



**Certification Policies
for
Shotcrete Nozzleman and
Shotcrete Nozzleman-In-Training**

*Last revised by the Certification Programs Committee
April 29, 2021*

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 Nozzleman certification.

The certification program policies are organized into seven sections as follows:

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| Section 1.0 | Certification Criteria |
| Section 2.0 | Examination Criteria |
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| Section 5.0 | Sponsoring Group Criteria |
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SECTION 1.0 CERTIFICATION CRITERIA

- 1.01 The American Concrete Institute (ACI) certification program for Shotcrete Nozzleman and Nozzleman-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. Additionally, at least 200 hours of the work experience shall be with the nozzleman providing direct hands-on manipulation of the shotcrete nozzle during shotcrete placement (hand nozzling). 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 hand nozzling 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.
- Note: A Nozzleman-in-Training must accumulate additional work experience hours (time directly operating the nozzle) to reach the full certification requirements. It is the intent of ACI Committee 506 - Shotcreting as expressed in ACI 506R, Guide to Shotcrete that a Nozzleman-in-Training is qualified to accumulate hours on projects requiring ACI-certified shotcrete nozzlemen by shooting under the direct supervision of a currently ACI-certified shotcrete nozzleman whose certification(s) reflect the process and orientation being shot. The certified nozzleman directly supervising the NIT must be in a physical position to visually monitor all aspects of the shotcrete placement when the NIT is operating the nozzle, and the certified nozzleman supervising is fully responsible for the quality of shotcrete placement when an NIT is operating the nozzle.*
- 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

- 2.01 The content of the written and performance examinations shall be derived directly from the *Job Task Analysis for ACI Shotcrete Nozzleman Certification* (Annex 660.1-1).
- 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 a verbal examination.
- 2.08 Verbal 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. Certification in an overhead orientation is an add-on to their current vertical certification in that process and will be effective for the same time period as their current vertical certification.
- 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 in Appendix I. The steel reinforcing bars identified in Appendix I can be replaced by similar size fiber reinforced polymer bars designed for use in reinforced concrete having diameters similar to those of steel reinforcing bars. Wood dowels or smooth FRP bars 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 RE-EXAMINATION 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* (Annex 660.1-2).

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 IV).

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

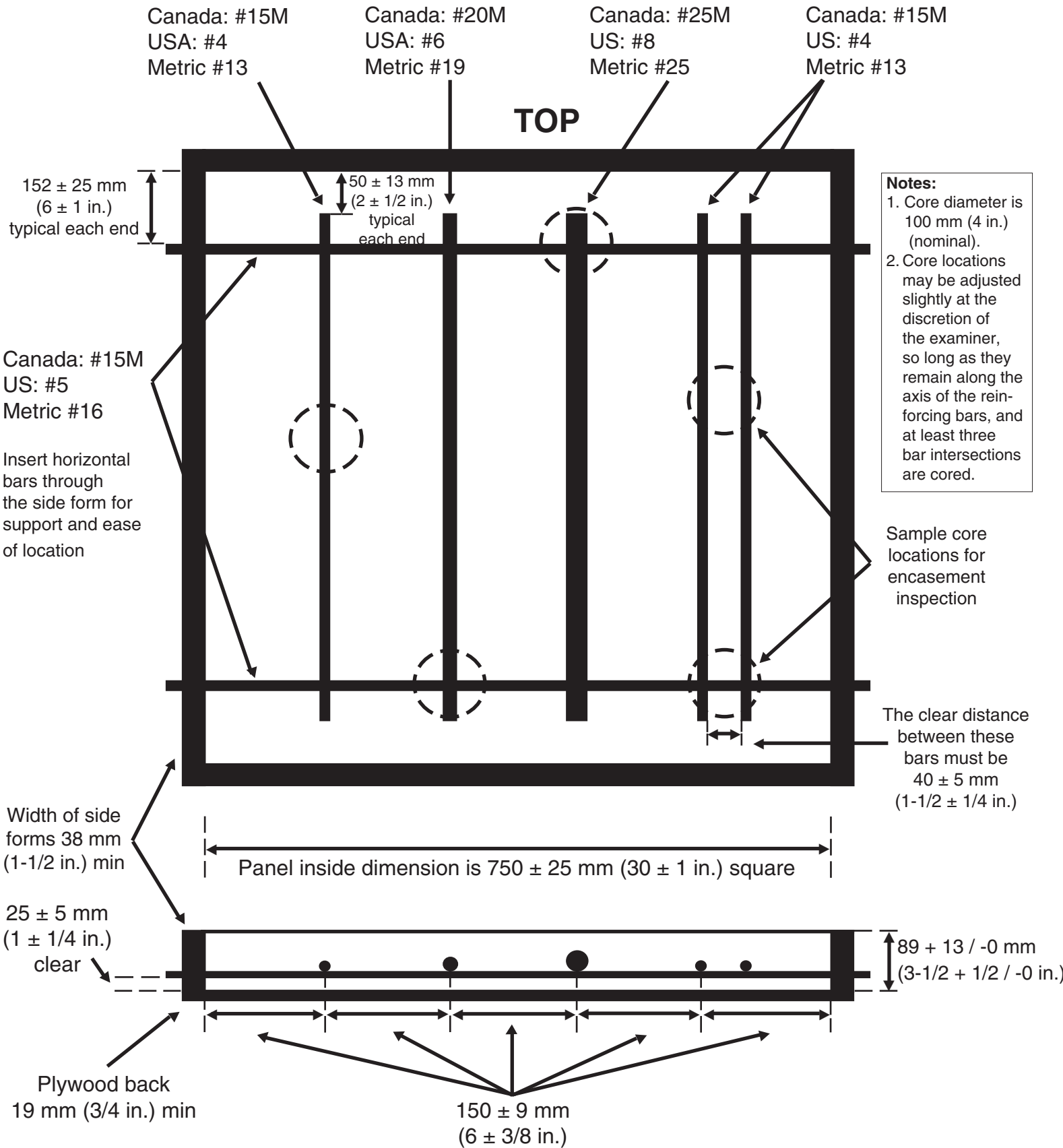
Shotcrete Nozzlemen may recertify for an additional five (5) year period by successful completion of all the certification requirements outlined in Sections 1.0, 2.0, and 3.0 of this policy or, if eligible, by participating in the alternative recertification process as follows:

- 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-mix 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:
 - 1. 1000 hours of work experience as a shotcrete nozzleman (wet-mix or dry-mix) with at least 200 hours in the process and the orientation for which recertification is sought within the two (2) years immediately prior to seeking recertification.OR
 - 2. 2500 hours of work experience as a shotcrete nozzleman (wet-mix or dry-mix) with at least 500 hours in the process and the orientation for which recertification 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 verbal 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.

