

514 HOT-MIX ASPHALT QUALITY MANAGEMENT PLAN

514.1 Introduction

This Quality Management Plan (QMP) is a procedure for approval of hot mix asphalt (HMA) plants for use on UDOT Projects. It entails personnel requirements, equipment requirements, and record keeping procedures of hot mix suppliers. The intent is to provide UDOT materials personnel with a plan under which each facility will comply. This QMP includes requirements for suppliers to provide production records demonstrating that the processes are in compliance with department specifications. The QMP also includes an appendix which describes the processes and procedures that the contractor and UDOT will follow in implementing this plan. Also included is a non-binding annex which provides background and commentary on the requirements.

514.2 Procedures to becoming a Certified HMA supplier

Each HMA plant is required to incorporate lime into HMA by becoming a certified supplier using in-line lime slurry or becoming a certified supplier using marination, or alternatively, using marinated aggregates that have been produced under inspection.

To become a certified supplier, HMA suppliers will submit a letter of intent to the UDOT Asphalt Engineer.

1. The submittal will include, but is not limited to, the Quality Control (QC) Plan, meeting the requirements of section 514.3. Include the name, position, address, and telephone number of the individual responsible for quality control of the lime system. The letter must be signed by someone having legal authority to bind the company.
2. UDOT Central Materials, or its designee, will review the submittal and conduct an inspection of the plant. After review and inspection, the supplier will be certified and added to the certified supplier list, or deficiencies observed in the QC plan, plant inspection, or both will be communicated in writing to the supplier. Once the deficiencies have been addressed satisfactorily the supplier will be added to the certified supplier list.
3. UDOT maintains a list of certified suppliers for HMA plants on its Materials website.

514.3 Quality Control Plan

The QC Plan will address the following items.

These items are considered minimum content and each item should be addressed with an appropriate amount of description to adequately describe how the supplier will execute its operation.

1. Management & Personnel

A. QC Plan Manager

- i. Each hot mix facility will designate a QC Plan Manager.
- ii. The QC Plan Manager is responsible for the implementation of the Quality Management Plan (QMP).
- iii. The QC Plan Manager will have the responsibility to oversee plant process operations and correct any deficiencies to the QC Plan.
- iv. The QC Plan Manager will have the authority to fully enforce the plan.

B. Plant Operation personnel

- i. Training - Each QC Plan will contain a training program outline demonstrating the training methods used to train personnel on UDOT standards and quality requirements including, but not limited to, the following:
 - i. Internal QC Plan Requirements
 - ii. UDOT mixing plant specifications
 - iii. Proper hydrated lime injection methods and documentation
- ii. Management organization chart will demonstrate the management hierarchy and the roles of plant operation personnel, QC plan manager, and other pertinent management positions.

2. Equipment

- A. Hot Plant production equipment will be able to perform in a manner to ensure that Department specifications can be met. The items for QC Plan inclusion and verification include, but are not limited to:
 - i. Lime storage – free flowing and protected from contamination and the elements.
 - ii. Water metering and delivery– capable of delivering the required quantity of water within the required tolerances.
 - iii. Lime metering and delivery – capable of delivering the required quantity of lime within the required tolerances.
 - iv. Pugmill – capable of thoroughly mixing aggregates, lime, and water to provide a uniform coating of lime.
 - v. Material handling – capable of isolating individual products; protecting them from contamination, segregation, and degradation; and clearly identifying the type of material, if it has been treated, and when it was treated.
 - vi. Location and fixture where the full stream of virgin aggregate/lime mixture can be sampled and tested for moisture content

3. Records Retention and availability

- A. Provide production and stockpile records that clearly identify the lime addition process and period for various HMA or marinated aggregate stockpiles or portions of stockpiles such that compliance with Department requirements can be readily established.
 - i. Aggregates – clearly identify individual aggregate types, treatment status, and date of treatment or duration of marination as appropriate.
 - ii. Water – clearly identify quantities of water used for a given production run. Identify the moisture content of the aggregates prior to treatment, the target moisture content, and the actual moisture content. . Perform moisture content testing after the lime pugmill and prior to the dryer or stockpile to verify the virgin aggregate/lime mixture contains at least 3% water by weight of dry aggregate. AASHTO T-255 Moisture of Aggregate by Drying. Test and document at least once for each 1,000 tons of mix production.
 - iii. Lime – clearly identify the quantity of lime as reported by the metering system as well as the quantity indicated by beginning inventory, lime deliveries, and ending inventories and indicate how these methods are reconciled; report actual lime rate of addition and the target rate.
 - iv. Calibration – maintain and provide upon request records of calibration including equipment calibrated, date of calibration, production rate and quantity of material used to calibrate, reference equipment used to calibrate (platform scales, calibrated tanks, etc.), span adjustment or other settings used to establish calibrated setting, means to protect calibrated settings from inadvertent adjustment, and other information as may be necessary to establish that material flow rates can be monitored and controlled during production.

