

American Concrete Institute

Certification Policies for Shotcrete Nozzlemen and Shotcrete Nozzlemen-In-Training

*Approved by the Certification Programs Committee
May 6, 2015*

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The statements contained herein are a consolidation of approved policies and procedures. This policy statement supersedes all previous action of the ACI Board of Direction with respect to Shotcrete Nozzlemen certification and is effective.

Appendix II revised by Committee C660 April 14, 2013.

The certification program policies are broken down into eight sections as follows:

- Section 1. Certification Criteria
- Section 2. Examination Criteria
- Section 3. Re-examination Criteria
- Section 4. Appeals
- Section 5. Sponsoring Group Criteria
- Section 6. Examiner/Supplemental Examiner Criteria
- Section 7. ACI Responsibilities
- Section 8. Recertification Criteria

SECTION 1.0 CERTIFICATION CRITERIA

- 1.01 The American Concrete Institute (ACI) certification program for Shotcrete Nozzlemen and Nozzlemen-In-Training each require successful completion of both a written examination and a two-part performance examination, all to be completed within a one-year period.
- 1.02 No specific education is required as a prerequisite for Shotcrete Nozzleman certification.
- 1.03 For ACI Shotcrete Nozzleman certification, 500 hours of verified work experience as a nozzleman, with at least 100 hours in the process *and the orientation of that process* for which certification is sought is a prerequisite. Required work experience must be documented on an ACI Work Experience Form and submitted to the Sponsoring Group conducting the certification session prior to the scheduled testing date. The required 500 hours of work experience must be reviewed and verified by the Sponsoring Group and the scheduled examiner prior to certification session.
- 1.04 ACI Shotcrete Nozzleman-In-Training (NIT) certification is available to applicants who do not possess 500 hours of work experience, but do possess a minimum of 25 hours of work experience in the process being sought (vertical orientation only). The examiner of record may require an ACI-certified nozzleman to be present during the performance exam, however the ACI certified nozzleman's interaction with the examinee is strictly limited to the safety of the shooting operation.
- 1.05 Upon successful completion of both the written and performance exams, applicants shall be certified as either ACI Shotcrete Nozzleman or ACI Shotcrete Nozzleman-In-Training for a period of 5 years.
- 1.06 NITs may upgrade to ACI Shotcrete Nozzleman by completing work experience as described in Section 1.03 and submitting for verification documented evidence of the work experience in a detailed log. The log shall contain all of the following information in a legible format:
- A) For each project the NIT has shot on provide general project information including:
1. Project name
 2. Project location
 3. Type of work (repair, new structure, thicknesses of sections shot)
 4. Process used (wet-mix or dry-mix)
 5. Description of equipment (type of wet-mix pump or dry-mix gun, material hose diameter, type of nozzle, capacity of air compressor)

6. Name of project supervisor
7. Employer (with contact name and phone)

B) Details of the time shooting for each project to include:

1. Dates shooting
2. Hours on the nozzle
3. Orientation of shooting
4. Area (ft²) or volume (yd³) placed

Each entry for the details of time shooting in the log shall represent no more than one week's work. Upon completion of the minimum of 500 hours of shooting work experience, a printed copy of the log shall be reviewed and signed by the NIT's current employer, along with the signature of the NIT. The signed log shall be submitted to the LSG, who will send to the ACI examiner of record. Upon satisfactory review by the ACI examiner of record, the NIT shall become an ACI Shotcrete Nozzleman in the process(es) and orientation(s) reflected in the verified work experience for the remainder of the original NIT certification term (less than 5 years).

- 1.07 Certification as an ACI Shotcrete Nozzleman may be renewed by satisfying the recertification requirements.

SECTION 2.0 EXAMINATION CRITERIA

GENERAL REQUIREMENTS

- 2.01 The content of the written and performance examinations for certification as a Shotcrete Nozzleman is derived from:
- *Shotcrete for the Craftsman* (ACI CCS-4)
- 2.02 All written and performance examinations are closed book. Notes or other technical materials shall not be permitted in the examination area.
- 2.03 The examinations shall be conducted by the examiner, proctors, and/or supplemental examiners as applicable (See Section 6).
- 2.04 The examiners, proctors, supplemental examiners, and/or sponsoring groups do not have any jurisdiction over the content of any examination, or over the grading of the written examination.

WRITTEN EXAMINATION

- 2.05 The examinee will be required to pass a written examination for each type of

process in which he/she wishes to be certified (wet-mix and/or dry-mix).

