## Section 311. — Stabilized Aggregate Surface Course

01 NOV 2024 – FP-24

**WFL Specification 01 NOV 2024 3110010**

**Include the following when work is required in this Section.**

Delete this Section and substitute the following:

Description

### 311.01

This work consists of constructing a stabilized aggregate layer with imported surface course aggregate. The aggregate layer is stabilized by incorporating a solid form of calcium chloride.

Aggregate stabilization is designated as imported surface course aggregate.

Material

### 311.02

Conform to the following Subsections:

Calcium chloride solid 725.02(b)

Imported surface course aggregate 703.05A

Water for construction 725.01(c)

Construction Requirements

### 311.03 Proportioning.

Determine the maximum density and optimum moisture content according to AASHTO T 180, method D for the imported surface course aggregate in two ways; first for the aggregate without calcium chloride, and second for the aggregate mixture including calcium chloride at the target percentage. Use the proctor with calcium chloride to monitor yield and final compaction of the mixture.

The target calcium chloride content is 1.85 percent by dry mass of aggregate. The target water content is from 2 percent below the optimum moisture content to optimum moisture content.

### 311.04 General.

Store calcium chloride in closed, weatherproof containers. Do not discharge calcium chloride into wetlands and the waters of the United States.

The CO will arrange an off-site informational session prior to stabilization work to discuss aggregate stabilization practices, if requested. Attendance of the project superintendent, work foreman, key stabilization personnel, and QCM is required at the informational session.

Conduct an on-site pre-work meeting according to Subsection 153.04, prior to beginning work on calcium chloride stabilization.

Prepare the surface for imported surface course aggregate according to Section 303. Start the placement of imported surface course aggregate within 5 days of completing roadway reconditioning, unless otherwise approved by the CO.

(a) Weather requirements. Begin application or mixing operations when all of the following conditions are met:

**(1)** the mean daily temperature is not expected to fall below 40 °F for a 7-day cure period after calcium chloride is incorporated;

**(2)** the ambient air temperature is 40 °F or above, and is not expected to fall below 40°F within 48 hours;

**(3)** no precipitation is occurring or forecast to occur within 24 hours; and,

**(4)** the underlying surface is not frozen or muddy.

(b) Control of mixture. Continuously monitor calcium chloride content, moisture content, and aggregate yield according to Section 153 during production and placement. Stop production and provide immediate corrective action if yield calculations, moisture content measurement, or other observations indicate specifications are not being met. Report moisture content and calcium chloride yield twice daily to the CO according to Subsection 153.04(b)(1). Adjust operations as approved by the CO to ensure an accurate yield is maintained.

Maintain the accuracy of the amounts of calcium chloride, aggregate, and water content within the following tolerances during pugmill or in-place mixing and placement:

**(1)** Calcium chloride: 1.85 percent ±0.15 percent by dry mass of aggregate. Use an independent measuring device with display, accurate to ± 0.05% of the mass of calcium chloride.

**(2)** Water: ±1.0 percent by mass (maintain moisture content from 2 percent below optimum to optimum).

**(3)** Aggregate: ±2.0 percent by mass.

Calculate the calcium chloride yield according to the following formulas:

$$^{Tons}/\_{ft}= \frac{\left(T×0.95×γ×W×D\right)}{2000} $$

$$^{Pounds}/\_{SQYD}= \left(T×0.95×γ×D\right) ×9$$

Where:

T = Target calcium chloride content in decimal percent

$γ$ = Maximum dry density of aggregate, lb/ft3

W = Width of calcium chloride application, ft

D = Depth of mixing calcium chloride, ft

Incorporate calcium chloride using pugmill mixing as described in Subsection 311.05 or in-place mixing as described in Subsection 311.06.

### 311.05 Pugmill Mixing

**.**

(a) Calcium chloride mixing. Use a stationary pugmill with weighing or metering equipment capable of accurately controlling the material entering the mixer. Interlock the metering controls for the aggregate feed with those of the calcium chloride and water to ensure uniform introduction of material into the mixer.