4. Details for plant inspection access

- A. Contact information
- B. Safety training and PPE requirements

514.4 Compliance

The QC plan manager is responsible for the compliance of the plan. If after reasonable effort, the approved plan is not complied with, the following may occur: The department may mandate the facility provide a new QC Plan, and/or marinated aggregates that cannot be shown

to have been produced in a manner consistent with this QMP shall not be used on UDOT projects.

Implementation of the QMP will be approved and reviewed by UDOT Central Materials. Plant inspections will be under the direction of UDOT Central. Plant approval is subject to annual review. Plants found out of compliance may have their certified supplier status under immediate review. UDOT Central will have discretion to remove suppliers from the certified list if deficiencies are not corrected within a reasonable amount of time. Suppliers can continue to supply by stockpile marination performed under UDOT inspection, subject to adjustment in Department compensation to recover the additional inspection costs.

Each plant will be monitored by UDOT region and project personnel or their representatives. UDOT personnel will have immediate access to retained records upon request for the previous day's production.

1. If a supplier chooses to not become a Certified Supplier, or fails to maintain Certified Supplier status, HMA production from the plant in question will be limited to the use of individual marinated aggregate stockpiles that have been produced under UDOT inspection. The Department will deduct \$0.50 from each ton of asphalt mix containing marinated aggregates produced by an uncertified supplier under UDOT inspection.
 - A. Process – apply dry hydrated lime to damp aggregates or lime slurry to damp or dry aggregates and allow to cure before using in hot mix asphalt. Treat the individual aggregate fractions (bins) to provide for gradation control through the hot plant cold feed or hot bin system.
 - i. If adding dry lime to damp aggregates, determine saturated surface dry (SSD) moisture content of the individual aggregate fractions. Condition the aggregate to at least two percent (2.0%) above saturated surface dry condition prior to application of lime.
 - i. Use lime that meets the materials requirements of Section 02746, Hydrated Lime.
 - ii. Add lime at a minimum of one and one-half percent (1.5%) by weight of dry aggregate. In order to achieve this combined rate with uniform coating and no excess lime agglomerations, adding approximately two percent (2%) lime to the fine aggregate fractions and approximately one percent (1%) to the coarse aggregate fractions may be necessary.
 - iii. Provide a horizontal twin shaft pugmill of appropriate capacity.
 - a. Adjust mixing paddles in the pugmill and the aggregate flow rate so the aggregate being discharged is completely and uniformly coated by the lime.
 - b. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.

- iv. Deliver lime or lime slurry to the twin shaft pugmill for mixing with aggregate.
 - v. Marinate the aggregate and lime mixture in a stockpile for a minimum of 48 hours.
 - vi. Adjust lime content as necessary, based on approved mix design or the results of Hamburg Wheel Tracker Testing performed on the produced mix.
 - vii. Heavy and/or sustained precipitation may result in the loss of lime from aggregates exposed to the elements. After periods of heavy and/or sustained precipitation inspect the treated aggregates and discard or retreat those materials that do not have adequate residual lime.
- B. Equipment – Provide equipment capable of performing in a manner that ensures Department requirements will be met.
- i. Lime storage – free flowing and protected from contamination and the elements.
 - ii. Water metering and delivery– capable of delivering the required quantity of lime within the required tolerances.
 - iii. Lime metering and delivery – capable of delivering the required quantity of lime within the required tolerances.
 - iv. Pugmill – capable of thoroughly mixing aggregates, lime, and water to provide a uniform coating of lime.
 - v. Material handling – capable of isolating individual products; protecting them from contamination, segregation, and degradation; and clearly identifying the type of material, if it has been treated, and when it was treated.
- C. Use of Marinated Aggregates – HMA may be produced with a plant that is not certified if the aggregates are produced under UDOT inspection.
- i. The Department reserves the right to perform Hamburg Wheel Tracker Testing on mix produced with marinated aggregates as a means of final acceptance. Provide and maintain maps, drawings, descriptions, or other such means of clearly identifying the individual marinated stockpiles and dates of production. Use marinated materials within 60 calendar days of production. The use of marinated aggregates beyond the 60 calendar-day period will be at the Department’s discretion and may require additional processing.

APPENDIX TO 514 HOT-MIX ASPHALT QMP

I. Introduction

This standard specifies requirements and procedures for a certification system that is applicable to all suppliers of hot mix asphalt (HMA). In accordance with the UDOT requirements of QMP 514 – Hot Mix Asphalt, Hot Mix Asphalt (HMA) suppliers wishing to produce HMA for UDOT projects after January 1, 2012, must apply for and receive certification by the Department in the area of Hot Mix Asphalt Production. Upon determination of proper process control and recordation procedures by the supplier, the Department will issue an Approved HMA Supplier certification for the specific plant or plants identified within the submittal. This certification is permanent unless suspended or revoked through the procedures outlined below. The certification is plant-specific and cannot be transferred to other plants. Certified portable plants that are moved will require a field inspection to verify that the plant has been re-assembled and calibrated in compliance with the original certification.