APPENDIX I



Reinforced test panel layout with core sampling locations -- Includes proposed construction method.

APPENDIX II

SHOTCRETE CORE GRADES

*ONLY FOR USE IN THE EVALUATION OF CORES DURING SHOTCRETE
NOZZLEMAN CERTIFICATION ACCORDING TO CP-60*

October 2012

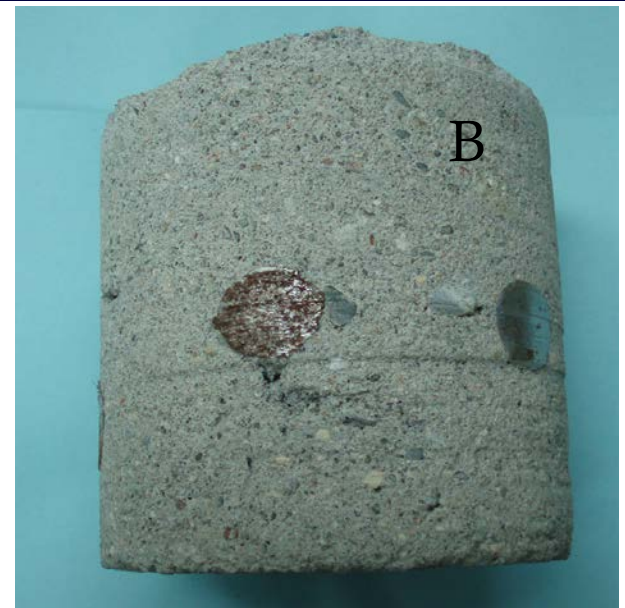
Core grading is not an exact science; evaluation & grading of cores require judgment from the Examiner.

This grading process should employ the use of both photos and written description to provide guidance and, when needed, other aspects linked to the placement of shotcrete such as the inspection of the back of the panel for rebound or overspray entrapment or other visible defects not necessarily found on the surface of the cores.



Core Grade 1

Dry-mix shotcrete, two #4 bars, perfect encapsulation



Core Grade 1

Dry-mix shotcrete, two #4 bars, small sandy area less than in depth



Core Grade 1

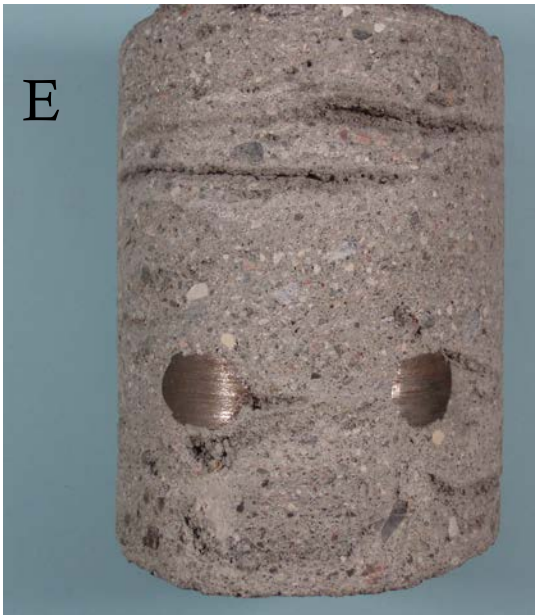
Dry-mix shotcrete, two #4 bars, small void less than $\frac{1}{4}$ in long and depth present under bar on left



Core Grade 1

Dry-mix shotcrete, intersection between #4 and #4 bars, perfect encapsulation

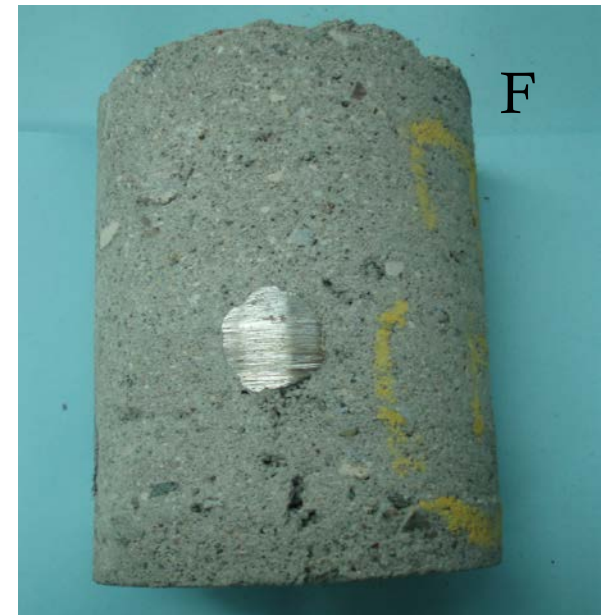
Core Grade 1: Shotcrete specimens are solid; there are no laminations, sandy areas or voids. Small air voids with a maximum diameter of $\frac{1}{8}$ in. and maximum length of $\frac{1}{4}$ in. are normal and acceptable. Sand pockets, or voids behind continuous reinforcing steel are unacceptable. The surface against the form or bond plane shall be sound, without a sandy texture or voids.



E

Core Grade 2

Dry-mix shotcrete, #4 bar,
sand lenses



F

Core Grade 2

Dry-mix shotcrete, #6 bar, small-
unconnected voids behind
reinforcement



G

Core Grade 2

Dry-mix shotcrete, intersection #4
bars, small size void.



H

Core Grade 2

Dry-mix shotcrete, #4 bar, small void.

Core Grade 2: Shotcrete specimens shall have no more than two laminations or sandy areas with dimensions not to exceed 1/8 in. thick by 1 in. long. The height, width and depth of voids shall not exceed 3/8 in. Porous areas behind reinforcing steel shall not exceed 1/2 in. in any direction except along the length of the reinforcing steel. The surface against the form or bond plane shall be sound, without a sandy texture or voids. .



Core Grade 3

Dry-mix shotcrete, #4 bar,
sand lenses



Core Grade 3

Dry-mix shotcrete, #8 bar, one
important void directly behind rebar,
smaller than $\frac{1}{4}$ dept and $\frac{3}{4}$ in long



Core Grade 3

Dry-mix shotcrete, intersection #4
bars, mid size void too large to be a
CG2.



