

EFNARC Nozzleman Certification Scheme

By Dan Millette

EFNARC was an acronym for “European Federation of National Associations Representing producers and applicators of specialist building products for Concrete,” which was founded by the European concrete industry in 1989. Over the years, the name of the organization has changed to “Experts for Specialised Construction and Concrete Systems,” but the acronym remains EFNARC. In cooperation with the International Tunneling and Underground Space Association (ITA), it was decided that there needed to be a standard for robotically sprayed concrete.

As is now occurring in North America, Europeans were early to convert from dry-mix shotcreting to the wet-mix process, especially in underground applications. In North America, the American Concrete Institute (ACI) began to offer shotcrete nozzleman certification programs for both dry-mix and wet-mix. But this certification program only deals with handheld nozzle application and is somewhat lacking in shooting methods for underground applications. The ACI program also does not deal with any type of mechanical or robotic arms or spraying equipment, which is becoming the standard in tunneling and mining operations.

Consequently, EFNARC and the ITA launched the Nozzleman Certification Scheme in 2009 to remedy these shortcomings in underground applications. Unlike the ACI program, the EFNARC program only deals with wet-mix shotcrete or “sprayed concrete” as it is termed in Europe, and rightfully so, as concrete is exactly what is being sprayed.

Program Differences

The EFNARC scheme does not even discuss dry-mix and they have no distinction between vertical and overhead certifications as the ACI program does; if you are shooting underground, then it is simply assumed that you will be shooting vertical and overhead. Other than the omission of the dry-mix, the education portion or the course for the EFNARC program is a little heavier on certain aspects than the ACI program. EFNARC has more emphasis on the materials that go into a mixture, including aggregate, cements, pozzolans, and chemicals, and their effects when shooting.

The course also spends some time discussing nozzle accelerators. One other item where there is significant focus is in the handling of plugged lines because this is a significant safety issue. There is also a section on concrete testing. Then, of course, there are the sections of the education portion that cover the equipment used to spray as well as procedures for unloading the mixers. One other major difference is that the ACI certification is valid for 5 years while the EFNARC certification is only valid for 3 years.

Examiner Selection

EFNARC examiners must fill in an application form and submit a résumé. EFNARC states that “an Examiner shall have a wide experience of underground construction and sprayed concrete applications.” The application form also asks the examiner in what region he expects to do certifications and in what language(s). The region can be as specific as a single portion of a country or as large as the entire world. Once accepted, the examiner must travel to the Hagerbach test facility in Switzerland for a 3-day course that consists of



both classroom application assessment and an examination and interview.

After completing and passing the examinations, an examiner is then issued a certificate and his/her contact information is posted on the EFNARC website.

Course Materials

A 157-page study guide is given to examiners at the initial certification and all course materials used by the examiner must be in accordance with this master document. The examiner is permitted to use slides as they appear or modify them slightly to accommodate regional differences. As an example, I have decided that I want to do the examinations in English (U.S. and metric), French, and Spanish, so I have put together four different presentations to accommodate all of these applications.

The examiner also receives the exam questions and the Practical Assessment Form in English and is free to also translate them into the languages of his choice.

Although the EFNARC Nozzleman Certification Scheme is intended to be a certification program only, the examiner is free to offer education and training separately or in conjunction with the certification and has access to the EFNARC course materials to do so. I have done several education-only sessions for mining companies and have been told that this has been instrumental in having them notice a significant improvement in their shotcrete applications.

Conducting Certifications

Certifications begin by either an individual or a company contacting the examiner directly. The certification session is a contract directly between the examiner and the examinee(s). Unlike the ACI program, there are no limits as to who the examiner contracts with—EFNARC trusts the examiner to be ethical and professional in his assessments.

The examinee must complete an application form stating his experience in underground application of sprayed concrete. When the class has been organized, the course material is reviewed by the examiner and then the candidates need to write an exam. This exam can also be administered orally and it is up to the examiner which method is preferable for each examinee. A list of 40 exam questions are given to the examiner upon completion of his certification and he must choose 25 of these for the nozzleman exam. But there must be a specific number of questions from each category, as outlined in the examiner documents. Even though the exam only contains 25 multiple-choice questions, in some cases there are five correct answers in one question and all five



must be chosen for full marks so it is not simply a 25-answer exam.

Another portion of the certification examination requires that the nozzleman be assessed in his work. This is where an examiner can immediately discern whether or not a nozzleman has the required experience and can stop the certification process at any time. Each nozzleman applicant is expected to shoot 4 to 5 yd³ (3 to 4 m³) of concrete during his practical assessment and he must do this in a tunnel-like structure with both vertical and overhead components, as in a real situation. All of the certifications with which I have been involved took place in either a mine or tunnel where the applicant(s) worked. During this assessment, the other applicants are not permitted to be at the assessment location. The applicant must first do a check of his equipment, move it into place, and set it up properly. He must then get the concrete delivered to the machine and spray both the ribs and the crown of the tunnel in the correct manner. He must then clean the machine and put it away for the day as he would at the end of his shift. Throughout this entire process, the examiner is marking items on the Practical Assessment Form and will tally up the marks at the end of the session. The examiner must also photograph the applicant in various stages of this assessment.

Whether or not an applicant passes the exam and practical assessment, all of the exams, practical assessment forms, and photographs are sent to the EFNARC secretary, who currently is a resident of England, along with a recommendation from the examiner. The examiner has the recommendation form as a tool to weed out marginal performers. If for some reason

an applicant passes the written exam and the practical assessment but there is clearly evidence that he is lacking experience, the examiner can recommend that the applicant not be granted certification. It is then up to EFNARC to make the final decision.

Once a nozzleman has been certified, he must then maintain a record of work, with validation from his employer, until his recertification is due. At this time, with sufficient experience, he only needs to undergo his practical assessment again.

A Worldwide Program

The EFNARC Nozzleman Certification Scheme is only 5 years old but is gaining acceptance worldwide. Because it is structured for the underground industries, it is quickly becoming recognized as a valuable tool for ensuring quality applications of shotcrete using robotic arms. There are now certified EFNARC nozzlemen throughout Europe; in most of Latin America, including Mexico; Australia; and some in Asia. North America has been a little slower to adopt this program but it is now starting to catch on in the mining environment.

Contractors and owners now have a choice of certification options for handheld nozzle certifications through ACI or the robotic certifications through EFNARC. I believe that by its 10th year of operation, the EFNARC Nozzleman Certification Scheme will have equivalent recognition as the ACI program has now.



Dan Millette, a Mining Engineer, is the Director of the Mining and Tunneling Division of The Euclid Chemical Company. Millette has over 30 years of experience in the shotcrete industry and is a certified EFNARC Nozzleman Examiner.

He is a member of ACI Subcommittee 506-F, Shotcreting-Underground, as well as a member of the Society for Mining, Metallurgy and Exploration (SME); the Canadian Institute for Mining, Metallurgy and Petroleum; and the Tunneling Association of Canada.