II. Application Process for HMA Suppliers

1. The hot mix supplier submits the request for HMA certification to the Office of the Asphalt Engineer.

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801-965-4426 (office)

801-633-8770 (cell)

2. Upon receipt of all required application documentation, the Department, or their representative, reviews the submitted documents for compliance with specification and QMP compliance. If the document review indicates the plant provides adequate equipment and process control, field inspections to verify equipment installation and Quality Control Plan (QCP) implementation will be performed. Upon successful determination of the presence of equipment, documents, and procedures, the Department will issue a certification for Hot Mix Asphalt production on UDOT projects.

III. HMA Plant Certification Submittal requirements:

1. Submit an application Letter
2. Submit an electronic copy of the Quality Control Plan for the plant to be certified. The QCP can be a corporate QCP that is the same for multiple plants; however, staffing plans and personnel information for the specific plant to be certified must be included.
3. Submit production records for the last 30 days of mix production, which include, at a minimum:
 - A. Submit daily summaries of total mix produced, lime mix produced, total lime quantity used, total water quantity used which provide sufficient detail to evaluate compliance with specification and QMP compliance.
 - B. Submit Bills of Lading (BOLs) for hydrated lime and document reconciliation of the delivered lime quantity with the quantity used in production demonstrating compliance with the tolerances shown in subsection V.6 of this document.
4. For new plants or plants with no documented history, submit a summary of corporate documentation practices or previous experiences with QCPs
 - A. Include a “commitment to meet and demonstrate” using quality control practices sufficient to meet the QMP requirements outlined herein. This may require provisional qualification until demonstration of capabilities.

- B. Submit the most recent lime equipment calibration records for the plant for which certification is being sought, including a list of metering devices and a description of practices for both dry lime and water introduction into the mix.
- 5. Provide access requirements and protocol for plant inspections by UDOT or their representatives. Requirements are expected to include contact personnel for the plant, any plant or operation-specific safety or training requirements, and any on-site protocols and personal protective equipment requirements for inspection staff. NOTE: The supplier shall provide unrestricted access to the plant during operations associated with UDOT projects. Nothing in this section shall be construed in such a manner as to restrict or needlessly delay access.

IV. QC Plan

The QC Plan will address the following items. These items are considered minimum content and each item should be addressed with an appropriate amount of description to adequately describe how the supplier will execute its operation in a manner that consistently provides the appropriate moisture and lime content, completely and uniformly coats the aggregates with lime, and accurately documents the process.

1. Management & Personnel

A. QC Plan Manager

- i. Designate a QC Plan Manager for each hot mix asphalt facility.
- ii. The QC Plan Manager is responsible for the implementation of the Quality Management Plan (QMP).
- iii. The QC Plan Manager will have the responsibility to oversee plant process operations and correct any deficiencies in the process that result in non-compliance with the QMP or specifications, and any deficiencies in the QC Plan.
- iv. The QC Plan Manager will have the authority to fully enforce the plan.

B. Training of Plant Operation Personnel

- i. Each QC Plan will contain a training program outline demonstrating the training methods used to train personnel on UDOT standards and quality requirements including, but not limited to, the following:

1) Internal QC Plan Requirements

- a) Quality Control sampling and testing
 - i) Cold feed moisture contents
 - ii) Validation of lime slurry ratio
- b) Qualitative / Visual evaluations
 - i) Items to be evaluated
 - ii) Schedule for evaluations
 - iii) Responsible personnel
 - iv) Documentation of evaluations and findings
- c) Decision tree for monitoring and corrective actions
 - i) Categories of findings / results
 - ii) Personnel responsible for decisions
 - iii) Notification protocols
 - iv) Time frame for decisions
 - v) Documentation practices and forms

2) UDOT mixing plant specifications

a) HMA Plant

- i) Positive means to determine the moisture content of aggregate
- ii) Positive means to sample all material components

- iii) Sensors to measure the temperature of the HMA at discharge
 - iv) The ability to maintain mix discharge temperature according to mix design
 - b) Horizontal twin-shaft pugmill
 - i) Adjust mixing paddles so that the aggregate being discharged is completely coated by the lime.
 - ii) Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.
 - 3) Proper hydrated lime application methods and documentation requirements
- ii. Provide an organization chart of the supplier's key personnel associated with the plant being qualified to illustrate the reporting structure for both quality control and production personnel for the plant. The organization chart will demonstrate the management hierarchy and the roles of plant operation personnel, QC Plan Manager, and other pertinent management positions such as Corporate Quality Control, Plant Operators, Plant Foremen, Administrative Support, Field and Laboratory Sampling and Testing personnel, and any other staff that is involved in the Quality Control process for the facility. Identify any Quality Control functions provided by entities other than the supplier.
- iii. Provide contact information for the individuals identified above, including name, telephone, and email.

2. Equipment

Hot Mix Asphalt production equipment will be able to perform in a manner to ensure that Department specifications can be met. The items for QC Plan inclusion and verification include, but are not limited to:

- A. Lime application process must meet requirements of Sections 02741 and 02746.
 - i. Provide means of measuring or metering water, lime, aggregates, binder, RAP, and any and all other constituents.
 - 1) Meters – volumetric or mass flow
 - 2) Vane feeders
 - 3) Weigh depletion devices
 - 4) Weigh belts or augers
 - 5) Impact meters
 - 6) Scales for loadout, calibration, etc.
 - ii. Temperature measuring devices
 - iii. Tanks and other storage units
 - iv. Conveyors

3. Records Retention and availability

The QC Plan will include how the supplier will manage auditable, on-site record keeping of the following items:

- A. Daily Production records
 - i. Lime application including, but not limited to, flow meter reading/charts, scales, etc.
 - ii. Dedicated Water addition for lime slurry records e.g. pump runs, flow meter, etc.
 - iii. For marinated aggregates, provide production and stockpile records that clearly identify the lime addition process and period for various marinated aggregate stockpiles or portions of stockpiles such that compliance with Department requirements can be readily established.