Core Grade 3

Dry-mix shotcrete, intersection #4
bars, linear defect from bar extending
to back of panel. No interconnection
detected or void against panel.

Core Grade 3: Shotcrete specimens shall have no more than two laminations or sandy areas with dimensions exceeding $\frac{3}{16}$ in. thick by $1\frac{1}{4}$ in. long, or one major void, sand pocket, or lamination containing loosely bonded sand not to exceed $\frac{5}{8}$ in. thick and $1\frac{1}{4}$ in. in width. The surface against the form or bond plane may be sandy with voids containing overspray to a depth of $\frac{1}{16}$ in.



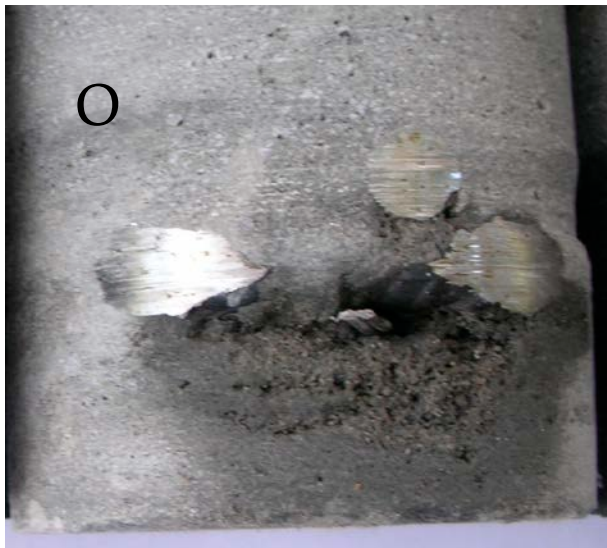
Core Grade 4

Wet-mix shotcrete, #6 bar,
single void, 1/2" on the
surface, 3/4" deep.



Core Grade 4

Dry-mix shotcrete, #8 bar, one
important void directly behind rebar,
1/2" on surface and 3/4" deep



Core Grade 4

Dry-mix shotcrete, intersection #4 bars,
mixture of entrapped rebound and void.
Flaw is 1" in size on surface.



Core Grade 4

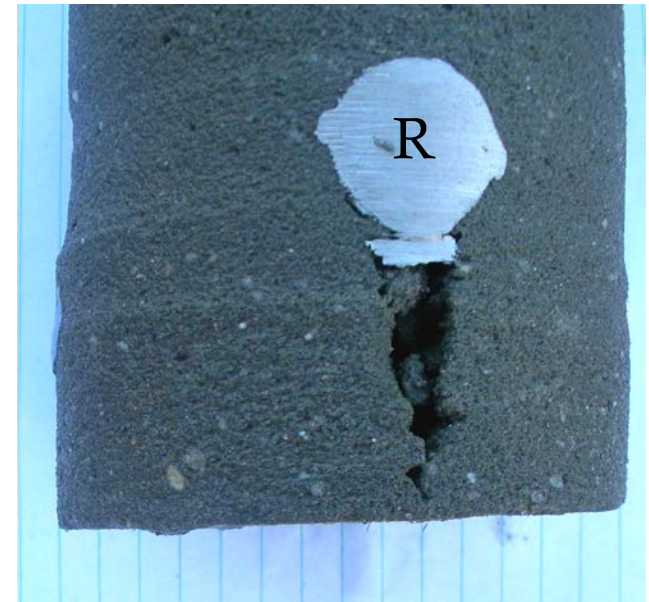
Dry-mix shotcrete, #6 bar, entrapped
rebound visible on both size of core;
no visible trace at back of panel

Core Grade 4: Grade 4 core: The core shall meet in general the requirements of Grade 3 cores, but may have two major flaws such as described for Grade 3 or may have one flaw with a maximum dimension of 1 in. (25 mm) perpendicular to the face of the core with a maximum width of 1 1/2 in. The end of the core that was shot against the form may be sandy and with voids containing overspray to a depth of 1/8 in.



Core Grade 5

Dry-mix shotcrete, #8 bar,
large void behind each bar



Core Grade 5

Wet-mix shotcrete, #8 bar,
one important void directly behind rebar,
over 1" long on core surface, trace at
the back of the core



Core Grade 5

Dry-mix shotcrete, intersection #4
bars, large sand lenses.



Core Grade 5

Dry-mix shotcrete, intersection
#4 and #6 bars, 1/2" void behind
bar on both sides with sandy
reflection on the back of the
panel.

Core Grade 5: Grade 5 core: 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.

APPENDIX III

SECURING TEST PANELS

- I. Vertical panels:
 - A. Vertical panels are to be positioned within 0 to 10 degrees of vertical at or near grade.
 - B. Backing or bracing and foundation support must be rigid enough to preclude excessive vibrations and guard against panel tipping either forward or backward.
 - C. Dynamic forces against the panel vary with equipment used, but should resist a horizontal force of at least 100 lb minimum.

- II. Overhead panels:
 - A. Overhead panels are to be positioned horizontally at an elevation approximately 2.5 meters (8 ft) from grade.
 - B. On average, the total weight of a full shotcreted test panel will weigh 350 to 425 lb. In addition, a weight of 50 to 100 lb is often added on top of the empty panel before shooting to minimize vibration. (See drawing of a typical overhead setup at the end of this *Appendix*).