- 2.06 The entire written examination for either wet-mix or dry-mix will consist of 60 to 90 questions. The questions may be either true-false or multiple choice.
- 2.07 A maximum of 90 minutes shall be permitted for completion of either the wet-mix or the dry-mix examination. The examiner may allow additional time for an oral examination.
- 2.08 Oral administration of the written exam shall be permitted in special cases when conducted in accordance with ACI guidelines.
- 2.09 A score of 75% or higher constitutes a passing grade on each written exam.

PERFORMANCE EXAMINATION

- 2.10 The performance examination shall require the examinee to demonstrate all the essential steps involved in proper shotcrete technique from initial preparation through placing and curing.
- 2.11 All examinees are required to certify with a test panel in the vertical position. The examinee may choose to also certify in the overhead position. Each shooting position in each process requires a separate performance demonstration test panel.
- 2.12 The test panel to be shot shall be of the minimum dimensions and edge configuration shown in drawing sketch A, Appendix I. The vertical test panel shall be positioned within ten (10) degrees of vertical and the overhead panel shall be positioned horizontally at approximately 2.5 meters (8 feet) from grade.
- 2.13 Reinforcement shall be incorporated in the test panel per drawing Sketch A, Appendix I. The steel bars identified in *Appendix I* can be replaced by similar size fiber reinforced polymer bars having surface deformation similar to those of steel bars. Wood dowels or smooth FRP bars with grit coatings are not allowed as reinforcement in the test panel.
- 2.14 The shotcrete mixture design used shall be a mixture in common use in the geographic area of the test site. The mixture for the wet mix process may be a locally supplied ready mix or dry materials wet-mixed at the test site.

Dry mix may be pre-packaged materials or bulk materials dry-batched at the test site.

Mixtures may contain accelerators. The Host shall make information available

to the applicant regarding mixture design/methods and type of equipment to be used at least one week before conducting the performance examination.

- 2.15 The nozzleman is expected to verify the adequacy of the test panel form, reinforcing placement, panel support/bracing, etc., as part of the performance examination.
- 2.16 The nozzleman shall be supported by an adequate crew consisting of an experienced gunman or pump operator, and an optional nozzle helper/airlance-blowpipe operator.
- 2.17 All work shall be done in the direct presence of the examiner or supplemental examiner(s) as applicable in Section 6.07.

PERFORMANCE EVALUATION

- 2.18 The examinee's performance will be evaluated based on a two-part performance examination: Part I, demonstrating to the examiner or supplemental examiner the examinee's knowledge of all the items covered on the Performance Checklist; and Part II, five (5) cores will be cut from the performance demonstration test panel to evaluate soundness of shotcrete.
- 2.19 Grading of the Part I performance workmanship will be based on a point system as set forth on the performance checklist, with points deducted for failure to perform, or incorrect performance of various required elements.
- 2.20 The minimum passing grade for the Part I performance evaluation shall be 75%.
- 2.21 For Part II, grading of the cores is based on visually examining, measuring defects and grading each of five (5) cores located as shown on sketch A, Appendix I; grading considers various defects, such as (but not limited to) sand lenses, porosity pockets, random voids, and especially voids around reinforcing bars (*ref.*: Appendix II).
- 2.22 A test panel with any single core grade exceeding grade 3, or with more than two (2) of the five (5) cores having a core grade 3 will be declared a failure. Core grades shall not be averaged.

SECTION 3.0 REEXAMINATION CRITERIA

- 3.01 Failure of the written examination by the criteria cited in Section 2.09 shall require reexamination on the written examination for the process that was failed.

- 3.02 Failure of either Part I or Part II of the performance examination shall require reexamination on the entire performance examination.
- 3.03 Reexamination of a performance examination on the same day as original examination will only be permitted at the examiner's option and on a time-and-materials-available basis, subject to processing all other scheduled examinees.
- In the event of equipment malfunction during shooting of a test panel, the examinee is permitted to wash out said panel and start over.
- 3.04 The performance exam for the vertical test panel must be passed for certification to be issued (see Section 2.11). If an examinee pursues certification in the overhead position as well and fails the performance exam for the vertical test panel, the entire performance exam must be retaken including (if still desired) the performance exam for the overhead panel.
- 3.05 Reexamination on the written or the performance examination must be taken within one year of the initial examination. Otherwise, both the written and the performance examinations must be retaken in their entirety.

