

MATERIAL PLANT QUALITY PROGRAM



MPQP

State of California Department of Transportation
Division of Construction
July 2008



COVER

HMA Continuous
Mixing Plant

HMA Batch Plant

PCC Batch Plant

Errata: October 3, 2011. In 2012, Caltrans will publish the new *Material Plant Quality Program* (2012 MPQP).

2-12.0. ASPHALT RUBBER BINDER (ARB)

2-12.01. General

The effective date of these requirements is July 1, 2013. When plant control and data acquisition equipment, complying with these requirements, becomes operational before the effective date, the equipment must be used. The material producer will determine the operational viability of new plant control and data acquisition equipment until the effective date. Data captured before the effective date will be used only as a data report.

Asphalt rubber binder (ARB) ingredients—asphalt binder, asphalt binder modifier, scrap tire crumb rubber, and high natural rubber—constitute 100 percent of the ARB mixture. The addition of any other ingredients will be considered mathematically outside the mix formula.

Refer to Section 39-1.02D, “Asphalt Rubber Binder,” of the *Standard Specifications* for ingredient proportioning ratios and operational tolerances for each ratio.

Refer to Section 39-1.08C, “Asphalt Rubber Binder,” of the *Standard Specifications* for the asphalt binder, asphalt modifier, and ARB temperature limits and ARB reaction time requirements.

Refer to standard special provision SSP 37.2 for asphalt rubber seal coat requirements.

2-12.02 ARB Production

The ARB production plant is a stand-alone unit, independent of production plants for other products. HMA mixtures, pavement seals, and other mixtures use the completed ARB mixture as the binder. Perform all ARB proportioning at the ARB production site.

ARB production is a three-stage process:

Stage 1. Proportion an asphalt modifier with paving grade asphalt.

Stage 2. Proportion scrap tire crumb rubber and high natural rubber.

Stage 3. Proportion the pre-blended liquids, combine with the proportioned ground rubbers, and mix further for the specified time and temperatures.

Stages 1, 2, and 3 may be combined into a single stage.

When the asphalt and asphalt modifier are pre-blended, provide an asphalt heating tank equipped to maintain the blended ingredients at the necessary temperature before blending with the dry ingredients.

The method and equipment for combining the liquid and dry ingredients must be such that the resident engineer can readily determine compliance with proportioning requirements for each material and the completed ARB. The district weights and measures coordinator must approve all required equipment before use.

The plant process controller (PPC) must assure that combined liquids and combined dry ingredients have been proportioned to within their own ratio limits before proportioning the final liquid and dry mixtures for ARB.

The PPC must assign a lot number to each volume of ARB moved from the initial mixing chamber to reaction storage. The product volume represented by each lot must be the amount set aside for the reaction period. Leftovers and portions of lots may be combined and assigned a new non-repeating lot number. Reassigned lots must include all electronic data captured for the previous original lots used to generate the new lot.

Feed the liquid and dry ingredients directly into the mixer at a uniform rate. ARB must be mechanically mixed to provide for the complete blending of liquid and dry ingredients in a controlled fashion.

Produce ARB by either a batch or continuous method. Regardless of production method, proportion all ingredients by weight. Proportion liquid ingredients with a meter complying with Section 2-1.03, "Liquid Ingredient Measurement," of the 2012 MPQP [Ch. 2, I-C of 2008 MPQP].

Batch Method

The hopper scale system must include interlocks which prevent filling the hopper while drawing ingredients from the same hopper.

Use a PPC complying with Section 2-2.07, "Batch Mixing HMA Plants," of the 2012 MPQP [Ch. 2, II-F of 2008 MPQP]. The PPC must proportion all ingredients used in the production of the ARB.

Batch Tolerances

1. The zero tolerance for dry ingredient scales must be 0.5 percent of the total draft being weighed.
2. The indicated weight of material drawn from storage must not vary from the pre-selected target weight setting by more than 1.0 percent of the total draft target.

Continuous Method

Proportion dry ingredients with a conveyor scale or a loss-weight meter. Continuous proportioning must be fully automatic. This automatic system must proportion total asphalt binder to total rubber to within 0.5 percent of the target rate.

2-12.03 ARB Transportation

During transportation between the ARB production location and the end-use facility, the mixture must comply with all requirements for agitation, temperature control, and data log.

2-12.04 ARB Storage

During the proportioning and blending of the liquid ingredients, maintain the temperature of asphalt and the asphalt modifier to within 25°F of the specified temperature. ARB mixing and temperature control must be continuous from initial ingredient blending until the product end use.

When ARB is produced at a site remote from the end-use plant site, the receiving tank at the end-use site must be compliant with all agitation, heating, temperature, and data-reporting requirements.

Provide a safe sampling device capable of delivering a representative sample of the completed ARB. The device must meet the requirements of CT125 and section 92-1.02(c), "Sampling," of the *Standard Specifications*.

2-12.05 Ingredient and ARB Temperatures

During production, use automatic and continuous temperature sensing and recording equipment to control and document ARB and liquid ARB ingredient temperatures accurately. Continuous recording occurs when production temperature data are collected electronically at intervals of 1 minute or less. Temperature-sensing devices must be accurate to within 5°F.

Place temperature-sensing points at each liquid feed line where the blend is reacted and at each storage tank for completed ARB.

Install and maintain temperature indicators at the point where the ARB proportioning operation is controlled.

2-12.06 ARB Production Data Log

Subsequent to the lot number designation, correlate all captured data to the lot number. The PPC used for ARB production must produce a log of production data consisting of a series of snapshots captured at a maximum of 1-minute intervals throughout the period of daily production. Each snapshot of production data must be a register of production activity at the time and not a summation of the data over the preceding interval to the previous snapshot. The amount of material represented by each snapshot is the amount produced during the 0.5-minute interval before and the 0.5-minute interval after the capture time.

ARB temperature need not be captured during periods where the product temperature is below 370°F.

When ARB proportioning is used, the following data must be captured:

- A. Date of production.
- B. Production location.
- C. Time of day the data is captured.
- D. The assigned, non-repeating lot number.
- E. The certification of compliance numbers for dry and liquid ingredients currently used in the production process. Input liquid ingredients certificate numbers to the nearest 25-ton increment.
- F. Viscosity test results including sampling time. Viscosity testing frequency is as Section 39-1.04C, "Asphalt Rubber Binder," of the *Standard Specifications* requires.
- G. ARB temperature at each required sensing point.

- H. Ratio A—The high natural rubber to scrap tire crumb rubber ratio calculated from metered ingredient output.
- I. Ratio B—The asphalt modifier to asphalt ratio calculated from metered ingredient output.
- J. Ratio C—The total dry ingredient to total liquid ingredient ratio calculated from metered ingredient output.
- K. Total reacting time and the reaction ending time.

In addition, when a batch type proportioning system is used, capture the following data:

- A. Batch weight for each dry ingredient as determined by its scale system.
- B. Batch weight for each liquid ingredient as determined by its meter.

Also, when a continuous type proportioning system is used, capture the rate of flow for each dry and liquid ingredient determined by its metering system.

2-12.07 ARB Production Data Reports

Make as-collected raw data available to the resident engineer at all times during production and end use.

Remote end-use sites

Submit the production report generated from data collected at remote end-use sites to the resident engineer at a maximum interval of one workweek. A remote end-use site is one at a distance greater than 5 miles from the ARB production location.

Production and non-remote end-use sites

Submit the report generated from production data to the resident engineer daily.

Electronic media

Present the electronic media in a comma-separated values (CSV) format. Captured data for the ingredients represented by production snapshots must have allowances for sufficient fields to satisfy the amount of data required and include data titles at least once per report. The resident engineer must approve report formats.

Collect and hold data for the duration of the contract. All collected data must be submitted as electronic media. No handwritten reports or data will be accepted.

