

Section 9.2 Volume II

CONCRETE PRODUCTION FACILITIES GUIDE

9.2.1 PURPOSE

This guide establishes the Florida Department of Transportation policies governing the production of concrete for use by the Florida Department of Transportation, herein after called the Department. The guide also provides the concrete producer with information related to the methods and the minimum requirements for Quality Control Programs (QCP), and the criteria by which the Department will maintain that acceptance.

9.2.2 AUTHORITY

Code of Federal Regulations (CFR), Federal-Aid Policy Guide (FAPG), Subchapter G – Engineering and Traffic Operations, Part 637 – Construction Inspection and Approval, Subpart B – Quality Assurance Procedures for Construction Sections 334.044(2), 334.044(10)(a), and 334.048 Florida Statutes.

9.2.3 SCOPE

Principal user of this document is the Concrete Producer.

9.2.4 GENERAL INFORMATION

Concrete production facilities that supply concrete to Department projects must have a QCP accepted by the Department in accordance with the ***Florida Department of Transportation Specifications, Section 105***. A list of concrete production facilities, herein after called plants, with accepted QCPs that meet the requirements of this guide, will be maintained by the Department.

Concrete produced in accordance with the ***Florida Department of Transportation Specifications, Section 346*** and this guide shall be accepted based upon proper certification and verification of job site acceptance criteria.

Methods of sampling and testing materials shall be in accordance with the

Florida Department of Transportation Specifications, Section 346.

Reference to the sampling and testing methods shall be construed to mean the most current issuance, including interims or addenda.

The Department will inspect the plants every three months or less. The concrete producer may request a reduced scheduling frequency for the plant inspections to the District Materials and Research Engineer (DMRE). The reduced scheduling frequency shall be based on the plant coefficient of variation ($C_v = \sigma/\mu$: σ =standard deviation; μ =mean), previous plant inspections, failing samples attributed to the production facility, and a request from the producer. Upon meeting all criteria the plant may be changed to a reduced inspection frequency. If approved by the DMRE, the inspection frequency shall be a minimum frequency of once every six (6) months or less. These inspections will assist in ensuring the plant continues to produce a material that is in accordance with the accepted QCP, Specifications, and other Contract Documents.

9.2.5 REFERENCES

American Society for Testing and Materials (ASTM) Standard Test Methods and Specifications, Philadelphia, Pennsylvania

American Association of State Highway and Transportation Officials (AASHTO), Part II Tests, Washington, D.C.

Florida Department of Transportation Standard Specifications for Road and Bridge Construction.

Qualified Products List, Florida Department of Transportation

Field Sampling and Testing Manual, Florida Department of Transportation

9.2.6 CONCRETE PRODUCERS ROLES AND RESPONSIBILITIES

9.2.6.1 MATERIAL REQUIREMENTS

Meet the following requirements found in the Specifications:

Coarse Aggregate	Section 901
Fine Aggregate	Section 902
Portland Cement	Section 921
Water	Section 923
Admixtures	Section 924
Pozzolans and Slag	Section 929

Use materials containing no hard lumps, crusts, frozen matter, or that are not

contaminated with dissimilar material.

9.2.6.1.1 CEMENTITIOUS MATERIALS

Acceptance of the cementitious materials at the plant shall be based upon the delivery ticket and Mill Certificate. As a check on current quality, samples may be obtained and tested by the Producer or the Department.

Each brand or type of cementitious material shall be stored in a separate and clearly labeled weatherproof facility. Suitable, safe, and convenient means of collecting cementitious material samples will be provided.

Measure the cementitious materials by mass within an accuracy of 1% of the required amount, per component material. For concrete batches of 3 yd³ or less, an accuracy of 2% is allowed. Weigh the cementitious materials separately from other materials. When weighing the cementitious materials in a cumulative weigh hopper, weigh the cement first.

If bagged cementitious material is permitted, proportion the batch to use only whole bags. Store the silica fume, metakaolin and ultra fine fly ash in accordance with the manufacturer's recommendation.

9.2.6.2 AGGREGATES

Aggregate used on Department projects must be accordance with **Rule 14-103, FAC**. A list of approved sources will be maintained by the Department and made available from the State Materials Office (SMO).

As minimum suitable bins, stockpiles or silos will be provided to store and identify aggregates without mixing, segregating or contaminating the different sources or grades. Department of Transportation designated, approved pit number and aggregate grade shall be include in the Identification.

Aggregates shall be measured by mass or volume within an accuracy of 1% of the required amount.

Handling the aggregates so as to minimize segregation and recover material from the stockpile for use in the mix so it will remain within Specification limits is the responsibility of the concrete producer. Stockpiles shall be maintained in a well drained condition to minimize free water content and to not promote algae/fungal growth. The plant shall make available to the Department, from the recovery side of the stockpile where feasible, the quantities of aggregate necessary for sampling and testing to ensure compliance with the Specifications and other Contract Documents.

