

**SECTION 300
BASES****SECTION 304
AGGREGATE BASE COURSE****DESCRIPTION**

304.01 This work consists of furnishing and placing one or more courses of aggregate and additives, if required, on a prepared subgrade.

MATERIALS

304.02 Aggregate. The aggregates shall meet the requirements of subsection 703.03.

Acceptance will be based on random samples taken from each lift.

304.03 Commercial Mineral Fillers. Portland cement shall conform to subsection 701.01. Hydrated lime shall conform to subsection 712.03.

CONSTRUCTION REQUIREMENTS

304.04 Placing. If the required compacted depth of the aggregate base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. When vibratory or other approved types of special compacting equipment are used, the compacted depth of a single layer may be increased to 8 inches upon request, provided that specified density is achieved and written approval is given.

304.05 Mixing. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.

304.06 Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T 180 has been achieved. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation.

The surface of the base course will be tested with a 10 foot straightedge, or other approved device. The surface shall be tested prior to the application of any primer or pavement. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed $\frac{1}{4}$ inch. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost to the Department.

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The above compaction and straightedge requirements shall not apply to shoulder gravel. Compaction of shoulder gravel shall be accomplished by wheel rolling, as directed.

METHOD OF MEASUREMENT

304.07 Aggregate base course will be measured by the ton, or by the cubic yard compacted in place.

BASIS OF PAYMENT

304.08 The accepted quantities of aggregate base course, of the class specified, will be paid for at the contract price bid per ton or per cubic yard, as shown in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Aggregate Base Course (Class___)	Ton, Cubic Yard

Water will not be measured and paid for separately but shall be included in the work.

Commercial mineral fillers, when used, will be measured and paid for in accordance with Section 307 or as provided in the Contract.

**SECTION 306
RECONDITIONING**

DESCRIPTION

306.01 This work consists of blading, shaping, wetting, and compacting the existing subgrade with moisture and density control.

CONSTRUCTION REQUIREMENTS

306.02 The top 6 inches of the existing subgrade shall be reconditioned by blading and rolling. Sufficient water shall be added to meet the density requirements as specified in the Contract. The reconditioned surface shall not vary above or below the lines and grades as staked by more than 0.08 foot. The surface shall be tested for smoothness and density prior to the application of any base course material. Where bituminous surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost to the Department. The surface shall be satisfactorily maintained until base course has been placed.

METHOD OF MEASUREMENT

306.03 Reconditioning will be measured by the square yard of subgrade, including auxiliary lanes, and shall include blading, shaping, scarifying, compacting the subgrade, finishing, and maintenance of the finished surface.

BASIS OF PAYMENT

306.04 The accepted quantities of reconditioning will be paid for at the contract unit price for reconditioning.

Payment will be made under:

Pay Item	Pay Unit
Reconditioning	Square Yard

Water will not be measured and paid for separately but shall be included in the work.

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**SECTION 307
LIME TREATED SUBGRADE**

DESCRIPTION

307.01 This work consists of treating the earth subgrade by combining lime and water with the pulverized soil subgrade material to the specified depth and compaction requirements as shown on the plans.

MATERIALS

307.02 Lime. Lime for lime treated subgrade shall be applied in slurry form. Dry application of lime will not be allowed unless otherwise approved by the Engineer. Commercial lime slurry shall be a pumpable suspension of solids in water. Lime for lime treated subgrade shall conform to the requirements of ASTM C 977 and rate of slaking test for moderate reactivity per ASTM C 110 and shall be the product of a high-calcium limestone as defined by ASTM C 51.

307.03 Water. Water used for mixing or curing shall be in accordance with subsection 712.01, with the additional requirement that the sulfate content shall be less than 500 ppm.

