

**STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL SPECIFICATION 888**

PORTLAND CEMENT CONCRETE PAVEMENT USING QC/QA

April 18, 2008

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Appendix 1 Proportioning Concrete Mixtures

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888.01 General. This work consists of constructing a Portland cement concrete pavement on a prepared surface by conforming to 451 for reinforced Portland cement concrete pavement or 452 for non reinforced Portland cement concrete pavement unless otherwise stated herein.

888.02 Materials. Furnish materials conforming to:

Fine aggregate

703.02

Fly ash**	701.13
Coarse aggregate	703.02, 703.13
Portland cement	701.01, 701.02, 701.04, 701.05
Ground granulated blast furnace slag**	701.11
Air entraining admixture.	705.10
Chemical admixture for concrete.	705.12***
Hot Applied Joint sealer	705.04
Prefomed elastomeric joint sealer	705.11
Prefomed filler	705.03
Curing materials	705.05, 705.06, 705.07 (Type 2)
Reinforcing steel	709.09, 709.10, 709.12
Tiebar steel	709.00
Dowel bars and basket assemblies	709.13
Expansion shield anchors	712.01 Type A

** May be used between April 1 and October 1.

*** Admixtures shall contain no more than 50 parts per million chloride ions by weight of cement.

888.03 Concrete Proportioning. Prior to construction, design and submit for acceptance the proportions of materials for all concrete mix designs to be used in the pavement. Follow the requirements of Appendix 1 for all concrete mix designs..

If using a calculated standard deviation from the project’s plant, the standard deviation may be calculated from compressive strength on concrete cylinders tested at age 28 days or may be from the analysis of cores, 28 to 90 days old

Include with each submitted mix design the source of materials and certified test data demonstrating the adequacy of the mix’s proportions. Submit a new mix design if any change in either aggregate or cement type is necessary.

888.04 Concrete Properties. Pavement concrete will have the properties listed below:

* Concrete Design Strength (psi)	# Cementitious Materials Content (lbs/cu. yd.)	Maximum Water Cementitious Materials Ratio	** Standard Size of Coarse Aggregate AASHTO No.	*** Air Content %	Slump in.	Yield %
See section 888.03	Based on meeting design strength requirements	0.45	57, 67, 7, 8	6	1-4 (25-100mm)	+/- 1

* Cores obtained conform to 888.15 will be tested for compressive strength and the data obtained will be analyzed to determine the project average and project standard deviation of the compressive strength. The required project strength shall be 1.65 project standard deviations greater than 4000 psi (27.5MPa).

Established by the mix design developed and accepted under 888.03. Cementitious materials may be 100 % Portland cement; 30% flyash; 30% ground granulated blast furnace slag (GGBF) Grade 100. With a maximum pozzolanic content of 50% of the Cementitious content. Cementitious proportions cannot differ from those tested in the actual accepted mix under 888.03

** Only provide coarse aggregate sizes greater than #57 after having all 703.02 quality tests and 703.13, freeze-thaw testing, performed on the coarse aggregate sources and submitting certified test data showing the aggregate meets specifications. Contact the Department for a history on aggregate sizes greater than #57. The Department will not pre-test large size stone. Determine the source to be used and have submitted for Approval under 703.02 and 703.13.

Provide a maximized coarse aggregate. Include #57s or 1" (25 mm) nominal coarse aggregate. Contractors may blend other coarse aggregate sizes with #57s and sand to develop the best gradation to eliminate as much cementitious material possible while still providing strength and finishing requirements.

*** The air content specified is the target air content. A working tolerance of +/- 2% will be allowed.

888.05 Early Opening Concrete Mixes

Provide Early Opening Concrete Mixes when the project plans require providing the Public access to use of the pavement, crossovers of the pavement or other access to pavement pours.

When plans require the early opening develop a concrete Mix following the same requirements as 888.03 and 888.04 except

A. A specific standard deviation overdesign is not required and the mix design will achieve a compressive strength of 2000 psi (14 MPa) in either 4 or 24 hours and the mix design will achieve a compressive strength of 4000 psi (27.5MPa) in 28 days.