- iv. Asphalt binder
 - v. Aggregates
 - vi. Hot Mixed Asphalt
 - vii. Mix temperature
 - B. Calibration Records demonstrating compliance with Sections 02741 and 02746
 - i. Metering devices
 - ii. Temperature measuring devices
 - iii. Tank Charts
 - C. Product Delivery Records
 - i. Lime delivery
 - ii. Asphalt Binder Delivery
 - iii. Other
 - D. Means by which UDOT can obtain any supplemental production records or supporting documentation, such as monthly spreadsheets or bills of lading upon request.
 - E. Sample forms

Provide examples of forms and the operation's typical reports to be used to verify QMP and specification compliance during production. Examples include QC test reports, visual inspection forms, daily plant printouts, and operator logs.
- V. Department Enforcement
 - 1. Reviews and Inspections for Initial Certification

The Department or its representative(s) performs documentation and field reviews to evaluate the level of compliance with the HMA Plant Certification Program upon receipt of the complete plant certification request submittal.
 - 2. Submittal Review

The Department or its representative(s) reviews submittal documents within two weeks of receipt for discrepancies, deviations, or omissions. Findings will be sent to the supplier for correction.
 - 3. Field review of quality control practices.

The Department or its representative(s) performs a field review of the plant. This review will be a plant walk-through with the goals of:

 - A. Evaluating plant personnel compared to QCP staffing plan.
 - B. Inspecting lime storage and metering equipment and systems for functionality.
 - C. Inspecting the lime application process for conformance with the QMP and specifications.
 - D. Observing plant operations to assess practices and QCP implementation. NOTE: The HMA plant and lime systems must be observed in while in operation.
 - E. Observation of marinated stockpile isolation, identification, aging, and use.
 - F. Reviewing calibration documentation or observing calibration of lime-related equipment.
 - 4. Inspector Qualifications
 - A. The Department provides experienced field inspectors that have completed a UDOT HMA QMP-specific training program that is tailored to plants and their respective quality control plans and practices.
 - B. Inspector Training Program

The Department provides a training program based on the supplier/plant specific information gathered during the implementation process with the goal of addressing the specific scope of supplier requirements outlined in the HMA QMP. The training will address specifics of initial findings and discussions with the plant operator or delegated contact, along with the documentation and communication of findings outside the scope of the HMA QMP.
 - 5. Reactive Inspections

At its discretion, the Department performs reactive inspections to review the recent and current practices by a certified plant to determine if the plant is adhering to the requirements of the certification program and its submitted quality control plan. These reviews may be initiated as random periodic verification inspections, as reaction to materials quality problems identified in the field, or as reaction to other occurrences that bring into question the control of the mix production processes.

A. Inspection Scope

Upon determination of the need for a reactive inspection, the Department, or its representatives, notifies the identified contact for the supplier of the need for either additional documentation and/or a field inspection of the plant. The inspection will be based on the requirements outlined within the HMA QMP. Other observations may be made and noted on the report but will be submitted to the Department as "Information Only" and not as findings requiring response by the supplier under this program.

B. Documentation

The supplier provides the requested documentation within seven (7) calendar days from the date of the notification. The Department or their representative provides the initial findings to and discusses them with the supplier's contact. Resolution of any items/findings from the review will be noted on the final report, along with unresolved issues.

C. Plant access

The supplier allows access to the plant as soon as practicable in accordance with subsection III.5 of this document. The Department or their representatives provides the initial findings and discusses them with the supplier's contact. Resolution of any items/findings from the review will be noted on the final report, along with unresolved issues.

D. Expected documentation to be reviewed includes:

- i. Daily plant production summaries, including summaries of total mix produced, lime mix produced, total lime quantity used, total water quantity used.
- ii. Copies of any logs maintained by operating or quality control personnel that supplement the daily plant production summaries.
- iii. Bills of Lading for hydrated lime for the time period in question, together with inventory and production reconciliation documents.

6. Allowable material quantity tolerances

A. Follow Specification 02746

7. Inspection Report

A. Within one working day (24 hours) of completion of the inspection, the Department or its representative(s) produces a summary of findings, including inspection observations and findings, discussions with supplier, actions taken by supplier and any resultant changes observed.

8. Field Validation Testing

A. The Department, at its discretion, uses field validation testing to verify the presence of properly-introduced lime in the mix. This may be in the form of Hamburg Wheel Tracker testing, chemical testing on cold feed or production mix materials, or other processes deemed appropriate by the Department. Testing failures will result in the initiation of a reactive inspection. If the reactive inspection identifies that the supplier followed the process control upon which certification was based, the results of the field validation testing will not be used to penalize the mix. If the reactive inspection identifies that proper process control procedures were not followed, the Department will address the mix and supplier certifications as outlined below.