9.2.6.2.1 WETTING COARSE AGGREGATE STOCKPILES, STORAGE BINS AND SILOS

The coarse aggregate shall be continuously and uniformly sprinkled with water for a period of 24 hours immediately preceding introduction into the concrete. Any request for deviations from the 24-hour sprinkling requirement shall be addressed in the Producer's QCP for consideration by the DMRE.

9.2.6.3 Admixtures

Concrete mixes shall use only admixtures approved by the Department. A certification from the admixture supplier that the admixture meets the requirements of *Florida Department of Transportation Specifications, Section 924* is required. The certification will include a statement from the admixtures' supplier or an accepted independent testing laboratory that the proposed admixture is compatible with all other admixture to be included in the concrete design mix. The admixture dosage rate of the product to be used shall be within the range of the manufacturer's technical data sheet.

Measure the admixtures by mass or volume. Use measuring equipment that has accuracy (under all operating conditions) within 3% of the quantity of admixture required for the batch. Measure each admixture separately, and add it to the mixing water in a separate sequence as the mixing water is introduced into the mix.

Store the admixtures in accordance with the manufacturer's recommendation.

9.2.6.4 SCALES AND METERS

The accuracy of all scales, meters, and other weighing or measuring devices, excluding admixture dispensers, shall be checked prior to production of concrete and once every three months thereafter, at a minimum. A qualified representative of a scale company registered with the Bureau of Weights and Measures of the Florida Department of Agriculture and Consumer Services shall conduct the check for accuracy.

The Department reserves the right to be present during all scale checks.

9.2.6.4.1 WATER MEASURING DEVICES

Water measuring devices used during batching operations will be checked for accuracy. The check for accuracy will be by weight or volume, and at least quarterly. The container used for accuracy verification must be capable of holding the maximum quantity of water normally used during the batching sequence.

If accuracy is checked by volume, the maximum capacity of the container in use must be known in gallons. To ensure accurate volume determination to the nearest 0.5 gallon, the graduation marks must be readily visible at each level checked. The accuracy of the container must be documented by a scale company registered with the Bureau of Weights and Measurements, Florida Department of Agriculture and Consumer Services.

Use of a flow meter mounted in series is acceptable provided the accuracy of the flow meter is traceable to the National Institute of Standards and Technology. The calibration device shall be checked annually for accuracy.

Measure the water by volume or weight. Whichever method is used, construct the equipment so that the accuracy of measurement is not affected by variations in pressure in the water supply line. Use a meter or weighing device capable of being set to deliver the required quantity and to automatically cut off the flow when the required quantity has been discharged. Ensure that the measuring equipment has accuracy, under all operating conditions, within 1% of the quantity of water required for the batch.

The following guidelines will apply when measuring devices are checked for conformity with accuracy requirements of the Specifications or as specified herein:

- (1) Devices will be checked up to the maximum quantity normally required for a batch.
- (2) As a minimum four-step checks will be made at approximately equal intervals. This will include the maximum quantity normally required for a batch.
- (3) The date of inspection, signature of the agency representative, observed deviations for each quantity checked and a statement that the device conforms to the Specifications and other

Contract Documents shall be included in the report provided by the qualified agency performing the check.

A copy of the report corresponding with the current certificate of inspection shall be available at the plant where the device is located.

- (4) A certificate of inspection bearing the date of certification and signed by a representative of the qualified agency shall be affixed to the measuring device.
- (5) Methods not specifically detailed above are considered acceptable if the District Materials Office (DMO) verifies compliance with the Specifications and other Contract Documents.

9.2.6.4.2 ADMIXTURE MEASURING DISPENSERS

Annual certification of admixture measuring dispenser accuracy shall be completed by the admixture supplier. Calibrate the dispensing equipment for calcium nitrite quarterly.

9.2.6.4.3 RECORDERS

Plants equipped with recording mechanisms must provide records that are clear, complete, and with permanent indications of the plants performance. Recorder information may be supplemented by the batcher during the batching operation. The Department shall be allowed to review recorder history at any time.

9.2.6.5 BATCHING ACCURACY

Failure to maintain batching operations of the plastic concrete within the tolerance for each component material requires immediate investigation and corrective action by the concrete producer. Failure to immediately investigate and implement corrective measures may be cause for suspension of the QCP.

9.2.6.6 BATCH ADJUSTMENTS FOR MATERIALS

Permissible adjustments to previously approved design mixes that may be made without a new design mix request are as follows:

- (1) Allowable variation of Coarse and/or Fine Aggregate: for a total of ± 75 lbs/yd³ of concrete.