Contents

Introduction..... 1

Chapter 1—Material Plant Quality Program

I. Scope..... 3

II. General..... 3

 A. Acceptance 3

 B. Material Plant Safety 3

 C. Frequency 3

 D. Timeline..... 4

III. Measurement of Quantities 4

 A. Weight Certificates 4

 B. Scale Undersupports..... 4

 C. Vehicle Scales..... 5

 D. Tare Weights 5

 E. Commercial Scales 5

 F. Non-commercial Devices 5

Chapter 2—Plant Equipment

I. General..... 6

 A. Security Seal..... 6

 B. Ingredient Indicators 6

 C. Liquid Measurement 6

 D. Dry Ingredient Measurement 6

 E. Ingredient Cutoffs 6

 F. Operational Tolerances..... 7

 G. Reference Documents 7

II. HMA Plant Equipment..... 7

 A. General 7

 B. Asphalt Binder Storage 8

 C. Rubber Binder Mixing Equipment..... 8

 D. Aggregate Drying..... 8

E. Aggregate Storage 8

F. Batch Mixing HMA Plants 9

G. Batch Tolerances 10

H. Continuous Mixing HMA Plants 10

I. HMA Mixing 11

J. HMA Storage 11

III. PCC Plant Equipment 12

IV. Volumetric Material Plant Equipment 12

V. Lime Slurry Treatment of HMA Aggregates 12

 A. Lime Slurry Production 12

 B. Lime Slurry Storage 12

 C. HMA Aggregate Treatment 12

VI. Dry Lime Treatment of HMA Aggregates 13

 A. Dry Lime Treatment with Marination 13

 B. Continuous Mixing Plants 13

 C. Batch Mixing 14

VII. Liquid Anti-Strip 14

 A. LAS in Batch Plants 14

 B. LAS in Continuous Mixing Plants 14

VIII. Cement Treated Bases 15

IX. Lean Concrete Bases 15

X. Bituminous Seals 15

Chapter 3—Material Plant Calibration and Dynamic Testing

I. Scope 16

II. Testing and Accepting Weighing and Measuring Devices 16

 A. General 16

 B. Dynamic Testing 16

 C. Proportioning System Calibration and Acceptance 17

 D. General Device Testing 17

III. Procedure for Hopper Scales	18
A. General	18
B. Inspection	18
C. Testing Equipment.....	18
D. Device Testing and Calibration	18
E. Report and Security Seal	19
IV. Procedures for Liquid Metering.....	19
A. General	19
B. Inspection	20
C. Testing Equipment and Provisions.....	20
D. Device Testing and Calibration	20
V. Procedure for Conveyor Scales.....	22
A. General	22
B. Inspection	22
C. Test Equipment and Provisions	22
D. Device Testing and Calibration	22
VI. Procedures for Volumetric Proportioning Plants	23
A. Volumetric Rapid Strength Concrete Proportioning	23
B. Volumetric Pavement Seal Proportioning	24
Appendix—Calibration and Production Error Limits	
Table A—Meter Testing Extremes.....	26
Table B—Conveyor Scale Testing Extremes.....	26



Introduction

Source

The State of California, Department of Transportation (Caltrans) developed the Material Plant Quality Program (MPQP) to combine construction-material production and plant-equipment specifications from several sources. Caltrans selected the following equipment and material-production requirements from Caltrans' *Standard Specifications*: Sections 39, "Asphalt Concrete"; 27, "Cement Treated Bases"; 28, "Lean Concrete Bases"; and 37, "Bituminous Seals," as well as various contract standard special provisions and California Test (CT) 109, "Method for Testing of Material Production Plants."

Reasons

The centralization of these specifications in a single document, the MPQP, has several advantages:

- Simplicity and ease of use in the material plant and equipment calibration and acceptance process.
- All production requirements for construction materials centrally located in one document.
- An updated Section 39, "Hot Mixed Asphalt," (HMA), free of material-production and equipment requirements.

Updates

Planned updates include:

- A section titled "Material-Production Quality Certification" (QC) that will set standards for certification by a QC report. This QC report will be a Caltrans-generated document that is to be completed and certified in writing by the contractor or material producer. Caltrans welcomes industry input in the development of this QC requirement.
- A weights-and-measures handbook to detail some of the methods and terms encountered during inspection, calibration and certification of the weighing, metering, and measuring devices.
- A section for the use and proportioning of baghouse collected fine particles at HMA plants. Input from the HMA plant manufacturing industry and HMA producers is welcomed and expected in formulating these requirements.
- Incorporation of the parts of Section 90, "Portland Cement Concrete," (PCC) of the *Standard Specifications* that deal with PCC production and plant-equipment requirements.



Chapter 1—Material Plant Quality Program

I. Scope

Plants producing construction materials for the State of California, Department of Transportation (Caltrans) must be approved under the Material Plant Qualification Program (MPQP) requirements. The MPQP covers these topics for material plant weighing and measuring devices: inspection, calibration, dynamic testing, and acceptance.

Chapter 2 of the MPQP, “Plant Equipment,” is directed to the material producer and specifies the equipment requirements for material plants. Chapter 3, “Material Plant Calibration and Dynamic Testing,” is directed to the user of the calibration and acceptance process and specifies the calibration and acceptance of plant proportioning systems.

II. General

A. Acceptance

The district weights and measures coordinator (WMC) has responsibility for material plant acceptance, within the limits of the MPQP when:

1. Required plant equipment is in place and functional.
2. Proportioning devices are calibrated to required tolerances.
3. Dynamic testing is complete.

Form CEM-4204, “MPQP Acceptance Sticker,” is issued when the following steps are complete:

1. Plant equipment safety inspection.
2. Type acceptance of measurement elements, except continuous conveyor scales, by the California Department of Food and Agriculture, Division of Measurement Standards (DMS).
3. Type acceptance of measurement elements outside the DMS area of responsibility by the WMC.
4. Device calibration.
5. Dynamic testing of the plant during operation.
6. Plant acceptance.

Do not produce material for Caltrans projects until plant acceptance is received.

B. Material Plant Safety

Plant areas accessed by Caltrans plant inspectors must comply with the applicable safety requirements of regulations administered by these agencies:

1. California Division of Occupational Safety and Health.
2. U. S. Department of Labor—Occupational Safety and Health Administration.
3. California Department of Transportation.

C. Frequency

The plant acceptance process must be performed when weighing or measuring devices are newly installed, repaired, or adjusted or when the plant is relocated. The resident engineer may order the acceptance process at any time on any type of plant.

- Batch-type plants must receive approval at least once every 12 months.
- For continuous mixing plants, including Hot Mixed Asphalt (HMA) plants that incorporate liquid anti-strip or lime treatment, the maximum acceptance interval must be no greater than six months.
- Volumetric proportioning plants must be calibrated and tested at the interval specified in the specifications.

All plants must be equipped to allow accuracy testing at any time, including before a project's first operation.

D. Timeline

When possible, perform plant inspection concurrently with the calibration of installed proportioning devices and the acceptance of the material plant. Inspection, device calibration, and plant acceptance may proceed in any order, but Caltrans intends that initial plant inspection and device calibration be conducted on the first plant visit. Subsequent visits may be needed to verify corrected deficiencies and finalize the acceptance. Notify the WMC at least five days before testing the material plant system or plant controls. Witness scales must be error tested within eight hours of device calibration.

If the dynamic plant testing is not completed before the plant start-up time, the WMC may issue a "Start-up Acceptance" letter that allows material production until the dynamic plant testing is completed. The time between the beginning of material production and completion of dynamic plant testing must not exceed 14 days.

III. Measurement of Quantities

A. Weight Certificates

Submit a weight certificate with each load of HMA and Portland Cement Concrete (PCC) delivered to the job site. Weight certificates must comply with DMS requirements.

1. HMA Weight Certificates

When HMA weight certificates are generated directly from batch weights, use these weights for determining pay quantities, provided:

- a. Total aggregate and supplemental fine aggregate weight per batch is printed. If supplemental fine aggregate is weighed cumulatively with the aggregate, the total batch weight of aggregate must include the supplemental fine aggregate.
- b. Total bitumen weight per batch is printed.
- c. Zero tolerance weight is printed before weighing the first batch and after weighing the last batch of each truckload.
- d. Each weight certificate is correlated with time, date, mix number, load number, and truck identification.

- e. A copy of the recorded batch weights is certified by a licensed weigh master and submitted to the resident engineer.
2. PCC Weight Certificates
Refer to Section 9, "Measurement and Payment," and Section 90, "Portland Cement Concrete," of the *Standard Specifications*.

B. Scale Undersupports

Scales used for pay or material proportioning must be supported as follows.

1. Small Scales

If a scale structure's total load (live and dead weight) is 15 tons or less, the undersupports for scale-bearing points must be constructed of structural grade steel with a minimum cross-sectional dimension of 20 inches and a minimum thickness of 1.5 inches. The total load on any one leg must be no greater than 2,000 pounds per square foot (psf). The ground under the scale must support 2,000 psf at each undersupport. The requirements for large scales may also be used for small scales.

2. Large scales

If a scale structure's total load (live and dead weight) is more than 15 tons, the undersupports for scale-bearing points must be constructed of PCC produced from commercial quality aggregates and cementitious material. The PCC must contain not less than 470 pounds of cementitious material per cubic yard. The undersupport's bearing surface must have a minimum width of 30 inches and a minimum thickness of 16 inches. The total load on any undersupport must be no greater than 4,000 psf. The ground under the scale must support 4,000 psf at each undersupport.

3. Drainage

Provide adequate drainage to prevent ground saturation under the scale.

4. Leveling

The scale structure including undersupports must remain level during device calibration and material production. Shimming, if necessary, must be securely attached using metal shims and must not exceed two inches.

5. Rigidity

The scale structure including undersupports must not move or deflect during production operations.

6. Wood

The scale structure including undersupports must not include wood.

C. Vehicle Scales

Vehicle scales must permit the entire vehicle or combination of vehicles to rest on the scale deck while being weighed. Combination vehicles may be weighed as separate units if they are disconnected while being weighed.

The maximum concentrated load must not exceed the manufacturer's designed sectional capacity of the scale.

Scale approach and exit ramps must be level with the scale deck for at least 30 feet. Scale bulkheads must resist displacement.

Mechanical indicating elements must be rigidly mounted, level, and plumb on a concrete foundation.

D. Tare Weights

Vehicles used to haul material being paid for by weight must be weighed empty. They must be weighed daily or more often as ordered by the resident engineer. Each vehicle must bear an identification number. Engineers may order loaded and unloaded vehicles to be weighed on other designated scales.

