

CONTRACTOR QUALITY CONTROL GENERAL REQUIREMENTS -VOLUMERIC MIXERS
(REV 5-8-23)

The following Dev105VM applies only to structural concrete Class I and II as delineated in the Plans.

SUBARTICLE 105-8.7 is expanded by the following:

105-8.7 Structural Concrete Production Facility Quality Control (QC) Personnel:

Ensure that each portland cement structural concrete production facility (plant), has designated personnel including plant manager of QC, concrete mix designer, concrete batch plant operator, and testing technicians to provide QC inspections and testing.

Upon Department approval, the functions of the above positions may be performed by the same person when it can be demonstrated that the plant's operation and quality of concrete will not be detrimentally affected and personnel have the qualifications required herein.

105-8.7.1 Plant Manager of QC: Ensure that the plant manager of QC has at least three years of concrete related experience and the following training certifications:

1. CTQP Concrete Laboratory Technician – Level 1 certificate.
2. CTQP Concrete Field Technician - Level 1 certificate.
3. Concrete Batch Plant Operator certification in accordance with

105-8.7.4.

As alternatives to these certifications, the Department will accept, one of the following:

- a. Prestressed Concrete Institute (PCI) QC Personnel Certification Level III.
- b. Precast Concrete Pipe, Box Culverts, Drainage Structures or Incidental Precast Concrete Plants Level II QC Inspector Certifications.
- c. National Ready Mixed Concrete Association (NRMCA) Certified Concrete Technologist Level 2.

105-8.7.2 Concrete Mix Designer: Ensure that the concrete mix designer has the CTQP Concrete Laboratory Technician Level 2 certification. As an alternative, the Department will accept any of the following qualifications:

1. PCI QC Personnel Level III Certification, for concrete mix designs of prestressed concrete products.
2. National Ready Mix Concrete Association (NRMCA) Certified Concrete Technologist Level 3.
3. Any of the Level II QC certifications in accordance with 105-8.9.2.2.

105-8.7.3 Qualified Testing Technicians: Ensure that the testing technicians have the following certifications:

1. ACI Concrete Field Testing Technician Grade I, for personnel performing concrete plastic property tests and ACI Self-Consolidating Concrete Testing Technician if testing self-consolidating concrete (SCC).
2. ACI Concrete Strength Testing Technician, for personnel performing tests on hardened properties of concrete.

105-8.7.4 Concrete Batch Plant Operator: Ensure that the concrete batch plant operator has a CTQP Concrete Batch Plant Operator Certification. As an alternative, the Department will accept the following certifications:

1. Precast Concrete Structures Association (PCSA) Batch Plant Operator,
2. NRMCA Certified Concrete Technologist Level 3, or
3. NRMCA Plant Manager Certification.

For dry cast concrete pipe and dry cast drainage structures, the Department will accept American Concrete Pipe Association (ACPA) Quality School Certification.

105-8.7.5 Volumetric Mixer Operator: Ensure that the concrete volumetric mixer operator has the following training certifications:

- 105-8.7.4. Concrete Batch Plant Operator certification in accordance with
- 105-8.7.3 2. ACI Concrete Field Testing Technician Grade I in accordance with
3. Volumetric Mixer Operator Certification issued by the Volumetric Mixer Manufacturers Bureau (VMMB), which may be viewed at the following URL: <https://www.vmmb.org/certifications.html>

STRUCTURAL PORTLAND CEMENT CONCRETE – VOLUMETRIC MIXERS (REV 5-8-23)

The following Dev346VM applies only to structural concrete Class I and II as delineated in the Plans.

SUBARTICLE 346-6.2 is expanded by the following:

346-6.2 Concrete Mix Design: Provide concrete that has been produced in accordance with a Department approved mix design, in a uniform mass free from balls and lumps.

For slump target values in excess of 6 inches, including flowing and self-consolidating concrete, utilize a grate over the conveyance equipment to capture any lumps or balls that may be present in the mix. The grate must cover the entire opening of the conveyance equipment and have an opening that is a maximum of 2-1/2 inches in any one direction. Remove the lumps and balls from the grate and discard them. Discharge the concrete in a manner satisfactory to the Engineer. Perform demonstration batches to ensure complete and thorough placements in complex elements, when requested by the Engineer.

Do not place concretes of different compositions such that the plastic concretes may combine, except where the Plans require concrete with a surface resistivity value of 29 kΩ or below and one with higher than 29 kΩ values in a continuous placement. Produce these concretes using separate mix designs. For example, designate the mix with calcium nitrite as the original mix and the mix without calcium nitrite as the redesigned mix. Ensure that both mixes contain the same cement, fly ash or slag, coarse and fine aggregates and admixtures. Submit both mixes for approval as separate mix designs, both meeting all requirements of this Section. Ensure that the redesigned mix exhibits plastic and hardened qualities which are additionally approved by the Engineer as suitable for placement with the original mix. The Engineer will approve the redesigned mix for commingling with the original mix and for a specific project application only.

