

Specification Cover Sheet

Complete only applicable items.

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QA: L

Page: 1

Of: 15

2. TITLE
WET PROCESS SHOTCRETE

3. DOCUMENT IDENTIFIER (Including Rev. No.)

BABEE0000-01717-6300-03363 REV 00

RECEIVED

4. QA CONTROLS

Specification subject to

Q

Controls

8/19/96

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EFFECTIVE DATE

DOCUMENT AND RECORDS CENTER

5. Rev. No./
(Date)

6. Description of Revision

This specification section is a revision of and supersedes BABEAB000-01717-6300-03363 REV01. This specification expands the scope from the TS North Ramp to encompass the Ramps, Main Drift and South Portal excavation. This revision has the following TBV and TBD on the design:

TBV-193-ESF Seismic design values need to be verified.

TBD-147-ESF Thermal stress values have yet to be determined.

TBV-069-DD Rock mass strength estimates for TSw1 and TSw2 need to be verified. (Added this revision)

TBD-146-ESF Thermal stress values have yet to be determined. (Added this revision)

TBV-224 Rock Mass properties of box cut need to be verified.

This specification section incorporates and modifies the following Engineering Change Requests (ECR's) and Field Baseline Change Proposals (BCP's) and closes these interim changes:

BCP-02-95-0180

ECR# E95-0001

ECR# E95-0025

ECR# E95-0052

ECR# E96-0022

This revision has made changes to Section 3.14 in response to DR YMQAD-96-D007.

The whole specification was extensively revised.

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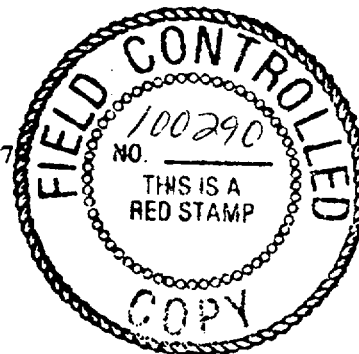
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PDR



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SECTION 03363

WET PROCESS SHOTCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

This Specification Section includes furnishing all labor, materials, and equipment necessary for batching, transporting, placing and maintaining quality control (QC) for wet mix, unreinforced and steel fiber reinforced, shotcrete used at the Exploratory Studies Facility (ESF) tunnel and portal excavations.

1.02 RELATED SECTIONS

Division 1 General Requirements

1.03 REFERENCES

The specific issue/version of the codes and standards applicable to this specification are established in the design analysis and may not be the latest version.

A. American Concrete Institute (ACI):

- | | | |
|----|---------------|--|
| 1. | ACI 214-77 | Recommended Practice for Evaluation of Strength Test Results of Concrete |
| 2. | ACI 506R-90 | Guide to Shotcrete |
| 3. | ACI 506.2-90 | Specification for Materials, Proportioning, and Application of Shotcrete |
| 4. | ACI 506.3R-91 | Guide to Certification of Shotcrete Nozzlemen |
| 5. | ACI 305R-91 | Hot Weather Concreting |
| 6. | ACI 306R-88 | Cold Weather Concreting |

B. American Society for Testing and Materials (ASTM):

- | | | |
|----|--------------|---|
| 1. | ASTM A820-90 | Standard Specification for Steel Fibers for Fiber Reinforced Concrete |
| 2. | ASTM C33-93 | Standard Specification for Concrete Aggregates |
| 3. | ASTM C42-94 | Standard Test Method for Obtaining and Testing Drilled Cores |

and Sawed Beams of Concrete

4. ASTM C94-94 Standard Specification for Ready-Mixed Concrete
5. ASTM C143-90 Standard Test Method for Slump of Hydraulic Cement Concrete
6. ASTM C150-95 Standard Specification for Portland Cement
7. ASTM C289-94 Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
8. ASTM C227-90 Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
9. ASTM C685-94 Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing
10. ASTM C1116-91 Standard Specification for Fiber-Reinforced Concrete and Shotcrete
11. ASTM C1064-86 Standard Test Methods for Temperature of Freshly Mixed Portland Cement Concrete
12. ASTM C1240-95 Standard Specification for Silica Fume for Use in Hydraulic-Cement Concrete and Mortar
13. ASTM C1140-89 Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
14. ASTM C1141-89 Standard Specification for Admixtures for Shotcrete
15. ASTM D75-87 Standard Practice for Sampling Aggregates