Take calcium chloride yield samples using an approved method at least twice daily during production. If yield test results indicate a rate outside the contract tolerances, correct the rate and perform additional yield testing.

Do not produce more treated aggregate than can be placed within 7 calendar days, unless approved by the CO. Do not produce treated aggregate if precipitation is anticipated before the treated aggregate can be placed. Do not utilize treated aggregate that has been exposed to precipitation prior to placement without approval.

(b) Placement. Follow the requirements of 311.06(a).

### 311.06 In-Place Mixing.

(a) Imported surface course aggregate placement. Transport and place the imported surface course aggregate after preparation of the surface and acceptance of the surface by the CO. Process the aggregate to full depth and width with a motor grader into a uniform windrow within one hour of delivery on the roadway, adjusting the moisture content to obtain a homogenous mixture with a moisture content within 2 percent below the optimum moisture content to optimum moisture content. Spread the material on the prepared surface in a uniform layer. Shape the road to the required cross section. Compact according to Subsection 311.07(c) by the end of the shift. Do not allow hauling vehicles to drive on the placed aggregate prior to windrow processing except when required to allow traffic to pass or in order to dump subsequent loads, as approved by the CO.

(b) Calcium chloride mixing. Incorporate calcium chloride within 14 days of placement of imported surface course aggregate, unless otherwise approved by the CO. Apply calcium chloride in a uniform layer across the full width of the surface to be mixed. Use distributor equipment capable of metering the application rate from the operator’s cab accurate to +- 0.05% of the mass of calcium chloride.

As an alternative, rotary mixing machines capable of closely metering calcium chloride and additional mixing water into the mixing process may be used, provided the required application rates are met and the application rates can be continuously controlled from the operator’s cab accurate to ± 0.05% of the mass of calcium chloride.

Verify the application rate by performing calcium chloride weight yield tests twice daily for each distributor. If yield test results indicate a rate outside the contract tolerances, then correct the application rate and perform additional yield testing. The CO may increase the test frequency. Do not spread more calcium chloride than can be incorporated within one hour.

Use rotary mixing equipment to uniformly incorporate the calcium chloride and additional mixing water into the imported surface course aggregate or imported surface course aggregate and existing aggregate to a compacted depth of 4 inches +0.0 inch/-0.5 inch. Mix the material one-lane at a time. Do not mix material across the crown of the road as shown in the plans.

(c) Processing. After mixing is complete, ensure a uniform product free of segregation, streaking, and inconsistent moisture content by processing the treated material with a motor grader to full depth and width. Shape the road to the required cross section. To the extent practicable, prevent hauling equipment from traveling on recently placed calcium chloride treated aggregate. If not practicable, route hauling equipment uniformly over the full width of the surface to minimize rutting or uneven compaction.

### **311.07 Compacting and finishing.**

Maintain the moisture content from 2 percent below optimum to optimum. Compact each layer full width. Roll from the sides to the center, parallel to the centerline of the road. Along curbs, headers, walls, and all places not accessible to the roller, compact the material with approved tampers or compactors.

Provide pneumatic tired rollers for initial compaction that have a minimum ballasted weight of 15 tons and have a minimum tire overlap of 1.5 inches. Provide single smooth drum rollers for final compaction to provide a smooth and uniform finished surface.

**(a) Pugmill mixing.**  Compact each layer of treated surface course aggregate to at least 95 percent of maximum dry density according to the proctor performed with calcium chloride. Meet compaction requirements for all sections of roadway prior to the end of the work shift. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures.

**(b) In-place mixing.** Compact the untreated imported surface course aggregate placed each shift to at least 95 percent of maximum dry density of the respective proctor by the end of shift. The CO may approve alternative test procedures if requested and if calcium chloride is to be incorporated within 2 days of aggregate placement.