- B. Additionally, more than one Hamburg Wheel Tracker failure for a given mix design, may result in rejection of an Approved HMA Mix Design as unacceptable, supplier certification and QMP compliance notwithstanding.
9. Tracking/Bracketing of Non-Compliant Mix
- The supplier identifies and reports any and all failures to meet the requirements of the QMP and specifications. If non-compliant mix is identified and reported by the supplier and incorporated into the work, the Department allows the tracking/bracketing of non-compliant mix to identify the actual quantity and location of non-compliant mix to be addressed. The supplier determines the quantity and location of non-compliant mix through field sampling and testing, delivery by tonnage converted to station and offset, or other methods as agreed to by the Department.
10. Department Response to Process Control Issues
- The Department responds to issues identified by inspections and documentation reviews with differing levels of response.
- A. Level I
 - i. Application

Issues that do not, in the opinion of the Department, directly affect the quality of the mix or the application of hydrated lime and where the supplier is proactively attempting to correct the issue.
 - ii. Action
 - 1) The Department allows the Supplier to continue production with the plant in question unless and until the Department feels the supplier is no longer proactively attempting correction, and
 - 2) Mix acceptance in accordance with the project specifications
 - B. Level II
 - i. Application
 - 1) Issues that do not, in the opinion of the Department, directly affect the quality of the mix or the application of hydrated lime and where the contractor is not proactively attempting to correct the issue, or
 - 2) Issues that, in the opinion of the Department, affect compliance with lime application requirements and the supplier is proactively attempting to correct the issue.
 - ii. Action
 - 1) The Department suspends Supplier certification of the plant in question until the issue has been resolved. Suppliers with suspended certifications will only be allowed to produce HMA using marinated materials from certified stockpiles (514 QMP Method C), and
 - 2) Mix acceptance in accordance with the project specifications.
 - 3) Loss of Dispute Resolution privileges for contractors not actively attempting corrections(reconcile with existing HMA and Dispute Resolution specifications)
 - C. Level III
 - i. Application
 - 1) Issues that, in the opinion of the Department, directly affect the quality of the mix and/or the application of hydrated lime and where the supplier is not proactively attempting to correct the issue.
 - 2) Level I and II issues that the supplier has not been able to correct in a timely manner.
 - ii. Action

- 1) The Department suspends Supplier certification of the plant in question. Suppliers with suspended certifications will only be allowed to produce HMA using marinated materials from certified stockpiles (514 QMP Method C). Re-certification will require submission of a new application and appropriate submittal documents, which will be subject to all reviews and inspections identified within the application process, and
 - 2) Mix acceptance in accordance with the project specifications, and
 - 3) Loss of Dispute Resolution privileges.
11. Reinstatement of Suspended Certification
Suppliers who have had their certifications suspended must submit an application for reinstatement. The application must specifically address the deficiencies that resulted in the suspension and must either directly reference the previous certification application or provide a new certification application as described herein.
12. Production of HMA by suppliers who are not certified
Suppliers who are not certified at time of production may only produce HMA using marinated aggregates produced under inspection by the Engineer.
13. Escalation practices for Dispute Resolution
The supplier can escalate initial Department judgment and responses to the UDOT Engineer for Materials and the Engineer for Construction.. The escalation notification must be submitted prior to the placement/ construction of any additional materials that would affect the judgment requirements or within 1 week of notification of the judgment, whichever is sooner.

Best Management Practices – Addition of Hydrated Lime to Hot Mix Asphalt Aggregates

- I. Purpose – these best management practices are intended to serve as guidance for the addition of hydrated lime to hot mix asphalt aggregates using either in-line or marination methods for Utah Department of Transportation projects. The practices discussed herein are not requirements. While the Department may use this document as a means to evaluate the practices of individual suppliers, it is important to recognize that the intent of the specifications can likely be met using practices other than those listed herein. “Hydrated Lime” and “lime” are used interchangeably in this document.
- II. Safety – Lime is a caustic material. Provide respiratory, eye, and skin protection to workers as appropriate and safeguard others and the surroundings from accidental or uncontrolled release of lime. Provide adequate and safe access to workers and sampling and inspection personnel to operation, maintenance, sampling, and inspection points. Guard and protect moving parts and provide ample and unobstructed passage for equipment and personnel.
- III. Plant operations – Plant operations that are designed to operate continuously tend to provide the most consistent results when they are operated continuously at a uniform rate. While beyond the scope of this document, the entire hot mix asphalt production and placement operation should be organized and managed in a manner that provides for continuous operation at a uniform rate. Regardless of what aspect of the entire operation governs the balanced production rate, that realistic production rate should be considered when sizing, locating, and calibrating production equipment.
- IV. Sources of Hydrated Lime – Obtain hydrated lime from pre-qualified suppliers in accordance with Section 02746, HYDRATED LIME. When possible, consideration should be given to obtaining lime from a supplier that has adequate capacity to meet all commitments throughout the life of the project and who provides a product with consistent characteristics from start to finish of the project.
- V. Sources of Water - Use potable water or water meeting ASTM C 1602. Screen out extraneous material when pumping water from streams, ponds, lakes, etc.
- VI. Control of Hydrated Lime – The fluid and potentially variable flow characteristics of hydrated lime should be considered when selecting, installing, and operating lime handling equipment. Lime should be handled in a manner that protects it from wind, moisture, and contamination, and that provides for positive control of the material, particularly at and downstream of any and all metering equipment.
 1. Storage of Hydrated Lime – Store and draw lime from a storage facility which provides protection from contamination and the elements. Provide agitation by air or other means to keep the lime in a uniform free-flowing condition.
 2. Metering of Hydrated Lime – Provide positive, repeatable, and calibrated metering of lime at a rate or rate(s) commensurate with planned production rates. Regardless of the metering system used, it should be placed on solid foundations that minimize the possibility of settlement or vibration, and the metering system should be isolated from