E. Commercial Scales

A commercial scale is a weighing or metering device used for the measurement of construction materials to be paid for by weight. Contractors furnish commercial scales at their own expense or use other sealed scales regularly inspected by the DMS or its designated representative. Volumetric systems are commercial if the volumetric units are generated by weighing or metering the ingredients.

Commercial scales must be suitable for the purpose intended and comply with:

1. Title 4, Chapter 9 of the California Code of Regulations.
2. California Business and Professions Code, Division 5.
3. This MPQP.

Devices not type-approved by the DMS must be type-approved by Caltrans in compliance with this MPQP.

F. Non-commercial Devices

Weighing, measuring, or metering devices required by the contract specifications for proportioning a material or product are “non-commercial devices.” Non-commercial devices must be tested and approved in compliance with this MPQP, and the WMC must be present during the testing.

Chapter 2—Plant Equipment

I. General

This part of the MPQP, “Plant Equipment,” specifies the equipment requirements for material plants.

A. *Security Seal*

Elements of the material plant controller that affect the accuracy or delivery of data must be available for the application of physical security seals. If a device produces a digital record of adjustment, an indication of adjustment, such as a span number on the device, is considered as being in a sealed condition.

These devices are inspected, and adjusting elements are sealed before the first production of materials for the contract. The WMC furnishes security seals. The resident engineer orders material production stopped when alteration, disconnection, or manipulation of the security seal occurs. The contractor must not resume production until the device is inspected and resealed by the engineer.

B. *Ingredient Indicators*

Indicators for proportioning devices must be in the plant control room. Indications must be clear, definite, accurate, and legible under normal operating conditions. If there is no plant control room, the proportioning device displays must be grouped and readable from where the proportion operations are controlled.

Ingredient deliveries must be indicated and recorded in pounds, tons, or gallons with decimal subdivisions. The indication must display rate of flow to show the rate of ingredient delivery. The indication must be equipped with a resettable totalizer to indicate the ingredient quantity delivered.

The indication for the mass-flow, Coriolis effect type meter must be in weight. Volume is not acceptable as a unit of measurement for these meters.

Indicators must be fully functional at all production rates. Multiple indicators for the same ingredient must agree to within 0.1 percent when compared directly.

During production, the asphalt binder totalizer must not register when the asphalt metering system is not delivering asphalt to the mixer.

C. *Liquid Measurement*

A meter is an electromechanical device designed to measure liquid ingredients. Meters must comply with production proportioning limits and calibration limits of Table A, “Meter Testing Extremes,” in the Appendix.

Meters for the determination of water quantity, liquid ingredients for slurry seal, and liquid admixture for PCC mixtures must be either volumetric or mass-flow type. Meters for the determination of quantities of other liquids and slurries must be of the mass-flow, Coriolis effect type.

D. Dry Ingredient Measurement

If a conveyor scale is used for measuring dry ingredients, it must comply with the limits for production proportioning and calibration specified in Table B, “Conveyor Scale Testing Extremes,” in the Appendix.

When other types of dry ingredient devices are used for weight proportioning, these systems must comply with the requirements in Table B, “Conveyor Scale Testing Extremes,” in the Appendix.

Do not use beam scales for proportioning dry ingredients.

E. Ingredient Cutoffs

Continuous mixing plants must be equipped with cutoff devices that stop production when ingredient flow is detected to be less than specified.

F. Operational Tolerances

HMA batch plant operational tolerances must comply with “Batch Tolerances” in Chapter 2, II-G.

PCC batch plant operational tolerances must comply with Section 90-5.02, “Proportioning Devices,” of the *Standard Specifications*.

For continuous mixing plant operational tolerances, conveyor scales must comply with Table B, “Conveyor Scale Testing Extremes,” and liquid meters must comply with Table A, “Meter Testing Extremes,” in the Appendix.

G. Reference Documents

Refer to the following documents:

1. State of California, *Standard Specifications* (edition specified in project special provisions)
2. Project special provisions
3. California Test (CT) 125, “Sampling Highway Materials and Products Used in the Roadway Structural Sections”

II. HMA Plant Equipment

A. General

Produce HMA in either a batch plant or a continuous mixing plant. Hot-feed control and cold-feed control indicate the location of the aggregate proportioning devices or process control. Batch plants must be hot-feed controlled. Continuous mixing plants must be cold-feed controlled. Continuous mixing plants may mix ingredients in the drier drum or by continuous pugmill mixing. Proportion ingredients before mixing them.

Proportion HMA ingredients by weight. At the plant, provide a separate vehicle scale to verify the weight of the various proportioned amounts.

HMA plants must comply with Section 7-1.01F, “Air Pollution Control,” of the *Standard Specifications*. Plants must be equipped with functioning devices that reduce dust emissions to comply with local, state, and federal air-quality mandates.

During production, do not use petroleum products such as diesel fuel and kerosene to release HMA from plant or hauling equipment. The resident engineer rejects HMA when petroleum-based release products are used.

1. Ingredient Temperatures

During production, use automatic and continuous temperature sensing and recording devices to accurately record HMA ingredient temperatures. Continuous recording occurs when production temperature data are collected electronically at not more than five-minute intervals. Temperature sensing devices must be accurate to 5°F increments.

Install one temperature sensing device in the asphalt binder feed line. Install one temperature sensing device to sense the temperature of the material leaving the drier. Install and maintain temperature indicators at the point where proportioning operations are controlled.

Retain collected temperature data for the contract's duration and submit to the resident engineer on request.

2. Sampling

The plant must provide samples of the HMA ingredients and the HMA mixture. The samples must represent actual production. Each sampling device and the sampling area must be safe and convenient. If a sample is taken from above ground level, provide a means for lowering the sample to ground level.

Material sampling must comply with CT 125, "Sampling Highway Materials and Products Used in the Roadway Structural Sections."

The plant must have an inspection dock that allows sampling from the hauling vehicle before it leaves the plant site. When a hauling vehicle is pulled up alongside the dock, the loaded HMA must be accessible. Instruct hauling vehicle drivers to stop at the dock when inspection personnel are on the dock and to remain there until directed by the person taking the sample.

B. Asphalt Binder Storage

Store asphalt binder for HMA in tanks that maintain the material at the specified temperature. Heating must be effective and controlled. Do not allow flame to touch the heating tank.

Locate and maintain the asphalt binder circulating pipe's discharge end below the asphalt binder surface in the storage tank.

Prevent different grades of asphalt binder from mixing while in storage.

C. Rubber Binder Mixing Equipment

During asphalt rubber binder production, use proportioning equipment that displays the percent of each component by weight.

Use a heating tank that maintains the mixture of asphalt binder and asphalt modifier at the specified temperature before adding crumb rubber modifier (CRM). The heating tank must be equipped with a thermostatic heat control and a temperature display accurate to $\pm 5^\circ\text{F}$. The heating tank must use temperature sensing devices capable of recording in compliance with "Ingredient Temperatures" in Chapter 2, II-A. Use a system that combines and mixes the asphalt rubber binder components and stores the asphalt rubber binder. Feed the liquid

components directly into the mixer through meters complying with “Liquid Measurement” in Chapter 2, I-C. The blending controller must be capable of varying the asphalt binder and asphalt modifier feed rates. During asphalt rubber production, the system must control the temperatures of asphalt binder and asphalt modifier to within 25°F of the specified temperature. The CRM feed must include a feed rate display. The system must include a storage tank that maintains the specified asphalt rubber binder temperature and homogeneity. The storage tank must be equipped with:

1. A heating system complying with “Asphalt Binder Storage” in Chapter 2, II-B.
2. A temperature display complying with “Ingredient Temperatures” in Chapter 2, II-A.
3. A central mixing tank equipped with an agitator that both mixes and maintains ingredient suspension until the reaction time is complete. The agitator must operate continuously and prevent buildup on the tank’s bottom or sides. Ensure complete mixing by controlling the component feed rates and limiting the volume of asphalt rubber binder. Provide a device to safely take representative asphalt rubber binder samples from the mixer.

D. Aggregate Drying

Feed aggregate directly to a drier at a uniform rate.

Without exceeding specified maximum HMA temperatures, continue drying until at the time of placement the moisture content of HMA does not exceed 1 percent. Moisture content is determined under CT 370.

Plants must have facilities and equipment to monitor moisture in aggregate and HMA. Control moisture content in all dry ingredients not subjected to drying before proportioning. The HMA proportioning controller must compensate for aggregate moisture.

E. Aggregate Storage

The measurement and storage specifications do not apply to fine material collected in skimmers, knock-out boxes, and centrifugal collectors. You may return fine material from these collectors without it being measured or stored separately if the fine material is returned at a rate commensurate with the plant’s production rate and at a point before the sampling device in batch plants or before mixing in continuous plants.

The fine material collected in dust control systems except cyclone collectors or knock-out boxes is supplemental fine aggregate.

The HMA producer must store separately and keep thoroughly dry each type of supplemental fine aggregate.

During storage, the HMA producer must prevent each size aggregate from intermingling.

If at least 20 percent of aggregate passes the No. 8 sieve, the plant must feed that portion from storage with a mechanical feeder.