- (2) Admixtures: Shall be within the manufacturer's technical data sheet range. Adjustments falling outside the technical data sheet range shall require design mix re-verification.
- (3) Allowable variation of Cementitious Materials: $\pm 6.5\%$ per cubic yard but not less than the specified minimum for that class of concrete.

The adjusted mix must meet the theoretical yield requirements of the approved mix design.

The DMRE will be advised of any adjustments to the concrete mix design. Batch adjustments shall be noted on the concrete delivery tickets.

9.2.6.7 BATCH ADJUSTMENTS FOR MOISTURE

Free moisture for the coarse and fine aggregates will be determined within two hours prior to each day's batching. Approximately half way through the batching operations additional moisture test shall be required on continuous concrete placements expected to exceed three hours. Adjustment of batch proportions will be made using these values.

One or more of the following methods shall be used to determine aggregate free moisture:

- (1) Use moisture probe readings, speedy moisture tester or Chapman flask for fine aggregate moisture. The accuracy of the moisture probe shall be verified at least weekly by the manufacturer's recommended method and by method (2) below. The Chapman flask and speedy moisture tester shall be verified at least weekly by method (2) below.
- (2) Calculate both coarse and fine aggregate free moisture based upon dry sample weights and adjusting for absorption per **AASHTO T 255**.
- (3) Towel dry coarse aggregate to calculate free moisture on saturated surface dry aggregate. The accuracy of towel drying shall be verified weekly by method (2) above.

9.2.6.8 SUBSTITUTION OF MATERIALS

Aggregate sources may be substituted within an approved base mix design provided that the aggregate are the same geological type and are from an approved source. The new aggregate source shall have a specific gravity (saturated surface dry) within 0.08 of the original aggregate source. Obtain the Department's approval for any material substitutions before beginning concrete placement. Provide a new base mix design for any cementitious

material or admixture substitution. The Department may take up to five working days to review any material substitution request.

When more than one concrete mix design is being substituted and the concrete design mixes use the same cement, admixtures, and has similar proportions, the concrete producer has the option to only test for chlorides of the mix design which has the greatest cementitious content to represent all such mixes. Perform testing for chlorides and assure compliance with ***Florida Department of Transportation Specifications, Section 346***. Ensure the substituted mix meets the theoretical yield requirements, does not exceed the maximum water to cementitious materials ratio, and the cement content equals or exceeds the approved base mix design.

The Department may require a single 3.0 yd³ minimum test batch at the plant to demonstrate that the plastic properties of the adjusted mix design is within the slump and air tolerances provided in ***Florida Department of Transportation Specifications, Section 346***. The theoretical unit weight of the proposed mix design will be within 2.0 lbs/ft³ of the originally approved theoretical mix design unit weight. Approved adjusted mixes may be transferred. When the Engineer determines that unsatisfactory results are obtained during production, the concrete producer shall return to the originally approved base mix design or obtain approval of a new mix design.

9.2.6.9 EQUIPMENT

Use equipment for handling ingredients, mixing concrete, handling the mixed concrete, transporting and depositing the mixed concrete that has no detrimental effect on the plastic concrete. Do not use equipment with aluminum surfaces in physical contact with the mixed product.

9.2.7 DESIGN MIXES

Design mixes shall meet the requirements of ***Florida Department of Transportation Specifications, Section 346. Form 675-010-03, Concrete Design Mix***, shall be used for design mix submittals.

Plants furnishing concrete to multiple projects may use approved concrete mix designs on different projects, provided component materials and project requirements of the approved mix design remain the same. The concrete producer shall submit mix design requests directly to the DMRE in the District that the plant is located.

If a plant is located out-of-state, submit the mix design to the nearest DMRE.

Make a separate submittal for each class of concrete and each particular

combination of component materials to be used at trial mix temperatures of 70 to 85°F, and for hot weather mixes at a minimum temperature of 94°F. Use only design mixes approved by the SMO for Department use.

On completion of the extended mixing period, ensure that the trial mix concrete has a slump within ± 0.75 inch of the target value (± 1.0 inch for mixes utilizing HRWR), and an air content between 2.0% and 5.0%. If below the target range, the producer may adjust the slump by a water addition. After the water addition, remix the concrete for a minimum of two minutes. Ensure that the mix temperature is not less than 94°F at any time.

The total water used in initial mixing and the final slump adjustment constitutes the design mix water content. Ensure that the total water to cementitious materials ratio does not exceed the maximum water to cementitious materials ratio in the **Florida Department of Transportation Specifications, Section 346**, for the respective class of concrete. The Department may require extended mixing for precast/prestressed concrete when centrally mixed at the placement site.