888.06 Concrete Field Laboratory and Test Equipment for Quality Control

A. Field Laboratory. Provide a field laboratory at the batch plant of adequate size to house equipment and perform the tests listed in 888.09 to be performed by Contractor Technician(s). provide and maintain adequate ventilation, heat, light, water, sinks and drainage, electrical and/or gas outlets and work tables, shelves required for the technician to use the test equipment Compressive strength testing equipment may be located at another site.

B. Batching Plants. Provide batch plant(s) with bins, weighing hoppers, and scales for the fine aggregate and the coarse aggregate as well as separate bins, weighing hoppers and scales for the cement. The cement bin, weighing hopper and scale will be properly sealed and vented to preclude dusting during operations. Provide separate bins if fly ash or other pozzolan is used.

Assure the batch plant conforms to ASTM C94 except as required herein. Document that all weighing or measuring devices have been independently certified for accuracy within the last 12-months and conform to ASTM C94. The concrete batch facility may be approved if a Certificate of Performance has been issued by the National Ready Mixed Concrete Association (NRMCA).

C. Mixers. Mixers shall conform to paragraphs ASTM C94.

D. Delivery Equipment. Equipment used for the delivery of concrete to the job site will meet the requirements of section 11 and 12 of ASTM C94.

888.07 Aggregate Handling, Measuring and Concrete Batch Documentation. Handle, haul and store aggregates to minimize segregation, avoid contamination, and assure a uniform grading within the specified gradation. Do not combine aggregates from different sources or of different gradings in the same stockpile. Do not use segregated or contaminated aggregates. Maintain uniform moisture content on all aggregates.

Separately weigh fine aggregate, coarse aggregate, cement and any pozzolans required by the approved mix design.

Assure batch weight tolerances conform to ASTM C94 for cementitious materials, aggregates, water and admixtures.

Provide concrete batch plant tickets conforming to 499.08 for each load of concrete delivered to the project. Also include the first load batch ticket conforming to 499.08.

If any sources of materials change during the concrete manufacturing process notify the Engineer and submit the first concrete load batch ticket of 499.08.

When requested by the Engineer provide aggregate moisture content test results.

888.08 Mixing Concrete. Mix concrete according to ASTM C94 sections 11 and 12 and 499

888.09 Portland Cement Concrete Test Methods. Conform to the following test methods:

Slump of Portland Cement Concrete	ASTM C 143/C 143M
Air Content of Freshly Mixed Concrete	ASTM C 231, ASTM C 173
Unit Weight / Yield of Concrete	ASTM C 138
Making Curing, and Testing Concrete Compressive Specimens	ASTM C 31, ASTM C39
Flexural Strength of Concrete	ASTM C 78
Obtaining and Testing Drilled Cores Specimens	ASTM C 42
Measuring the Length of Drilled Concrete Cores	ASTM C 174
Total Moisture of Aggregate by Drying	ASTM C 566
Sampling Fresh Concrete	ASTM C 172
Sieve Analysis of Fine and Coarse Aggregate	ASTM C 136, ASTM C 117
Sampling Aggregate	ASTM D 75

888.10 Pavement Quality Control. Provide Complete quality control of the concrete manufacturing, placing and curing operations.. Prepare and submit a quality control plan conforming to Appendix 2 of this specification. The Engineer will review and accept the plan prior to beginning of any paving operations.

Assure qualified personnel and equipment are used to measure the various properties of concrete assure they conform to this specification. Provide ACI Grade 1 field testing technicians for sampling and testing of plastic concrete. Provide OAIMA level II technicians for aggregate gradation testing and aggregate handling procedures.

888.11 Equipment. Provide equipment conforming to 451.03. The Contractor may eliminate providing a self recording system if the quality control plan provides monitoring and documentation as per Appendix 2.