CONSTRUCTION REQUIREMENTS

307.04 General. The Contractor shall construct one or more compacted courses of treated material, to the depth specified in the Contract. The treated material shall be a uniform blend of soil, lime, and water, free from loose or segregated areas. It shall have uniform density and moisture content and be void of all vegetation and other organic or man-made material. The subgrade shall be well bound for its full depth and width with a smooth surface suitable for placing subsequent courses. The Contractor shall regulate the sequence of the work to accurately apply and uniformly blend the lime at the designated rate and rework the courses as necessary to meet the above requirements.

The Contractor shall submit a mix design to the Engineer for approval, prior to constructing the test section.

The Contractor shall mix hydrated or quicklime with water to produce lime slurry at the job site with equipment specifically manufactured for this purpose.

Excessive aeration of lime slurry will not be permitted

The lime-treated subgrade shall not be mixed when it is raining, or when the subgrade material is frozen. The lime-treated subgrade shall not be mixed or compacted if the temperature of the lime or soil is below 35 °F.

307.05 Preparation of Subgrade. Prior to beginning any lime treatment the subgrade shall be constructed and finished to smooth and uniform surfaces conforming to the grades and typical sections specified. Variation from the subgrade

plane elevations specified shall not be more than ± 0.1 foot. The subgrade shall also be proof rolled in accordance with subsection 307.07. Soft or otherwise unsuitable subgrade disclosed by proof rolling shall be over-excavated, and replaced to a compacted stable state. The in-place density shall be at least 95 percent of AASHTO T 99 density within 0-3 percent of optimum moisture content.

307.06 Test Section. Prior to full-scale production, the Contractor shall construct a test section to demonstrate, to the satisfaction of the Engineer, subgrade stabilization using the materials, equipment, and methods to be used in full-scale production. The test section shall be at least 100 feet long, two spreading and mixing lanes wide, and the same depth as the course represented in the plans. The test section shall be constructed at a location approved by the Engineer.

The test section shall be tested in accordance with the same test requirements for the lime and soil design mix, and as determined by the Contractor.

If the test section is unsatisfactory, the Contractor shall adjust the materials, equipment, and methods or combinations thereof as necessary to conform to the specifications. Additional test sections shall be constructed as required to produce a satisfactory test section prior to full-scale production. Unsatisfactory test sections shall be removed and replaced at the Contractor's expense. Full production shall not begin until a satisfactory test section is completed and approved by the Engineer.

Prior to start of work, the Contractor shall determine the lime application rate, and the maximum dry density and optimum moisture content of the material after it has been treated with lime. All tests shall be performed in the presence of the Engineer. These test results will be used to determine the Contract requirements for lime application.

307.07 Proof Rolling. Both prior to and after the lime treatment, the Contractor shall perform proof rolling in accordance with subsection 203.09, except that final proof rolling will take place a minimum of seven days after lime treatment, unless otherwise approved by the Engineer.

307.08 Processing Materials. After the subgrade has been finished and approved as specified, the subgrade shall then be cut and pulverized by a cutting and pulverizing machine to the depth and width shown on the plans. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the lime-stabilized soil mixture. The machine shall uniformly cut and pulverize the loosened material to a depth not greater than 10 percent over the thickness of the lime-treated layer as specified in the Contract and shall have cutters that plane the base of the cut and pulverize zone to a smooth surface over the entire width of the cut. The machine must give visible indication at all times that it is cutting to the proper depth.

- (a) *Lime Application.* Lime shall be applied in the form of a slurry, on that area where the initial mixing operations can be completed during the same working day, and at the specified percentage of hydrated lime, by equipment capable of

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pumping and re-circulating the mixture while in transit. The slurry shall be applied through spray bars to assure a uniform flow and distribution.

- (b) *Initial Mixing.* Initial mixing shall take place immediately after lime application. The lime, soil, and water shall be thoroughly mixed and blended by a self propelled rotary type mixing machine, until a uniform mixture throughout the required depth and width is obtained and all clods and lumps are reduced to a maximum 2 inch diameter size. There shall be a minimum 6 inch overlap between passes to assure consistent mixing and breakdown.