Ensure that preparation and testing of the trial mixes is performed by a laboratory that is inspected and meets the requirements of **ASTM C1077**. The testing laboratory shall be capable of performing the required ASTM test methods for laboratories testing concrete and concrete aggregates and may request evaluation for the optional methods. Personnel performing plastic or hardened concrete testing shall be qualified as described in this guide.

Ensure that the 28-day strength (or strength at any other designated age) of trial mixes meets the above stated over design requirements to ensure that concrete sampled and tested at the point of placement has a strength exceeding the specified minimum strength.

Include the following with the mix design submittal:

- (1) The Department approved source identification number for coarse and fine aggregates, specific gravity, along with the size of coarse aggregate and target Fineness Modulus for fine aggregate. Identify other component materials by manufacturer, brand name, and type.
- (2) The actual proportions of raw materials intended to be combined to produce the concrete.
- (3) Test data from a single trial mix which demonstrates that the produced concrete using the proposed mix, designated ingredients and designated water to cementitious materials ratio will have a slump within ± 0.5 inch of the target value (or for mixes utilizing HRWR, within ± 1.0 inch of the target value), air content of 2.5% to 5.0% and strength required to meet

an over design which is the minimum required strength plus 1.6 standard deviations.

- (4) The chloride content of the proposed design mix. The Department will not approve mix designs when the chloride content of the trial mix exceeds the limits shown in ***Florida Department of Transportation Specifications, Section 346***.
- (5) For design mixes developed for use under hot weather concreting conditions: Hold the trial mix in the mixer for 90 minutes after completion of initial mixing. During the extended mixing period, turn the drum intermittently for 30 seconds every five minutes. Cover the drum with wet burlap or an impermeable cover material during the rest periods. At the end of the 90-minute period, remix the trial mix for a minimum of one minute and make a slump test to verify that the concrete is within the specified range for slump.
- (6) For design mixes proposed for use in wet drilled shafts, demonstrate the additional requirements in ***Florida Department of Transportation Specifications, Section 346***.
- (7) Submit strength test data for establishing the standard deviation of the plant to meet the specified strength of the mix submitted for approval within 1,000 psi. The strength test data shall represent either a group of at least 30 consecutive tests or a statistical average for two groups totaling 30 or more tests. When the Department cannot determine the plants standard deviation from historical data, apply an over design requirement, based on a singular trial mix, that is the minimum required strength plus 1,200 psi for minimum required concrete strengths of 5,000 psi or less. For minimum required concrete strengths above 5,000 psi, apply an over design requirement that is the minimum required strength plus 1,400 psi.

9.2.8 BATCHING REQUIREMENTS OF THE CONCRETE PRODUCTION FACILITY

9.2.8.1 BINS

Provide bins of adequate capacity for the required concrete production. Support the bins upon a rigid framework founded upon a stable foundation capable of holding them in a safe and secure position. Design each compartment to discharge efficiently and freely into the weigh hopper. Provide positive means of control so that as the quantity desired in the weigh hopper is approached, the material can be added slowly and the addition of further material can be stopped precisely. Use a discharging mechanism that

prevents loss of material when it is closed. Construct aggregate storage bins sufficiently tight to prevent leakage of material, and divide them into at least one compartment for the fine aggregate and one compartment for each size of coarse aggregate to be used. Provide compartment partitions that are sufficiently tight and high enough to prevent intermingling of the different materials. Construct leak-proof and moisture-proof cementitious bins, and provide them with vibrators or other means to aid the flow of cement from the bin.

9.2.8.2 WEIGH HOPPERS

Provide weigh hoppers consisting of suitable containers freely suspended from scales and protected from the elements so that accuracy is not adversely affected. Equip the hoppers with a discharge mechanism that prevents leakage or loss of material when closed. Vent hoppers to permit air to escape and equip them with vibrators or other equipment that ensures complete and efficient discharge of materials.

9.2.8.3 SCALES

Provide either beam type or springless dial type scales, or electronic devices such as load cells. Where using beam type scales, provide suitable means to hold poises securely in position after they are set. Keep scales clean and in good operating condition. Provide the scale operator with an unobstructed view of all indicating devices and convenient access to all controls. Use graduated weigh beam or dials to permit reading to 0.1% of the capacity of the scales.

Any scale can be required to be rechecked if deemed necessary by the Department. Check scales up to at least the maximum load normally handled on each respective scale.

Maintain cement scales, pozzolan scales, and coarse and fine aggregate scales to an accuracy of 0.5% of the maximum load normally handled.