888.12 Surface Smoothness. Provide and utilize materials, equipment, and methods necessary to obtain the smoothness requirements conforming to 888.16.C. The surface tolerance specification requirements are modified as follows for all mainline lanes and collector-distributor road pavements of constant width. Surface tolerance requirements for other areas such as ramps, acceleration and deceleration lanes, side roads, shoulders, crossovers, approach slabs, bridge decks, etc., are not a part of 888.12 and will conform to 451.

A. Equipment. Provide smoothness measuring equipment conforming to Supplement 1058. Furnish the Department's approval letter of the profiler and the operator to the Engineer. The Engineer will verify the smoothness measuring equipment conforms to Supplement 1058.04. The Engineer will verify the profile operator's certification against the operator list posted on the Office of Pavements webpage.

B. Smoothness Measurement. Measure the pavement surface smoothness in both wheel paths. Wheelpaths are located parallel to the centerline of the pavement and approximately 3.0 feet (1.0 m) inside all lane edges, measured transversely. Ensure the path of the profiler is parallel to the lane edges at all times. Measure the entire length of pavement, starting and stopping the profile runs when the profile sensor(s) is within 1.0 foot (0.3 m) of any existing pavement, pressure relief joint, approach slab, or other non pavement features (i.e. manholes, valveboxes). Remove any objects such as dirt, debris, curing covers, etc., prior to performing the surface smoothness measurements. Replace any curing covers after the measurements are taken. Repair any membrane curing damaged during the measurements.

Do not perform any surface smoothness measurements until the pavement has cured sufficiently to allow measuring without damaging the pavement. For the first three days, run the profile of each day's paving the next working day and give to the Engineer. When the pavement will not support the profiler on the next working day, notify the Engineer and inform the Engineer when the profile will be run. Notify the Engineer each day prior to performing any measurements.

Develop an International Roughness Index (IRI) according to ASTM E 1926 for each 0.1-mile (0.16 km) section. Submit two copies of the summary report from ProVAL conforming to Supplement 1100 and two electronic copies of all longitudinal pavement profiles in ProVAL compatible format to the Engineer. The Engineer will submit one copy of the summary report and one electronic copy of the profiles to the Office of Pavement Engineering.

Provide necessary traffic control and survey stationing for all surface smoothness measurements.

C. Mandatory Corrective Work. Perform corrective work for the applicable surface type. Corrective work must be performed on any 0.1-mile (0.16 km) section if the IRI exceeds 95 inches per mile (1.50 m/km).

Correct all areas having deviations, high or low points, in excess of 0.30 inches (7.6 mm) in 25 feet (7.6 m) or less. Correct any 0.1-mile (0.16 km) section having an IRI greater than 95 inches per mile (1.50 m/km). Perform corrective work by diamond grinding or removing and replacing. Use Portland cement concrete meeting the contract requirements for the replacement work.

Re-measure each 0.1-mile (0.16 km) section where corrective work was performed to ensure the IRI is less than 95 inches per mile (1.50 m/km) and there are no deviations greater than 0.30 inches (7.6 mm) in 25 feet (7.6 m) or less. Perform additional corrective work until the IRI is less than 95 inches per mile (1.50 m/km) and no deviations greater than 0.30 inches (7.6 mm) in 25 feet (7.6 m) or less exist.

Complete all corrective work prior to determination of pavement thickness.

If corrective work is required the surface texture after diamond grinding is acceptable and no additional texturing is required.

D. Exempted Corrections. Required corrective work resulting from contract requirements for maintaining traffic are considered exempted corrections. Exempted corrections occur primarily at ramps or other access points where paving must be suspended in order to maintain traffic. Required corrective work due to paving suspensions at the end of a work period, material availability, weather, or any reason other than maintaining traffic are not considered exempted corrections. No exempted corrections exist on projects where the maintenance of traffic plan does not interfere with paving operations. Perform exempted corrections according to the requirements for mandatory corrective work.