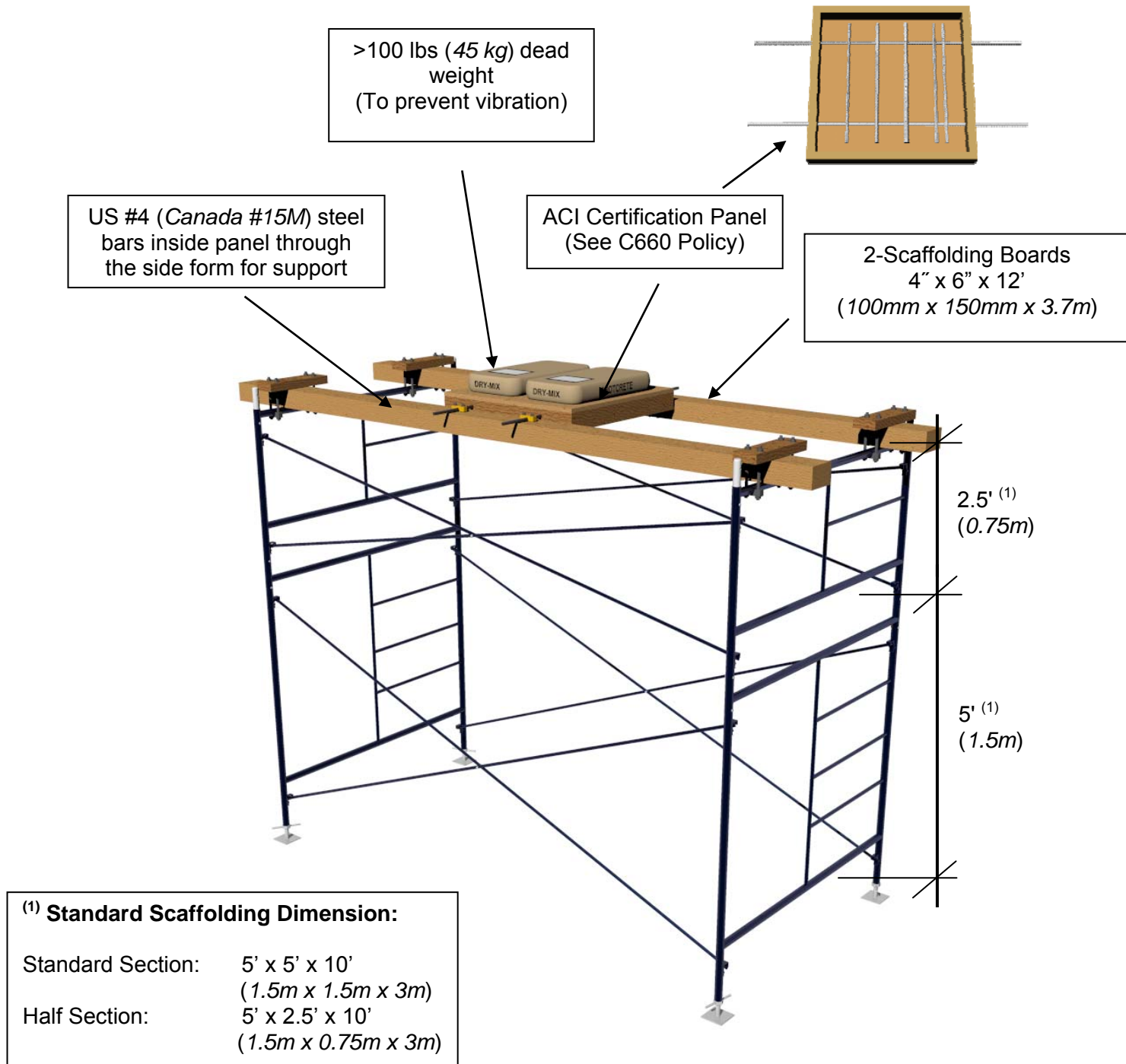
The number of panels and their spacing will then dictate the size and load-carrying capacity of the support framework. When multiple panels are to be shot in the same session, it is important to either allow adequate space between panels, or provide some means of protecting adjacent panels from over-spray.

- C. Metal scaffolding or shoring systems are the most common support methods used. These will usually come with recommended load capacity data. A safety factor of at least 3 times expected loads (or more, if OSHA or local safety authorities require) is recommended.
- D. For wood systems, 4 x 4 in. wood posts, along with horizontal beams sized (by calculation) for proposed spans, have been used.
- E. For any of the above noted systems, lateral/sway bracing is also extremely important. This needs to be taken into account when designing the systems so as to allow ready access under the panels for the nozzleman.
- F. The loads involved are substantial, therefore if there is any doubt or uncertainty about the load carrying capacity of a system, it should either be proof-loaded or designed by a P.E.

Drawing of a typical overhead setup follows on the next page.

APPENDIX III

ACI SHOTCRETE NOZZLEMAN CERTIFICATION - TYPICAL OVERHEAD SET-UP -



APPENDIX IV

ACI Shotcrete Nozzleman Certification Procedures for Sponsoring Groups, Hosts, and Candidates

1 - Introduction

This document describes the responsibilities of and relationship between ACI, its Shotcrete Nozzleman Certification Sponsoring Groups, the “Hosts” of Exam Sessions, and Certification Candidates.

Shotcrete Nozzleman Certification sessions are typically organized through the participation of “Hosts.” Hosts may make the certification session available to the public, but typically keep them private (“in-house”) for their own employees. The Host shall have no relationship with the session Examiner that is prohibited by the ACI Policy for ACI Certification of Shotcrete Nozzlemen (excerpted to Section 2.7 *Conflict-of-Interest* of this document).

2 - Definitions

2.1 Sponsoring Group: The entity identified by ACI as their agent in administering the ACI Shotcrete Nozzleman Certification program according to established ACI policy.

2.2 Host: The Host is the organization, group or individual in charge of planning and coordinating the facility for the certification session. The Host could be a consultant, contractor, association, union, etc...

2.3 Organizer: The single person identified by the Host as the coordinating contact for ACI, the Sponsoring Group and the Examiner.

2.4 Examiner: Individuals approved by ACI as Examiners, appointed by the Sponsoring Group to its roster of Examiners to fulfill all Examiner duties of a session.

2.5 Candidates: Individuals pursuing certification; Candidates become Participants when their Work Experience is verified by the Examiner.

2.6 Participants: Individuals pursuing certification who have been cleared to participate in the performance exam by Examiner verification of their work experience.

2.7 Conflict of Interest: 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 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.

ACI reserves the right to determine if a conflict of interest exists.

APPENDIX IV

2.8 ACI Shotcrete Nozzleman Certification Program Policies: The ACI Shotcrete Nozzleman program policies were created and are maintained by ACI Committee C 660 – *Shotcrete Nozzleman Certification*. The program policies are the ultimate authority in conduct and operation of the ACI Shotcrete Nozzleman Certification program. The policies can be found at <http://www.concrete.org/Certification/pdf/scn.pdf>.

2.9 ACI Examiner/Host Relationship Disclosure Form (Form A): A form that documents the relationship between the Examiner and the Host. Completion and signing of the form, and review and approval by the Sponsoring Group (i.e., the Sponsoring Group determines that no conflict-of-interest relationship exists between the Examiner and Host), is required before an order for exam materials is placed with ACI.