After calcium chloride incorporation, compact each layer to at least 95 percent of maximum dry density as determined in Subsection 311.03(a) for aggregate combined with calcium chloride. Meet compaction requirements for all sections of roadway where calcium chloride is incorporated prior to the end of the work shift. Determine the in-place density and moisture content according to AASHTO T 310 or other approved test procedures.

**(c) Finishing.** Finish the aggregate course to produce a surface that is smooth, dense, and free of compaction planes, ridges, or loose material. Compact the aggregate foreslopes to ensure they are dense and recoverable. Wheel-rolling with grading equipment tires may be approved by the CO for foreslope compaction. Shape the surface to the required template and check the surface with a 10-foot straightedge. Defective areas are surface deviations in excess of ½ inch in 10 feet between any two contacts of the straightedge with the surface, or noticeable dips, bumps or other undulations identified through visual inspection or vehicle ride inspection.

Correct all defective areas by loosening the material full depth, adding or removing material as required, adjusting moisture content, reshaping, and compacting. Alternative methods of correction, including patching or filling of potholes, may be submitted in writing for approval by the CO.

### 311.08 Acceptance.

See Table 311-1 for sampling and testing requirements, including the acceptance quality characteristic category.

**(a) Stabilization agent.** Calcium chloride will be evaluated under Subsections 106.02 and 106.03.

**(b) Imported surface course aggregate**. Aggregate gradation, plasticity index, fractured faces, and liquid limit will be evaluated under Subsection 106.05. Other aggregate quality properties will be evaluated under Subsections 106.02 and 106.04.

**(1) Aggregate gradation.** The upper and lower specification limits are equal to the calculated mean of all test results plus or minus the allowable deviations shown in Table 703-3A, except as follows:

*(a)*If the calculated mean value for any tested sieve exceeds the maximum gradation value shown in Table 703-3A, the upper specification is equal to the maximum gradation value plus the allowable deviation, and the lower specification is equal to the maximum gradation value minus the allowable deviation.

*(b)*If the calculated mean value for any tested sieve is less than the minimum gradation value shown in Table 703-3A, the upper specification is equal to the minimum gradation value plus the allowable deviation and the lower specification is equal to the minimum gradation value minus the allowable deviation.

**(2) Fractured faces.** When aggregate is produced from a gravel source, use the specification limit shown in Subsection 703.05A(f).

**(3) Liquid limit.** The specification limit is shown in Subsection 703.05A(g).

**(4) Plasticity index.** The specification limit is shown in Subsection 703.05A(h).

**(c) Construction**. Aggregate stabilization construction will be evaluated under Subsections 106.02 and 106.04. Compaction of imported surface course aggregate will be evaluated under Subsection 106.04.

**(d) Project inspections.** An intermediate inspection of each road will take place within 15 days of aggregate stabilization completion. The results of the intermediate inspection are not to be interpreted as final acceptance of the road. Correct all defects that arise after the intermediate inspection and prior to final acceptance by the CO, according to 311.07(c).

**(e) Reconditioning.** Preparation of the surface for imported surface course aggregate or in-place stabilization will be evaluated under Section 303.

Measurement

### 311.09

Measure the Section 311 items listed in the bid schedule according to Subsection 109.02 and the following as applicable.

When measuring surface course aggregate by the ton, deduct the computed mass of calcium chloride from the measured quantity, if the material is pugmill mixed and weighed as a mixture. In this case, compute the mass of calcium chloride using the actual approved percentage added to accepted quantities of dry surface course aggregate. The computed amount of calcium chloride paid shall not exceed the maximum specified percentage or the total amount of calcium chloride certified and delivered to the project.

Payment

### 311.10

The accepted quantities will be paid at the contract price per unit of measurement for the Section 311 pay items listed in the bid schedule, except the stabilized aggregate surface course contract price will be adjusted according to Subsection 106.05. Payment will be full compensation for the work prescribed in this Section. See Subsection 109.05.

WFL Specification 01NOV 2024 3110020

Include the following Table 311-1 when aggregate stabilization is required on Defense Access Roads (DAR) projects.