For plants using cold-feed control, each nominal aggregate gradation must be separated into sizes and stored as follows before being fed to the drier:

1. Aggregate for large stone mix must be separated into at least 4 sizes and stored separately.
2. Aggregate for one-inch open-graded friction course (OGFC) must be separated into at least two sizes and stored separately.

3. Aggregate for 3/4-inch and 1/2-inch HMA Type A, Type B, and RHMA-G must be separated into at least three sizes and stored separately.
4. Aggregate for 3/8-inch and 1/4-inch HMA Type A and Type B and for 1/2-inch and 3/8-inch OGFC may be unseparated and stored combined.
5. After aggregate separation, each size must be stored in a separate bin and recombined in compliance with the grading specified in the accepted job mix formula (JMF).
6. The minimum feed rate for each aggregate size must not be less than the aggregate feeder manufacturer's suggested minimum operating rate for the equipment being used.

For plants using hot-feed control, dried aggregate must be separated into the same sizes as for cold-feed control and the following:

- After separating the hot aggregate, each size must be stored in a separate bin and recombined in compliance with "Batch Mixing HMA Plants" (see F below) and the grading specified in the accepted JMF.
- Hot storage bins must prevent overflow into adjacent bins.

F. Batch Mixing HMA Plants

Batch proportioning must use an automatic plant controller. The only manual operation allowed for proportioning is a single operation of a switch or starter.

Proportioning devices must discharge materials from bins controlled by gates or mechanical conveyors.

The batching devices must be interlocked to prevent a new batch from starting until the weigh hoppers are empty, the scales are within zero tolerance, and the discharge gates are closed.

The bin withdrawal and weigh-box discharge must be interlocked to prevent more than one bin from discharging onto the same scale at the same time and the weigh box from being tripped until the required quantity from each required bin has been deposited.

Automatic proportioning devices must be interlocked to interrupt the weighing cycle when the amount of material drawn from storage varies from the preselected amount by more than the tolerances specified in the next section, "Batch Tolerance." If the weighing cycle is interrupted, do not use that batch unless it can be manually adjusted to comply with the specified tolerances based on the total batch weight.

Automatic proportioning devices must not use net weighing. You may not use material from another bin to compensate for an out-of-tolerance bin.

When partial batches are proportioned, the interlock tolerances—except the zero tolerance—must apply to the total aggregate weight in the partial batch.

Proportioning device controls for weight increments must be preset at the same time for the batch. The controls must be able to change the settings without delay and able to change the order of discharge from the bins.

Proportioning device controls must be equipped with a means to inspect the interlock tolerance settings. Inspection equipment and instructions must be available at the proportioning controller location.

Asphalt binder must be measured by a tank scale.

G. Batch Tolerances

The HMA producer must proportion ingredients by weight as follows:

1. The zero tolerance for aggregate scales must be 0.5 percent of the total batch weight of the aggregate.
2. The zero tolerance for scales weighing supplemental fine aggregate or asphalt binder must be 0.05 percent of the total batch weight of the aggregate.
3. The indicated weight of material drawn from storage must not vary from the pre-selected scale setting by more than the following percentages of the total batch weight of the aggregate:
 - a. For aggregate, 1 percent, except if supplemental fine aggregate is used and weighed cumulatively with the aggregate. Then the aggregate drawn immediately before the addition of supplemental fine aggregate must not vary more than 0.5 percent.
 - b. For supplemental fine aggregate, 0.5 percent.
 - c. For asphalt binder, 0.1 percent.

H. Continuous Mixing HMA Plants

Continuous mixing plants must use pugmill or drier-drum mixers.

The mixer must discharge into a storage silo that complies with “HMA Storage” in Chapter 2, II-J.

The HMA producer must provide a means for diverting HMA away from the silo to prevent incompletely mixed HMA from entering the silo. For continuous mixing plant proportioning:

1. Asphalt binder must enter the mixer through a liquid meter, complying with “Liquid Measurement” in Chapter 2, I-C.
2. Plant controller and metering systems must be capable of varying the binder delivery rate proportionate to the aggregate delivery at all production rates and rate changes.
3. Asphalt binder storage must be equipped with an automatic plant cut-off device that activates when the binder level exposes the pump suction line.
4. If supplemental fine aggregate is used, it must be proportioned by uniformly feeding the material within 1 percent of the specified amount and discharging directly into the mixer.
5. If fine material collected in the dust control systems is returned at less than 100 percent of the collection rate, it must be proportioned in compliance with the specifications for supplemental fine aggregate. This material may be returned to the aggregate stream without proportioning if (a) the return rate is commensurate with overall plant production, and (b) it is returned at or before the mixing section.
6. Conveyor scales must be used for weighing the combined aggregate and must comply with Table B, “Conveyor Scale Testing Extremes,” in the Appendix.
7. The conveyor scales, proportioning devices, and liquid ingredient meters must be interlocked and automatically adjust the feed rates for aggregates and binders to maintain the bitumen ratio in the accepted JMF. The bitumen ratio is pounds of asphalt binder per 100 pounds of dry aggregate. The plant must not be operated unless this automatic system is operating and in good working condition.

8. The proportioning system must indicate each dry and liquid ingredient's flow rate and have a resettable totalizer to determine the total amount of each ingredient in the mixture.
9. Aggregate bins, including supplemental fine aggregate bins, must be equipped to prevent material hang-up during plant operation.
10. Each belt feeder must have equipment to monitor the aggregate depth on the belt. The equipment must automatically shut down the plant when the aggregate depth is less than 70 percent of the target depth. There may be a delay between the sensing of less than 70 percent of the target depth and plant shut-down. The delay must be determined at the time of initial MPQP testing.
11. Each belt feeder must have equipment to monitor the aggregate stream beyond the belt or where it will detect revolutions of the idler pulley on the belt feeder. The equipment must automatically stop the plant when ingredient flow has stopped.
12. When continuous mixing plants are in full operation, they must have equipment to sample aggregate in compliance with CT 125, "Sampling Highway Materials and Products Used in the Roadway Structural Sections."
13. For supplemental fine aggregate metering, the plant must have equipment in each feed line preceding the proportioning device to safely sample the supplemental fine aggregate.

I. HMA Mixing

The charge in a batch mixer or the feed rate to a continuous mixer must not exceed the amount that permits complete mixing. The HMA producer must correct areas in the mixer where the material does not move or is not sufficiently agitated by making adjustments such as reducing the volume of material. The material discharged must be a homogeneous mix of thoroughly and uniformly coated aggregates. The completed mix must be visible for inspection at the discharge point.

If the HMA producer uses a batch mixer with hot-feed control, mixing must be in a twin shaft pugmill. Each charge in a batch mixer must be mixed at least 30 seconds in addition to any required dry mixing time.

J. HMA Storage

If HMA is stored, use silos. Do not stockpile HMA.

During production, the quantity of HMA stored in each silo must be at least 20 tons. You may store less after a plant has been shut down for at least 2 hours.

Each silo must have a visual indicator of the quantity stored.

Each silo must be equipped with a surge batcher that prevents segregation of HMA as it is placed into storage. A surge batcher is equipment placed at the top of the silo that catches the continuous delivery of HMA, converts the HMA to individual batches, and places the batches into storage.

The surge batcher must be independent from conveyors and chutes that collect HMA for discharge into silos and must be the last device to handle HMA before it enters the silo.

The surge batcher must be center loading and prevent material buildup.

Do not use rotary chutes as surge batchers.

Multiple storage silos must be served by an individual surge batcher for each silo.

Material handling between the highest elevation and subsequent placement in the silo must be free from oblique movement.

Discharge gates on surge batchers must operate automatically and discharge after no less than two tons of HMA is collected. The gates must close before the last collected HMA leaves the device. HMA must not deflect during gate opening and closing.

Do not use OGFC stored over two hours or any other HMA stored over 18 hours.

Do not use HMA with hardened lumps. If HMA has hardened lumps, stop storing in silos that held that material until the cause is corrected.

III. PCC Plant Equipment

Plant equipment must comply with Section 90, "Portland Cement Concrete," of the *Standard Specifications* and this MPQP.

IV. Volumetric Material Plant Equipment

Volumetrically proportioned materials must comply with Section 37, "Bituminous Seal," of the *Standard Specifications* and other provisions dealing with volumetrically proportioned materials.

V. Lime Slurry Treatment of HMA Aggregates

Lime slurry treatment of HMA aggregates consist of proportioning dry hydrated lime and water to produce a slurry and treating HMA aggregates in a continuous operation.

A. Lime Slurry Production

Produce lime slurry by either a batch or continuous method.

1. Batch Method

Proportion dry lime by weight. Weigh dry lime at the slurry production site using a scale appropriate for the lime draft amount used. If the dry lime draft is less than nine tons, use an automatic batch controller. Automatic batch controllers used for lime slurry aggregate treatment must comply with "Batch Mixing HMA Plants" in Chapter 2, II-F.

Use a water meter equipped with a resettable totalizer to measure water that will be used in the slurry.

If you use an automatic controller to batch the dry lime, it must also control the water proportioning. The indicated water draft must be within 1.5 percent of its total draft weight.

2. Continuous Method

Proportioning dry lime with a conveyor scale.

Use a meter to measure water to be used in the slurry.