C. Yucca Mountain Site Characterization Project (YMP) Documents

1. YAP-15.1Q Control of Nonconformances

1.04 QUALITY ASSURANCE

- A. Quality Assurance shall be conducted in accordance with Specification Section 01400 and applicable controls from other Specification Sections. This specification covers both Q shotcrete and non-Q shotcrete. QA Controls are denoted with underlining and are preceded by "QA Control".

- B. Shotcrete which is permanent function ground support in the main tunnel, alcove transition zones, south portal headwall and any other areas classified Q on drawings will be designated as Q shotcrete.
- C. Shotcrete installed in alcoves beyond the transition zone or installed for other reasons, such as sealing a bulkhead or for personnel safety, is considered non-Q but shall be subject to Q controls in Sections 1.04D3b, 1.06, 2.01 E2, 2.01C and 3.02 D. All other QA controls listed in this Specification Section only apply as a "QA Control" to the Q shotcrete.
- D. Acceptance of Product

Shotcrete is a commercial grade item. Based upon the critical characteristics, shotcrete shall be qualified in this application as follows:

1. Post Installation Testing

- a. QA Control: 34.5 MPa (5,000 psi) required unconfined compressive strength, f'_c , at twenty-eight days by ASTM C42 for representative cores obtained from test panels or in-place cores.
- b. Shotcrete represented by samples that fail 28-day strength requirements or workmanship grading shall be dispositioned using Yucca Mountain Site Characterization Project Administrative Procedures for non-conformance.

2. Pre and Post Installation Inspections

Inspections shall be conducted as follows:

- a. QA Control: Inspection grading of core samples from construction panels or in-place coring in accordance with core grading procedures described in Paragraph 3.12 D.
- b. Monitoring of surface preparation prior to shotcreting as described in Paragraph 3.12B.

3. Receipt verification of materials:

- a. QA Control: Periodic checking of materials for conformance with the requirements of this Specification Section.
- b. QA Control: Receipt inspection of materials received are in accordance with the requirements of Paragraph 2.01.
- c. QA Control: Receipt inspection that required documents are received, acceptable, and in accordance with the requirements of this Specification Section.

4. Field Verification:

Storage of Materials

Cement, aggregates, and admixtures shall be stored in accordance with Specification Section 01600 Part 1, 2, & Paragraph 3.02 A, B & D, and manufacturers recommendations (if provided). In addition aggregate stockpiles shall comply with Paragraph 3.10 of this Specification Section.

1.05 DEFINITIONS

- A. Shotcrete: Portland Cement concrete, pneumatically projected at high velocity onto a prepared surface by means of compressed air which may contain approved admixture(s) suitable to attain quick set, high early strength, adequate compaction, and adhesion.
- B. Wet Mix Process: Shotcrete in which all the ingredients including water, are mixed before introduction into the delivery hose. Compressed air is introduced to the material flow at the nozzle. If used, accelerator is normally added at the nozzle.
- C. f'_c : The specified required unconfined compressive strength of the shotcrete as defined by ACI 214.
- D. Nozzle Operator: The individual who controls the shotcrete nozzle. Commonly referred to as the nozzleman.

1.06 SYSTEM DESCRIPTION

Shotcrete will be applied to rock surfaces in the tunnel, alcoves or portal excavations, where indicated on the Drawings, to seal the profile and bind the opening perimeter into a contiguous mass thereby preventing degradation of the rock surface. Shotcrete which is part of a permanent function ground support system designed to provide maintainable long-term ground support in designated areas is classified Q.