Alternately, place a construction joint at the location of the change in concretes as approved by the Engineer.

Ensure that the mix designs for volumetric measuring units include the current calibration for each of the concrete mix ingredients in accordance with manufacturer's recommendations. The calibration must include the functional controls and settings for the mix design. Repeat the calibration of the volumetric measuring unit under the following conditions:

1. Every six months, when the mixer has produced at least 20 cubic yards in six months.
2. When the concrete is not meeting the requirements of the specifications.
3. After any repairs of the batching or mixing unit.

SUBARTICLE 346-6.3 is expanded by the following:

346-6.3 Delivery Certification: Ensure that an electronic delivery ticket is furnished with each batch of concrete before unloading at the placement site. The delivery ticket may be proprietary software or in the form of an electronic spreadsheet, but shall be printed. Ensure that the materials and quantities incorporated into the batch of concrete are printed on the delivery ticket. Include the following information on the delivery ticket:

1. Arrival time at jobsite,
2. Time that concrete mix has been completely discharged,
3. Number of revolutions upon arrival at the jobsite,
4. Total gallons of water added at the jobsite,
5. Additional mixing revolutions when water is added,
6. Total number of revolutions.

Items (3) through (6) do not apply to non-agitating concrete transporting vehicles.

Ensure the batcher responsible for production of the batch of concrete signs the delivery ticket, certifying the batch of concrete was produced in accordance with the Contract Documents.

Sign the delivery ticket certifying that the design mix maximum specified water to cementitious materials ratio was not exceeded due to any jobsite adjustments to the batch of concrete, and that the batch of concrete was delivered and placed in accordance with the Contract Documents.

346-6.3.1 Volumetric Mixers: The Engineer, upon concurrence of the State Materials Office (SMO), may allow the use of volumetric mixing at the jobsite for Class I, Class I (Seal), Class I (Pavement) and Class II concrete.

Ensure that the concrete producer furnish a delivery ticket in accordance with Section 350 and Materials Manual Volume II Section 9.3. The signature of the Volumetric Mixer operator is required on delivery tickets, in lieu of the signature of the batch plant operator.

ARTICLE 346-8 is expanded by the following:

346-8 Plastic Concrete Sampling and Testing.

QC tests include air content, temperature, slump, and preparing compressive strength cylinders for testing at later dates. In addition, calculate the water to cementitious materials ratio in accordance with FM 5-501 for compliance to the approved mix design.

Ensure that each truck has a rating plate and a valid mixer identification card issued by the Department. Ensure that the revolution counter on the mixer is working properly, and calibration of the water dispenser has been performed within the last twelve months. Reject any concrete batches that are delivered in trucks that do not have mixer identification cards. Remove the mixer identification card when a truck mixer is discovered to be in noncompliance and the mixer deficiencies cannot be repaired immediately. When the mixer identification card is removed for noncompliance, make note of the deficiency or deficiencies found, and forward the card to the District Materials and Research Engineer who has Producer QC Plan acceptance authority.

Perform plastic concrete tests on the initial delivery from each plant of each concrete design mix each day. Ensure QC technicians meeting the requirements of Section 105 are present and performing tests throughout the placement operation. Ensure a technician is present and performing tests throughout the placement operation at each placement site. If a project has multiple concrete placements at the same time, identify the technicians in the QC Plan to ensure minimum sampling and testing frequencies are met. Ensure that the equipment used for delivery, placement and finishing meets the requirements of this Specification.

When a truck designated for QC testing arrives at the discharge site, a subsequent truck may also discharge once a representative sample has been collected from the QC truck and while awaiting the results of QC testing. Reject non-complying loads at the jobsite. Ensure that corrections are made on subsequent loads. Immediately cease concrete discharge of all trucks if the QC truck has failing test. Perform plastic properties tests of concrete on all trucks prior to the first corrected truck and the corrected truck. When more than one truck is discharging into a pump simultaneously, only the truck designated for QC testing may discharge into the pump to obtain a representative sample of concrete from the QC truck only.

Furnish sufficient concrete of each design mix as required by the Engineer for verification (VT) testing. When the Engineer's VT test results do not compare with the QC plastic properties test results, within the limits defined by the Independent Assurance (IA) checklist comparison criteria, located in Materials Manual Chapter 5, disposition of the concrete will be at the option of the Contractor.

On concrete placements consisting of only one load of concrete, perform initial sampling and testing in accordance with this Section. The acceptance sample and plastic properties tests may be taken from the initial portion of the load.