The dry lime conveyor scale and the water meter must be interlocked so that the dry lime and water feed rates are adjusted automatically at each production rate to maintain the lime-to-water ratio in the accepted JMF. Meters and scales must be equipped with rate-of-flow indicators showing the delivery rates of dry lime and water and resettable totalizers determining the total amounts of dry lime and water introduced into slurry storage tank.

B. Lime Slurry Storage

Store lime slurry in a central mixing tank equipped with an agitator that both mixes and keeps the lime in suspension until it is applied to the aggregate. Agitation must be continuous while the slurry is in storage, and storage time must not exceed 24 hours. Agitation must prevent a consolidated lime buildup on the storage tank's bottom or sides. The storage tank for slurry must be equipped with a level-sensing device that automatically and immediately stops the slurry and aggregate proportioning when the slurry pump suction line is exposed.

C. HMA Aggregate Treatment

Use continuous proportioning and mixing for producing lime slurry-treated aggregate. Introduce slurry into the mixer with a mass-flow, Coriolis effect type meter. The proportioning system must be capable of varying the slurry delivery rate proportional to the aggregate delivery rate.

The conveyor scale for the aggregate and the slurry meter must be interlocked so that the feed rates of the aggregate and slurry are adjusted automatically at all production rates and rate changes to maintain the approved lime ratio. The plant must not be operated unless this automatic system is operating and in good working condition.

The slurry meter and the aggregate feeder must be equipped with devices that determine the feed rate while the plant operates. Meters and conveyor scales used for proportioning aggregates and slurry must be equipped with rate-of-flow indicators that show the delivery rates of slurry and aggregate. Meters and scales must also have resettable totalizers that determine the total amounts of slurry and aggregate introduced into the mixer. The slurry totalizer must not register when the slurry metering system is not delivering material to the mixer.

Mix lime slurry and aggregate in a twin shaft, pugmill type mixer. The mixer must produce a homogeneous mixture of coated aggregates at mixer discharge. When the aggregate treatment operation stops for more than one hour, clean the treatment operation of partially treated aggregates and lime.

VI. Dry Lime Treatment of HMA Aggregates

Dry lime treatment of HMA aggregates consists of treating aggregates with hydrated lime. Lime may be added to the aggregate as a dry ingredient. After treating with lime, mix the aggregate in a batch plant or a continuous mixing plant.

The dry lime totalizer must not register when the dry lime proportioning device is not delivering material to the mixer.

A. Dry Lime Treatment with Marination

If treating aggregate with marination, treat aggregate by individual sizes and transfer them directly from the treatment mixer to marination stockpiles.

B. Continuous Mixing Plants

Before treating, combine aggregate in compliance with the JMF. Treated material mixed in continuous mixing plants must meet these specifications:

1. Proportion hydrated lime by weight. Determine the weight with a conveyor scale.
2. At the time of mixing the dry lime and aggregate, the aggregate moisture content must be enough to assure the complete coating of the aggregate with lime. The aggregate moisture

- content must not cause the loss of aggregate between the point of weighing the continuous stream of combined aggregate and the dryer. Add the water needed for mixing and coating the aggregate before the point of aggregate weight determination at the conveyor scale.
3. The production controller must capture the weight of the blended aggregates after all additional water has been added to the mixture. Data from the following must be used by the production controller to determine the amount of dry lime to be added to the treatment process:
 - Output from the aggregate conveyor scale.
 - Input from the target dry lime content.
 - Input from the aggregate moisture content.
 - Output from the dry lime conveyor scale.
 4. Determine the aggregate moisture content when the aggregate is weighed on the aggregate conveyor scale. This determination must be frequent enough to control the dry lime to aggregate ratio.
 5. If the lime treated aggregate is used in an HMA plant, the plant must be equipped with a baghouse dust system. Return material collected in the dust system to the mix.
 6. The conveyor scale for the combined aggregate and the dry lime conveyor scales must be interlocked so that the feed rates of the aggregates and dry lime are adjusted automatically at all production rates and production rate changes to maintain the target lime ratio. The plant must not be operated unless this automatic system is operating and in good working condition.
 7. Mix dry lime, aggregates and water with a twin shaft, pugmill type, continuous mixer. The mixer must produce homogeneous, thoroughly and uniformly coated aggregates at the mixer discharge. When the aggregate treatment operation stops for more than one hour, clean the treatment operation of partially treated aggregates and lime.

C. Batch Mixing

1. Lime-treating HMA aggregates at a batch mixing plant must be a continuous and separate operation. Use a separate controller, a conveyor scale for the lime, and a conveyor scale for the aggregate.
2. Proportion lime, control moisture, and control proportioning, all as specified for “Continuous Mixing Plants” in Chapter 2, VI-B.
3. When the aggregate treatment operation stops for more than one hour, clean the treatment operation of partially treated aggregates and lime.
4. Mix aggregate, lime, and water as specified for “Continuous Mixing Plants” in Chapter 2, VI-B.

VII. Liquid Anti-strip

Proportion liquid anti-strip (LAS) and add it to the asphalt binder at the HMA plant before using the binder in HMA production.

The HMA plant must have a sampling device in the feed lines connecting LAS storage to the LAS metering system. The sampling equipment must comply with “Sampling” Chapter 2, II-A.

A. LAS in Batch Plants:

1. Proportion LAS by weight using either a Coriolis effect type meter or a container scale.
2. The plant batch controller must operate automatically and comply with “Batch Mixing HMA Plants” in Chapter 2, II-F. The automatic batch controller must produce a log of batching data. The log consists of actual weights for each ingredient in the batch throughout production. Collected batch data must be stored by the plant controller for the duration of the contract.
3. LAS proportioning must be an integral part of the plant batching control equipment.
4. Zero tolerance for the LAS container scale is ± 0.01 percent of the asphalt binder batch weight.
5. The indicated LAS scale weight may vary from the preselected weight setting by up to ± 0.02 percent of the asphalt binder batch weight.
6. Dispense LAS into the stream of asphalt binder as it enters the pugmill.
7. If a container scale is used, weigh LAS before combining with asphalt binder. Keep the container scale separate from other ingredient proportioning. The container scale capacity must be no more than twice the volume of the maximum LAS batch size. The container scale’s graduations must be smaller than the proportioning tolerance or 0.001 times the container scale capacity.

B. LAS in Continuous Mixing Plants:

1. Proportion LAS by mass, and add it to the asphalt binder in the production stream between the asphalt binder proportioning and the asphalt binder addition to the aggregate. The plant must comply with “Continuous Mixing HMA Plants” in Chapter 2, II-H. The plant controller must produce a log of production data. The log consists of actual weights for each ingredient in the batch at five-minute intervals during production. Collected batch data must be stored by the plant controller for the duration of the contract.
2. Proportion LAS with a mass-flow, Coriolis effect type meter. The meter must be of the appropriate size for the intended flow. Locate the transmitter and the indicator for the meter where the HMA proportioning operations are controlled. Provided a display that indicates the meter set points.
3. The LAS totalizer must not register when the metering system is not delivering LAS to the mixer.
4. The LAS meter must be interlocked with the other scales, meters, and proportioning devices to maintain the LAS content specified in the accepted JMF. The LAS content must be within ± 0.02 percent of the accepted JMF. Do not operate the plant unless this automatic system is operating and in good working condition.

VIII. Cement Treated Bases

Cement treated bases must comply with Section 27, “Cement Treated Bases,” of the *Standard Specifications*.

IX. Lean Concrete Bases

Lean concrete bases must comply with Section 28, “Lean Concrete Bases,” of the *Standard Specifications*.

X. Bituminous Seals

Bituminous seals must comply with Section 37, “Bituminous Seals,” of the *Standard Specifications*. If reference is made to CT 109, use the MPQP chapter “Material Plant Calibration and Dynamic Testing.”

Chapter 3—Material Plant Calibration and Dynamic Testing

I. Scope

This chapter consists of procedures to test, calibrate, and accept proportioning devices, including material plant scales and meters.

II. Testing and Accepting Weighing and Measuring Devices

A. General

This procedure identifies Caltrans' requirements for material plants that supply construction materials to Caltrans projects. A material plant is a combination of devices that produce construction materials. The district weights and measures coordinator (WMC) oversees the testing and inspecting of material plants. It is not the responsibility of any Caltrans employee to direct the producer's operation or to operate any controller or proportioning device connected with material production.

Inspect each device or procedure specified for material production that may affect mix quality. Use a plant checklist for the plant type in question. The WMC provides standardized inspection checklists.

B. Dynamic Testing

Dynamic testing tests plant functionality during production and is an integral part of the MPQP.

Perform dynamic testing before acceptance of the equipment's accuracy.