loads or movement induced by other equipment. Possible metering methods include the following:

- A. Weigh Depletion Silo – Provide a silo of adequate capacity mounted on load cells connected to metering that provides a continuous indication of the change in mass as the lime is discharged through a variable speed vane feeder or similar device.
 - i. Provide agitation by air or other means to keep the lime in a uniform free-flowing condition.
 - ii. Protect the system from the influence of wind or other external factors.
 - iii. Do not operate the system while the lime silo is being filled, or provide a means to ensure consistent operation at the desired production rate when the weigh depletion system is inoperable during filling of the silo.
- B. Weigh Depletion Hopper – provide a hopper of adequate capacity suspended from load cells connected to metering that provides a continuous indication of the change in mass as the lime is discharged through a variable speed vane feeder or similar device.
 - i. Provide agitation by air or other means to keep the lime in a uniform free-flowing condition.
 - ii. Provide a butterfly valve or other means immediately upstream of the weigh hopper to prevent flow into the hopper during metered discharge.
 - iii. Protect the system from the influence of wind or other external factors.
 - iv. Provide a means to ensure consistent operation at the desired production rate when the weigh depletion system is inoperable during filling of the silo.
- C. Belt Scale – provide a belt scale of appropriate capacity.
 - i. Introduce the lime onto the belt scale in a manner that avoids impact or other variable loading.
 - ii. Install the belt scale in a manner that prevents movement of the lime on the belt during operation. A level installation is recommended.
 - iii. Protect the system from the influence of wind or other external factors, which will likely require complete enclosure of the belt scale.
 - iv. Operate the belt scale for a sufficient period of time prior to calibration and operation to “warm up” the belt.
- D. Weigh Auger – provide an enclosed auger of appropriate capacity suspended from load cells or a mechanical scale.
 - i. Introduce the lime into the weigh auger in a manner that avoids impact or other variable loading.
 - ii. Install the weigh auger in a manner that prevents and minimizes movement of the lime around the auger flights during operation. A level installation is recommended.
 - iii. Protect the system from the influence of wind or other external factors.

- iv. Calibrate the weigh auger at anticipated production rates. The flow rate of lime in an enclosed auger is unlikely to follow changes in auger speed and/or bed depth in the auger in a linear fashion, so interpolation between known metering rates may produce error.
 - E. Impact Meter – provide an impact meter of appropriate capacity. Introduce the lime to the impact meter in a manner that avoids variable or erratic loading.
 - 3. Provide a means to synchronize lime delivery with plant production.
 - A. Interlock the lime system with the plant control system, or;
 - B. Provide a positive means of controlling the lime system from the control room or control panel of the plant
 - 4. Provide a means to verify operation of lime system
 - A. Interlock lime system with the plant control system with automatic shutdown provisions
 - B. Provide audible and/or visual low or no flow warnings in the plant control room or at the plant control panel
 - C. Provide other such positive indication of lime system operation, such as meter or totalizer displays.
- VII. Control of Water – sufficient water to activate the lime must be made available during the addition of hydrated lime to hot mix asphalt aggregates.
1. For lime slurry systems, sufficient water must be provided to create a free-flowing slurry that does not contain lumps or agglomerations of lime.
 2. For dry lime on damp aggregate applications, a minimum of two percent (2%) above a saturated surface dry condition must be available on the aggregates prior to the addition of lime.
 3. Provide positive, repeatable control of water flow.
 - A. volumetric water metering of appropriate capacity, or;
 - B. mass flow rate water metering of appropriate capacity, or;
 - C. Constant rate pump and delivery system coupled with flow control
 - i. Butterfly valve with position indexing, or;
 - ii. Ball valve with position indexing, or;
 - D. Variable rate pump and delivery system with clear, repeatable control setting(s), or;
 - E. Some combination of the above.
 - F. NOTE: Options A, C and D require testing of the moisture content of the aggregate stream or other means of verifying presence of adequate moisture delivery.**
 - G. NOTE: Metering of water should not be considered as a replacement for continuous plant cold feed moisture corrections unless sampling and testing of the cold feed aggregates on the weigh belt has demonstrated metering information to be an accurate representation of cold feed moisture.**
 4. Calibrate the water meter at anticipated flow rate(s).
 5. Provide a means to synchronize water delivery with plant production.