The Constructor may utilize non-Q shotcrete to control surface ravelling, or as a construction aid to seal lagging in accordance with the drawings. The Constructor may use shotcrete to seal bulkheads or for personnel safety at the Constructor's discretion (non-Q). QA Control: A/E approval and TCO concurrence is required before application of shotcrete anywhere in the ESF.

PART 2 PRODUCTS

2.01 MATERIALS

A. Delivery, handling, and storage of materials shall be in accordance with Specification Section 01600 Part 1, 2, & Paragraph 3.02 A, B & D, and manufacturers recommendations (if provided). In addition aggregate stockpiles shall comply with Paragraph 3.10 of this Specification Section.

B. Portland Cement

Cement used shall conform to the requirements of ASTM C150, Type II. Cement shall be tested by the manufacturer and shall be furnished with documentation that confirms conformance to ASTM C150. Cementitious material shall be protected from pre-hydration and contamination.

C. Aggregate

Aggregates shall conform to ASTM C33. Aggregate gradation shall conform to ASTM C33, Table 2, Size No. 7 for coarse aggregate, and ASTM C33, Section 6.1 for fine aggregate.
QA Control: Alkali reactivity shall be tested to ASTM C289 or ASTM C227.

D. Water

Mixing water shall comply with the requirements of ASTM C94.

E. Admixtures (If Used)

1. Admixtures shall conform to ASTM C1141 Type I requirements.
2. QA Control: The use of chloride based compounds as accelerators is prohibited.
3. Each admixture shall be furnished with documentation certifying that the admixture meets the requirements of ASTM C1141.

F. Steel Fiber Reinforcement (If Used)

1. The fiber shall be uniformly distributed throughout the mix, in accordance with ASTM C1116.
2. Steel fiber reinforcement shall conform to ASTM A820, Types I and II.
3. The steel fiber shall have a nominal size of 0.25 mm x 0.56 mm x 25 mm.

G. Silica Fume (If Used)

Silica fume shall conform to ASTM C1240 with a maximum addition of 15 percent by weight of cement.

2.02 MIX DESIGN

- A. The mixes shall be designed to provide an unconfined compressive strength (f'_c), of 34.5 MPa at 28 days when tested; and a slump that does not exceed 75 mm at the pump.
- B. Twenty days minimum prior to shotcrete placement the Constructor shall submit for A/E acceptance a proposed mix design for the shotcrete with the tolerances of any variable components identified. The design shall include a complete list of materials and copies of test reports showing that the mix has been successfully tested to produce shotcrete with the properties specified. The proportions of ingredients selected on the basis of trial mixes and field trials shall be used in the actual application of shotcrete. The Constructor shall submit test results on test panels for each mix design being considered following the testing guidelines of Paragraph 3.12 C. 3. of this Specification Section. (HOLD POINT)
- C. Proportions. The combined aggregate shall be a blend of sizes as required to produce a combined grading within the limits of ACI 506R, Table 2.1, Gradation No. 2. The cement or equivalent cementitious materials content shall be a minimum of 420 Kg per cubic meter of batched shotcrete.

PART 3 EXECUTION

3.01 BATCHING AND MIXING

- A. Equipment: Provide equipment and establish procedures to batch and completely mix materials at a rate to maintain continuous placement capability and assure uniformity of product. The constructor may batch shotcrete under any approved A/E concrete batching procedures generated from other specifications provided that the procedure and this specification do not have conflicting requirements. If new batch procedures for shotcrete are required they shall be submitted to the A/E for approval.
- B. Mix proportions shall be controlled by weight batching in accordance with ASTM C94 or by volume batching meeting the requirements of ASTM C685. Volume batching shall be checked by a weight batch every week during production.
- C. Transit Mixing from Surface to Subsurface (If Used)
 - 1. Mix and deliver shotcrete in a transit mixer. Ready mixed shotcrete shall comply with the requirements of ASTM C94.
 - 2. In accordance with the approved mix design, water and retarding admixtures (if used) may be added in the transit mixer to mix and predampen the shotcrete; however, the Constructor's handling procedures must include measures to minimize retention time as a means to minimize retarding admixture dosages. The water and admixture may be added

underground if adequate measures to prevent fugitive dust emissions are in place.