1. Dynamic Testing of Batch Plants

Dynamic testing of batch plant proportioning devices includes:

- Interlocks—Review individual batch weights to ascertain batch controller performance for interlock tolerances. The controller must batch within the specified zero tolerances and draft cutoff tolerances for the product being produced.
- Material Leakage—Material leakage that would alter the measurement accuracy must not occur. Material leakage from batch bins may be determined by holding a batch weight for a short time to see if the indicated weight changes. The “weight inspect” feature of the batch controller must stop the batch process long enough to see if material is leaking from the gates.
- Batch Ingredient Ratio, HMA—Use actual batch weights to calculate ingredient ratios. The binder content is a percent of the dry aggregate, not of the total mix. The batch controller must be programmed to deliver the correct binder ratio.
- Batch Ingredient Ratio, PCC—Use recorded batch data to calculate the ingredient ratios. These ingredient ratios must be within specified tolerances.
- Batch Lockout—During an interval of 30 minutes or more, observe and note the percentage of batches in which one or more drafts are outside the specified zero or cutoff tolerances. Specifications do not allow the acceptance of a batched ingredient draft that is out of tolerance unless corrected by removing or adding material.

- Device Functionality—During mix production, note the functionality of these items: thermometers, silo cutoffs, load-ticket generation, surge batchers, waste-mix handling, moisture meters, and cold-feed control.
 - Weight Certificates—Review the printing of ingredient batch weights on the mix weight certificates. The actual as-batched ingredient weights must be printed on the weight certificates as specified. Design or theoretical weights are not acceptable as batch weights.
 - Aggregate Moistures—Check that aggregate moistures are being calculated as a percent of the dry aggregate.
2. Dynamic Testing of Continuous Mixing Plants

Dynamic testing of continuous mixing plant proportioning devices includes:

- Continuous Ingredient Ratio—During plant operation at the planned production rates, the plant controller must maintain the correct ingredient ratios. Observe the rate and total for the aggregate being used, and compare it with the rate and total for the binder. The time needed to check the plant controller functionality differs depending on the plant production rate, but the minimum timed test must be at least ten minutes. Incorrect ingredient ratios indicate a need for a recalibration of individual proportioning devices or a problem with the plant controller blending capabilities.
 - Moisture Correction—Determine whether the aggregate moisture system is functioning properly. If there is a separate indication of wet aggregate delivery, compare it to the dry aggregate delivery displayed on the plant controller.
 - Multiple Indication—If like ingredients have multiple indicators, see that the multiple indicators are within specifications. Discrepancies on multiple indicators for the same material delivery indicate proportioning process mismanagement.
 - Material Leakage—Ingredient leakage must not occur after measurement. Material leakage is determined by visual inspection. Material leakage and, conversely, material storage after measurement are detrimental to continuous proportioning accuracy.
 - Device Functionality—During mix production, note the functionality of the required devices and procedures, including these items: thermometers, silo cutoffs, load ticket generation, surge batchers, wasted mix handling, low-flow and no-flow interlocks, material mixing, mix handling, moisture control, and cold-feed control.
3. Dynamic Testing of Volumetric Proportioning Systems

Observe the production process using the calibrated ingredient delivery rates.

Rapid strength concrete special provisions require follow-up and spot testing adequate for the required dynamic testing.

C. Proportioning System Calibration and Acceptance

Perform a pre-test inspection of the weighing and measuring system and controls:

1. Note and record the model number, serial number, and manufacturer's name.
2. Determine whether the device, system, or control has been either type-approved for commercial use in the State of California under the requirements of DMS or tested and approved previously by the Division of Construction. An approved list of weighing and

measuring devices, systems, and controls, including HMA continuous mixing plants, is maintained by the Division of Construction.

3. Do not perform the MPQP certification if the device, system, or control is not currently approved.
4. Ascertain whether the indicating and recording elements are compatible with their intended use and are located properly.
5. Make a visual inspection of the device's details. Any faulty condition affecting the plant functionality that can be detected visually must be corrected before continuing with the MPQP certification.

D. General Device Testing

The MPQP certification is completed by checking fixed points such as intermediate points during a buildup test or corner loading on a batch weigh hopper. The total test load or throughput must be at least equal to the intended operating capacity.

If an automatic batching system with remote indicators is used, these remote indicators become the primary indicators.

Commercial class test weights and volumetric liquid provers must be compared to California state standards and certified by an authorized representative of the DMS. These standards must comply with the specifications and tolerances for commercial standards established by the National Institute of Standards and Technology. This comparison must be performed at least once every five years.

The producer must provide the access, modifications, special equipment, and labor necessary to perform the inspection and testing. The WMC witnesses the testing including witness scale error testing and records the necessary information on form CEM-4201, "MPQP Report—Slurry Seal Mixer Truck Calibration." A copy of the form must be sent to the Division of Construction, immediately. Another copy must be furnished to the producer and the resident engineer. The WMC attaches CEM-4204, "MPQP Acceptance Sticker," on each proportioning device found to be accurate by the testing and after successfully completing the dynamic testing and plant inspections.

Upon witnessing acceptable accuracy of the device, the WMC seals the adjusting elements that change the measuring device's accuracy.

Interlock settings must be tested for accuracy.

Written manufacturer's operating instructions must be available at the control panel of each automatic batching or continuous mixing control system. These instructions must contain the procedure for checking interlock tolerance settings and a means for determining span-adjustment settings for computerized controls. If automatic controllers are used, the instructions must contain a detailed procedure for setting controller parameters that comply with Caltrans specifications.

A buildup test complying with "Device Testing and Calibration" below may be used in conjunction with test weights to check a hopper scale or vehicle scale's high range. When a buildup test is required, the producer must obtain the WMC's authorization of the intended buildup method to be used before testing.

Attachments to the scale or meter that are necessary for material production must be attached during weighing system accuracy testing.

III. Procedure for Hopper Scales

A. General

The maximum allowable error for hopper and tank scale testing is two scale graduations.

Test and calibrate scale-mounted tanks used to weigh liquids in compliance with the specifications for scale-mounted hoppers used to weigh dry ingredients.

B. Inspection

Inspect the scale for compliance with “Testing and Accepting Weighing and Measuring Devices” in Chapter 3, II.

Inspect the weigh system load cells. In multiple load-cell applications, the load cells must be of the same value on the same device. Load-cell values must be appropriate for their intended use.

C. Testing Equipment

Supply at least 25% of the scale capacity in DMS-certified test weights.

If automatic batch controllers are used, the producer must provide an electronic load-cell simulator to facilitate controller interlock testing. The load-cell simulator must have a range and sensitivity compatible with the device being tested.

D. Device Testing and Calibration

1. General

Check indication oscillations. The maximum oscillation is two scale graduations.

Set the zero-load balance after the scale testing equipment is installed.

For dial mechanical indicators:

- a. Lock the dial and release the locking mechanism. The indicator must return to zero, even if the action is repeated.
- b. Lock the dial and shake the hopper or tank. After releasing the locking mechanism, the indicator must return to the starting point.

2. Buildup Test

If there are not enough test weights available or the means to hang the required test weights to achieve full capacity, the contractor must provide an acceptable means of building up or substituting other weight.

For hopper scales, the buildup method replaces a portion of the test weight with aggregate or another product used during production:

- a. Hang available test weights to at least one-fourth of the scale’s operational capacity, and calibrate the scale system to this known weight.
- b. Remove the known weight, and replace it with a weight of material in the hopper equal to but not in excess of test load of known weight.
- c. Add the known weight again to the built-up weight. Repeat as necessary to attain capacity. The total buildup weight may not exceed three times the known weight.

E. Report and Security Seal

After a successful test of proportioning devices, the recorded span adjustment settings will be made available to the contractor, the plant inspector, and the resident engineer. The WMC applies security seals under “Security Seal” in Chapter 2, I-A.

IV. Procedures for Liquid Metering

A. General

If the liquid meter system includes a separate, stand-alone controller, this controller must be the only controller used for liquid meter testing and calibration. The calibration procedure must be separate from the main plant controller’s calibration procedure. After the successful testing of the separate, stand-alone controller, the main plant controller must be adjusted to exactly track the calibrated, stand-alone controller.

If the meter does not self-calibrate, the main plant controller must be used for the liquid meter testing and calibration.

The meter manufacturer’s name and model number must be on the device identification plates. For multiple part meters, this identification must be on the meter proper and the meter transmitter. A copy of the DMS-approved type approval must be submitted with the meter.

The liquid meter must comply with “Liquid Measurement” in Chapter 2, I-C and “Testing and Accepting Weighing and Measuring Devices” in Chapter 3, II.

1. Meter by Weight

A mass-flow meter is a device that measures the flow of liquids by weight. This device records and indicates the weight of liquid passing through it without input of the liquid’s temperature or specific gravity.

2. Meter by Volume

A volume meter is a device that measures liquid volumetrically. The device records and indicates the volume of liquid throughput. This measurement must be manually converted to weight and may require the input of the liquid’s temperature and specific gravity.

B. Inspection

Meter installations must be inspected visually for proper connections and conditions before tests for accuracy are performed. The meter installation must comply with the meter manufacturer’s instructions, a copy of which must be furnished to the WMC.

C. Testing Equipment and Provisions

1. General

Test the liquid meter at the material-production site under normal operating and environmental conditions. Reschedule the testing when weather conditions cause the witness scale indicator to fluctuate more than three graduations.

The metering systems at HMA plants must be operated in the circulate mode for at least 15 minutes just before testing and calibration to heat and fill the system.

Test drafts must be weighed on a witness scale at the proportioning plant. Witness scale error testing must be performed with test weights complying with “General Device Testing”

in Chapter 3, II-D and must produce a witness scale within two graduations of the test weight load.