Affix a certificate of inspection bearing the date of the certification showing signature of the scale company representative to each weighing device. Make available at the plant a copy of the scale company's report corresponding with the current certificate of inspection showing the date of inspection, signature of the scale company representative, the observed scale deviations for the loads checked, and a statement that the scale meets the accuracy requirements for commercial scales as identified in **Chapter 531 of the Florida Statutes (F.S.)**, pertaining to specifications, tolerances and regulations, as administered by the Bureau of Weights and Measures of the Florida Department of Agriculture.

9.2.9 MIXERS

9.2.9.1 GENERAL REQUIREMENTS

Provide mixers that are capable of combining the components of the concrete into a thoroughly mixed and uniform mass, free from balls or lumps, which are capable of discharging the concrete with a satisfactory degree of uniformity.

9.2.9.2 DESIGN

Use truck mixers of the inclined axis revolving drum type, or concrete plant central mixers of the non-tilting, tilting, vertical or horizontal shaft types.

Make available at the plant at all times a copy of the manufacturer's design, showing dimensions and arrangement of blades. The concrete producer may use mixers that have been altered from such design in respect to blade design and arrangement, or to drum volume, when concurred by the manufacturer and approved by the DMRE. For initial design changes, the producer shall provide uniformity test data, based on **ASTM C92** testing.

Ensure that metal rating plates are attached to each mixer specifying its mixing speed, agitating speed, rated capacity and unit serial number.

9.2.9.3 TRUCK MIXERS

Use truck mixers with a drum that is actuated by a power source independent of the truck engine or by a suitable power take-off. Ensure that either system provides control of the rotation of the drum within the limits specified on the manufacturer's rating plate, regardless of the speed of the truck. Use truck mixers of the revolving drum type that are equipped with a hatch in the periphery of the drum shell which permits access to the inside of the drum for inspection, cleaning and repair of the blades.

Use truck mixers equipped with revolution counters and mounting, by which the number of revolutions of the drum may be readily verified.

Ensure that the water supply system mounted on truck mixers is equipped with a volumetric water gauge or a water meter in operating condition. Annually calibrate water measuring devices on truck mixers or other water sources used for concrete water adjustments.

Where a truck mixer volumetric gauge controls job site water additions, ensure the truck mixer is parked in a level condition during on-site water adjustments so that the gauge is indicating a specific tank volume before and

after the concrete adjustment. Ensure that the water measuring equipment has an accuracy of within 3% of the indicated quantity.

Truck mixers meeting these requirements and ***Florida Department of Transportation Specifications, Section 346*** will be issued an identification card by the DMRE upon request from the concrete producer. Identification cards shall be displayed in the truck cab when delivering concrete for Department use. Failure to display the identification card in the truck cab shall be cause for rejection of the delivered concrete. The Contractor may remove the identification cards when a truck mixer is discovered to be in noncompliance. When the identification card is removed for noncompliance, the Contractor shall forward the identification card to the DMRE in the District that the plant is located.

As an exception to the above, when the deficiency involves only an inoperable revolution counter, the truck mixer identification card will not be removed. However, the Contractor will note the deficiency on the card. The concrete producer will be allowed to deposit the concrete in the mixer, and the truck mixer will then be removed from use until the revolution counter is repaired or replaced. On the next delivery to any Department project, after repair or replacement of the counter, the truck mixer operator shall make known that the revolution counter is operable and obtains the Contractor's initial on the truck mixer identification card. Without such inspection and documentation of corrective action, the Contractor may reject the truck mixer at any time it is again found to have an inoperable revolution counter. The revolution counter will be set to zero prior to mixing each load.

The concrete producer shall inspect all truck mixers at least once each week for changes due to accumulation of hardened concrete or to wear of blades or chutes. The blades or chutes shall be repaired or replaced as necessary to meet these requirements. Any appreciable accumulation of hardened concrete shall be removed before any mixer may be used.

Copies of the most recent water measuring equipment calibration shall be kept in the truck cab and available upon request.

9.2.9.4 CENTRAL MIXERS

Use stationary type mixers equipped with a timing device which will automatically lock the discharge lever when the drum is charged and release it at the end of the mixing period. In the event of failure of the timing device, the Department may allow operations to continue during the day that failure was noticed for the first time. Do not extend such operations beyond the end of that working day. The mixer shall be operated at the speed recommended by the manufacturer.

The concrete producer shall inspect all mixers at least once each week for changes due to accumulation of hardened concrete or to wear of blades.

9.2.9.5 CLEANING AND MAINTENANCE OF MIXERS

Repair or replace mixer blades of revolving drum type mixers when the radial height of the blade at the point of maximum drum diameter is less than 90% of the design radial height. Repair or adjust mixers of other designs per manufacturer's instructions. Resolve questions of performance through mixer uniformity tests as described in **ASTM C 94**.