- A. Interlock the water system with the plant control system, or;
 - B. Provide a positive means of controlling the water system from the control room or control panel of the plant
 - C. For constantly-operated water systems utilizing a diversion or recirculating system during plant shutdown, provide a clear indicator of operating and bypass or recirculation settings.
6. Provide a means to verify operation of water system
- A. Interlock water system to plant control system with automatic shutdown provisions, or;
 - B. Provide audible and/or visual low or no flow warnings in the plant control room or at the plant control panel, or;
 - C. Provide clear other such positive indication of water system operation, such as meter or totalizer displays.

VIII. Integrated Lime and Water System Control – provide controls and metering that provides for consistent, repeatable, and recordable operation that results in a process and product that meets all project requirements.

1. Install, operate, and maintain meters, controls, and similar devices in accordance with manufacturer recommendations.
2. Coordinate plant, lime, and water system operations.
 - A. Interlock all system controls; or
 - B. Provide a means for operating and monitoring all systems simultaneously by the plant operator from a single location.
3. If more than one meter is installed in a given system, all meters must be calibrated so as to provide identical readings, OR a single meter shall be designated as the reference meter and the output from other meters disregarded. Install the reference meter in the plant control room or at the plant control panel.
4. Provide a means to measure and record total quantities of materials used.
 - A. Provide resettable, calibrated totalizers that provide data consistent with related flow meters.
 - B. Provide a means to prevent metering or totalizing of materials that are wasted, recirculated, or otherwise not incorporated into the finished product, or provide a clear and consistent means of accounting for these quantities.
 - C. Provide inventory tracking / mass balance information.
 - i. Beginning inventories
 - ii. Deliveries or additions to the system
 - iii. Waste or reject from the system
 - iv. Ending inventories
 - v. Calculations showing actual and target values
 - vi. Documentation and explanation of any adjusting entries used to reconcile mass balance information with metering information

IX. Calibration - Calibrate all equipment that is used to establish, monitor, and control the rate of lime, water, and aggregates.

1. Establish and maintain calibration records in such a manner that the one can readily ascertain:
 - A. Which weighing, measuring, interlock, and no- or low-flow devices have been calibrated and when.
 - B. Which method(s) were used to perform the calibrations, including descriptions and identifications of:
 - i. Electronic load cell simulators
 - ii. Test masses
 - iii. Test containers, provers, hoppers, vehicles, tanks, or similar used during calibration
 - iv. Witness scales including documentation of error testing
 - v. When the calibrations were performed.
 - vi. Product flow rates and test run durations used during calibrations.
 - vii. Who performed the calibrations.
 - viii. The span-adjustment settings or other record(s) of adjustment, or, if the device does not produce a record of adjustment, the means by which the calibration setting was physically secured.
 2. Maintain these calibration records in such a manner that they are legible and readily available to plant and Department personnel at all times.
 3. Maintain a summary of calibrations such that one can determine how often calibration is likely to be necessary for a given device and how much deviation can be expected.
 4. Calibrate equipment upon initial installation, subsequent relocation, after maintenance or repair, and periodically as necessary to maintain sufficient precision to meet project requirements.
- X. Maintenance – perform maintenance such that process performance is consistent and meets project requirements.
1. Maintain functionality of devices necessary for operation and control, and repair or replace damaged or malfunctioning devices before they adversely affect the product.
 2. Inspect and maintain equipment such that no ingredient leakage occurs after points of measurement.
- XI. Application of Hydrated Lime to Hot Mix Asphalt Aggregates – Add hydrated lime to all asphalt pavement mixes as required.
1. Add the necessary quantity of lime, as determined by the mix design and/or Hamburg Wheel Tracker test, subject to the minimum quantities noted below.
 2. Base the amount of hydrated lime used on the dry weight of the virgin aggregate.
 3. Use either Method A or Method B in accordance with Section 02746, Hydrated Lime, of the specifications, unless Method B is called for in the bid documents or is directed by the Engineer as a result of failing to obtain or maintain Certified HMA Supplier status.
 4. Add the quantity of lime in a manner that results in uniform distribution of lime and moisture and a uniform coating of lime on the aggregates free from clumps or agglomerations of lime and/or aggregates.