For the calibration procedure, the producer must provide a suitable container capable of receiving the full flow of material delivered from the meter for the size of the required test draft. Meter installation must be plumbed to facilitate the diversion of the test draft to the container. The meter system must not leak calibration liquid or air. If testing material is lost during the calibration run between the liquid storage and test weight determination on the witness scale, cancel the testing until it is corrected. Any physical change of the meter system requires a restart of the calibration procedures.

Product flow rates used during device testing must be commensurate with anticipated production flow rates. Specifications for minimum test draft size, witness scale capacity, and witness scale graduations must comply with Table A, "Meter Testing Extremes," in the Appendix.

The device plumbing must allow the resident engineer to clearly ascertain that none of the liquid passing through the meter during calibration is diverted before entering the test draft container.

2. Tank Scales

Some plant configurations include a scale-mounted tank for calibration. This tank may be used as the witness scale if it meets the specifications in Table A and other specifications for witness scales and calibration containers in this MPQP.

3. Provers

A "prover" is a calibrated vessel with test draft capacity as specified in Table A. Provers must comply with DMS requirements. The prover must be maintained in a level position throughout the test run.

D. Device Testing and Calibration

1. General

A rate meter is a digital display of the speed of the operation in units such as tons-per-hour or gallons-per-minute. A totalizer is a digital display of the amount in units such as tons or gallons delivered at any time. Check the rate indicator against the totalizer's indicator for an interval of at least one minute. Time the interval with a stopwatch. The indicated rate must track the rate determined from the totalizer.

Before starting the meter calibration, send calibration liquid through the system to bring the calibration path to an as-used condition. Leave the system at the same degree of "empty" for all test runs. This exercise will ensure the meter system is in the same condition for all of the test runs, including the first one. Reset the totalizer to zero and re-tare the calibration container before the start of each calibration test run.

Hoses, ropes, and other paraphernalia on or hanging from the calibration container may affect the weighing accuracy of the test draft. If fill hoses are left attached to the calibration container during the weighing process, the witness scale may require error testing again after the hoses have been softened by the hot asphalt.

Record the meter's span number (calibration constant) for each test in the series. Each series of tests consists of at least three runs. Each calibration run size must comply with Table A, "Meter Testing Extremes," in the Appendix or the large draft option. Calibration flow rates must be commensurate with flow rates anticipated during production.

If the liquid is used in an HMA mixture, apply the asphalt binder content from the proposed job-mix formula to the aggregates flow rate to determine asphalt binder flow rate. In the case of lime slurry treatment of HMA aggregates, apply the ratio of lime slurry to aggregate.

Read the meter totalizer with the indicator at rest. Totalizer readings must not be made on the fly. The meter totalizer indicator must start from zero, return to zero, or both and must not advance its indications before material delivery.

At the individual test run's end, as indicated by the process controller, log the amount measured by the meter, the value from the meter totalizer, or the weight delivered. Compare the meter indication for the measured liquid for any individual test run with the weight determined by weighing the measured liquid on the witness scale. Make determinations of accuracy by comparing metered results with actual results from the witness scale.

Calculate error with the formula $E = A - M$, where $E = \text{error for the run}$, $A = \text{the actual weight of the liquid as determined on the witness scale}$, and $M = \text{the weight of the liquid as determined by the meter}$.

Determine the percentage error with the formula $\%E = (E/A) \times 100$

Average error for the device is the combined percent error for three sequential runs divided by three. If the metering device is adjusted before completion of the three calibration runs, the test is aborted, and a new series must be initiated. Error limits must comply with Table A in the Appendix.

2. Large Draft Option

At the option of the producer, a large draft calibration test may be used. The minimum test draft must be 1000 gallons. The large draft option requires a vehicle scale located at the proportioning plant as the calibration witness scale. Error-test the vehicle scale with test weights. The minimum graduation of the vehicle scale's indicator must not be greater than 0.01 tons.

3. Small Draft Option

If the witness scale has a maximum capacity of 5,000 pounds and a maximum graduation of one pound, the material producer may choose to use a 300-gallon test draft instead of the required 1,000-gallon test.

4. Buildup Method

A buildup method may be used to error-test the witness scale capacity in excess of 25 percent of its operational limit. Error testing must produce a witness scale that is accurate to within two graduations of the test weight load. A newly error-tested witness scale does not have to be re-tested for a period of seven days if it remains isolated from uses outside of the device calibration.

V. Procedure for Conveyor Scales

A. General

Type approval by DMS is not required for conveyor scales. This procedure applies to all conveyor scale installations.

B. Inspection

Identify the manufacturer’s name and model number on the model identification plate.

Protect the weighbridge and the conveyor at the weighbridge from the wind and weather.

Install in accordance with the scale manufacturer’s instructions. Submit a copy of the instructions to the WMC.

Position the conveyor’s incline to prevent material slippage along the conveyor during operation.

Construct undersupports for conveyor scale-bearing points to comply with “Scale Undersupports” in Chapter 1, III-B.

C. Test Equipment and Provisions

Test the conveyor scale at the material-production site under normal operating and environmental conditions. Reschedule the testing when weather conditions cause the witness scale indicator to fluctuate more than three graduations.

Restart of the calibration procedures for any physical change of the conveyor scale. Changes that trigger retesting the device include any of the following:

1. A component of the conveyor or conveyor scale is changed, adjusted, or altered.
2. The conveyor incline angle is changed.
3. The physical location of the conveyor scale is changed.

If the conveyor has been idle for a period of two hours or more, run the conveyor in an empty mode for not less than 25 minutes before the start of testing.

For the calibration procedure, the producer must provide a suitable container capable of receiving the full flow of material being delivered from the conveyor scale. This calibration container must be readily portable.

If the testing material leaks or is lost during the calibration run at any place between the weighbridge and determining the test weight on the witness scale, cancel the testing until it is corrected. The testing procedure must not lose excess product into the atmosphere.

The producer must designate the maximum production speed for the device being tested. The successfully tested calibration speeds become the production speed limits. Intermediate testing ranges, as applied to the maximum production speed, must comply with Table B, “Conveyor Scale Testing Extremes,” in the Appendix.

D. Device Testing and Calibration

For calibration, use either pre-weighing or post-weighing the testing material on the witness scale. When a pre-weighed test load is passed over the conveyor scale, examine the conveyor-loading hopper before and after the test to assure that all the material used for the calibration

check actually passed over the conveyor scale. For batch plants or continuous mixing plants, it may be necessary to process calibration material through the system to bring the calibration path to an as-used condition. If bringing the path to an as-used condition, run the system to the same degree of “empty” for each test run.

Before starting the calibration procedure, conduct a zero-load test, and calibrate the conveyor scale to the manufacturer’s recommendations. Set the zero-load condition with the conveyor in motion and with all necessary attachments for normal operation in place. If zero creep is present, it must be self-compensating with positive readings compensating for negative readings.

The calibration medium must be the same type of material to be used in production.

The plant must be equipped to make the accuracy check before the a project’s first operation and when the resident engineer directs. The witness scale must be located at the plant and must comply with Table B. Error-test the witness scale with test loads of known weight. You may use a buildup method to check the scale capacity in excess of 25 percent of its operational limit. Error testing must produce a witness scale accurate to within two graduations of its calibration test weight including any buildup weight. A newly error-tested witness scale does not have to be re-tested for a period of seven days if it remains isolated from uses outside the device calibration.

A computer-controlled production plant normally displays the input settings for the numerical security seal (span number) digitally. The plant manufacturer must supply instructions for how to display and calibrate the adjusting element span numbers. The Division of Construction is responsible for accepting each proportioning system and supplying the inspection instructions. If the adjusting elements do not produce a numerical security seal (span number), the device must be left in a secure condition by placing a physical security seal by the WMC. Refer to “Security Seal” in Chapter 2, I-A.

Compare the rate indicator with the totalizer indicator for several intervals of at least one minute. Time the interval with a stopwatch. Check the current specifications for the product being produced to determine the maximum allowable error for like indicators.

If the conveyor scale system includes a separate, stand-alone controller, it must be the only controller used for the conveyor scale’s testing and calibration. The calibration procedure must be separate from the main plant controller. After the successful testing of the separate, stand-alone device, the main plant controller must be precisely adjusted to track the calibrated proportioning device. If the conveyor scale is not supplied with the means of self calibration, the main plant controller is used for the conveyor scale testing and calibration.

If the material-production rate exceeds 400 tons per hour, you may perform a high-speed calibration consisting of two two-minute runs for each calibration rate greater than 400 tons per hour. The average error for each pair of runs must not exceed 1.0 percent. This average high-speed error must be used as the high-speed result.

Record the span-adjustment setting and zero the conveyor scale’s totalizer before each test run. Divert the test flow of calibration material into the calibration container at each of the designated rates. Each series of tests must consist of at least three runs using the rates required in Table B, “Conveyor Scale Testing Extremes,” in the Appendix. Determine the empty weight (tare) of the calibration container at the start of each test run. If any material is lost during the test run, start the test run over.