3. A method of measurement for adding water and admixtures underground, if used, shall be approved by the Constructor's QC organization (refer to ASTM C94, Paragraph 8.3).

D. Ready-Mixed Shotcrete Transported from Surface to Subsurface (If used)

Batched Shotcrete delivered to the tunnel portal for subsequent transport to a subsurface delivery point shall meet all the requirements of ASTM C94, Sections 11 and 12. Equipment used for transport of the ready mixed shotcrete shall be approved by the A/E. (HOLD POINT)

3.02 PRODUCTION OF SHOTCRETE

- A. The inclusion in the mix of rebound or previously expended material is unacceptable.

B. Temperature Control

1. Follow the guidelines in ACI 305R, Hot Weather Concreting and ACI 306R, Cold Weather Concreting to evaluate temperature controls required to ensure that the shotcrete will not be adversely affected by temperature. Excess water shall never be used to slow shotcrete set time. Batched shotcrete shall not exceed 32 degrees C. Do not place wet process shotcrete if tunnel ambient temperature exceeds 32 degrees C.
2. Methods of Heating and Cooling: The Constructor shall submit for review and approval prior to installation a procedure for heating or cooling the shotcrete. (HOLD POINT)

- C. Accelerator may be added to the extent necessary for suitable early strength commensurate with the application. The quantity of accelerator shall be within manufacturer's recommendations.

- D. QA Control: Admixtures containing organic components shall not be used except when alternative means are unacceptable including hotweather precaution to reduce prehydration. Twenty days prior to use of any organic admixture, the Constructor shall submit for acceptance to the A/E a request to use that admixture in the shotcrete application. The submittal shall include the reasons why alternative means are unacceptable. (HOLD POINT)

3.03 SURFACE PREPARATION

Surfaces against or upon which shotcrete is to be placed shall be free from standing water, mud or debris prior to placing shotcrete. All surfaces shall be free from oil, grease, or any other substance which will prevent bonding of the shotcrete. Rock surfaces against which shotcrete is to be placed shall be scaled to remove loose, semi-detached rock fragment. However, there may be situations where complete removal of fragments may be hazardous or inadvisable, including where early support is required and where the in place rock is fractured. Rock surface shall be washed with water and the surface shall attain surface saturated dry condition prior to shotcrete application.

3.04 SHOTCRETE PLACEMENT

- A. Placement: Shotcrete shall be applied to the required thickness tolerances at the locations shown on the applicable Drawings or as necessary for worker safety. The coverage of any welded wire fabric shall be in accordance with ACI 506.2, Parts 3.3.3 and 3.3.4.
- B. QA Control: The Constructor shall use certified shotcrete nozzle operators as specified in Paragraph 3.14 to operate the shotcrete nozzle.
- C. Twenty days prior to the start of shotcrete placement, the Constructor shall submit a placement plan for acceptance describing: preconstruction-testing of mix design, control of thickness, dust control, surface preparation, curing of in-place shotcrete, curing and handling of test panels including provisions for chain of custody, precautions taken to avoid and/or control spills of cementitious materials and methods for prompt removal of rebound. (HOLD POINT)

3.05 REINFORCEMENT

Shotcrete reinforcement, including steel fiber reinforcement, shall be incorporated as indicated on the Drawings.

3.06 REPAIR OF DEFECTS

Repair defects in accordance with non-conformance report.

3.07 FINISHING

Provide natural gun finish with thickness tolerances as indicated on the Drawings.

3.08 JOINTS

Unless construction joint configurations are otherwise shown on the Drawings, the edge of the placed shotcrete shall be tapered to facilitate a smooth transition between adjacent application areas. The shotcrete thickness to tapered length ratio shall not be less than 1:4.