3 - Responsibilities

3.1 Host Responsibilities: The Host is in charge of naming an Organizer who will serve as the Host's agent/representative throughout the certification process. The Host is responsible for all safety aspects related to the certification process. The Host is responsible for payment of the fees and expenses related to the Certification session. All fees and expenses will be billed through the Sponsoring Group at the established standard rates. The Host must provide completed certification Work Experience forms, materials, and equipment for certification as well as a safe working area for the examinations. The Host is also responsible for the extraction of the required cores (under Examiner supervision) from each Participant's test panels. A complete listing of Host responsibilities can be found on the *Host Responsibilities Checklist and Acknowledgement (Form B)*.

3.1.1 The Host must provide a current certificate of insurance to Sponsoring Group staff prior to the certification session. The Host's insurance must include general liability insurance with a minimum of one (1) million dollars coverage per occurrence.

3.1.2 The Host must provide to Sponsoring Group staff prior to the session, a certificate of Workman's Compensation Insurance for all participants in the session.

3.1.3 The Host must complete and submit the *Host Responsibilities Checklist and Acknowledgment (Form B)*.

3.2 Organizer Responsibilities: The Organizer coordinates with the Examiner to properly execute all Host responsibilities, including ensuring that the Host's exam venue is properly prepared for the exam session (e.g., materials, equipment, and presence of the Participants).

3.3 Candidate Responsibilities: The Candidate is responsible for completing and signing their prerequisite 500 hours of nozzleman experience on an ACI Work Experience form. Candidates are also required to participate in a brief conversation with the Examiner as part of the ACI Work Experience evaluation. The completed form(s) must be submitted to the Host's Organizer for final review, signature, and submission to the Sponsoring Group. Intentional falsification of work experience documentation may result in invalidation of the session examinations, forfeiture of fees, and legal action.

3.4 Participant Responsibilities: Attend the ACI Certification exams.

3.5 Sponsoring Group responsibilities: The Sponsoring Group is responsible for all fees for exam processing, reporting, and issuance of credentials charged by ACI, and for billing Hosts for all Sponsoring Group costs incurred related to the execution of the examination sessions. The Sponsoring Group will coordinate all session details between the Host's Organizer, the session Examiner, and ACI. The Sponsoring Group is solely responsible for assigning the Examiner for the examination session.

APPENDIX IV

The Sponsoring Group will handle all financial transactions related to the examination session, including payment to the Examiner for services rendered. The Sponsoring Group fields the initial request from the potential Host, gathers the session information, and coordinates distribution and processing of all paperwork to ensure all requirements (e.g., conflict of interest met prior to the exam session). An overview of the process for administering an ACI Shotcrete Nozzleman examination session is reflected in Form D.

3.6 Examiner Responsibilities

3.6.1 ACI Examiner/Host Relationship Disclosure Form: The Examiner is required to complete, sign, and submit to the Sponsoring Group for review the *ACI Examiner/Host Relationship Disclosure Form*. The Examiner is responsible for notifying the Sponsoring Group if at any point they realize that their relationship with the Host and/or Candidates is a conflict-of-interest relationship as defined in Section 2.7.

3.6.2 ACI Shotcrete Nozzleman Certification Program Policies: The Examiner's responsibilities are described in the *ACI Certification Policies for Shotcrete Nozzlemen*, which was created and is maintained by ACI C 660 and approved by the ACI Certification Programs Committee: these include marking the performance exam, grading the cores and supervising the written exam.

3.6.3 Verification of Participant's Work Experience: The Examiner will receive copies of each Candidate's Work Experience Form(s) from Sponsoring Group. An Examiner's evaluation of a Candidate's Work Experience consists of two separate steps:

Step #1: The Examiner must review the information submitted on the Candidate's Work Experience Form for completeness and feasibility.

Step #2: The Examiner must speak directly with the Participant prior to approving and signing the Candidate's Work Experience Form. The complete content and length of the Examiner's interview with the Candidate is left to the Examiner's judgment and discretion in deciding if, in their opinion, the Candidate possesses the required minimum amount of work experience. Every Candidate interview must however include the following:

- The identity of the Candidate.
- Discussion of any items on the Candidate's Work Experience Form that seem incomplete, unclear, or not feasible.
- Discussion on the Candidate's nozzleman experience, including how long they have been a nozzleman, the type of projects in which they have been involved, and the type of equipment they have used.

Once the Examiner is satisfied with the accuracy of the information on each Candidate's Work Experience Form(s) and that a minimum of 500 hours as a nozzleman has been verified, the Examiner must sign and date the Candidate's Work Experience Form(s) and return the signed forms to the Sponsoring Group.

APPENDIX IV

Regardless of a Candidate meeting the Work Experience prerequisite, if at any point during the performance examination the Examiner witnesses Candidate's actions that are unsafe, the Examiner must discontinue the performance examination of that Candidate, mark the performance exam at the step at which the action was witnessed, and direct the Candidate to leave the examination area.

3.6.4 Examiner Arrival at the Examination Session: Examiners must confirm that all required exam venues, equipment and materials are available and conform to *ACI Certification Policies for Shotcrete Nozzlemen* prior to beginning the exam session. If any items are missing, incomplete, or not functioning properly, the Examiner must suspend beginning the session and notify the Organizer/Host immediately.

The Examiner must also check photo Identification of each Candidate and confirm that each has been properly admitted to the examination session (i.e., are identified as having been interviewed and their work experience verified).

3.6.5 Required documentation of Performance Exams: The Examiner must take photos of each Candidate (face shot), the back of each test panel after stripping, and the Candidate's cores. The mix design should also be documented and submitted to ACI.

3.6.6 Return of Session Materials: The Examiner must ship all session materials to the Sponsoring Group for final review and organization via a traceable method of shipping. The Sponsoring Group will then forward the completed examination documents to ACI for processing.

3.6.7 Examiner Compensation: The session Examiner must ensure that he will accept compensation for time and expenses related to the certification session only from the Sponsoring Group. The Examiner will under no circumstances directly invoice the Host nor accept payment of any kind, including non-monetary, from the Organizer/Host.

3.6.8 Examiner Personal Conduct Guidelines: The Examiner must refrain from promoting their employer or any organization with which they are affiliated (except for ACI), or those entities products or services during the ACI examination process.

A summary document: *Procedures for Planning, Preparation, and Execution of an ACI Shotcrete Nozzleman Certification Exam Session* can be found in **Form D**.