Table 311-1

Sampling, Testing, and Acceptance Requirements

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Remarks |  | Not required when using Government- provided sources | " | " | " | " | − | " |
| Reporting Time |  | Before using in work | " | " | End of shift | " | " | " |
| Split Sample |  | Yes, when requested | " | " | " | Yes, when requested | " | " | " |
| Point of Sampling |  | Source of material | " | " | " | Flowing aggregate stream (bin or belt discharge) or conveyor belt | " | " | " |
| Sampling Frequency | **Source** | 1 per type & not less than 5 per source of material(2) | " | " | 1 for each 6 hours of production but not less than 2 per day per stockpile, min | " | " | " |
| Test Methods Specifications | AASHTO T 96 | AASHTO T 104 | AASHTO T 210 | WFLHD-DMSO | AASHTO T 27 & T 11 | ASTM D5821 | AASHTO R 58 & T 89, Method A | AASHTO R 58 & T 90 |
| Category | − | − | − | − | − | − | − | − |
| Characteristic |  | LA abrasion (coarse) | Soundness using sodium sulfate (course & fine) | Durability Index (course & fine) | Accelerated weathering | Gradation | Fractured faces | Liquid limit | Plasticity index |
| Type of Acceptance (Subsection) |  | Measured and tested for conformance (106.04 & 105) |  |  | Process control (153.03) |  |  |
| Material or Product (Subsection) |  | Imported aggregate source quality (703.05A) |  |  | Imported aggregate (703.05A) |  |  |

Table 311-1 (continued)

Sampling, Testing, and Acceptance Requirements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Remarks | **Proportioning** | Report proportion of aggregate, calcium chloride, & water | **Production** | When using imported aggregate |
| Reporting Time | Before using in work | 4 hours |
| Split Sample | Yes, when requested | Yes, when requested |
| Point of Sampling | Processed material before incorporating in work | In-place mixing: from windrow immediately after processing Pugmill mixing: flowing aggregate stream (bin or belt discharge) or conveyor belt prior to adding stabilizer |
| Sampling Frequency | 1 for each mixture or change in material | 1 per 1000 tons & not less than 3 |
| Test Methods Specifications | AASHTO T 180, Method D(1) | AASHTO T 27 & T 11 |
| Category | − |  | II | II | II | II |
| Characteristic | Moisture- density | Gradation | No. 4 | No. 40 | No. 200 | Other specified sieves |
| Type of Acceptance (Subsection) | Measured and tested for conformance (106.04) | Statistical (106.05) |
| Material or Product (Subsection) | Proportioning (311.03(a)) | Imported aggregate (703.05A) |

(1) Minimum of 5 points per proctor.

(2) Furnish at least five reports, but not less than one report per rock type for each source. Reports must be dated within 1 year of intended use. Obtain samples representative of aggregates being furnished. Include rock type and sample location on test reports.

Table 311-1 (continued)

Sampling, Testing, and Acceptance Requirements

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Remarks | **Production (continued)** | − | − | − |  | − |
| Reporting Time | 4 hours | " | " | " | 4 hours |
| Split Sample | Yes, when requested | " | " | No | No |
| Point of Sampling | In-place mixing: from windrow immediately after processing Pugmill mixing: flowing aggregate stream (bin or belt discharge) or conveyor belt prior to adding stabilizer | " | " | " | In-place, after compaction |
| Sampling Frequency | 1 per 1000 tons (900 metric tons) & not less than 3 | " | " | Minimum 2 per day | 1 per 500 tons or 3000 yd2  |
| Test Methods Specifications | AASHTO R 58 & T 89, Method A | ASTM D5821 | AASHTO R 58 & T 90 | AASHTO T 255 | AASHTO T 310 or other approved procedures |
| Category | II | II | II | − | − |
| Characteristic | Liquid limit | Fractured faces | Plasticity index | Moisture content of aggregates | In-place density & moisture content |
| Type of Acceptance (Subsection) | Statistical (106.05) | Process control (153.03) | Measured and tested for conformance (106.04) |
| Material or Product (Subsection) | Imported aggregate (703.05A) | Mixture (311.03) |