Divide the difference between the weight accumulated on the conveyor scale totalizer (metered) and the weight indicated on the witness scale when the calibration container is weighed (actual) by the actual weight to determine the percent error for the calibration run. The average percentage error for the three test runs is the sum of the deviations of the three individual test runs divided by three. If the device is adjusted before completion of the three calibration runs, the test is aborted, and a new series must be initiated. Device error must be within the limits expressed in Table B, "Conveyor Scale Testing Extremes," in the Appendix.

VI. Procedures for Volumetric Proportioning Plants

A. *Volumetric Rapid Strength Concrete Proportioning*

1. General

Volumetric Rapid Strength Concrete (RSC) batch mixer trucks proportion aggregate and cement by volume. The delivery rates of aggregate and cement per revolution of the aggregate feeder must be calibrated at appropriate gate settings for each batch mixer truck used and for each ingredient source.

Determine that the batch mixer trucks comply with applicable specifications before starting calibrations. Cover any rotating and reciprocating equipment on batch mixer trucks with metal guards.

2. Testing Equipment and Provisions

Calibration tests for cement and aggregate proportioning devices must be conducted with a platform scale located at the calibration site. This platform scale must have a maximum capacity not exceeding 2.5 tons with maximum graduations of 1.0 pound.

Perform witness scale error testing with test weights conforming to this MPQP to produce a witness scale that is within two graduations of the test-weight load. The scale and equipment needed for the calibration of proportioning systems must be available for use at the production site during production.

The batch mixer truck must allow an accuracy check to be made before the first operation and when directed by the resident engineer. After production begins, calibrate the proportioning devices every 30 days. If the source or type of any ingredient is changed, calibrate the proportioning devices. A spot calibration consists of calibrating the cement-proportioning system only. Perform a two-run spot calibration each time 50 tons of cement passes through the batch mixer truck. If the spot calibration falls outside the specifications, complete a full calibration before resuming production.

Ingredient indicators must work before starting proportioning and mixing and must be visible when standing near the batch mixer truck.

3. Device Testing and Calibration

For aggregate proportioning, calibrate batch mixer trucks at three different aggregate gate settings commensurate with production. Use two or more calibration runs for each of the different aggregate gate openings. The deviation for any individual aggregate belt feeder delivery rate check run must not exceed 1.0 percent of the mathematical average of all runs for the same gate opening and aggregate type. Each test run must be at least 1,000 pounds. Do not reuse fine aggregate for device calibration.

For cement proportioning, the delivery deviation of the cement-proportioning system for any individual delivery-rate check run must not exceed 1.0 percent of the mathematical average of three runs of at least 1,000 pounds each. Do not reuse cement for device calibration.

Proportion water with a meter. Test and approve the meter under “Procedures for Liquid Metering” in Chapter 3, IV. The water meter must be equipped with rate-of-flow indicators to show the delivery rate and a resettable totalizer to determine the total of water introduced into the mixture. The totalizer must not register when the water metering system is not delivering water to the mix.

Proportion liquid admixtures with a meter. This meter must be tested under “Procedures for Liquid Metering” in Chapter 3, IV.

4. Ingredient Certificate of Compliance

Submit a Certificate of Compliance under Section 6-1.07, “Certificates of Compliance,” of the *Standard Specifications* with each delivery of aggregate, cement, and admixtures used for calibration tests. Submit the certificate to the resident engineer with a certified copy of the weight of each delivery. The Certificate of Compliance must state that the materials source used for the calibration tests is from the same source used in the planned work. The Certificate of Compliance must affirm the material supplied complies with the specifications and must be signed by an authorized representative who has the authority to act for the producer.

B. Volumetric Pavement Seal Proportioning

1. General

Slurry seal mixer-spreader trucks proportion aggregate and emulsion by volume. The delivery rates of aggregate and emulsion per revolution of the aggregate feeder must be calibrated at appropriate gate settings for each mixer-spreader truck used and for each aggregate source before the first slurry seal production and at least once every six months during production.

Determine that mixer-spreader trucks comply with the requirements of Section 37, “Bituminous Seals,” of the *Standard Specifications*, this MPQP, and all applicable special provisions. Cover rotating and reciprocating equipment on mixer-spreader trucks with metal guards. Be very careful around mixer spreader trucks since they are constantly moving.

2. Testing Equipment and Provisions

Calibration tests for ingredient proportioning devices must be conducted with an error-tested vehicle scale. This witness scale must be located within three miles of the aggregate stockpile.

Equip the mixer-spreader truck for the accuracy check.

Ingredient indicators must be in working order before beginning proportioning and mixing operations and must be visible when standing near the mixer-spreader truck.

3. Device Testing and Calibration

- a. Aggregate Conveyor Rate Determinations—Pre-weigh a loaded truck and run at least three tons of aggregate from the truck-mounted hopper over the belt and through the pugmill. Register the number of counts on the aggregate belt-feeder revolution counter.

Determine the number of dry pounds of aggregate delivered to the pugmill per unit of the aggregate belt-feeder revolution counter.

Reweigh the truck after the test run, divide the net weight change by the revolutions counted, and reduce the results by the moisture content of the aggregate to obtain a dry pounds of aggregate per revolution.

Continue this operation for a total of three runs at the approximate gate setting to be used during the production of slurry seal. These three test runs must not deviate from their combined mathematical average by more than 2.0%.

After using the above procedure to establish belt-feeder delivery consistency, run two more runs that bracket the initial delivery rate.

An alternate aggregate calibration option is to capture the material leaving the mixer-spreader truck, without loss, and deposit it into a container.

- b. Emulsion Pump Rate Determination—Use the witness scale as setup for the aggregate test.

Pre-weigh a mixer-spreader truck, empty of aggregate and loaded with emulsion. Run at least 1,200 gallons from the truck-mounted emulsion storage, through the emulsion pump, and into separate tank. The aggregate belt-feeder must run in an empty mode to make the aggregate belt-feeder revolution counter functional. Register the number of counts on the counter.

Reweigh the mixer-spreader truck after the test run, divide the net weight change by the revolutions counted, and reduce the results for temperature correction to obtain a corrected pounds of emulsion per unit of the aggregate belt-feeder revolution counter.

Continue this operation for a total of three runs at the approximate emulsion rate to be used during the production of slurry seal. None of these three runs must deviate from their combined mathematical average by more than 2.0%. The average of the results produced by these three test drafts will be used for the emulsion pump rate determination for use in operational calculations.

If the producer elects to use a variable rate emulsion pump, continue the test with the following procedure: after using the initial three test drafts to establish the emulsion pump delivery consistency, run two more runs that bracket the initial delivery rate.

The emulsion pump and all plumbing must be free of leaks.

Appendix

Calibration and Production Error Limits

Table A—Meter Testing Extremes

Meter Size	Size Designation	Minimum Test Draft	Witness Scale Maximums		Maximum Individual Error*	
			Capacity	Graduation	Asphalt, LAS, Lime Slurry, Epoxy HMA Admixtures	Water
≤ 0.50"	Very Small	50 lb.	100 lb.	0.1 lb.	±0.5%	±1.5%
0.51" - 0.99"	Small	200 lb.	500 lb.	0.5 lb.	±0.5%	±1.5%
1.00" – 1.49"	Medium	2,500 lb.	5,000 lb.	1.0 lb.	±0.5%	±1.5%
≥ 1.50"	Large**	8,500 lb.	80,000 lb.	20.0 lb.	±0.5%	±1.5%

* Meters used for proportioning at continuous mixing HMA plants and lime slurry treatment plants must be accurate to within 0.5% of the test load for an average of three test runs and no individual test run error may exceed 1.0% of the test load.

** Refer to Chapter 3, IV-D, 2-3, "Device Testing and Calibration, Large Draft Option and Small Draft Option."

Table B—Conveyor scale Testing Extremes

Product		Maximum Error		Test Size Minimum	Witness Scale Maximums		Approximately Operational Testing Range
		Average	Individual		Capacity	Graduation	
Agg, HMA	agg	1.0%	2.0%	3 min.*	40 tons	20 lb	***
	dust	1.0%	2.0%	15 min.	5,000 lbs.**	1.0 lb	***
Lime, Marinate	agg	1.0%	2.0%	3 min.*	40 tons	20 lb	***
	lime	1.0%	2.0%	1,000 lbs.	5,000 lbs.**	1.0 lb	***
Lime, Dry	agg	1.0%	2.0%	3 min.*	40 tons	20 lb	***
	lime	1.0%	2.0%	1,000 lbs.	5,000 lbs.**	1.0 lb	***
All Other	> 100 tph	1.0%	2.0%	3 min.*	40 tons	20 lb	***
	11-100 tph	1.0%	2.0%	1,000 lbs.	5,000 lbs.**	1.0 lb	***
	< 10 tph	1.0%	2.0%	100 lbs.	250 lbs.**	0.1 lb	***

* Use a three-minute or longer calibration run unless the calibration rate exceeds 400 GPH.

** The witness scale size for baghouse dust will depend on the amount of material delivered during the 15-minute test run.

*** Producer designates the maximum and minimum rate per Chapter 3, V-C, "Test Equipment and Provisions." The low rate must be ≤ 30% of the maximum rate. The mid rate must be approximately 60% of the maximum rate.

**State of California Department of Transportation
Division of Construction
Office of Construction Engineering, MS44
P.O. Box 942874
Sacramento, California 94274-0001**