4 - Review of sessions: ACI may review any ACI examination session to ensure conformance to ACI certification policies and a proper testing environment has been provided. Selection for review of sessions is at the discretion of ACI.

Reviews are conducted according to the Review Checklist assembled by ACI Committee C 660.

APPENDIX IV

Form A ACI Examiner/Host Relationship Disclosure Form

Session Information

Scheduled Begin Date: _____ Scheduled End Date: _____

Host: _____

Session Location: _____

Wet or Dry Mix: _____

The following is a declaration of the Examiner's relationship with the Host and must be completed by the Examiner, submitted to the Sponsoring Group and forwarded to ACI with the exam session materials.

Note: Not all relationships constitute a Conflict or Interest. ACI reserves the ultimate determination in assessing if a conflict of interest exists.

Are you personally related to the Host or any of the Certification Candidates? *(If Yes, please explain)*

Are you currently or have you ever been employed by the Host organization or any of its parent or subsidiary organizations? *(If Yes, please explain)*

Are you currently in a business relationship with the Host or any of its parent or subsidiary organizations? *(If Yes, please explain)*

Are you currently, or in the 6 months prior to the scheduled exam date, in a business relationship on the same project as the Host, its parent, or any subsidiaries? *(If Yes, please explain)*

By completing and submitting this form, I am providing the Sponsoring Group with information to determine if a conflict-of-interest relationship exists between me, the Host or the Candidates that would preclude my ability to administer ACI Certification exams in compliance with ACI Policies. I assure that the answers provided on this form are complete and accurate to the best of my knowledge.

Examiner Signature: _____

Date: _____ Examiner Name: _____

Please return this completed form to the Sponsoring Group Staff

APPENDIX IV

Form B

Host Responsibilities Checklist and Acknowledgement

General

- Communicate Certification session needs\parameters to ACI Sponsoring Group (SG) Staff, including:
 - Number of candidates
 - Method sought (wet- or dry-mix)
 - Language(s) of Candidates and any need for translators
 - Roster/ID Numbers of Candidates Recertifying
 - Requests for oral examination on the written exam
 - Requests for special accommodation under the Americans with Disabilities Act (ADA)
- Communicate to SG staff if you are willing to open the session to the public (the Host retains final approval of all Candidates' participation in the session)

Work Experience

- Initiate completion of each Candidate's *Work Experience Form(s)*, verify their accuracy, sign each form and return all completed forms directly to SG Staff.
- Ensure that each Candidate is available to speak directly with the session Examiner as part of the verification of their work experience. If an interpreter is required, it is the responsibility of the Host to arrange for such services.

Session Initiation and Payment

The session will be initiated once all required documentation and payment are received by SG staff:

- Signed *Host Responsibilities Checklist and Acknowledgement*
- Signed Contract for Services and any required deposit/fees.
- Completed *Work Experience Form(s)* for each Candidate
- Copy of photo ID for each Candidate
- Insurance documentation – See 3.1.1 & 3.1.2 of this procedures document

Written Exam

- If the written exam will be administered (e.g. first-time examinations and written exam retests) a suitable classroom area must be secured.
- If any Candidate has requested and been granted oral testing on the written exam, including assistance from an interpreter, they should be tested apart from the main group to eliminate any disruption this could cause to the main group.

Performance Exam

- Coordinate and secure a safe working area
- Secure and make available all equipment and ensure it is properly working: gun/pump, compressor, hose, nozzle, blow pipe, etc.
- Determine mix and have sufficient shotcrete material available.
- Fabricate Performance Test Panels and scaffolding according to ACI program policies. Fiberglass rebar may be used in place of steel (this is easier on the core bits).
- Erect scaffolding for the overhead test panels and secure the test panels
- Provide forklift or any other type of adequate lifting equipment for the overhead panels
- Provide weather protection for the test panels
- Ensure water set up with recommend minimum pressure for the dry process
- Provide hot water for either process in cold weather
- Provide burlap or plastic for curing of the test panels
- Provide personal protection equipment for each applicant
- Arrange for site clean-up and equipment clean-up

This *Host Responsibilities Checklist and Acknowledgement* must be submitted to ACI as an original, completed and signed two-sided form

APPENDIX IV

Form B - *continued* Host Responsibilities Checklist and Acknowledgement

Coring

- Arrange for/coordinate the coring as required in the *ACI Program Policies for Certification of Shotcrete Nozzlemen*.
- Provide coring equipment with 4 in. core bits (each panel takes 20-30 min to core)
- Provide manpower to move and core the test panels

Cancellation Policy

Make sure you understand the cancellation Policy at the time you sign the contract and return it to the SSG.

By signing this form, I understand that I am initiating an ACI Certification Examination session. I understand the requirements as stated on this form and preceding procedures, and I agree to accept responsibility for all items. I accept responsibility and costs for any delay related to unfulfilled or insufficiently completed requirement.

I recognize and accept the Examiner's authority and judgment on all items and issues related to the examination session.

I accept responsibility for all costs and delays resulting from "acts of God" that are outside the control of the Host, Organizer, Sponsoring Group, Examiner, or ACI's control. This includes those that result in delay or cancellation of the Examiner attendance.

Host\Organization Name:

Session Date & Location:

Host Organizer\Contact Name:

Signature

Date

APPENDIX IV

Form C

ACI Examiner Personal Conduct Guidelines

As an ACI approved Examiner, it is critical that you conduct yourself in a manner that is solely representative of ACI and not another company, organization or employer.

This includes the following:

- Refrain from promoting the services or products provided by any company or organization other than ACI while representing ACI during examination sessions. Examples of this type of promotion may include:
 - o citing specific examples of your companies' work
 - o distributing company- or organization-specific materials
 - o offering special pricing for your company's, or your organization's products or services
 - o promoting your company's, or your organization's products or services to personnel who participate in or sponsor a session

- It is not acceptable to wear clothing bearing your employer or organization's name/logo while serving as an ACI Examiner. *An exception to this rule is permitted for protective clothing and safety items used during shotcreting operations.*

- It is acceptable to mention your employer if asked.

In summary, when you act as an Examiner for ACI, you are an agent of ACI and must remain neutral in regards to promoting specific products, brands, and services.

