineer. If a cable plow is used to install the cable, it must be accomplished in a manner which is satisfactory to the engineer. Care must be exercised to avoid tension or any other cable damaging action.

Splices in buried conductors will be permitted only where the connections are made at lights and where it is necessary to tap into the supply conductors. Hand taped buried splices shall be made using crimped connectors to fasten wires. The splice insulation shall consist of one-half lapped plastic tape, built up to a thickness of  $1\frac{1}{2}$  times the cable diameter. The



tape should be tapered a distance of at least one inch over the cable insulation.

**122-3.4 Testing.** The contractor shall test and demonstrate to the satisfaction of the engineer that:

(a) All circuits are operable, which shall include functioning of each control not less than 10 times and continuous operation of each lighting and power circuit for not less than one-half hour.

(b) All low-intensity lamps are supplied by at least 107 volts and that beacon lamps are supplied at rated voltage.

### ***Method of Measurement***

**122-4.1** The quantity to be paid for in this item shall consist of a lighting system, as shown on the plans, constructed in place and accepted as a complete system.

### ***Basis of Payment***

**122-5.1** Payment shall be made at the contract lump sum price for each completed and accepted low intensity lighting system. This price shall be full compensation for furnishing all materials, for all preparation, assembly, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

**Item L-122-5.1** Construction of Airport Low Intensity Lighting System—per system.

## **ITEM L-123 INSTALLATION OF TOUCHDOWN ZONE LIGHTS, INSET AND BASE MOUNTED**

### ***Description***

**123-1.1** This item shall consist of touchdown zone lights, inset in pavement or base mounted in concrete encasement, furnished and installed for series circuit operation in accordance with this specification, at the locations and in conformity with the dimensions, design, and details shown on the plans. This item shall include furnishing and installing the light bases in concrete encasement or drilling and installing the inset fixtures in the pavement, conduit lead-ins, wire in saw kerfs, transformers, and lamps. This item shall also include mounting the light units, all wire and cable connections, the testing of the installation, the adjustment of the light fixtures, and all incidentals necessary to place the lights in operation as completed units to the satisfaction of the engineer.

### ***Equipment and Materials***

**123-2.1 General.** (a) Airport lighting equipment and materials covered by FAA specifications shall have the prior ap-

proval of the Federal Aviation Agency, Airports Service, Washington, D.C., 20553, and shall be listed in Advisory Circular No. 150/5345-1, "Approved Airport Lighting Equipment."

(b) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when so requested by the engineer.

**123-2.2 Lights.** The touchdown zone lights shall be of the type specified and shall conform to the requirements of one of the following specifications:

(a) L-838, "Semiflush Prismatic Airport Light," Type III.

(b) L-843, "Specification for L-843 Airport In-Runway Touchdown Zone Light."

(c) L-845, "Specification for L-845 Semiflush Inset Prismatic Airport Light," Type I. Each unit shall be furnished complete with lamp.

**123-2.3 Insulating Transformers.** Insulating transformers shall conform to the following specification:

L-844, "Individual Lamp Series-to-Series Type Insulating Transformer for 5,000-Volt Series Circuit 20/6.6 Amperes 200 Watt".

**123-2.4 Transformer Bases.** Transformer bases shall conform to the following specification:

L-837, "Large-Size Light Base and Transformer Housing."

**123-2.5 Tapes.** Plastic electrical insulating tape shall be Scotch Electrical Tape No. 88 as manufactured by the Minnesota Mining and Manufacturing Company, or an acceptable equal all-weather tape.

**123-2.6 Concrete.** Concrete and reinforcing steel shall conform to the applicable provisions of Item P-501, "Portland Cement Concrete Pavement".

**123-2.7 Conduit.** Rigid steel conduit and fittings shall conform to the requirements of Federal Specification WW-C-581. Flexible conduit shall be of a standard manufacture and have a suitable protective covering.

**123-2.8 Squeeze Connectors.** Squeeze connectors, if specified, shall be similar and equal to Crouse-Hinds Type CGB cable connector with a neoprene rubber bushing.

**123-2.9 Sealer Materials.** Sealer materials shall be in accordance with Item P-606.

**123-2.10 Wire.** Wire for installation in saw kerfs shall be in accordance with "Specification for L-846 Electrical Wire for Lighting Circuits To Be Installed in Airport Pavements."