9.2.10 MIXING AND DELIVERING CONCRETE

9.2.10.1 GENERAL REQUIREMENTS

Operate all plant mixers at speeds per the manufacturer's design or recommendation. Do not allow the volume of mixed batch material to exceed the manufacturers rated mixing capacity. Mix concrete containing silica fume, metakaolin or ultra fine fly ash in accordance with their supplier's recommendations.

When necessary and in order to produce concrete of the specified temperature during cold weather conditions, heat either the mix water or the aggregates or both prior to batching. Apply the heating uniformly in a manner, which is not detrimental to the mix. Do not heat the aggregates directly by gas or oil flame or on sheet metal over fire. Do not heat the aggregates or water to a temperature of over 150° F. If either is heated to over 100° F, mix them together prior to the addition of the cement. Ensure the cement does not come in contact with the materials, which are in excess of 100° F. Include in the QCP measures to maintain free moisture in a well drained condition when heating aggregates.

9.2.10.2 CENTRAL MIXING

After all materials are in the mixer, mix the concrete a minimum of two minutes or the manufacturer's recommended minimum mixing time, whichever is longer.

9.2.10.3 TRANSIT MIXING

Initially mix each batch between 70 and 100 revolutions of the drum at mixing speed. When water is added at the job site, mix the concrete 30 additional mixing revolutions. When mixing for the purpose of adjusting consistency, do not allow the total number of revolutions at mixing speed to exceed 160. Discharge all concrete from truck mixers before total drum revolutions

exceed 300. All revolutions of the drum shall be counted in the total number of revolutions.

Do not haul concrete in mixer trucks loaded with more than the rated capacity shown on their attached plates.

9.2.10.4 CHARGING THE MIXER

Charge each batch into the drum so that some water enters both in advance of and after the cementitious material and aggregates. If using fly ash (other than ultra fine fly ash) in the mix, charge it into the drum over approximately the same interval as the cement. The concrete producer may use other time intervals for the introduction of materials into the mix when the concrete producer demonstrates; using test requirements specified in **ASTM C 94**, that he can achieve uniformity of the concrete mix.

For concrete mixes containing specialty ingredients (silica fume, metakaolin, ultra fine fly ash, corrosion inhibitor calcium nitrite, accelerators, high range water reducers, etc.), charge the batch materials into the mixer in a sequence recommended by the supplier of the specialty ingredients. Adjust the weight of mixing water for a concrete mix containing a corrosion inhibitor and accelerator admixture. Account for water in the corrosion inhibitor and accelerator as described in the manufacture's technical data sheet.

9.2.11 QUALITY CONTROL PROGRAM

The QCP of any concrete producer shall meet the requirements of **Florida Department of Transportation Specifications, Sections 105**. The QCP is used to describe how the concrete producer will maintain the properties of concrete to the point of discharge at the project site. The QCP shall address how the water to cementitious materials ratio and the plastic properties tests of concrete will be controlled to meet Specification requirements. The qualification of personnel, source of materials, and equipment used to produce concrete shall be addressed in the QCP. Quality control of the concrete shall be achieved through statistical evaluation of test results. The concrete producer shall use a Department approved laboratory and qualified personnel to test concrete.

The plant shall be on the Department's list of producers with accepted QCP prior to production of concrete for Department projects. The accepted QCP shall be the minimum required control of concrete on all Department projects.

9.2.12 PERSONNEL

Plants supplying concrete to Department projects shall have adequate qualified personnel. Batch Plant operator, certified technicians and manager of quality control are required positions for a plant. At the discretion of the Department, certain functions of the above positions may be combined when it can be demonstrated that the plants operation and quality of the concrete will not be detrimentally affected. Technicians shall be qualified through the Construction Training and Qualification Program (CTQP) or an equivalent training program as defined in ***Florida Department of Transportation Specifications, Section 105***. Qualified technicians utilizing equipment with a valid calibration/verification will perform quality control sampling and testing. This qualification of any technician shall be made available upon request.

9.2.12.1 BATCH PLANT OPERATOR

Personnel who have quality control functions or who sign concrete certification/delivery tickets must demonstrate, through examination, adequate concrete related knowledge. Plant Operators shall be present during batching operations. The Plant Operator shall be qualified by CTQP or an equivalent training program as defined in ***Florida Department of Transportation Specifications, Section 105***.

9.2.12.2 CERTIFIED TECHNICIANS

Personnel who perform the tests on the plastic properties of concrete, such as slump, temperature, air content, making/curing concrete cylinders, and calculating the water to cementitious materials ratio, shall be qualified as an ***ACI Concrete Field Testing Technician Grade I***.

Personnel who perform the tests on the hardened properties of concrete, such as strength determination of cylinders or beams, shall be qualified as an ***ACI Concrete Strength Testing Technician***.