APPENDIX IV

Form D

Procedures for Planning, Preparation, and Execution of an ACI Shotcrete Nozzleman Certification Exam Session

1. **Sponsoring Group (SG)** receives initial Request for Session.
2. **SG** collects session information:
 - a. Host
 - b. Organizer (Host Representative)
 - c. Date
 - d. Location
 - e. Wet- or Dry-mix process
 - f. Overhead
 - g. Number of candidates
 - h. Language(s) of Candidates and any need for translators
 - i. Roster including ID Numbers of Candidates Recertifying
 - j. Requests for oral examination on the written exam
 - k. Requests for special accommodation under the Americans with Disabilities Act (ADA)
 - l. Education needs (the level of Education offered by the Sponsoring Group, if any, is at the discretion of the Group)
3. **SG** sends the *ACI Examiner/Host Relationship Disclosure Form* to the Examiner for completion and return.
4. **Examiner** completes and returns *ACI Examiner/Host Relationship Disclosure Form*
5. **SG** receives and reviews the *ACI Examiner/Host Relationship Disclosure Form* and determines if a conflict-of-interest relationship (COI) exists.
 - a. If a COI exists, SG may seek another Examiner and repeat the process or forward the Request for Session to ACI.
 - b. If no COI exists, the SG sends to the Host the following:
 - i. *Host Responsibilities Checklist and Acknowledgement*
 - ii. *Work Experience Form(s)* [Initial Exam (500 hour) forms for those certifying for the first time, and Recertification (1000 hr) forms for individuals seeking recertification through performance examination ONLY.
 - iii. *ACI Certification Policies for Shotcrete Nozzlemen*
 - iv. Contract for Services (it is strongly suggested that the SG collect payment for all services prior to the exam session)
6. **Organizer** receives *Host Responsibilities Checklist and Acknowledgement* and *Work Experience Form(s)* and distributes *Work Experience Form(s)* to Candidates, advising each they must participate in the Examiner interview if contacted.
7. **Candidates** complete the *Work Experience Form(s)* and return them to the Organizer.
8. **Organizer** receives the *Work Experience Form(s)* has them reviewed for accuracy, verified, and signed by the Candidates' Employer(s), and returns them to the Sponsoring Group.
9. **SG** receives the *Work Experience Form(s)*, reviews them for completeness, and forwards them to the Examiner.
10. **Examiner** receive copies of each Candidate's *Work Experience Form(s)* from Sponsoring Group, and performs the following verification procedure:
 - a. Review the information submitted on the Candidate's *Work Experience Form* for completeness and feasibility.
 - b. Interview the participant prior to approving and signing the Candidate's *Work Experience Form(s)*. The complete content and length of the Examiner's interview with the Candidate is left to the Examiner's judgment and discretion in deciding if, in their opinion, the Candidate indeed possesses the required minimum amount of work experience. Every Candidate interview must however include the following:
 - The identity of the Candidate
 - Discussion of any items on the Candidate's *Work Experience Form* that seem incomplete, unclear, or not feasible

APPENDIX IV

Form D - *continued*

Procedures for Planning, Preparation, and Execution of an ACI Shotcrete Nozzleman Certification Exam Session

- Discussion on the Candidate's nozzleman experience, including how long they have been a nozzleman, the type of projects in which they have been involved, and the type of equipment they have used.

Once the Examiner is satisfied with the accuracy of the information on each Candidate's *Work Experience Form(s)* and that a minimum of 500 hours as a nozzleman has been verified, the Examiner signs and dates the Candidate's *Work Experience Form(s)* and returns the forms to the Sponsoring Group.

11. **SG** confirms the exam date with the Organizer and orders exam materials from ACI based on the information collected in #2, and the number of eligible Candidates Participants). SG creates a session roster of Participants for the Examiner.
12. **SG** receives the exam materials, verifies the contents are correct (per the exam order) and provides the materials and the session roster to the Examiner.
13. **Examiner** receives the exam materials and contacts the Organizer to discuss the venue, materials, and equipment requirements stated in the Written Exam, Performance Exam, and Coring sections of the *Host Responsibilities Checklist and Acknowledgement*
14. **Organizer** prepares for the exam session by following the requirements stated in the Written Exam, Performance Exam, and Coring sections of the *Host Responsibilities Checklist and Acknowledgement*, and arranging the attendance of Participants.
15. **Examiner** verifies all required facilities, equipment and materials are available and conform to ACI Shotcrete Certification Program Policies prior to beginning the exam session. If any items are missing, incomplete, or not functioning properly, the Examiner must suspend beginning the session and notify the Organizer/Host immediately. Once the Examiner is satisfied everything is in order, he conducts the exam session including the following:
 - a. Except for ACI or the Sponsoring Group, refrain from promoting current employer or any organization with which the Examiner is affiliated, or those entities products or services during the ACI examination process. Examiner.
 - b. Check photo Identification of each Participant and confirm that each has been properly admitted to the examination session (i.e., are identified as having been interviewed and their work experience verified).
 - c. Administer the written exam employing any resources for oral examination or translation as arranged by prior negotiation with the Sponsoring Group.
 - d. Administer the performance exam, employing any Examiner applicants as arranged by ACI or the Sponsoring Group. Record the performance of the Examiner candidate on the appropriate form and return to ACI for processing and inclusion in their Examiner record.
 - e. Direct the stripping and coring of the test panels, organize and grade the cores, and complete and sign the performance exam checklists and summary reports.
 - f. Take photos of each Participant (face shot), the back of each test panel after stripping, and the Participant's cores. Document and submit the mix design to ACI (include in the exam materials).
 - g. Refrain from soliciting or accepting any form of compensation for time and expenses related to the certification session from the Organizer/Host.
 - h. Ship all session materials to the Sponsoring Group for final review and organization via a traceable method of shipping. This includes either hard copy or electronic copies of all photos.
16. **SG** receives the exam materials from the Examiner, organizes the materials, verifies the completeness of the package (including all *Work Experience Forms*, both verified and denied), and returns to ACI via traceable method of shipping.
17. **SG** remits payment to the Examiner, ACI and any other vendors for services rendered in the planning and execution of the exam session and processing and issuance of credentials.