888.13 Joint Sealing Choose either to seal or not seal transverse and longitudinal contraction joints according to 451.15. Construct unsealed contraction joints according to 451.08 (D). Always seal any plan expansion joints, joints constructed adjacent to fixed objects, or joints required by specification.

888.14 Pavement Lot Determination. Divide the total area of the paving lane into 2000 square yard (1650 square meter) Lots. A paving lane is defined as any width of pavement placed

in a single operation. Separately placed lanes shall make up separate sampling units. One randomly located core location will be determined from each sampling unit. Random locations shall be determined by the Engineer as per Supplement 1064.

Intersections, entrance lanes, crossovers, ramps, shoulders, etc. may be considered individually or collectively to form sampling units of the appropriate size.

If 888.05 concrete is used determine the Lot separately for each concrete mix type.

888.15 Pavement Thickness and Pavement Strength Requirements.

Construct pavement to obtain a uniform thickness equal to or greater than the specified thickness.

Obtain cores from each pavement lot determined in 888.14. Determine the pavement's thickness from core measurements. Follow the requirements of 451.17 for core locations, determined limits of deficiencies and remove and replacement limits.

Obtain cores from each pavement lot to determine compressive strength. Test cores for compressive strength of the pavement when the pavement cores are 28 days to 90 days. Have an approved laboratory test the Cores. The Engineer will designate random locations and the Contractor will obtain two side by side cores. Provide one of the two cores at each random location to the Engineer for Quality Assurance testing conforming to Appendix 3. Have the other random location core tested by the approved laboratory.

Fill all cores holes with a concrete material approved by the Engineer.

888.16 Pay Adjustments.

Payment will be at of the unit bid price upon completion of any section of pavement. Final pay adjustments to the unit bid price will be made upon completion of the pavement operations and all strength, thickness and smoothness data is tabulated and pay adjustments applied per 888.16.A thru 888.16.C to the unit bid price.

A. Thickness Calculate the project average thicknesses of cores according to 451.17.

Calculate pay adjustments according to 451.17.B

B Concrete Strength. Record the compressive strength data for each 888.14 Lot of concrete. Calculate the project average compressive strength of all Lot cores of the same concrete mix type. Calculate the project standard deviation of the project compressive strength for concrete mixes other than 888.05. Calculate the project required design strength by multiplying the project standard deviation time 1.65 and then adding 4000 psi (27.5MPa).

Percent Pay = (Project Average Strength (PAS) / Project Required Design Strength(PRDS)) X 100 % When the PAS is greater than the PRDS maximum payment will be the unit bid price

For 888.05 concrete determine payment as follows:

Core compressive strength is greater than or equal to 4000 psi (27.5MPa) Percent Pay = 100% of unit bid price.

Core strength less than 4000 psi (27.5MPa) = Core compressive strength/4000 psi (27.5MPa) X 100%

C. Pavement Smoothness.

1. Calculate the IRI for each lane for each 0.1-mile (0.16 km) section of paving. The IRI for a 0.1-mile (0.16 km) section is the average of the IRI of the two wheel paths.

A lump sum pay adjustment will be made according to the following schedule for each lane for each 0.1-mile (0.16 km) section, regardless of lane width. Pay adjustments are based on design pavement thickness. Pavement thickness is the total thickness of Portland cement concrete placed as part of the contract and does not include any free draining base, aggregate base, stabilized subgrade, etc.

PAY SCHEDULE		
IRI	PAY ADJUSTMENT	
Inches per mile per 0.1 mile section (m/km per 0.16 km section)	Pavement Thickness less than 8 inches (200 mm)	Pavement Thickness 8 inches (200 mm) and greater
45 (0.71) or less	\$375.00	\$875.00
Over 45 to 50 (0.71 to 0.79)	\$225.00	\$525.00
Over 50 to 55 (0.79 to 0.87)	\$150.00	\$350.00
Over 55 to 60 (0.87 to 0.95)	\$75.00	\$175.00
Over 60 to 70 (0.95 to 1.10)	\$0.00	\$0.00
Over 70 to 75 (1.10 to 1.18)	-\$150.00	-\$350.00
Over 75 to 80 (1.18 to 1.26)	-\$300.00	-\$700.00
Over 80 to 85 (1.26 to 1.34)	-\$450.00	-\$1050.00
Over 85 to 90 (1.34 to 1.42)	-\$600.00	-\$1400.00
Over 90 to 95 (1.42 to 1.50)	-\$750.00	-\$1750.00
Over 95 (1.50)	(1)	(1)