If any of the QC plastic properties tests fail, reject the remainder of that load, and any other loads that have begun discharging, terminate the LOT and notify the Engineer. Make cylinders representing that LOT from the same sample of concrete.

Following termination of a LOT, obtain samples from a new load, and perform plastic properties tests until the water to cementitious materials ratio, air content, temperature and slump comply with the Specification requirements. Initiate a new LOT once the testing indicates compliance with Specification requirements.

Suspend production when any five loads in two days of production of the same design mix are outside the specified tolerances. Increase the frequency of QC testing to one per load to bring the concrete within allowable tolerances. After production resumes, obtain the Engineer's approval before returning to the normal frequency of QC testing.

If concrete placement stops for more than 90 minutes, perform initial plastic properties testing on the next batch and continue the LOT. Cylinders cast for that LOT will represent the entire LOT.

When the Department performs Independent Verification (IV), the Contractor may perform the same tests on the concrete at the same time. The Department will compare results based on the Independent Assurance (IA) Checklist tolerances.

346-8.1 Volumetric Mixer: The Volumetric Mixer shall have a metal rating plate plainly marked with the gross volume of mixed concrete and a valid identification card issued by the Department. Reject any concrete batched or mixed in a unit that does not have valid identification card.

SUBARTICLE 346-9.2 is expanded by the following:

346-9.2 Sampling Frequency: As a minimum, sample and test concrete of each mix design for water to cementitious materials ratio, air content, temperature, slump and compressive strength once per LOT as defined by Table 346-9. The Engineer will randomly verify one of every four consecutive LOTs of each mix design based on a random number generator. The Department may perform Independent Verification (IV) testing to verify compliance with specification requirements. All QC activities, calculations, and inspections will be randomly confirmed by the Department.

The LOT size for concrete from a Volumetric Mixer is defined as one day's production or 20 cubic yards, whichever comes first.

| Table 346-9 Sampling Frequency | |
|-----------------------------------|--|
| Class Concrete ⁽¹⁾ | LOT Size |
| I | One day's production or 20 cubic yards whichever comes first |
| I (Seal) | |
| I (Pavement) | |
| II | |

Section 9.2 Volume II

STRUCTURAL CONCRETE PRODUCTION FACILITIES GUIDE

SUBSECTION 9.2.10 is expanded by the following:

MIXERS

9.2.10.1 General Requirements

Provide mixers that can combine the components of the concrete into a thoroughly mixed and uniform mass, free from balls or lumps, and which can discharge the concrete with a satisfactory degree of uniformity.

Inspect all mixers at least once each week.

9.2.10.2 Design

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

Make always available at the Plant a copy of the mixer manufacturer's design, showing dimensions and arrangement of blades. The concrete Plant may use mixers that have been altered from such design in respect to blade design and arrangement, or to drum volume, when authorized by the mixer manufacturer and approved by the DMRE. For initial design changes, provide uniformity test data, based on **ASTM C94** testing.

The metal rating plates must be attached to each mixer to specify its mixing speed, agitating speed, rated capacity and unit serial number. The unit serial number represents the entire mixing system. The metal rating plate may be located on the inside of the driver's door. Mixer drum identification numbers or part numbers may or may not compare with the serial number on the rating plate. Should a drum be replaced, documentation from the mixer manufacturer must identify any deviations from the rating plate.

9.2.10.3 Truck Mixers Description

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. Either system must provide control of the rotation of the drum within the limits specified on the mixer manufacturer's rating plate, regardless of the speed

of the truck. Use truck mixers 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.

Ensure truck mixers equipped with a volumetric water gauge are parked in a level condition during on-site water adjustments and for calibration. Ensure that the water measuring equipment has an accuracy of within 3 percent of the indicated quantity.

Truck mixers meeting these requirements shall be issued a mixer identification card by the DMRE upon request from the Plant. Failure to present the identification card upon request shall be cause for rejection of the delivered concrete. The Contractor shall remove the identification cards when a truck mixer is discovered to be in noncompliance and the deficiency cannot be repaired immediately. When the identification card is removed for noncompliance, the Contractor shall note the deficiency on the identification card and forward the identification card to the DMRE in the District with QC Plan acceptance authority.

The concrete Plant 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 made available upon request.

9.2.10.4 Automated Slump Monitoring System

Proposed automated slump monitoring system include the following items:

- (1) Slump is measured by the ready-mixed concrete truck.
- (2) Slump is adjusted and controlled by the ready-mixed concrete truck.
- (3) All water additions and slump adjustments are recorded.

The Plant's QC Plan shall include:

- (1) Automated slump monitoring system information.
- (2) Provisions for training on the proposed automated slump monitoring systems. As a minimum, the Plant shall provide training on the automated slump monitoring system for drivers, QC personnel, and verification inspection personnel.
- (3) Calibration procedures.