### ***Construction Methods***

**123-3.1 General.** The touchdown zone light fixture shall be installed on a large size light base and transformer housing in

new pavements, when specified, or on inset receptacles in existing pavement. The touchdown zone lights shall be installed at the approximate location indicated on the plans. The exact location shall be as directed by the engineer.

## **NEW RUNWAYS—RIGID OR FLEXIBLE PAVEMENT— BASE MOUNTED**

**123-3.2 Concrete Encasement Areas.** Proper alignment of the base mounted touchdown fixtures shall be accomplished by installing the bases in concrete encasement areas. In rigid pavements, these areas are leave-outs in the paving operation. The leave-outs for rigid pavements shall be 25' x 4' centered longitudinally in the slab, using 25' paving lanes and 20' transverse joint spacing. In flexible pavements, the encasement areas are excavated after the runway has been paved. The excavated area in flexible pavement shall be a minimum of 14' x 4'. Care should be exercised to remove all disturbed material.

The excavated openings and/or leave-outs will accommodate the subsequent installation of the light bases, flexible conduit, and touchdown zone light fixtures. The concrete encasement in excavated openings or leave-outs shall be flush with the pavement and extend 4½ inches below the light base. The concrete used to fill the encasement areas shall conform to Item P-501, "Portland Cement Concrete Pavement."

**123-3.3 Installation of Large-Size Base and Transformer Housing.** Any fill material within the pavement encasement area shall be excavated to a depth of approximately 4½ inches greater than the depth of the base. The base(s) shall be supported in the leave-out or excavated area in such a manner that the top of the base flange shall be 1¾ inches below the finished pavement. The bases shall be connected together with 2-inch flexible conduit. In addition, there shall be a 2-inch flexible conduit installed from the outermost base to the edge of the concrete encasement. This flexible conduit shall slope downward to permit drainage, and it shall connect to the 2-inch rigid conduit installed under the pavement.

The contractor shall exercise care to adequately support the bases when placing the concrete around them in order to assure proper alignment and elevation of the finished installation. This may be accomplished with an anchorage system or jig. All bases shall be installed so that the top fitting of the lighting fixture will be at the proper elevation with respect to the finished pavement. The top fitting shall be level in a horizontal plane.

**123-3.4 Cable Entrance.** The primary cable shall be installed through the rigid conduit under the pavement and through the flexible conduit connecting the bases as a separate item under Item L-108. The contractor shall install the cable as shown on the plans.

**123-3.5 Cable Connections.** The contractor shall install sufficient cable in each light base to permit connections to be made above the pavement.

A field-attached connector per Specification L-823, "Plug and Receptacle, Cable Connectors," shall be installed on the primary supply cables in accordance with manufacturer's instructions. The field connectors shall be plugged into the mating primary connectors of the transformer. The joint where the transformer mating connectors come together shall be wrapped with at least two layers of plastic tape, one-half lapped, extending at least 1½ inches on each side of the joint.

**123-3.6 Assembling the Unit.** The runway touchdown zone light, Specification L-838, Type III, or Specification L-843, Type B, shall be assembled on the base and connected in accordance with manufacturer's instructions. The transformer secondary leads shall be connected to the fixture leads by means of a disconnecting plug and receptacle. A lamp of proper rating shall be installed in the fixture.

**123-3.7 Orientation.** The contractor shall align and orient each fixture in accordance with manufacturer's instructions. Final adjustments shall be made at night to the satisfaction of the engineer in charge.

### **EXISTING RUNWAYS—RIGID OR FLEXIBLE PAVEMENTS—INSET MOUNTED**

**123-3.8 Saw Kerfs.** Regardless of the type of pavement, saw kerfs shall be provided for the touchdown zone inset light wireways. A saw kerf shall be provided from the edge of the pavement transversely to branch wireways as shown on the plans. The transverse saw kerf will carry six, one-conductor wires, size No. 10 AWG, and shall be cut to the depth and width shown on the plans. The branch wireways shall be longitudinal saw kerfs provided from the transverse saw kerfs, at right angles, to the edges of each drilled housing or receptacle hole. Each longitudinal saw kerf shall carry two, one-conductor wires, size No. 10 AWG, and shall be the depth and width shown on the plans. Where a saw kerf crosses a joint, the cut shall be the depth and width shown on the plans.