(1) Corrective work required see 888.12

Pay adjustments will be based on the measured IRI after any mandatory corrective work or, at the Contractors option, corrective work performed on any section with an IRI greater than 70 inches per mile (1.10 m/km) to reduce or eliminate the negative pay adjustment.

As an option perform corrective work in the form of diamond grinding to improve the profile on any course prior to the surface course.

Negative pay adjustments apply to sections with mandatory corrective work and exempted corrections.

888.17 Multiple Deficiencies. When a pavement exhibits multiple deficiencies for thickness (888.16.A) and strength (888.16.B), the reduced unit price will be calculated for each and the lowest reduced unit price will be used. The adjustment for smoothness (888.16.C) will conform to the lump sum requirements of 888.16.C.

888.18 Method of Measurement. The Department will measure Portland Cement Concrete Pavement by the number of square yards (square meters) completed and accepted in place. The width equals the pavement width shown on the typical cross section of the plans plus additional as the Engineer directs in writing. The Department will field measure length along the center line of each roadway or ramp. The Department will determine the area width and length.

888.19 Basis of Payment. Payment is full compensation for furnishing and preparing of all materials, including reinforcement, all load transfer devices, placing, finishing and curing, and all labor, equipment, tools, surface smoothness testing and reporting, field laboratory, testing, supplies and incidentals necessary to complete the work. For pavements found deficient in thickness or compressive strength, the Department will pay the reduced price conforming to 888.17. The Department will pay the increased or decreased amount for smoothness conforming to 888.16.C.

No payment will be made for any 0.1-mile (0.16 km) section for smoothness 888.16.C with an IRI greater than 95 inches per mile (1.50 m/km), until corrective work has been completed and the IRI has been reduced to less than 95 inches per mile (1.50 m/km).

The Department will not pay extra for pavement with an average thickness greater in excess than shown on the plans.

The Department will pay for accepted quantities at the contract price as follows:

Item	Unit	Description
888	Square Yard (Square Meter)	Portland Cement Concrete Pavement, ___ inches thick (Reinforced per 451)
888	Square Yard (Square Meter)	Portland Cement Concrete Pavement ___ inches thick (Non reinforced per 452)

APPENDIX 1

PROPORTIONING CONCRETE MIXTURES

- 1.1 General**
- 1.2 Procedure**
- 1.3 Mix Acceptance Criteria**
- 1.4 Documentation**

1.1 General. The Contractor will develop the mix proportions for the Portland cement concrete mixtures as specified in 888.03 thru 888.05. The proportions chosen will be tested in an approved laboratory for the specification requirements of 888.03, 04 and 05.

1.1.1 Materials. Use materials in the trial mixes from the same material sources and type proposed for use in the work. Assure they meet the requirements of the specifications.

1.1.2 Approved Laboratory. An approved laboratory will demonstrate they are equipped, staffed and managed to batch and test Portland cement concrete according to the applicable AASHTO or ASTM methods of test. The laboratory will be a Cement and Concrete Reference Laboratory (CCRL). Submit the CCRL inspection report documenting the laboratory inspection was completed to the Department for review and approval. If the report shows any deficiencies, provide documentation the deficiencies were corrected before the Department will accept the Laboratory.

1.2 Procedure.

1.2.1 Proportioning Procedure. Develop the concrete mix design according to the current edition of the American Concrete Institute Standard ACI 211.1. Use the absolute volume method. Design the concrete for extreme exposure conditions. Mix and test the physical properties of the proposed design according to ACI and this supplemental specification.