9.2.12.3 MIX DESIGN TECHNICIAN

Personnel who have quality control functions of designing a concrete mix must demonstrate, through examination, adequate concrete related knowledge. Such examinations will deal with Specifications and concrete quality control procedures. The Mix Design Technician shall be qualified as a ***CTQP Concrete Laboratory Technician Level II***.

As an alternative to the CTQP Level II qualification, for concrete pipe and precast/prestressed concrete products, the Department will accept the following qualification:

- (1) PCI Quality Control Personnel, Level III Certification, for concrete mix designs of the prestressed products.
- (2) Level II Quality Control Inspectors Qualification for concrete mix designs of the pipe and dry-cast concrete box culverts meeting the requirements of ***Materials Manual Volume II Section 6.2***.
- (3) Level II Quality Control Inspectors Qualification for concrete mix designs of the precast concrete drainage structures and incidental precast concrete products, meeting the requirements of ***Materials Manual Volume II Section 6.3***.

9.2.12.4 MANAGER OF QUALITY CONTROL

Personnel who perform the duties of managing the quality control of the plant shall be qualified as outlined in ***Florida Department of Transportation Specifications, Section 105*** and have the following duties and responsibilities:

- (1) Implement policies and procedures of the QCP.
- (2) Maintain liaison with Project Manager and the Department on all activities related to quality control.
- (3) Supervise the activities of all quality control technicians, ensuring sufficient manpower in all areas related to quality control testing and inspection.
- (4) Review all quality control procedures to ensure compliance with Specifications and other Contract Documents.
- (5) Ensure all quality control records are properly prepared and reviewed.
- (6) Ensure that quality control activities are performed in accordance with documented instructions and procedures.
- (7) Develop and maintain a filing, storage, and retrieval system for quality control records.

9.2.13 RECORDS

All records shall be kept on file at each plant and made available upon request by the Department. The following updated information shall be available at each plant:

- (1) Accepted concrete producer QCP.
- (2) Approved concrete design mixes.
- (3) Materials source/specification compliance (delivery tickets, certifications, miscellaneous test reports).
- (4) Quality control data (aggregate gradation and absorption worksheets & concrete chloride test data).
- (5) Aggregate moisture control records including date and time of test. Verify the accuracy of the moisture test method at least weekly. Is the scale calibrated annually and does it cover the full weighing range?
- (6) Annual calibration records for water measuring devices on trucks or other water sources for concrete water adjustments.
- (7) Manufacturer's mixer design data.
- (8) Federal poster.
- (9) A copy of the scale company's report corresponding with the current certificate of inspection, showing the date of inspection, signature of the scale company representative, the observed scale deviations for the loads checked.
- (10) Certification documents for admixture weighing and measuring dispensers.
- (11) Weekly mixer inspection reports.
- (12) A daily record of all concrete batched for delivery to Department projects, including respective design mix numbers and quantities of batched concrete.
- (13) Recorder history, if the plant is equipped.

9.2.14 SAMPLING AND TESTING OF MATERIALS

9.2.14.1.1 GENERAL

Sampling and Testing of materials and concrete for quality control purposes is the responsibility of the concrete producer. Frequency of sampling must be designed to provide adequate data to operate the QCP for each design mix. Table 1 designates the minimum sampling and testing frequencies that will be performed in a well controlled plant. The

QCP shall indicate an increased sampling rate when any QCP limit is reached. All sampling and testing shall be conducted in accordance with current Florida Sampling and Testing Methods, AASHTO, or ASTM sampling and testing methods. For both coarse and fine aggregate being used, the specific gravity (saturated surface dry) shall be provided to the concrete production facility by the aggregate producer providing the coarse and fine aggregate.

TABLE 1	
Material and Required Tests	Minimum Sampling Frequency For Each Source and Grade
Coarse Aggregate* Gradation Absorption Total Minus 200	1 every 30 days 1 every 30 days 1 every 30 days
Fine Aggregate* Gradation Absorption (Screenings only) Total Minus 200	1 every 30 days 1 every 30 days 1 every 30 days
Cementitious Materials	Delivery Ticket and Mill Certificate
Admixtures	Certification
Water	As required in Specification Section 923*
Chlorides	1 every 30 days or in accordance with this guide

Materials Certification and Delivery Tickets must be kept on file for three years from date of materials receipt at the plant.

* Minimum sampling frequency may be reduced

9.2.14.1.2 CHLORIDE TESTING

It is the responsibility of the concrete producer to make sure chloride content of all reinforced concrete produced for the Department does not exceed the maximum allowable limits indicated in **Florida Department of Transportation Specifications, Section 346**.