The mixing machine shall make at least of two passes to uniformly mix the lime, water, and soil to the full depth of the pulverized layer. Non-uniformity of color reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing. Streaks and pockets of lime will also be considered evidence of inadequate mixing, and shall require additional mixing to correct.

The moisture content of the mixture immediately following the blending of water, lime, and soil shall not be less than optimum as determined by AASHTO T 99, plus necessary hydration moisture. Hydration moisture will be considered as one percentage point for each percent of lime being added. When proper mixing has been accomplished, the mixture shall be cured for at least 48 hours. Light rolling to seal the surface of the mixture shall be required. The mixture shall be maintained in a moist condition throughout the entire curing period.

- (c) *Final Mixing.* After the required curing period, the mixture shall be uniformly mixed by a self-propelled rotary type mixing machine and maintained at approximate optimum moisture content as determined herein. If the lime stabilized soil mixture contains clods, they shall be reduced by approved pulverization so that the remainder of the material shall meet the gradation requirements of Table 307-1 when tested dry by laboratory sieves. If it is determined that additional lime needs to be added to the previously mixed subgrade, the total depth of the subgrade shall be mixed.

307.09 Compaction

- (a) Compaction of the lime and soil mixture shall begin immediately after final mixing. The material shall be aerated or sprinkled as necessary to maintain the mixture within the specified moisture content limits during and following compaction. The field density for the compacted mixture shall be at least 95 percent of the maximum density of laboratory specimens prepared from samples taken from the lime soil material in place after curing and prior to compacting. The specimens will be compacted and tested in accordance with AASHTO T 99, and the in-place field density will be determined in accordance with Colorado Procedure (CP) 80. Any mixture that has not been compacted shall not be left undisturbed for more than 30 minutes. The moisture content of the mixture at the start of compaction shall be at 2 ± 1 percent above the optimum moisture

content. The optimum moisture content will be determined in accordance with AASHTO T 99.

- (b) The finished surface shall be smooth and uniform conforming to the typical sections specified. All irregularities, depressions, or weak spots, which develop, shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.
- (c) In addition to the requirements specified for density, the full depth of the materials shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, the Engineer will conduct tests. If the material fails to meet the density and strength requirements in accordance with the lime and soil design mix, it shall be reworked to meet these requirements at the Contractor's expense. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Variation from the subgrade plan elevations specified shall not exceed 0.04 foot. Should the material, due to any reason or cause, lose the required stability, density, or finish, before the next course is placed or the work is accepted, it shall be recompacted and refinished at the Contractor's expense.

307.10 Finishing and Curing . When initial compaction of the top layer of the lime-stabilized soil mixture is nearing completion, the surface shall be shaped to the required lines, grades, and cross section, and compaction continued until uniform and adequate compaction is obtained. The treated material shall be maintained at a moisture content satisfactory for proper curing by one of the following:

- (1) Sprinkling for a period of seven days.
- (2) Sprinkling for a period less than seven days until emulsified asphalt prime coat (diluted 1 to 1) is applied in accordance with subsection 307.10, item (3) below.
- (3) Applying a protective film of emulsified asphalt prime coat (diluted 1 to 1 with water) immediately after the lime-treated subgrade has been finished. One application shall be made consisting of 0.20 gallon diluted mixture per square yard.

The completed section shall be cured for a minimum of seven days before further courses are added or any traffic is permitted, unless otherwise directed by the engineer. Acceptable compressive strength test results shall be in a range from a minimum of 160 pounds per square inch to 500 pounds per square inch.

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307.11 Construction Joints. Construction joints are not required after each day's work unless there is a time lapse of seven days or more between the processing of adjacent sections. If construction joints are required, they shall be formed by cutting back into the completed work to form a vertical face. Damage to completed work shall be avoided.