3.09 CURING AND PROTECTION

- A. Initial curing of shotcrete in the tunnel and alcoves requires that freshly applied shotcrete be at ambient temperature and humidity and kept moist by continual spraying for a period up to 72 hours.
- B. Shotcrete placed outside of the tunnel in the portal box cut shall be kept continuously moist by water spray for a minimum of 24 hours. The contractor may use alternative means to initially cure the box cut shotcrete in accordance with the recommendation of ACI 506.2R by submitting the proposed method to the A/E for approval.
- C. Final curing of shotcrete should take place at ambient temperature and humidity.
- D. Liquid, membrane-forming curing compounds shall not be used.

3.10 STORAGE OF MATERIALS

Aggregates shall be delivered for storage to a prepared hard, clean surface in a manner that will preclude the inclusion of foreign material.

3.11 EQUIPMENT

- A. Shotcrete equipment shall be kept clean and in good operating order.
- B. The transit mixer or other delivery transporter shall be washed after use and wash water removed to prevent inadvertent contamination from admixture residue.

3.12 FIELD QUALITY CONTROL

- A. The Constructor shall be responsible for recording shotcrete placement location, installation witnessing and test documentation in accordance with this Specification Section, Specification Section 01400 and Specification Section 01501. The Constructor's documentation shall include as a minimum:
 - 1. QA Control: Documentation of shotcrete application area which is sufficiently accurate to permit subsequent identification of the application area at any time following installation.
 - 2. Document date and time of shotcrete installation, batch number(s)
 - 3. QA Control: Document installation thickness as attaining the specified thickness within the tolerance given on the applicable drawing.

B. Monitoring: The Constructor's QC inspector shall monitor surfaces prior to shotcreting for loose material, debris, chips, mud, dirt or other foreign matter to ensure removal to the extent practical. The inspector shall also inspect reinforcement (if used), and embedded items (if used) to assure compliance with the Drawings and the requirements of this Specification Section.

C. Sampling and Testing

1. QA Control: Sampling and testing of aggregates shall be performed, and may be performed by the Constructor's testing laboratory working under the general oversight of the Title III Engineering organization.

Final acceptance of test results shall be by the Constructor's QC organization.

2. Aggregates: Upon delivery of aggregates to the batch plant, fine and coarse aggregates shall be sampled in accordance with ASTM D75 and tested for compliance with ASTM C33. Aggregates shall be sampled during plant production and tested for moisture content and gradation.

3. Shotcrete

- a. The in-place shotcrete shall be visually monitored between coats and immediately following final application for laitances, loose material, cracking, sloughing, and sagging.
- b. QA Control: The Constructor shall make 460 mm x 460 mm nominal size steel test panels placed in the vertical position for every 40 m³ of shotcrete placed but at least one panel per shift. The shotcrete shall be applied perpendicular to the receiving surface and a minimum of 150 mm thick. The Constructor's regular nozzle operator shall place the panels during the regular course of the work. The panels shall be cured initially for a minimum 48 hours in the same or similar conditions as the work, including humidity, temperature, and shielding from direct sunlight. The test panels shall be covered with wet burlap and plastic immediately before removal from the tunnel or portal excavation area. The panel, when removed from the tunnel or portal excavation area, shall be immediately transported to the testing laboratory for coring and curing.
- c. A chain of custody shall be established from the time the test panels are placed to where they are stored during initial field curing through transporting to the test facility. The constructor shall assure that the panels are handled, transported and treated properly.
- d. QA Control: The Constructor shall extract a minimum of eight cores of a nominal 75 mm diameter and a length meeting an L/D ratio of between 1.94 and 2.10 from each panel. These cores shall be graded under Paragraph 3.12 D. Time tolerances may be relaxed and cores placed in moisture conditioning in accordance with ASTM C42 until removed for testing. Two cores shall be tested at three days, two cores shall be tested at seven days, and two cores shall be tested at twenty-eight days in accordance with

ASTM C42. The remaining two cores will be held for 90 days for further testing if needed. They may be discarded after 90 days if the 28 day breaks exceeded the specified strength and all cores were of grade 2.5 or better.