End of Policy Text

ANNEX 660.1-1

Job Task Analysis (JTA) for ACI Shotcrete Nozzleman Certification 2/25/18

Resource: ACI CCS-4 *Shotcrete for the Craftsman*

1. Understand the basic properties of concrete
2. Know composition of concrete (main ingredients, typical proportions and how mixed)
3. Understand the fundamentals of concrete (workability, consolidation, hydration, curing, strength)
4. Know the different types of cements
5. Know supplemental cementitious materials
6. Know the difference between fine and coarse aggregate
7. Understand aggregate size distribution
8. Know harmful substances in aggregates
9. Know the definition of potable water
10. Know the various types of admixtures
11. Understand the w/cm and how water content affects concrete
12. Know the definition of shotcrete
13. Know the difference between wet-mix and dry-mix shotcrete processes
14. Know the different types of dry-mix shotcreting equipment
15. Know the different types of wet-mix shotcreting equipment
16. Know the advantages of each process
17. Know the difference between different types of nozzles
18. Know generally how the shotcreting equipment operates
19. Understand the effect of equipment layout
20. Understand the importance of the air compressor capacity for quality work
21. Understand the importance of substrate surface preparation
22. Know the impact of rebound and overspray on quality
23. Understand the requirements for proper encapsulation of reinforcement
24. Understand the different techniques required for vertical vs overhead placement
25. Understand how compaction and proper encasement of rebar affect the quality of the shotcrete
26. Understand the techniques required for shooting corners and obstacles
27. Understand how curing affects concrete strength and durability
28. Understand how to limit early-age plastic shrinkage cracking
29. Understand the finishing process
30. Understand hot and cold weather shotcrete placement
31. Know the safety hazards of the shotcrete process
32. Understand the test methods of shotcrete
33. Identify shotcrete crew members and describe their responsibilities
34. Describe weather conditions and their effect on shotcrete
35. Demonstrate the verification steps of the ACI performance test panel integrity
36. Demonstrate plugged hose safety procedure
37. Demonstrate proper hand signals to communicate with the wet-mix pump/dry-mix gun operator
38. Execute proper start-up procedure (nozzle clear, hose connectors secure, etc.)
39. Perform shotcrete placement following proper sequence to minimize rebound and overspray entrapment
40. Perform shotcrete placement using proper movement to encapsulate reinforcement
41. Shoot a test panel exhibiting the ability to properly encase embedded reinforcement

ANNEX 660.1-2

AMERICAN CONCRETE INSTITUTE

Policy on Sponsoring Groups for Certification

Approved by the ACI Board of Direction
March 21, 1991

Last revised by the ACI Certification Programs Committee
October 18, 2011

In developing certification exams for the concrete construction industry, the American Concrete Institute (ACI) has set forth minimum criteria by which an individual's proficiency is to be judged. Typically, ACI is not in a position to deliver certification exams directly to participants; therefore, it is necessary for ACI to have the ability to delegate this authority. However, if the need arises, ACI reserves the right to conduct exam sessions itself according to each program Policy.

In order to allow others to deliver its certification exams, ACI has adopted the "Sponsoring Group" concept. Sponsoring Groups act as agents of ACI in the delivery of ACI certification exams. Therefore, prior to being selected as an ACI Sponsoring Group, and for the duration of the period in which the group is authorized to act as a Sponsoring Group, such groups are subject to the following policies:

1. Sponsoring Groups shall be approved, in writing, by ACI's Certification Department (hereafter referred to as ACI) before they will be permitted to conduct an ACI¹ certification exam session. In all cases, approval of Sponsoring Groups shall be at the sole discretion of ACI.
2. In reviewing applications, ACI will consider, among other factors, the following:
 - A) The ability and willingness of the applicant to include in their constituency segments of the concrete construction industry impacted by the exams which they have applied to conduct. This includes individuals involved in the specification, production, design, construction, testing and inspection of concrete and concrete products. The applicant must establish a governance structure with representation appropriate to all of the exams for which the applicant has applied.

¹ For the purposes of this policy, references to "ACI certification" and "ACI certification program(s)" include only those administered solely by ACI (ACI programs). Programs with cosponsors are not directly addressed by this Policy.

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ANNEX 660.1-2

Policy on Sponsoring Groups for Certification

8. If an existing Sponsoring Group or ACI Chapter is solicited to administer an examination and participation is declined, or if a sponsor does not request an examination upon initial availability from ACI, or if a requested examination is not administered within two years following approval, administration of said examination may become available to other potential sponsors.
9. If more than one applicant wishes to sponsor an ACI certification exam in the same operational jurisdiction and there is documented need for more than one group to conduct the examination in that jurisdiction or portion thereof, a system of coordination between those groups shall be established. A description of this system shall be considered along with any new Sponsoring Group application and must be included in the governance system for any existing Sponsoring Group. In all cases, ACI reserves the right, in its sole discretion, to select a delivery system that in its judgment is best able to serve the interests of ACI.
10. Applicants wishing to sponsor ACI certification examinations on a "national" or "regional" basis will, in appropriate circumstances, be approved to conduct exams under specific conditions at the discretion of ACI.
11. Approved Sponsoring Groups are responsible for:
 - A) Maintaining control over the administration of ACI Certification exams offered within their operational jurisdiction. This includes, but is not limited to, maintaining control over the ethical and professional integrity of every sponsored examination session and providing ongoing oversight of exam session coordinators, examiners, and other exam delivery personnel.
 - B) Conducting a sufficient number of exam sessions and providing equitable access to those exam sessions for all individuals seeking ACI Certification within the group's operational jurisdiction.
 - C) Conducting all ACI exams in a manner which complies with the intent of ACI's policies and procedures governing certification.
 - D) Formulating, publishing, and enforcing consistent and equitable pricing for ACI Certification exams offered by the Sponsoring Group within their operational jurisdiction.
 - E) Developing and implementing participant registration processes that satisfy the policy requirements of each exam offered by the Sponsoring Group and verifying that each participant has met the eligibility requirements of the program before being allowed to complete an ACI exam.

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- F) Collecting exam fees from participants, paying materials invoices to ACI within 30 days of receipt, and distributing compensation to examiners and other program delivery personnel as warranted.
 - G) Developing a program delivery process that establishes separation between the education/training and testing divisions of the Sponsoring Group.
12. ACI has the right to revoke a Sponsoring Group's authority to conduct an ACI certification exam at any time, with or without cause, and with or without notice.
 13. Appeals resulting from the denial or revocation of Sponsoring Group status will be reviewed by ACI Staff for determination of appropriate action on a case-by-case basis.
 14. This policy shall become effective sixty (60) days after its approval by the ACI Certification Programs Committee, and shall render all previous Policy versions null and void. Sponsoring Groups shall be notified of this new policy in writing within thirty (30) days after it is approved by the ACI Certification Programs Committee.
 15. The Certification Programs Committee shall review, revise as necessary, and reapprove this Policy at intervals not exceeding two years in length.