SECTION 4.0 APPEALS CRITERIA

- 4.01 All appeals shall be directed initially to the examiner.
- 4.02 In the event that the examinee is not satisfied with the decision of the examiner regarding an appeal, the examinee may pursue an appeal with ACI according to the following order:
1. Sponsoring Group
 2. ACI Director of Certification
 3. The Certification Appeals Committee (consisting of the Director of Certification, the Chairman of the Certification Programs Committee, and the Chairman of Committee C660)
 4. Committee C660, Shotcrete Nozzleman Certification
 5. Certification Programs Committee
- 4.03 Appeals submitted to ACI for consideration must be received, in writing, within sixty (60) days of the receipt of the examination at ACI Headquarters.

SECTION 5.0 SPONSORING GROUP CRITERIA

Groups desiring to conduct ACI Certification program(s) shall adhere to the current policy

on Sponsoring Groups for Certification.

Note: The Sponsoring Group Policy was approved by the ACI Board of Direction on March 21, 1991, and revised by the ACI Certification Programs Committee October 18, 2011.

Because of specialized venue and equipment requirements, Shotcrete Nozzleman certification examination sessions are typically conducted as “in-house” sessions. The business, organization, or individual providing the venue (and equipment) for the session is known as the “host” for the purposes of this Policy.

Note: The “ACI Shotcrete Nozzleman Certification Policy For Hosts and Participants” is considered part of the present policies (Appendix 4).

For the Shotcrete Nozzleman Certification program (both wet & dry processes), Sponsoring Groups shall also be responsible for the following:

- 5.01 Ensure that the ACI Host Relationship Disclosure form is signed and completed by the scheduled examiner, and that the relationship between the host and examiner does not constitute a conflict of interest.
- 5.02 Ensure that the required work experience for each applicant is documented on an ACI work experience form, that the examiner has verified the experience, and that all required signatures are present on the form prior to conducting a certification session.

Note: The prerequisite 500 hours work experience documentation is not required if proof of participation in a previous ACI Shotcrete Nozzleman Certification session is demonstrated.
- 5.03 Ensure that a copy of all applicants’ work experience forms and the ACI Host Relationship Disclosure form is provided to ACI.
- 5.04 Ensure that no financial or barter transactions involving ACI certification services take place between the examiner and the individuals pursuing certification or their employers. All payments for certification exam services are required to be made directly to the Sponsoring Group. All compensatory payments for certification examination services to the examiner shall be made directly by, and only from, the Sponsoring Group.
- 5.05 Exceptions to the requirements of Sections 5.01 through 5.04 may be granted on a case-by-case basis, and only with the expressed written approval of the ACI Director of Certification.

SECTION 6.0 EXAMINER/SUPPLEMENTAL EXAMINER CRITERIA

- 6.01 The examiner shall be approved by ACI with the assistance of a Task Group under Committee C660 for dry-mix and/or wet-mix shotcrete. Qualifications shall be submitted on Form D3 for each process.
- 6.02 The examiner shall be authorized by ACI to conduct Nozzleman Certification examinations for only the shotcrete process for which the examiner is approved.
- 6.03 In order to be considered for approval as an examiner the applicant shall meet the following requirements:
- A) Be knowledgeable about shotcrete and thoroughly familiar with the current applicable reference documents.
 - B) Have a total of at least 5 years documented experience in at least two of the following four categories:
 - 1) Testing, inspection, and quality control of shotcrete
 - 2) Supervision of shotcrete construction work
 - 3) Design or evaluation of shotcrete structures
 - 4) Shotcrete nozzling
 - C) Have sufficient experience to evaluate and judge the qualifications of shotcrete nozzleman applicants and conduct written and performance examinations. For each process, this experience must be, but is not limited to:
 - Knowledge of both vertical and overhead spraying
 - Knowledge and experience on more than one type of equipment (gun, pump, nozzle)
 - D) Have, to the satisfaction of the examiners of record, participated in all phases of at least two (2) ACI-sanctioned Nozzleman Certification programs for each process for which approval is sought, with different examiners of record for each session. For the first session, the applicant must serve as proctor and supplemental examiner. For the second session, the applicant shall serve as a proctor and supplemental examiner and personally conduct all phases of the session including written examination, performance examination, and core grading, under direct supervision of the examiner of record for both vertical and overhead.
 - E) Have attained a passing grade on the written exam for each process sought.

6.04 In order to maintain examiner status, an examiner shall meet the following requirements:

- A) Have conducted or assisted in at least (3) ACI-sanctioned Nozzleman Certification programs in five (5) years,
- B) Stay current on the Policies by visiting the ACI website, reading and responding to the examiner newsletter, or attending an examiner round table or virtual meeting with sponsoring group at least once a year.