For the three and seven day tests the laboratory test breaks may be scheduled to normal business days/hours and the results prorated for the three and seven day breaks. QA Control: The 28 day compressive strength test shall meet the standard time tolerances since it is considered as the acceptance criteria.

- e. QA Control: Strength shall be evaluated following the recommended practice for evaluation of strength in ACI 214. Control charts for results of strength tests shall be made as shown in Figure 4.4 of ACI 214 for three, seven and 28-day strengths. The Title III engineering shall be notified of any adverse trends and low sample values that will likely cause a non-conformance to the 28-day strength. Test results shall be reported to the A/E as they become available or as requested by the A/E.
- f. The shotcrete shall meet the specified strength and shall not contain defects in excess of those specified under Paragraph 3.12 D of this Specification Section.
- g. When shotcrete test panel cores do not meet the specified requirements, additional samples shall be taken and tested in accordance with paragraph d above. These samples shall be taken from the in-place shotcrete from the area of work represented by the test panel. The test results from the additional samples shall be provided as part of the non conformance disposition. QA Control: These core samples shall be a nominal 75 mm diameter and full thickness of the in-place shotcrete. For in-place core samples with an L/D ratio less than 1.94, the results shall be corrected in accordance with ASTM C42.
- h. Slump of the fresh batched shotcrete shall be tested in accordance with ASTM C143 to the tolerances of the approved mix design. Temperature of the fresh batch shotcrete shall be tested in accordance with ASTM C1064.
- i. Temperature of freshly placed shotcrete shall be taken with a concrete thermometer in accordance with ASTM C1064.

D. QA Control: Shotcrete Core shall be graded for workmanship in accordance with the following criteria:

- 1. GRADE 1: Shotcrete specimens are solid; there are no laminations, sandy areas, or voids. Small air voids with a maximum diameter of 3 mm and maximum length of 6 mm are normal and acceptable. The surface against the form or bond plane shall be sound with full paste, without a sandy texture, or voids.

2. GRADE 2: Shotcrete specimens shall have no more than two laminations or sandy areas with dimensions not to exceed 3 mm thick by 25 mm long. The height, width, or depth of voids shall not exceed 10 mm. The surface against the form or bond plane shall be sound with full paste, without a sandy texture, or voids.
3. GRADE 3: Shotcrete specimens shall have no more than two laminations or sandy areas with dimensions exceeding 5 mm thick by 32 mm long, or one major void (height, width, or depth greater than 10 mm), sand pocket, shadow, or lamination containing loosely bonded sand not to exceed 16 mm thick and 32 mm in width. The surface against the form or bond plane may be sandy with voids containing overspray to a depth of 2 mm.
4. GRADE 4: The core shall meet in general the requirements of Grade 3 cores, but may have two conditions such as described for Grade 3 or may have one flaw with a maximum dimension of 25 mm perpendicular to the face of the core with a maximum width of 38 mm. The end of the core that was shot against the form may be sandy and with voids containing overspray to a depth of 3 mm.
5. GRADE 5: A core that does not meet the criteria of core Grades 1 through 4, by being of poorer quality, shall be classified as Grade 5.
6. Determination of grade from test panels or in-place cores shall be by computing the mean of a minimum of two core specimens.
7. A mean numerical grade of 2.50 or less is acceptable, a mean grade of 2.51 or greater is unacceptable. Individual shotcrete cores with a numerical grade higher than 3 are unacceptable.

NOTE: The preceding core grades are based on cores of a nominal 76 mm diameter by a nominal 152 mm long dimension.

E. QA Control: Strength Test Results: The Constructor shall evaluate the unconfined compressive strength of the shotcrete (f_c') in accordance with ACI 214.

1. The average of the test results of the two samples as required in Paragraph 3.12 C. 3. d. shall be considered the acceptable value. The Constructor, at his option, may sample additional cores from the same test panel and include them in determining the average 28 day strength of a panel.
2. If a specimen shows evidence, other than low strength, of improper sampling, handling, curing or testing, it shall be discarded and the strength of the remaining core shall then be considered the test result.