**123-3.9 Wire Placement.** Prior to the installation of the wires in the pavement, all saw kerfs shall have all vertical edges chamfered at intersections. Further, all saw kerfs shall be sandblasted, flushed with a high-velocity water jet, and blown out with a high-velocity air jet or wiped dry to ensure good bond. The wires shall be placed in the wireways and anchored in the bottom of the saw kerfs with sufficient rubber wedges or other suitable material to hold the wires in place at a depth of at least ½-inch below pavement surface. No splices shall be made in the single conductor wires except at each light. The splices to the fixture leads shall be made with a pre-insulated

connector sleeve, crimped with a tool that requires a complete crimp before releasing. Splices shall be made at staggered locations and wrapped with one, half-lapped layer of an approved insulation tape. After the wires have been placed in the saw kerfs, the saw kerfs shall be filled to the level of the pavement surface with liquid sealer as called for in the specifications.

**123-3.10 Installation of Inset Lights.** In rigid or flexible pavements, a hole of the proper size shall be drilled at the locations shown on the plans. Where base and/or subbase is encountered below the drilled portion of the pavement, it shall be excavated to a minimum of 3.5 inches below the bottom of the receptacle or housing and backfilled with concrete using high early-strength cement conforming to Item P-501. The concrete backfill shall be brought up to an appropriate level below the bottom of the receptacle or housing allowing at least  $\frac{1}{8}$ -inch space for sealer material. The hole and fixture shall be cleaned and a sufficient quantity of sealer material, of the proper consistency, shall be placed in the prepared recess hole so that all voids will be completely filled when the unit is installed in its final position.

The housing or receptacle portion of the inset fixtures shall be installed at the proper elevation and aligned with a jig. This holding and leveling device shall be left in place until the sealer has reached its initial set. Any excess sealer shall be wiped clean from the receptacle and pavement. After placing the receptacle or housing in the drilled hole, the lead wires shall be properly arranged with respect to their splicing position in the wireways. It may be necessary to place temporary plugs or roving material (hemp, jute, etc.) for blocking wireway entrances into the drilled recesses in order to retain sealer material during setting of the fixture. After curing of sealer, the top assembly shall be installed in accordance with manufacturer's instructions. The fixtures shall be installed level in a horizontal plane.

**123-3.11 Secondary Wire Connections.** Connections in the secondary circuit wires shall be made to the fixture leads using pre-insulated connectors crimped with a tool which requires a full crimp before releasing. The connections shall be wrapped with one layer of one-half lapped electrical insulating tape. The connections to the transformer secondary shall be made with an Elastimold Cable Connector, Style 90P, or an approved equal. This connector shall be plugged directly into a matching connector on the transformer secondary lead. The joint where the connectors come together shall be wrapped with at least two layers of plastic electrical tape, one-half lapped, extending at least  $1\frac{1}{2}$  inches on each side of the joint.

Do not use glyptol or lacquer over vinyl plastic tape as they act as a solvent to the tape.

**123-3.12 Primary Cable Connections.** The primary cable shall be installed as a separate item under Item L-108. The con-

tractor shall bring cables into the bases, located near the runway edge, as shown on the plans. In making connections in the transformer base, the contractor shall pull cables into each base and leave sufficient slack cable inside the base to permit connections to be made above ground.

Connections to the primary cables shall be made with connectors as shown on Figure 14 of Specification L-823, "Plug and Receptacle, Cable Connectors." These connectors shall be plugged directly into matching connectors on the transformer primary leads. The joint where these connectors come together shall be wrapped with at least two layers of plastic electrical insulating tape, one-half lapped, extending at least 1½ inches on each side of the joint.

**123-3.13 Joint Crossings.** Where saw kerfs cross joints in rigid pavement, their depth shall be increased as shown on the plans. These areas shall be packed with roving materials during the pouring of the sealer into the remaining portions of the saw kerfs. After the sealer has cured, the roving material shall be removed and the joint area shall be filled with joint sealing material to the level of the surrounding pavement. The sealing material shall conform to Item P-605.

