

SECTION 307 LIME-TREATED SUBGRADE

307.01. DESCRIPTION.

This work shall consist of furnishing and placing one or more courses of a mixture of soil, lime, and water in accordance with these Specifications and in reasonably close conformity with the lines, grades, thickness, and typical cross sections shown on the Plans or established by the Engineer.

In subgrade extents designated on the Plans or by the Engineer as having excessive rock—the dimensions or quantities of which 25 percent or more is greater than 2 1/2 inches (63 mm), which makes full compliance impractical—the Engineer may waive certain portions of the Standard Specifications as described below. The Engineer may require exploratory scarifying by the Contractor before designation of extents for which the full compliance of Specifications is waived.

307.02. MATERIALS.

Materials shall meet the requirements specified in the following Subsections of Section 700 - Materials.

Water	701.04
Hydrated Lime	706.01
Quick Lime	706.02
By-Product Lime	706.03

Store lime in a suitable, weather-tight building or compartment which will (1) protect it from dampness and (2) permit easy access for proper inspection and identification of each shipment. Lime shall not be used if for any reason it has become partially set or if it contains hard lumps or cakes. Do not mix limes from different sources in storage, even though they have been tested. By-product lime from residual or waste piles *from approved sources* may be used in lieu of hydrated or quick lime.

307.03. EQUIPMENT.

Equipment meeting the requirements of Subsection 301.03 shall be used on the project.

307.04. CONSTRUCTION METHODS.

- (a) **General.** The primary requirement of these Specifications is to secure a completed course of treated material containing a uniform lime mixture
- (1) free from loose or segregated areas,
 - (2) of uniform density and moisture content,
 - (3) well bound for its full depth, and
 - (4) with a smooth surface suitable for placing subsequent courses.
- It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, to maintain the work, and to rework the courses as necessary to meet the above requirements.
- (b) **Weather Limitations.** Lime slurry or dry hydrated lime shall not be applied unless the air temperature is at least 40° (4°C) and rising. The air temperature shall be taken 4 feet (1.2 m) above the ground in the shade and away from artificial heat.

Dry-quick lime shall not be applied unless the air temperature is at least 30°F(-1°C) and rising. The Contractor shall be responsible for the protection and quality of the lime treated subgrade under any weather conditions.

- (c) **Preparation of Existing Roadbed.** Prior to beginning any lime treatment, compact and shape the roadbed to reasonably close conformity with the typical sections, lines, and grades as shown on the Plans or established by the Engineer. Roll the subgrade as directed by the Engineer, and correct any soft areas that this rolling may reveal.
- (d) **Scarifying and Loosening.** Scarifying and loosening may be required prior to the application of lime to achieve the desired results as determined by the Engineer. Take precautions to avoid forming furrows of loosened material below the depth specified for the bottom of the treated subgrade.

NOTE: The length of roadway scarified and loosened at any time shall not exceed the length in which the first mixing (paragraph 307.04(f)1) can be completed in two calendar days.

- (e) **Application of Lime.** The proportion of lime indicated on the Plans is approximate. Apply lime at the rate prescribed by the Engineer, based on tests of the subgrade soil. Provide equipment for proper control of application rate of the lime. Where tests indicate a significant change in the subgrade soil, the Engineer will establish a new rate as deemed necessary for the section of road affected, and at the time of placing and spreading the lime, will advise the Contractor of the final rate for the said section.

NOTE: Do not apply lime when wind conditions are such that blowing lime becomes objectionable to traffic and adjacent property owners; and do not use a motor grader to spread hydrated lime.

When lime is applied to the soil ahead of the mixing plant, place the lime only on that area where the first mixing operations can be completed during the same working day. During the interval of time between application and mixing, lime that has been exposed to the open air for a period of six hours or more may not be accepted for payment; in addition, payment will not be made for lime loss due to excessive washing or blowing.

(1) Dry Method.

- 1.1 *Quick Lime.* When quick lime is used, the equipment for spreading lime shall be an approved type which shall demonstrate its ability to distribute the lime at controlled amounts uniformly.
- 1.2 *Hydrated Lime.* Bagged hydrated lime may be used for dry-method application only under unusual circumstances, i.e., when it would be impossible or impracticable to use other methods and only upon written approval of the Engineer provided that all applicable Federal, State, and local laws are met. The bagged lime shall bear the manufacturer's certified weight.