1.2.2 Test Procedure. Batch the design concrete in two separate batches. Test each batch in the plastic state for air, consistency and yield. Adjust each batch to produce a plastic concrete having an air content, consistency, and yield equal to the specified value plus or minus the following tolerances:

Air content, + or – 1 percent; Slump, + or – ½ inch (13 mm); Yield, + or - 2 percent.

After the concrete batch meets the prescribed property limits, make 6 x 12 inch (150 x 300 mm) standard concrete cylinders for compression testing at the ages of 24 hours (+/- 4 hours), and 3, 7, 14 and 28 days. The value of the physical properties of each mix will be the average of the physical properties established from the two batches.

When testing for early opening mixes change the testing times for compressive strength to the required time of opening and for 28 days.

1.3 Mix Acceptance Criteria. If concrete plant's production standard deviation is established, the physical properties of the mix in 1.2.2 will have an average strength equal to or greater than the 4000 psi (27.5 Mpa) plus two times the standard deviation.

The production plant may establish a 28 day compressive strength standard deviation from a concrete mix with similar components by using 28 day old cylinder results or core results tested from 28 to 90 days of age. At least 30 individual test results will be needed to establish the standard deviation from a previous mix. The previous mix design will have used the same aggregate gradation to be used on the project.

If the concrete plant cannot establish a standard deviation based on previous mixes, the design mix will be acceptable if average strength of the mix equals 4000 psi (27.5 Mpa) plus 1100 psi (7.6 Mpa).

For early opening mixes the standard deviation requirement is not required.

1.3.1 Re-design and retest any laboratory mix not meeting the requirements of 1.3.and the supplemental specification. hen it will be considered acceptable as the design mix for the class of concrete being designed.

1.4 Documentation. Submit documentation, including a listing of the material type and size used, brand name and the producer/manufacturer source of the materials. Include gradation requirements for the aggregates if a special blend is being used. Identify the mix developed and any special requirements included in the contract documents for the project in which the mixture is to be used. Include the test data developed according to 1.2.2 and identify the laboratory which developed the mix and test data on the mixture.

APPENDIX 2

PROCEDURES FOR QUALITY CONTROL FOR PORTLAND CEMENT CONCRETE PAVEMENT

- 2.1 General**
- 2.2 Quality Control Plan**
 - 2.2.1 Plan Content**
 - 2.2.2 Documentation**
 - 2.2.3 Corrective Action**
 - 2.2.4 Non-Conforming Materials**

2.1 General. The Contractor is responsible for control of the quality of the materials and work as required in Section 888.10. A Contractor developed Quality Control Plan is required so that these control processes to be followed are documented for the Department. In fulfilling this responsibility the contractor must understand, measure and document what goes into his processes, what happens in these processes and what comes out of these processes.

2.1.1 Purpose. This Appendix establishes minimum requirements for a Contractor's Quality Control System. Use these requirements as a procedural guide in detailing the inspection, sampling and testing required to maintain compliance with the specification requirements.

2.1.2 General Requirements. Provide and maintain a Quality Control System that will provide the Department assurance that all materials and products will conform to the contract requirements. Perform or have performed the inspections and tests required to substantiate product conformance to contract documents and accepted quality control plan. Document Quality Control inspections and tests and provide for review to the Department at least daily and throughout the life of the contract. Maintain standard equipment and qualified personnel required by the Specifications to assure conformance to the contract requirements. Procedures will be presented to the Department for review before the work is started.

2.2 Quality Control Plan. Prepare a Quality Control Plan (QCP) detailing the type and frequency of inspection, sampling and testing deemed necessary to measure and control the various properties of materials and construction required by the Specification. The sampling and testing portion of QCP will detail sampling location and techniques and testing frequency to be used. If verified, the Department may use Quality Control sampling and testing performed by the Contractor for acceptance. Submit the Quality Control Plan to the Engineer before the work begins.