**123-3.14 Tests.** Before filling the saw kerfs for inset lights, the secondary series circuit for each subsector shall be tested for continuity and insulation resistance to ground. The insulation resistance shall be a minimum of 50 megohms. The entire installation shall be operated for not less than one-half hour as a completed system prior to acceptance. These tests shall consist of operating each control not less than 10 times. The completed primary circuit shall be tested in accordance with the applicable provisions of Item L-108, "Installation of Underground Cable for Airports."

### ***Method of Measurement***

**123-4.1** The quantity of lights to be paid for under this item shall be the number of each type of touchdown zone lights installed as complete units in place, ready for operation, and accepted by the engineer.

### ***Basis of Payment***

**123-5.1** Payment shall be made at the contract unit price for each touchdown zone light installed in place by the contractor and accepted by the engineer. This price shall be full compensation for furnishing all materials; for all preparation, assembly, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

**Item L-123-5.1 Touchdown Zone Lights, In Place—per each.**

## **ITEM L-124 INSTALLATION OF RUNWAY CENTERLINE AND TAXIWAY TURNOFF LIGHTS**

### ***Description***

**124-1.1** This item shall consist of runway centerline and taxiway turnoff lights, inset in holes drilled into the pavement, furnished and installed for series circuit operation in accordance with this specification, at the locations and in conformity with the dimensions, design, and details shown on the plans. This item shall include the drilling and sawing of recesses and wireways in the pavement, assembling the light units, furnishing and installing wire in saw kerfs, wire and cable connections, transformers, and lamps, the testing of the installation, and all incidentals necessary to place the lights in operation as completed units to the satisfaction of the engineer.

### ***Equipment and Materials***

**124-2.1 General.** (a) Airport lighting equipment and materials covered by FAA specifications shall have the prior approval of the Federal Aviation Agency, Airports Service, Washington, D.C., 20553, and shall be listed in Advisory Circular No. 150/5345-1, "Approved Airport Lighting Equipment."

(b) All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specifications, when so requested by the engineer.

**124-2.2 Lights.** The runway centerline and taxiway turnoff lights shall be of the type specified and shall conform to the requirements of the following specification:

**L-842, "Specification for L-842 Airport Centerline Light."**

Each unit shall be furnished complete with a lamp and a lamp bypass device.

**124-2.3 Insulating Transformers.** Insulating transformers shall conform to one of the following specifications:

(a) L-834 "Individual Lamp Series-to-Series Type Insulating Transformers for 5,000-Volt Series Circuit," 6.6/6.6 Ampere 200 Watt.

(b) L-844 Individual Lamp Series-to-Series Type Insulating Transformer for 5,000-Volt Series Circuit 20/6.6 Amperes 200 Watt."

**124-2.4 Transformer Base.** Transformer bases shall conform to the following specification:

**L-837 "Large-Size Light Base and Transformer Housing."**

**124-2.5 Tapes.** Plastic electrical insulating tape shall be Scotch Electrical Tape No. 88 as manufactured by the Minnesota Mining and Manufacturing Company, or an acceptable equal all weather tape.

**124-2.6 Sealer Materials.** Sealer materials shall be in accordance with Item P-606.

**124-2.7 Conduit.** Rigid steel conduit and fittings shall conform to the requirements of Federal Specification WW-C-581.

**124-2.8 Squeeze Connectors.** Squeeze connectors, if specified, shall be similar and equal to Crouse-Hinds Type CGB cable connector with a neoprene bushing.

**124-2.10 Wire.** Wire for installation in saw kerfs shall be in accordance with "Specification for L-846 Electrical Wire for Lighting Circuits To Be Installed in Airport Pavements."

### *Construction Methods*

**124-3.1 Placing the Lights.** The runway centerline and taxiway turnoff lights shall be installed at the approximate location indicated on the plans. The exact location shall be as directed by the engineer.

**124-3.2 Pavement Drilling.** In both rigid and flexible pavements, fixture recesses and wireways shall be drilled and sawed according to the location and dimensions shown on the plans. Extra depth and special treatment are required where wireways cross rigid pavement joints. This extra depth and special treatment shall be in accordance with the plans. The longitudinal alignment of the drilled fixture recess holes shall be within  $\frac{1}{4}$  inch.