(2) Slurry Method. Lime shall be mixed with water into a slurry by either of the following methods.

- 2.1 *Central Plant.* Mixing shall be accomplished through integral paddles, recirculating pumps, or other devices that will meet mixing requirements. The slurry distributor truck, hauling from the central plant, shall be equipped with a recirculating pump or agitator of sufficient size which will keep the lime and water in a uniform mixture until spread.
- 2.2 *Transit Mix.* The lime from the storage bin shall be metered or weighed by an approved method into the tank transit mix equipment. The tank truck shall be equipped with a

recirculating pump or agitator to maintain a uniform mixing of the lime and water while in transit.

The distributor truck shall be equipped with a pump, regardless of the type of mixing method used. The slurry will be applied through the spray bars under pressure to assure a uniform flow and distribution. The slurry produced by either method shall consist of a minimum mixture of approximately 1 ton (0.9 metric ton) of lime to each 500 gallons (1893 L) of water and shall not contain more than 40 percent lime.

NOTE: Use of compressed air for mixing will not be permitted.

- (3) **By-product Lime.** When by-product lime is used, the equipment for spreading lime shall be an approved type which will demonstrate its ability to uniformly distribute the lime at controlled amounts.
- (f) **Mixing.** The mixing procedure shall be as described below:
- (1) **First Mixing.** Mix the soil, lime, and water until a uniform mixture is obtained in which all clods and nonaggregate lumps are reduced to a maximum of 2 1/2 inches (63 mm) diameter size. The quantity of water necessary for the first mixing operation will vary with the nature of the material, normally 3 to 5 percentage points above the optimum moisture content of the compacted treated soil. Add sufficient water in the first mixing process to insure proper chemical action between the lime and soil. When proper mixing has been accomplished, allow the mixture to cure. Curing time when hydrated lime is used shall be 72 hours at temperatures above 32°F (0°C). Curing time when quick lime is used shall be 48 hours at temperatures above 32°F (0°C). Curing time when by-product lime is used shall be 60 hours at temperatures above 32°F (0°C).

During the curing period, maintain the material in a moist condition. Seal the surface of the modified area by light rolling to the extent that the surface will repel water and contain the moisture. When deemed necessary by the Engineer, rescarify any portion of the area under modification for additional sprinkling to insure proper moisture for the curing.

- (2) **Final Mixing.** After the required curing time, mix the material uniformly by approved methods. Reduce all clods until the soil-lime mixture meets the following requirements when tested dry by laboratory sieves:

Minimum passing 1 1/2 inch (37.5 mm)	100%
Minimum passing No. 4 (4.75 mm) sieve	60%

- (3) **Depths of 8 inches (200 mm) or greater compacted thickness.** No course treated shall exceed 8 inches (200 mm) in depth. If the depth of material to be treated in cut sections is more than 8 inches (200mm), remove that portion above the lower 8 inches (200 mm) so that the bottom course can be treated in place. The upper portions of the cut section also shall be treated in courses not more than 8 inches (200 mm) in depth.

During normal fill construction, accomplish lime treatment by adding and mixing the amount of lime as required on the plans to each 8 inch (200 mm) lift, completing the depth of fill to the typical section shown on the plans.

On each properly compacted course (except the final course), the initial mixing shall be considered the final and only mixing necessary.

Variations to the mixing depths that may be properly performed by special equipment or methods may be used only after approved by the Engineer.

- (4) **Designated Excessive Rock Areas.** In areas designated by the Engineer as excessive rock areas, it is the intent that the completed course of treated material shall comply with the Standard Specifications as to uniformity of lime mixture, density, moisture content, and depth insofar as practicable. Mixing and pulverization shall be accomplished in two stages and shall be sufficient to accomplish the intent of the Specifications. The particle size requirement may be waived by the Engineer.
- (5) **Quick Lime Mixing.** Within two hours after spreading quick lime and before water is added, approved means shall be used to turn under a significant portion of the quick lime to reduce harmful exposure to the heat of hydration. Sufficient water shall be added within 6 hours after spreading to permit hydration of the quick lime.