Calibration of the automated slump monitoring system shall be done on an annual basis, or when a truck is rejected in accordance with **FDOT Specifications Section 346**. All system records including calibration records shall be made available at the Plant to the Department upon request.

Mix concrete at speeds and number of revolutions as recommended by the mixer manufacturer, when water is added enroute to the project site. Automatic introduction of water will be disabled when entering the project site or when the maximum water to cementitious materials ratio for the mix design is reached. If the system adds water in transit, the concrete shall be re-mixed at mixing speed upon arrival to the project for an additional 30 revolutions. Water shall not be added during the discharge of the batch.

9.2.10.5 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. Operate the mixer at the speed recommended by the central mixer manufacturer.

9.2.10.6 Mixer Cleaning and Maintenance

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 percent of the design radial height. Repair or adjust mixers of other designs per mixer manufacturer's instructions. Resolve questions of performance by performing mixer uniformity tests as described in **ASTM C94**.

9.2.10.7 Volumetric Mixers:

Submit a QC Plan in accordance with **Materials Manual Section 9.2.12** to the DMRO. The Volumetric Mixer shall have a metal rating plate plainly marked with the gross volume of mixed concrete.

Upon the satisfactory review of the Volumetric Mixer QC Plan and satisfactory initial inspection, the DMRE will accept the QC plan, issue an identification card that must be kept with the Volumetric Mixer, and include the Volumetric Mixer's identification number on the list of Department's Certified Volumetric Mixers. Upon the DMRE's acceptance of the Volumetric Mixer's QC Plan, the SMO will assign the identification number.

Volumetric Mixers must meet design standards and guidelines of the **Volumetric Mixer Manufacturers Bureau (VMMB) 100-01**. Each Volumetric Mixer must produce a concrete mix meeting the consistency and uniformity requirements of **ASTM C685**. Any modification of the mix design requires DMRE approval based on the mixer calibration, and demonstration of the consistency and uniformity of concrete test data.

Perform weekly inspections of the Volumetric Mixer, when it is used. The inspection records shall be available to the Department for review.

During production for Department Projects, perform the required QC sampling and testing of plastic and hardened concrete, including the chloride tests. Provide the material certifications for concrete materials ingredients. Enter the required data in MAC.

SUBSECTION 9.2.13 is deleted and the following substituted:

I. 9.2.13 PERSONNEL

Plants supplying concrete to the Department projects shall have adequate qualified personnel. Concrete Batch Plant Operator, qualified technicians, and Plant Manager of QC are required positions for a Plant. A qualified Volumetric Mixer operator is required when concrete is produced in a Volumetric Mixer.

The Plant QC personnel shall meet the Structural Concrete Production Facility QC Personnel requirements of **FDOT Specification Section 105**.

SUBSECTION 9.2.16 is expanded by the following:

II. 9.2.16 DELIVERY TICKET/CERTIFICATION

The following information is required information for each concrete delivery and must be furnished with each load. The information contained within **FDOT 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 mix design. A sample of a delivery ticket is provided in **Appendix "A"**. Use this form or a similar form containing the same information:

- (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 shall match the truck number on the delivery ticket.
- (7) Class of concrete.
- (8) Mix design 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) Maximum allowable water addition at the job site. Unit of measure must be indicated.
- (13) Number of revolutions at mixing speed before leaving for job site.
- (14) Amount of mixing time for central mixer.
- (15) Coarse and fine aggregate sources (Department assigned Source No.).
- (16) Actual amount of coarse and fine aggregates batched in pounds.
- (17) Percent of free moisture in coarse and fine aggregates.
- (18) Cement producer's name and type of cement.

- (19) Total amount of cement batched in pounds.
- (20) Producer's name, brand name and class (whichever might apply) of supplementary cementitious material used.
- (21) Total amount of each supplementary cementitious material batched in pounds.
- (22) Admixture manufacturer, type and total amount of each admixture used.
- (23) Total amount of water batched and added after the truck leaves the Plant in gallons or pounds before leaving for the job site. Unit of measure must be indicated.
- (24) Statement of compliance with the **Contract Documents**.
- (25) Original signature of Batch Plant Operator and technician identification number.

Notes:

- Items 12 and 13 do not apply to non-agitating concrete transporting vehicles.
- Items 1, 2, 4, 6, and 9 through 13 do not apply to precast operations with onsite Plants.

9.2.16.1 Volumetric Mixer Delivery Ticket

The Volumetric Mixer delivery ticket shall meet the requirements of **FDOT Specifications Section 350**, and **Materials Manual Section 9.3**. The signature of the Volumetric Mixer operator is required on delivery tickets, in lieu of the signature of the batch plant operator.