WFL Specification 01 NOV 2024 3110030

Include the following Table 311-1 when aggregate stabilization is required on projects that are not Defense Access Roads (DAR) projects.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Remarks |  | Not required when using Government- provided sources | " | " | " | " | − | " |
| Reporting Time |  | Before using in work | " | " | End of shift | " | " | " |
| Split Sample |  | Yes, when requested | " | " | " | Yes, when requested | " | " | " |
| Point of Sampling |  | Source of material | " | " | " | Flowing aggregate stream (bin or belt discharge) or conveyor belt | " | " | " |
| Sampling Frequency | **Source** | 1 per type & not less than 5 per source of material(2) | " | " | 1 for each 6 hours of production but not less than 2 per day per stockpile, min | " | " | " |
| Test Methods Specifications | AASHTO T 96 | AASHTO T 104 | AASHTO T 210 | WFLHD-DMSO | AASHTO T 27 & T 11 | ASTM D5821 | AASHTO R 58 & T 89, Method A | AASHTO R 58 & T 90 |
| Category | − | − | − | − | − | − | − | − |
| Characteristic |  | LA abrasion (coarse) | Soundness using sodium sulfate (course & fine) | Durability Index (course & fine) | Accelerated weathering | Gradation | Fractured faces | Liquid limit | Plasticity index |
| Type of Acceptance (Subsection) |  | Measured and tested for conformance (106.04 & 105) |  |  | Process control (153.03) |  |  |
| Material or Product (Subsection) |  | Imported aggregate source quality (703.05A) |  |  | Imported aggregate (703.05A) |  |  |
| Remarks | **Proportioning** | Report proportion of aggregate, calcium chloride, & water | **Production** | When using imported aggregate |
| Reporting Time | Before using in work | 4 hours |
| Split Sample | Yes, when requested | Yes, when requested |
| Point of Sampling | Processed material before incorporating in work | In-place mixing: from windrow immediately after processing Pugmill mixing: flowing aggregate stream (bin or belt discharge) or conveyor belt prior to adding stabilizer |
| Sampling Frequency | 1 for each mixture or change in material | 1 per 1000 tons & not less than 3 |
| Test Methods Specifications | AASHTO T 180, Method D(1) | AASHTO T 27 & T 11 |
| Category | − |  | I | I | I | II |
| Characteristic | Moisture- density | Gradation | No. 4 | No. 40 | No. 200 | Other specified sieves |
| Type of Acceptance (Subsection) | Measured and tested for conformance (106.04) | Statistical (106.05) |
| Material or Product (Subsection) | Proportioning (311.03(a)) | Imported aggregate (703.05A) |
| Remarks | **Production (continued)** | − | − | − |  | − |
| Reporting Time | 4 hours | " | " | " | 4 hours |
| Split Sample | Yes, when requested | " | " | No | No |
| Point of Sampling | In-place mixing: from windrow immediately after processing Pugmill mixing: flowing aggregate stream (bin or belt discharge) or conveyor belt prior to adding stabilizer | " | " | " | In-place, after compaction |
| Sampling Frequency | 1 per 1000 tons (900 metric tons) & not less than 3 | " | " | Minimum 2 per day | 1 per 500 tons or 3000 yd2  |
| Test Methods Specifications | AASHTO R 58 & T 89, Method A | ASTM D5821 | AASHTO R 58 & T 90 | AASHTO T 255 | AASHTO T 310 or other approved procedures |
| Category | II | I | I | − | − |
| Characteristic | Liquid limit | Fractured faces | Plasticity index | Moisture content of aggregates | In-place density & moisture content |
| Type of Acceptance (Subsection) | Statistical (106.05) | Process control (153.03) | Measured and tested for conformance (106.04) |
| Material or Product (Subsection) | Imported aggregate (703.05A) | Mixture (311.03) |