CAUTION: Uncovered quick lime may be hazardous when in the presence of moisture.

- (g) **Compaction.** Compact the mixture during the same day as the final mixing unless approval is obtained from the Engineer to continue compaction on the following day. The target density shall be determined in the field by the soil-lime mixture obtained from the roadway when compaction is started. The test method for the target density will be as specified in Subsection 106.03—modified to provide one compacted specimen of the soil-lime mixture as obtained from the roadway and separate portions of the sample used for additional specimens with the moisture reduced or increased. Aerate or sprinkle the material as necessary to provide the optimum moisture within plus or minus 2 percentage points. Continue compaction until the entire depth of mixture is uniformly compacted to not less than 100 percent of the target density. Field density will be determined in accordance with Subsection 202.02(b)(2).

Compact depths of two or more lifts or courses in lifts or courses as specified in the mixing procedure. Sprinkle or dry the material as necessary to provide the moisture for proper compaction. Continue compaction until the entire depth of mixture is compacted to a satisfactory condition as demonstrated by test rolling (Section 203) with the further requirement that the top 6 inches (150 mm) of the uppermost course be compacted to not less than 100 percent of the target density established in accordance with the paragraph above.

Sprinkle and roll the material, immediately correcting any/all irregularities, depressions, or weak spots which develop by scarifying the areas affected, adding or removing material as required, and reshaping and recompacting by sprinkling and rolling.

In addition to the requirements specified for density, the full depth of the material shown on the Plans shall be uniformly compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests, as necessary, will be made by the Engineer. If the material fails to meet the density requirements, rework it as necessary to meet these requirements. Throughout this entire operation, maintain the shape of the course; the surface upon completion shall be smooth and in conformity with the typical sections shown on the Plans and to the established lines and grades.

NOTE: 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 sole expense of the Contractor.

In areas designated by the Engineer as excessive rock areas, compaction must be in substantial compliance with the Standard Specifications. However, it is recognized that the soil-lime mixture may not be uniform and some variation is to be expected in both the target density and optimum moisture dependent on the lime content of a given sample. In the event that the in-place density tests are not practical because of rock in the soil-lime mixture, the Engineer may waive the density and moisture content requirements and approve compaction by visual observation in lieu of such tests.

- (h) **Finishing and Curing.** After the final layer of the lime-treated subgrade has been compacted, bring it within reasonable compliance to the lines, grades, and typical sections. Then, finish the completed section with a suitable roller sufficiently light to prevent hair cracking. Maintain the treated material at a moisture content satisfactory for proper curing by sprinkling until a prime, seal, or succeeding course is placed, whichever occurs first.
- (i) **Tolerance.** The finished surface tolerance shall be in conformity with Section 301.

307.05. METHOD OF MEASUREMENT.

Lime will be measured by the ton (metric ton).

Lime-treated subgrade will be measured by the square yard (square meter).

Prime coat will be measured and paid for in accordance with Section 408.

Water and rolling will not be measured for payment.

307.06. BASIS OF PAYMENT.

Accepted quantities, measured as provided above, will be paid for at the contract unit price as follows:

- (A) LIME TON (METRIC TON)
 (B) LIME TREATED SUBGRADE SQUARE YARD (SQUARE METER)

Such payment shall be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

- Payment for quick lime *shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent CaO by weight.*
- Payment for hydrated lime *shall be based upon a 90 percent available lime index by rapid sugar method, calculated as percent Ca(OH)² by weight.*
- Payment for by-product lime *shall be based on a substitution ratio calculated on a 90 percent available lime index by rapid sugar method.*

When the available lime index percentage falls below 90 percent, payment will be made at an adjusted price—which shall be reduced at the rate of one percent of the Contract unit bid price for lime for each percent, or fraction thereof, from 90.0 percent down to—and including—an available lime index of 80.0 percent.

When the available lime index falls below 80.0 percent for the type of lime used, add a sufficient quantity of additional lime of the same type to bring the total amount to the required 90.0 percent of available lime index at no additional cost to the Department.