2.2.1 Plan Content.

2.2.1.1 The QCP will identify:

1. the personnel responsible for the Contractor's Quality Control.

2. The company official who will act as the quality liaison with Department personnel
3. The qualified Technicians who will conduct the inspection, sampling and testing will be identified along with proof of their qualification.

2.2.1.2 The class or classes of concrete involved in the work will be listed separately along with the approved mix design of Appendix 1.

2.2.1.3 The QCP will document the process control requirements shown in Table 2.2. The process control activities shown in Table 2.2 are considered to be normal activities necessary to control the production and placing of a concrete mixture at an acceptable quality level. Before testing aggregate gradation samples split the sample and retain the split until the Department designates further disposition.

2.2.1.4 Sampling and Testing will be in accordance with 888.10 and measuring and testing equipment will be standard and properly calibrated as required in the referenced test procedures.. Any alternative sampling methods and procedures and inspection equipment to be used will also be detailed in the QCP.

2.2.2 Documentation. Maintain adequate records of all inspections and tests. The records will indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and the corrective action taken. Submit your documentation procedures for review and approval of the Department prior to the start of the work and to compliance checks during the progress of the work. When the Department has standardized form the Contractor will use those forms and documents. All conforming and non-conforming inspections and test results will be kept complete and will be provided the Engineer daily during the progress of the work. All quality control records and reports documenting the Contractor's Quality Control inspections and tests will be turned over to the Department upon completion of the work.

2.2.3 Corrective Action. Take prompt action to correct conditions that have resulted in, or could result in, materials and products not conforming to the requirements of the specification. Make corrections and/or modifications to the QCP and submit to the Engineer to deal with not conforming products, procedures and materials. The Engineer may also require QCP modifications at any point in the process

2.2.4 Non-Conforming Materials. Establish in the QCP and maintain the system for controlling non-conforming material, including procedures for identification, isolation and disposition of any such material. Materials identified as non-conforming materials will not be used in the work.

TABLE 2.2 CONTRACTOR PROCESS CONTROL REQUIREMENTS

Process Control Requirement	Minimum Frequency
2.1.A Plant	
1. Mixer Blades	Prior to start of work and weekly during paving
2. Scales	
a. Tare	Daily
b. Calibration	Prior to start of paving
c. Calibration verification	Weekly
3. Gages and Meters	
a. Calibration	Prior to start of paving
b. Calibration verification	Weekly
4. Admixture dispensers	
a. Calibration	Prior to start of paving
b. Calibration verification	Weekly
2.2.B Materials	
1 Aggregates	
a. Gradation	Daily
b. Moisture	Daily
c. Percent passing 75 micron sieve	Daily
d. Stockpile condition	Daily
2 Cementitious Material	
a. Source verification	Each load
b. Temperature	As required
3. Water	
a. Turbidity	As required
b. pH	Daily if not treated
4. Admixtures	
a. Source and type verification	Daily
b. Storage condition	Daily
2.2.C Pre-Pour preparation	
1. HIPERPAV operations	At least each day of pavement production conforming to 451 & 452.
2. Subbase preparation	Define procedure and frequency
3. Dowel/load transfer device installation and checking	Define procedure and frequency
4. Reinforcement placement	Define procedure and frequency
2.2.D Plastic Concrete	
1. Air Content	One each ½ day of operation
2. Slump	One each ½ day of operation
3. Temperature	As required
4. Yield	First day of paving and every fifth day afterwards
5. Thickness	As required
6. Vibrator data monitoring	At least every ½ hour record the time of day, each individual vibrator frequency, station location and paver track speed. See section 888.11 for

	reporting requirements.
2.2.E Paving operations	
1. Joint installation operations and methods	Define procedures
2. Finishing	Define procedures
3. Pavement Grooving	Methods
4. Curing	Materials and methods
5. Joint sealing	Materials and methods
2.2.F Hardened Concrete	
1. Strength for opening to traffic	Methods
2. Strength for payment	As required
3. Smoothness	As required

The contractor will make and document any other inspections and tests as deemed necessary to insure the quality of the finished pavement.