5. Method A: Lime Slurry – apply a slurry of hydrated lime and water to hot mix asphalt aggregates.
 - A. Add lime at a minimum of one percent (1.0%) by weight of virgin aggregates.
 - B. Maintain the lime slurry in a fluid, free-flowing condition free from lumps or agglomerations of lime.
 - C. Provide a horizontal twin shaft pugmill of appropriate capacity.
 - i. Adjust mixing paddles in the pugmill and the aggregate flow rate so the aggregate being discharged is completely and uniformly coated by the lime slurry.
 - ii. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.
 - iii. Be aware that the irregular discharge from a pugmill can result in significant variations in aggregate weigh belt loadings and corresponding oscillations in plant control systems if the pugmill is located upstream of the weigh belt and the pugmill discharge is not attenuated by a scalping screen or other means.
 - D. Deliver lime slurry to the twin shaft pugmill for mixing with aggregate.
 - E. Adjust lime content as necessary, based on results of Hamburg Wheel Tracker test.
6. Method B: Lime and Aggregate Stockpile Marination – apply dry hydrated lime to damp aggregates and allow to cure before using in hot mix asphalt. Treat the individual aggregate fractions (bins) to provide for gradation control through the hot plant cold feed or hot bin system.
 - A. Determine saturated surface dry (SSD) moisture content of the individual aggregate fractions.
 - B. Condition the aggregate to at least two percent (2.0%) above saturated surface dry condition prior to application of lime.
 - C. Add lime at a minimum of one and one-half percent (1.5%) by weight of dry aggregate. In order to achieve this combined rate with uniform coating and no excess lime agglomerations, adding approximately two percent (2%) lime to the fine aggregate fractions and approximately one percent (1%) to the coarse aggregate fractions may be necessary.
 - D. Provide a horizontal twin shaft pugmill of appropriate capacity.
 - i. Adjust mixing paddles in the pugmill and the aggregate flow rate so the aggregate being discharged is completely and uniformly coated by the lime.
 - ii. Do not allow volume of material in the pugmill to extend above the vertical position of the blade tips.
 - iii. Be aware that the irregular discharge from a pugmill can result in significant variations in aggregate weigh belt loadings and corresponding oscillations in plant control systems if the pugmill is

located upstream of the weigh belt and the pugmill discharge is not attenuated by a scalping screen or other means.

- E. Deliver lime to the twin shaft pugmill for mixing with aggregate.
- F. Marinate the aggregate and lime mixture in a stockpile for a minimum of 48 hours.
- G. Use the marinated aggregate within 60 days.
- H. Provide production and stockpile records that clearly identify the marination period for various stockpiles or portions of stockpiles such that compliance with minimum and maximum marination periods can be readily established.
- I. Adjust lime content as necessary, based on results of Hamburg Wheel Tracker test.
- J. Heavy and/or sustained precipitation may result in the loss of lime from aggregates exposed to the elements. After periods of heavy and/or sustained precipitation inspect the treated aggregates and discard or retreat those materials that do not have adequate residual lime.

XII. Quality Control – provide process and quality control that result in a clearly documented process that produces lime-treated hot mix asphalt aggregates that conform to all project and performance requirements.

- 1. QC Plan – provide a quality control plan that meets or exceeds the requirements of the 514 HOT MIX ASPHALT QUALITY MANAGEMENT PLAN
 - A. Management and Personnel
 - i. QC Plan Manager
 - ii. Plant Operation Personnel
 - B. Equipment
 - C. Records Retention and Availability

XIII. Documentation – Provide clear, legible, consistent documentation of lime addition processes sufficient to establish compliance with project requirements.

- 1. Daily Reports – prepare daily production reports or summaries for each day that HMA containing lime is produced for the Department. These reports should contain the following information:
 - A. Total Lime – report total lime added to UDOT mix. This should be based on metering and control system information reconciled against inventory management. If mix is produced for non-UDOT projects during the same shift, clearly identify the quantities of materials associated with those mixes. If non-UDOT production is not reported, clearly identify how the quantities of different materials were identified, recorded, and reconciled. For marination operations, report the lime used by aggregate fraction.
 - B. Total Water – report water used to create lime slurry or added to cold feed aggregates to create a two percent over SSD condition as appropriate. If water is added to create a two percent over SSD condition, provide the results of testing used to determine SSD and existing moisture content for the various aggregate fractions.

- C. Total Mix Tons – report the total quantities of mix(es) produced for each shift. If mix is produced for non-UDOT projects during the same shift, clearly identify the quantities of materials associated with those mixes. If non-UDOT production is not reported, clearly identify how the quantities of different materials were identified, recorded, and reconciled. Clearly identify any waste or reject materials and quantities of lime and aggregates associated with those materials. For marination operations, report the tons of each aggregate fraction treated.
- D. Weekly Inventory – Provide a summary of beginning lime inventories, lime deliveries, lime used, and ending lime inventories on a weekly basis or more frequently. Provide supporting documentation such as bills of lading and clearly identify how differences between the inventory summary and metering have been reconciled.

XIV. Submittals – Submit such information as is required to satisfy project requirements or in response to requests for information.

1. Hydrated Lime certificates of compliance / use of Qualified Source – provide at start of project and in advance of any change in lime source of supply.
2. Water – identify source of water at start of project and, if not potable, information to demonstrate compliance with ASTM C 1602
3. Calibration Information – maintain calibration records as described above and provide them to the Department upon request.
4. Quality Control Plan – submit during application to become a Certified Supplier, at least two weeks prior to initiation of marination operations, and/or when any changes to the QCP are made.
5. Daily Reports – make available to the Department as required by the 514 Hot-Mix Asphalt Quality Management Plan and the Specifications. If normal document processing creates a delay in finalizing daily reports, make draft daily reports available.
6. Weekly reports - make available to the Department upon request.
7. Bills of Lading or Other Supporting Documents - make available to the Department upon request.