**124-3.3 Saw Kerfs.** Regardless of the type of pavement, the wireways shall be saw kerfs in the pavement as shown on the plans. The transverse saw kerf between each group of fixtures and the transformer located near the runway edge will carry four, one-conductor wires, size No. 10 AWG. Longitudinal saw kerfs shall be provided from the transverse saw kerf in each direction through the center of each drilled receptacle hole. The saw kerf shall continue below and through the recessed hole at a depth sufficient to carry the single No. 10 AWG return wire. Each longitudinal saw kerf shall carry two, one-conductor wires, size No. 10 AWG. The longitudinal and transverse saw kerfs shall be of the depths and widths shown on the plans.

**124-3.4 Wire Placing.** Prior to the installation of the wires in the pavement, all saw kerfs shall have all vertical edges chamfered at intersections. The saw kerfs shall also be stand-blasted, flushed with a high velocity water jet, and blown out with a high velocity air jet or wiped dry to ensure good bond. The wires shall be placed in the wireways and anchored in the bottom of the saw kerfs with sufficient rubber wedges or other suitable material to hold the wires in place at a depth of at least  $\frac{1}{2}$  inch below pavement surface. No splices shall be made in the single conductor wires except at each light. The splices to the fixture leads shall be made with a pre-insulated connector sleeve, crimped with a tool that requires a complete



crimp before releasing. Splices shall be made at staggered locations and wrapped with one, half-lapped layer of an approved insulation tape. After the wires have been placed in the saw kerfs, the saw kerfs shall be filled to the level of the pavement surface with liquid sealer as called for in the specifications.

**124-3.5 Installation of Runway Centerline and Taxiway Turn-off Fixtures.** Recess holes shall be drilled in the pavement at the locations and to the tolerances shown on the plans. Prior to placing the receptacle in the drilled hole, the lead wires shall be properly arranged on the receptacle with respect to their splicing position in the saw kerf. It may be necessary to place temporary plugs for blocking wireway entrances into drilled recesses in order to retain sealer during setting of receptacle. A sufficient quantity of paste sealer material shall be placed into the holes for securing the receptacles. The top edge of each receptacle shall be installed level with the surrounding pavement surface with the aid of a jig. This holding and leveling device (jig) shall be left in place until the sealer has reached its initial set. If any voids are present around the edges of the receptacle after the initial set, they may be filled with a liquid sealer. Any air bubbles shall be broken and excess sealer wiped clean from the receptacle and pavement. Precautions should be taken to keep the receptacle interior clean during the sealing process.

When installing the receptacles for the curved portion of the taxiway turnoff, the receptacles shall be oriented to provide the optimum guidance by being aimed at a point 500 feet from the light fixture on the path of the approaching aircraft. After the sealer has cured, the top assembly shall be installed in accordance with manufacturer's instructions.

**124-3.6 Cable Entrance.** The primary cable shall be installed as a separate item under Item L-108. The contractor shall bring cables into the bases, located near the runway edge, as shown on the plans.

**124-3.7 Cable Connections.** In making primary cable connections in transformer bases, the contractor shall pull cables into each base and leave sufficient slack cable to permit connections to be made above ground.

Connections to primary cable shall be made with connectors conforming to Figure 14 of Specification L-823, "Plug and Receptacle, Cable Connectors." These connectors shall be plugged directly into matching connectors on the transformer primary leads. The joint where these connectors come together shall be wrapped with at least two layers of plastic electrical insulating tape, one-half lapped, extending at least 1½ inches on each side of the joint.

Connections in the secondary circuit wires shall be made only to the fixture leads using preinsulated connectors crimped with a tool which requires a full crimp before releasing. The

connection shall be wrapped with one layer of one-half lapped electrical insulation tape. The connection to the transformer secondary shall be made with an Elastimold Cable Connector, Style 90P, or an approved equal, plugged directly into a matching connector on the transformer secondary lead. The joint where the connectors come together shall be wrapped with at least two layers of plastic electrical tape, one-half lapped, extending at least 1½ inches on each side of the joint.

Do not use glyptol or lacquer over vinyl plastic tape as they act as a solvent to the tape.