APPENDIX 3

QUALITY ASSURANCE PROCEDURES FOR PORTLAND CEMENT CONCRETE PAVEMENT

- 3.1 General
- 3.2 Procedures
- 3.3 Basis of Comparison

3.1 General. The Department is responsible for Quality Assurance. The Engineer will oversee and maintain a program of assuring the QCP is followed and process control measurements, tests and results are accurate. This Appendix sets forth minimum methods required to verify that the Contractor's process control system is working and verifies a quality product is delivered.

3.1.1 Definitions.

Quality Assurance Samples and Tests – Tests conducted by the Department to verify the process control test results furnished by the Contractor.

Quality Control Samples and Tests – All of the samples and tests performed by the Contractor, or his designated representative, used for controlling the various attributes of the concrete produced for use in a Department project. These samples and tests will be used by the Department to support acceptance decisions when Department verified.

Acceptance – The use of Department verified Contractor Quality Control test results and Department Acceptance test results to verify acceptability of the materials being furnished.

Retained Gradation Sample – A sample that has been graded and the combined retained sieve portions saved in a sealed sample bag for retesting later.

3.2 Quality Assurance Procedures.

3.2.1 Aggregates. Appendix 2 requires all gradation samples be retained for Department validation. At least once each week during paving operations the Department will go to the laboratory and select, at random, the split retained aggregate gradation sample for assurance testing. The Department will determine the gradation and compare to the gradation of the same quality control sample conforming to 3.3.1.

3.2.1 Air Content. The Department will perform quality assurance testing at a minimum frequency at least 10 percent of the Contractor's sampling frequency. Sampling will be random without prior notification to the Contractor. The results of the Department's test will be compared to the latest 10 sample results of the contractor air tests and will conform to 3.3.2

3.2.2 Compressive Strength. Section 888.16 requires the Contractor obtain additional cores at random locations indicated by the Department. The Department will select 1 out of every 10 additional Department directed cores to be tested by the Laboratory. The test data will be

compared to the Contractor tested core obtained from the same location required in 888.16. The core comparison will conform to 3.3.3.

3.3 Basis of Comparison.

3.3.1 Aggregates. The maximum difference between the Contractor test result and the Department test result for any sieve fraction will not exceed the D2S limit set forth in AASHTO T 27. If the comparison of percent passing for any sieve exceeds that given in T 27 then the Department will choose, at random, two additional retained samples from that week and test and compare. If both samples meet the criteria in AASHTO T 27 for each sieve fraction tested the verification is accepted. If any sieve fraction comparison does not meet the criteria in T 27 the Department will stop paving until the Contractor conducts an immediate investigation to determine the cause of the lack of comparison and makes revisions to the QCP to eliminate the problem from further work.

3.3.2 Air Content. Using the contractor quality control test results calculate the average and standard deviation for the concrete test population. The Department's quality assurance result will fall within the contractor quality control average plus or minus 1.65 times the standard deviation (avg. + or - 1.65s).

If the air test is outside the range stop paving until

- a. the air test equipment used by both the Contractor and the Department are used to perform side by side testing from the same batch and the results are within 1.0%.
- b. the testing procedures used are verified.

Make any required modifications or changes to the QCP, the technician and equipment to obtain item a before continuing paving.

3.3.3 Compressive Strength. The Department will compare each individual core tested to the adjacent core tested by the Contractor. No cores will have a difference exceeding 750 psi (4.5 Mpa). If the difference is greater, both the Contractor's laboratory and the Department's laboratory will check the accuracy of the equipment for conducting the compressive strength of the cores. If the discrepancy between cores still exists, the Contractor will re-core the LOT in dispute and the two cores will be tested in the Department's Central Laboratory. The results of these tests will be compared and the difference will not exceed 650 psi (4.5 Mpa). If the re-cores can not be verified the project Lots will be cored by the Contractor and tested by the Department for payment under 888.16.B.