Sampling and Testing: Sampling for chloride determination shall start on the first day of production of each mix design at the plant and repeat every 30 calendar days or less thereafter, as necessary to produce concrete meeting **Florida Department of Transportation Specification Section 346**. Chloride test results shall be obtained within 10 calendar days of sampling from a laboratory meeting and maintaining at all times the qualification requirements in the **Florida Department of Transportation, Section 105**. Determine the chloride content of each

mix design in production at the plant or as described in this section. Concrete sampling for a mix design shall restart any time concrete production is suspended for any reason for more than 30 calendar days.

When more than one mix design uses the same cement, aggregates, admixtures, and has similar proportions, the concrete producer has the option to only test for chlorides of the mix design with the most amount of cementitious content to represent all such mixes. The certificate must clearly indicate all mix designs covered by the test.

Certify from the first day of production and every 30 calendar days or less thereafter to the Contractor that all reinforced concrete produced meets the requirement of **Florida Department of Transportation Specifications, Section 346**. Include in the certification all pertinent chloride test data that supports the concrete meeting the Specifications. The Department will require properly executed certifications showing the chloride content within the required limits for acceptance of all concrete produced in accordance with the Specifications. Example certification forms may be obtained as outlined in **Florida Department of Transportation Specifications, Section 6**.

Each chloride test report shall include a copy of the test sheet produced by the "**Chloride 2000**" software program described in test method **FM5-516** or equivalent software. The test sheet shall include all volumetric and potentiometric measurements for the control, as well as the triplicate samples described in the test method.

Fifty grams of concrete powder for each test shall be retained for a minimum of 180 calendar days for independent assurance purposes. The concrete powder shall be kept in a sealed container and this container shall be kept in a room to prevent possible contamination. The powder shall be properly labeled to identify lab number, mix design number, production date, sampling date, test date, and test results. The Department may at any time request samples of the powder for testing purposes. The Corrosion Research Laboratory at the SMO will inspect each chloride testing laboratory once a year. The inspection will cover proper execution of the test method, equipment calibration records, and review of test reports since the last inspection.

If chloride test results exceed the limits shown in **Florida Department of Transportation Specifications, Section 346**, suspend concrete production immediately for every mix design using the same component materials, including admixtures, until corrective measures are made. A copy of the sample information and chloride test report for the failed sample shall be sent to the DMRE and the Corrosion Research Laboratory at the SMO as soon as the test results are available.

If the chloride test results are not obtained within 10 calendar days of concrete sampling, the Engineer may suspend concrete production until corrective measures are made.

When the source of any component material, including admixtures, for the concrete is changed, sampling for chloride determination shall restart the first day of production of the mix with the new component material.

9.2.15 DELIVERY TICKET/CERTIFICATION

The following information is required information for each concrete delivery. All information shown on the delivery ticket/certification must be furnished with each load. The information contained within **Florida Department of Transportation Specifications, Section 346** is required information on each delivery ticket/certification. The original signature on the delivery ticket shall certify to the accuracy of the recorded information and compliance with the approved design mix including the chloride content requirements. A sample of a delivery ticket is provided in **Appendix "A"**, and must contain:

- (1) Serial number of delivery ticket.
- (2) The plant number as assigned by the Department.
- (3) Date of batching.
- (4) Contractor's name.
- (5) FDOT Financial Project Number.
- (6) Truck number making the concrete delivery.
- (7) Class of concrete.
- (8) Design mix number.
- (9) Time all materials are introduced into mixer.
- (10) Cubic yards in this load.
- (11) Cumulative total cubic yards batched for job on date of delivery.
- (12) Chloride test date and test results
- (13) Maximum allowable water addition at the job site.
- (14) Number of revolutions at mixing speed before leaving for job site.

- (15) Amount of mixing time for central mixer.
- (16) Coarse and fine aggregate sources (Department assigned Pit No.).
- (17) Actual amount of coarse and fine aggregates batched in pounds.
- (18) Percent of free moisture in coarse and fine aggregates.
- (19) Cement producer and type.
- (20) Total amount of cement batched in pounds.
- (21) Producer, brand name and class (whichever might apply) of Pozzolan or Slag.
- (22) Total amount of pozzolan or slag batched in pounds.
- (23) Producer, supplier, type and total amount of air entraining agent used.
- (24) Producer, supplier, type and total amount of admixtures used.
- (25) Total amount of water batched at the plant in gallons or pounds.
- (26) Statement of compliance with the Specifications and other Contract Documents.
- (27) Original signature of Batch Plant Operator and technician identification number.

9.2.16 TRAINING

Training will be in accordance with ***Florida Department of Transportation Specifications, Section 105*** and the appropriate sections of the ***Materials Manual Volume II***

9.2.17 FORMS

Concrete Design Mix Form No 675-010-03
Example Concrete Delivery Ticket – Appendix A, Materials Manual Volume II, Section 9.2