F. QA Control: Monitoring the operational records in paragraph 3.15.

3.13 HOUSEKEEPING

Upon completion of shotcrete work the Constructor shall remove all rebound.

3.14 PERSONNEL QUALIFICATIONS

QA Control: The Constructor shall document training and certification of nozzle operators.
At least twenty days prior to installation of Q shotcrete, the Constructor shall submit for A/E review and approval a procedure for the certification and training of nozzlemen following the guidelines of ACI 506.3R. (HOLD POINT) The procedure shall include provisions for written testing of the nozzlemen and workmanship testing. Workmanship test panels sizes shall be in accordance with ASTM C1140 and shall have a minimum area of 0.37 m² (4 ft²).

3.15 OPERATIONAL RECORDS

The following operational information shall be recorded:

- A. Batch time, delivery time, discharge time, and batch proportions used.
- B. Admixture quantities used
- C. Time, and temperature of placement location
- D. Special precautions for hot/cold weather
- E. Identity of the nozzle operator who performed work.

PART 4 SUBMITTALS AND NOTIFICATION

4.01 SUBMITTALS

Submittals shall be in accordance with Specification Section 01300, the attached Submittal and Notification Requirements sheet and applicable YMP procedures.

4.02 NOTIFICATION

Should any changes in this Specification Section be required to comply with these requirements, the Constructor shall notify the A/E in writing.

SUBMITTAL AND NOTIFICATION REQUIREMENTS

ONLY APPLICABLE ITEMS ARE TO BE COMPLETED

| SECTION NO. 03363 | STATUS | | | | | | TIMING | | | | | | | | | | | | NOTIFICATION | | | |
|---|-------------|--------|---------------|--------|--|--|------------------|------------------|----------------------|-------------------|---------------|-----------------------|--------------|-------------|---------------------------|--|--|--|----------------|-------------|--|--|
| | INFORMATION | REVIEW | CERTIFICATION | RECORD | | | PRIOR TO TESTING | DAYS AFTER AWARD | PRIOR TO FABRICATION | PRIOR TO SHIPMENT | WITH SHIPMENT | PRIOR TO INSTALLATION | DAILY REPORT | AS DIRECTED | PRIOR TO FINAL ACCEPTANCE | | | | WITNESS (DAYS) | HOLD (DAYS) | | |
| TITLE: Wet Process Shotcrete | | | | | | | | | | | | | | | | | | | | | | |
| Requirements Paragraph | | | | | | | | | | | | | | | | | | | | | | |
| Shotcrete Application Approval and TCO concurrence 1.06 | | | | X | | | | | | | | X | | | | | | | | | | |
| Mix Design 2.02B | | X | | | | | | | | | | X | | | | | | | 20 | | | |
| Batch Plant Procedures (If Needed) 3.01A | | X | | | | | | | | | | X | | | | | | | | | | |
| Equipment submittal 3.01 D | | X | | | | | | | | | | X | | | | | | | X | | | |
| Heating and Cooling procedure 3.02B2 | | X | | | | | | | | | | X | | | | | | | X | | | |
| Organic Admixture Use 3.02D | | X | | | | | | | | | | X | | | | | | | 20 | | | |
| Shotcrete placement plan 3.04C | | X | | | | | | | | | | X | | | | | | | 20 | | | |
| Alternative Box Cut Curing Method (optional) 3.09B | | X | | | | | | | | | | X | | | | | | | | | | |
| Control charts 3.12C3e | X | | | | | | | | | | | | | X | | | | | | | | |
| Adverse Trend Notification 3.12C3e | X | | | | | | | | | | | | | X | | | | | | | | |
| Nozzelmen training and certification procedure 3.14 | | X | | | | | | | | | | X | | | | | | | 20 | | | |
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COMMENTS:

"X" in the Notification Columns denotes a Hold or Witness point is required in the specification subsection, but prior notification of the A/E is not necessary.

END OF SPECIFICATION SECTION