6.05 Examiners, Supplemental Examiners, and Proctors must recuse themselves from any conflict-of-interest situation while acting as agents of ACI in conducting exam sessions. This includes but is not limited to meeting the following conditions:

- A) Examiners, supplemental examiners, and proctors shall not be professionally or personally related to the Host, its parent or subsidiaries, or examinees at the time of the exam session.
- B) Examiners and supplemental examiners shall not be employed by the same organization (including parent or subsidiaries) as any of the examinees at the time of the exam session.
- C) Examiners, supplemental examiners, and their employers shall not be in a business relationship with the Host, its parent or any subsidiaries at the time of the exam session.
- D) Examiners, supplemental examiners, and their employers shall not be in a business relationship on any project that the Host, its parent, or any subsidiaries have a business relationship at the time of, and six (6) months prior to, the exam session.

Note: ACI policies are intended to aid in the identification and remediation of any aspect of the examination process that could result in invalidation of an exam session and sanction of an Examiner. It is not possible to enumerate even identify all conflict-of-interest situations for listing in this policy, therefore, ACI urges Examiners and Sponsoring Groups to communicate with ACI during the session planning stages and obtain guidance from ACI leaving enough time for adjustments prior to the exam session if needed to assure policy compliance.

6.06 Supplemental examiners shall have experience in shotcrete work per paragraph 6.03B, and shall be approved by and perform at the direction of the examiner.

6.07 Supplemental examiners shall be permitted to assist in conducting Part I and Part II of the performance examination.

6.08 Proctors shall be permitted to assist the examiner in conducting the written examination.

6.09 Proctors shall satisfy the following requirements:

A) Be selected by the examiner

B) Be considered trustworthy and conscientious by the examiner.

6.10 The examiner shall be directly responsible to:

A) Complete and submit to the Sponsoring Group prior to the session a signed and completed ACI Host Relationship Disclosure form.

B) Review and verify each applicant's work experience. Verification requires the completion of two steps:

1. Review each applicant's work experience submitted on an ACI form for completeness and feasibility (i.e., it is possible for the applicant to have accumulated the required experience within the timeframe reflected on the Work Experience Form).

2. Contact and speak directly with the applicant prior to approving / signing the applicant's Work Experience Form; this may be by phone if the applicant's identity can be verified, or in person. The complete content and length of the Examiner's interview with the applicant is left to the Examiner's judgment and discretion in deciding if, in their opinion, the applicant possesses the required minimum amount of work experience. Every applicant interview must include the following:

- Verification of the applicant's identity.
- Discussion of any items on the applicant's Work Experience Form that seems incomplete, questionable, or require clarification.
- Discussion of the applicant's nozzleman experience including how long they have been a nozzleman, the type of work they have been involved in (vertical vs overhead, dry- vs wet-mix, etc.), and the type of equipment they have used.

Once assured of the accuracy of the information on the applicant's Work Experience submission and that a minimum of hours (as per Section 1.03) as a nozzleman has been demonstrated, the Examiner must sign and date the applicant's ACI approved work experience form and return a signed copy to the Sponsoring Group.

C) Select the supplemental examiners and proctors.

- D) Verify the qualifications of the supplemental examiners and proctors according to the criteria outlined in Section 6.07 through 6.10.
- E) Communicate examination needs to the Sponsoring Group.
- F) Verify the identity of each examinee at the session (photo ID), and assure that the examinees are aware of the certification criteria. In addition, a photo must be secured of each participant (face shot) at the session.
- G) Verify that the examinees have signed the release statement on the written and performance examinations at the session prior to testing.
- H) Verify that materials, mix designs, and equipment are suitable for the program.
- I) Verify that the test panel conforms to Appendix I, Sketch A, and verify the reinforcing bar location (to ensure accurate locations for later coring).
- J) Verify that test panels are secured to minimize vibration and prevent tipping or collapse.

Note: Appendix III of this Policy contains approximate weight and force parameters and an example of a configuration that has been used successfully. Overhead applications deserve particular attention due to the weights involved and the potential for “dropouts” (in-place shotcrete falling out during or immediately after shooting). All ACI shotcrete nozzleman certification sessions shall comply with all applicable Federal, Regional, and Local safety regulations.

- K) Be present and in full supervision during the examination sessions (written and performance).

Note: Historical administrative experience indicates that maximum of 14 panels in one day is advised to facilitate Examiner control of sessions. Examiner(s) exceed this number of panels only in special cases if the program policies are maintained throughout the duration of the examination session, and the order, fairness, objectivity and thoroughness of the process intended by the policies are preserved.