307.12 Thickness Acceptance. Lime treated subgrade will be accepted for minimum thickness on a lot basis. A lot will consist of 1,500 square yards. One core shall be taken at random by the Contractor's Quality Control Inspector in each lot. When the measurement of the core from a lot is not deficient by more than 0.5 inch from the minimum plan thickness, full payment will be made. When such measurement is deficient by more than 0.5 inch and not more than 1.0 inch from the plan thickness, two additional cores shall be taken at random and used in determining the average thickness for that lot. The thickness of the core shall be determined by average caliper measurement of cores tested in accordance with ASTM C 174. When the average measurement of the three cores is not deficient by more than 0.5 inch from the plan thickness, full payment will be made. If the average measurement of the three cores is deficient by more than 0.5 inch but less than 1.0 inch from the plan thickness, the entire lot may be left in place and a 10 percent price reduction to the contract unit price will be made. If the average measurement of the three cores is deficient more than 1.0 inch but less than 2.0 inches from the plan thickness, the entire lot may be left in place and a of 50 percent price reduction to the contract unit price will be made. When the average thickness is deficient by more than 2.0 inches, the entire lot shall be replaced at the Contractor's expense.

Table 307-1
SCHEDULE FOR MINIMUM SAMPLING AND TESTING

Element and Procedure	Process Control	Acceptance	Remarks
pH ASTM C 977 (App) (Design) ASTM G 51 (Field)	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	pH will be determined after % lime has been established based on unconfined compressive strength
Atterburg Limits AASHTO T 89, T 90	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	Reduce by ½ original PI
Swell Potential ASTM D 4546	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	½ % or less with 200 psf surcharge pressure Modified as per local practices
Unconfined Compressive Strength ASTM D 5102 (Procedure B)	1/5,000 sq. yds. or fraction thereof 1/soil type	1/10,000 sq. yds. or fraction thereof 1/soil type.	Determined by design plan criteria. Do not immerse in water after moist-cure period. The tests shall be conducted on samples cured in a moist environment for 5 days @ 100 °F
Thickness Acceptance ASTM C 174	A lot is defined as 1 core per 1,500 sq. yds. or fraction thereof	1/3,000 sq. yds. or fraction thereof	When measurement is <0.5", 2 additional cores shall be taken in that lot and the average of 3 cores will determine the thickness of that lot
Gradation CP 31	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	1" – 100% passing; #4 – 60% passing, dry sieving after final mixing
Determining Percent Relative Compaction Soil-Aggregate by Nuclear Method CP 80	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	Minimum 95% of maximum dry density as per AASHTO T 99. Moisture content of mixture at the start of compaction shall be at 2 ± 1% above optimum moisture content
Moisture Density Curve AASHTO T 99	1/soil type	1/soil type	
Sulfate AASHTO T 290	1/soil type	1/soil type	Sulfate content shall be less than 0.2% by weight in a 10:1 water to soil solution.

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METHOD OF MEASUREMENT

307.13 Hydrated lime will be measured by the ton. If quicklime is used the pay quantity will be determined using the certified lime purity for each truckload as follows:

Pure quicklime (CaO) • 1.32 = Hydrated Lime (Ca(OH)₂)

Quicklime delivered • % purity • 1.32 = A

Quicklime delivered • % inert material = B

A + B = total hydrated lime produced = pay quantity

Processing lime-treated subgrade will be measured by the square yard for the area completed and accepted. Overlap mixing will not be measured and paid for separately but shall be included in the work.

BASIS OF PAYMENT

307.14 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment shall include all processing materials, lime application and mixing, compaction, and materials used in curing.

Payment will be made under:

Pay Item	Pay Unit
Hydrated Lime	Ton
Processing Lime Treated Subgrade (___Inch)	Square Yard

Test sections and coring will not be measured and paid for separately, but shall be included in the work.

All proof rolling will be measured and paid for in accordance with Section 203.