**124-3.8 Joint Crossings.** Where saw kerfs cross joints in rigid pavement, their depth shall be increased as shown on the plans. These areas shall be packed with roving material during the pouring of the sealer into the remaining portions of the saw kerfs. After the sealer has cured, the roving material shall be removed and the joint area shall be filled with joint sealing material to the level of the surrounding pavement. The sealing material shall conform to Item P-605.

**124-3.9 Assembling the Units.** The top assembly of the centerline and taxiway turnoff lights shall be installed in accordance with manufacturer's instructions. The units shall be cleaned and dried before the top assembly is secured in place. Care should be exercised to properly seat all gaskets. In addition, all screws, bolts, or other securing hardware shall be tightened with a torque wrench or screwdriver in accordance with manufacturer's recommended torque. A lamp of the proper rating shall be installed in each fixture.

**124-3.10 Tests.** Before filling the saw kerfs, the secondary series circuit for each subsector shall be tested for continuity and insulation resistance to ground. The insulation resistance shall be a minimum of 50 megohms. The entire installation shall be operated for not less than one-half hour as a completed system prior to acceptance. These tests shall consist of operating each control not less than 10 times. The completed circuit shall be tested in accordance with the applicable provisions of Item L-108, "Installation of Underground Cable for Airports."

### ***Method of Measurement***

**124-4.1** The quantity of lights to be paid for under this item shall be the number of each type of runway centerline or taxiway turnoff lights installed as complete units in place, ready for operation, and accepted by the engineer.

### ***Basis of Payment***

**124-5.1** Payment shall be made at the contract unit price for each runway centerline or taxiway turnoff light installed in place by the contractor and accepted by the engineer. This price shall be full compensation for furnishing all materials; for all

crimp before releasing. Splices shall be made at staggered locations and wrapped with one, half-lapped layer of an approved insulation tape. After the wires have been placed in the saw kerfs, the saw kerfs shall be filled to the level of the pavement surface with liquid sealer as called for in the specifications.

**124-3.5 Installation of Runway Centerline and Taxiway Turn-off Fixtures.** Recess holes shall be drilled in the pavement at the locations and to the tolerances shown on the plans. Prior to placing the receptacle in the drilled hole, the lead wires shall be properly arranged on the receptacle with respect to their splicing position in the saw kerf. It may be necessary to place temporary plugs for blocking wireway entrances into drilled recesses in order to retain sealer during setting of receptacle. A sufficient quantity of paste sealer material shall be placed into the holes for securing the receptacles. The top edge of each receptacle shall be installed level with the surrounding pavement surface with the aid of a jig. This holding and leveling device (jig) shall be left in place until the sealer has reached its initial set. If any voids are present around the edges of the receptacle after the initial set, they may be filled with a liquid sealer. Any air bubbles shall be broken and excess sealer wiped clean from the receptacle and pavement. Precautions should be taken to keep the receptacle interior clean during the sealing process.

When installing the receptacles for the curved portion of the taxiway turnoff, the receptacles shall be oriented to provide the optimum guidance by being aimed at a point 500 feet from the light fixture on the path of the approaching aircraft. After the sealer has cured, the top assembly shall be installed in accordance with manufacturer's instructions.

**124-3.6 Cable Entrance.** The primary cable shall be installed as a separate item under Item L-108. The contractor shall bring cables into the bases, located near the runway edge, as shown on the plans.

**124-3.7 Cable Connections.** In making primary cable connections in transformer bases, the contractor shall pull cables into each base and leave sufficient slack cable to permit connections to be made above ground.

Connections to primary cable shall be made with connectors conforming to Figure 14 of Specification L-823, "Plug and Receptacle, Cable Connectors." These connectors shall be plugged directly into matching connectors on the transformer primary leads. The joint where these connectors come together shall be wrapped with at least two layers of plastic electrical insulating tape, one-half lapped, extending at least 1½ inches on each side of the joint.

Connections in the secondary circuit wires shall be made only to the fixture leads using preinsulated connectors crimped with a tool which requires a full crimp before releasing. The

connection shall be wrapped with one layer of one-half lapped electrical insulation tape. The connection to the transformer secondary shall be made with an Elastimold Cable Connector, Style 90P, or an approved equal, plugged directly into a matching connector on the transformer secondary lead. The joint where the connectors come together shall be wrapped with at least two layers of plastic electrical tape, one-half lapped, extending at least 1½ inches on each side of the joint.