- L) Ensure that neither they nor their examiner candidates and/or supplemental examiners individually observe more than one examinee conducting tests at any one time during the performance examination.
- M) Verify that the performance evaluations were conducted by examiners or by approved supplemental examiners, review and co-sign the performance checklists where appropriate.

- N) Arrange for removal and positive identification of cores from test panels.

Note: All panels are to be cored, even if the examinee fails other parts of the performance exam. In the particular situation where encapsulation of reinforcement is so inadequate that it may prove unsafe to core or it proves impossible to extract a complete specimen, detailed photographs of the back panel are required along with a detailed description of the defects justifying the canceling of coring; such description should be presented in the examinee's performance exam document.

- O) Perform or direct the layout of core locations.
- P) Be present and in full supervision of panel stripping and coring. Photograph the back of the stripped panel prior to coring.
- Q) Visually examine and grade cores. Photograph all extracted cores that reflect the performance of the examinee and take individual photos of cores with failing core grades.
- R) Collect and summarize all test data (complete and sign the Performance Checklist - Part II, Grading Summary, and Checklist Report for each examinee) and collate with written examinations.
- S) Forward all test data to the Sponsoring Group for preparation and shipment to ACI Headquarters, Certification Department.
- T) Conduct detailed interviews of examiner applicants assisting in administering sessions, evaluating their abilities in administering examinations, and forwarding the results of their evaluation to ACI Headquarters with the session materials.

SECTION 7.0 ACI DUTIES AND RESPONSIBILITIES

- 7.01 ACI shall approve the local sponsoring group.
- 7.02 ACI shall approve the examiner. Examiner re-approval is required every five (5) years.
- 7.03 Examiner approval may be suspended or revoked by ACI at any time. The following are examples of behavior that could lead to suspension or revocation:
- A) Falsifying documents
 - B) Failure to adhere to Section 6.04, 6.05 and 6.10 of this Policy
 - C) Conveying or implementing any shotcrete related task or information

during an examination session that are not supported and/or contradictory to current ACI guidelines and technical writings

- 7.04 ACI shall authorize the sponsoring group to conduct examination sessions for Shotcrete Nozzleman Certification.
- 7.05 ACI shall grade the written examinations and review the results of the performance examination/evaluations, and notify the examinee and examiner of the final results in writing.
- 7.06 ACI shall certify the examinees who have satisfied the certification requirements.
- 7.07 ACI shall issue a certificate, wallet card, and hard-hat decal to successful examinees.

SECTION 8.0 RECERTIFICATION

Shotcrete Nozzlemen may recertify for an additional five (5) year period by successful completion of all the certification requirements outlined in Sections 1.0, 2.0, and 3.0 of this policy or, if eligible, by participating in the alternative recertification process as follows:

- 8.01 The recertification process described in Section 8.02-8.03 is available only to candidates who meet the following criteria:
 - A) Nozzlemen previously certified by ACI who are seeking recertification in the same process (wet- or dry-mix) as their previous ACI-issued certification; and
 - B) Nozzlemen participating in recertification within 6 years of their previous ACI-issued certification; and
 - C) Nozzlemen possessing at least 1000 hours of work experience as a shotcrete nozzleman per process (wet- or dry-mix) with at least 200 hours in the process for which recertification is sought within the two (2) years immediately prior to seeking recertification or possessing an average of 500 hours per year with at least 100 hours in the process for which certification is sought within the five (5) years immediately prior to seeking recertification.

Shotcrete Nozzlemen-In-Training who do not collect enough work experience to upgrade to full Shotcrete Nozzleman certification within the five year certification period as described in Section 1.06 may renew NIT certification only through the process described in Sections 1.04-1.05.

- 8.02 Information described in Sections 8.01A through 8.01C required for determination of candidate eligibility for recertification shall be gathered, evaluated, and verified by the examiner prior to administration of any recertification examination as described in Sections 8.03A and 8.03B.
- 8.03 Candidates who meet the criteria listed in Section 8.01 as determined by the Examiner may renew their certification (recertify) by successfully completing:
- A) A structured interview with the Examiner. The interview is in lieu of the written exam requirement imposed for initial certification and is designed to substantiate that the candidate has retained his knowledge of the safe and competent application of shotcrete and is made aware of any new developments in this area of concrete construction; and
 - B) A performance examination per the policies described in Sections 2.01 through 2.04, Sections 2.10 through 2.22, and Sections 3.02 through 3.04.
- 8.04 The oral interview must be conducted within the time frame described in Section 8.01B. If the interview is not conducted within this time frame, the candidate seeking recertification shall be required to take the written examination per the policies described in Sections 2.05 through 2.09, and Sections 3.01 and 3.05.