Do not use glyptol or lacquer over vinyl plastic tape as they act as a solvent to the tape.

**124-3.8 Joint Crossings.** Where saw kerfs cross joints in rigid pavement, their depth shall be increased as shown on the plans. These areas shall be packed with roving material during the pouring of the sealer into the remaining portions of the saw kerfs. After the sealer has cured, the roving material shall be removed and the joint area shall be filled with joint sealing material to the level of the surrounding pavement. The sealing material shall conform to Item P-605.

**124-3.9 Assembling the Units.** The top assembly of the centerline and taxiway turnoff lights shall be installed in accordance with manufacturer's instructions. The units shall be cleaned and dried before the top assembly is secured in place. Care should be exercised to properly seat all gaskets. In addition, all screws, bolts, or other securing hardware shall be tightened with a torque wrench or screwdriver in accordance with manufacturer's recommended torque. A lamp of the proper rating shall be installed in each fixture.

**124-3.10 Tests.** Before filling the saw kerfs, the secondary series circuit for each subsector shall be tested for continuity and insulation resistance to ground. The insulation resistance shall be a minimum of 50 megohms. The entire installation shall be operated for not less than one-half hour as a completed system prior to acceptance. These tests shall consist of operating each control not less than 10 times. The completed circuit shall be tested in accordance with the applicable provisions of Item L-108, "Installation of Underground Cable for Airports."

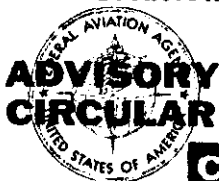
### *Method of Measurement*

**124-4.1** The quantity of lights to be paid for under this item shall be the number of each type of runway centerline or taxiway turnoff lights installed as complete units in place, ready for operation, and accepted by the engineer.

### *Basis of Payment*

**124-5.1** Payment shall be made at the contract unit price for each runway centerline or taxiway turnoff light installed in place by the contractor and accepted by the engineer. This price shall be full compensation for furnishing all materials; for all

# Federal Aviation Agency



## CHANGE

AC NO: 150/5370-1 CH 2

AIRPORTS

EFFECTIVE :

12/28/65

**SUBJECT :** CH 2 TO ADVISORY CIRCULAR NO. 150/5370-1,  
SUBJ: STANDARD SPECIFICATIONS FOR CONSTRUCTION  
OF AIRPORTS

1. **PURPOSE.** This advisory circular change deals solely with a substitution of one type of membrane curing compound for another.
2. **CHANGE.** Change 1 to this advisory circular specified, under Item 501-2.10(d), the use of membrane curing compounds conforming to Interim Federal Specification TT-C-00800, Type 2, Curing Compound, Concrete, for New and Existing Surfaces. On all future projects, membrane curing compounds conforming to the American Association of State Highway Officials (AASHTO) Standard Specifications for Liquid Membrane - Forming Compounds for Curing Concrete (AASHTO Designation M 148, Type 2) should be used instead of those conforming to the Interim Federal Specification. This substitution may also be made on current projects where practicable.
3. **RECOMMENDATION.** At locations where slipperiness problems are anticipated, a special provision may be added to the project specifications which requires that compounds conforming to AASHTO M 148, Type 2, have all-resin bases.

*Charles H. Bowers*  
for Cole Morrow, Director  
Airports Service

preparation, assembly, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-124-5.1 Runway Centerline or Taxiway Turnoff Lights, In Place—per each.

## **DIVISION VII—TESTS**

### **TEST T-611 COMPACTION CONTROL TESTS**

611-1.1 Description—page 552. Delete the last paragraph and substitute the following: "The following compaction tests shall be applied to airport construction in accordance with the design of the pavements; that is, A and B tests shall be used for pavements designed for 30,000 pounds gross aircraft weight or more, and C and D tests shall be used for pavements designed for less than 30,000 pounds gross aircraft weight."

Under A and B, delete "(15,000 SWL or more)" and substitute "(30,000 gross aircraft weight or more)."

Under C and D, delete "(less than 15,000 SWL)" and substitute "(less than 30,000 gross aircraft weight)."

## **DIVISION VIII—APPENDIX**

Delete pages 575 to 580, inclusive.