Quality factors affecting NDT personnel qualification and certification process

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Abstract

Qualification and certification of NDT personnel is driven by the primary goal to ensure correct and responsible execution of NDT tasks. The article provides justification for necessity of professional qualification for NDT personnel and responsibility of the Employer for its personnel. In addition it provides key objectives that need to be implemented in order to execute the qualification and certification process with desired outcomes. The article further focuses on training as often overlooked part of the qualification process. Requirements on lecturers; courses design and execution; balance between theoretical, specific and practical part of the training; and sufficiency of training materials including books, equipment and test samples is discussed. The document reflects specific approach for employer and independent qualification and certification.

Keywords: qualification process, certification, ISO 9712, NAS410, SNT-TC-1A, ASME ANDE-1

1. Introduction

This article is discussing the goal of qualification and certification process and objectives necessary to achieve to provide quality qualification service as a qualification center or outside agency.

The employer is fully responsible for his/her personnel (ISO 9712 [1], paragraph 5.5.5, ANDE-01 paragraph 1-3.5c [2]), and he/she expects from the qualification and certification process that his employee is ready for his/her work from technical point of view and therefore the qualification and certification process need to be driven such a way to satisfy this requirement.

2. High quality qualification and certification process

Many may declare, that the best quality training center should deliver the biggest ratio of the trainees successfully throughout the examination process. Others may oppose by telling that the real quality lies behind strict examination and therefore only tough and merciless examination center ensures high quality of the process itself. Some may even say, that the quality lies behind the certification body and nobody else (if applicable), because they are taking the responsibility by issuing the certificates.

Despite the incentive behind each of the statement is clear, such concepts are somehow wrong in their very principle. It is tempting to use such performance indicators because they are easy to measure. Nevertheless, high success rate of a training center can be both the result of perfect teaching as well as mere teaching according to the examination content with no context with real applications behind. High fail rate of the examination center may mean the center is tough savior of quality or an organization with no real touch on reality of NDT inspection process, asking ridiculous questions that
are not even close to the subject. Certification body assurance is also limited. Providing of certificate is based on satisfying list of criteria (education, training, examination, experience and visual acuity) that are only indirectly under control of the certification body (ISO 9712, paragraph 7.1 and 9.1).

Lets forget for a while what employer may want (save money and time, because it is his expense) and what the training and examination center wish (collect as much money as possible, because that makes them profitable). No matter if you are the employer, outsourcing organization of NDT personnel or the qualification agency, nor if you are using independent or employer qualification system, the real goal of qualification process is a conscious NDT inspector/operator, that is able to do his/her duties correctly and responsibly, understanding his delegated power, roles, and responsibilities derived from them and behaving in accordance with all of that.

From such statement is easy to derive the roles of each of the bodies in the qualification process. Training center represents the tutor, examination center the validator and certification body the guarantor. One without another is meaningless. It is even more visible in employer qualification system, where qualification needs to be tailored by the qualification agency to the customer’s needs and be according to internal requirements (SNT-TC-1A [3] paragraph 5.0, EN4179 [4] paragraph 4.1).

Therefore the quality of the training center cannot be determined by the success rate, but its training content relevance and ability to prepare the trainee to his real industrial practice as much as possible. Similarly, the examination center quality assessment cannot be driven by the fail rate, but by ability to verify that the trainee successfully learned how to behave in industrial practice as intended. And lastly, certification quality assessment is to approve that all previous processes were according to given standards and regulations and that they are not result of a randomness, luck or protectionism (ISO 9712 paragraph 5.3.1 and 5.3.2, for employer systems this is responsibility of Responsible L3).

3. Differences in qualification systems

There is a fair number of qualification systems, and it can be very difficult for an obscure observer to get oriented. In general, the qualification systems can be divided into 2 groups according to the NDT performance liability model:

- independent qualification,
- employers' qualification.

3.1 Independent qualification systems

Independent qualification (e.g. ISO 9712, ASME ANDE-1, ASNT ACCP) requires the impartiality and independence of the Qualification and Certification body to the employer, thereby ensuring compliance with standard conditions for qualification of NDT personnel. According to this principle,
qualified personnel can be theoretically considered as fully equivalent regardless of the Training and Examination Center under a specific qualification system. (Independent) training organization takes responsibility for acquiring technical knowledge. Independent examination organization takes responsibility for validating acquisition of such knowledge, and independent certification body issues certificate on basis of fulfillment of following requirements: basic education (ability to read), practice in NDT process, successful completion of training, passing the examination, visual acuity (ability to see). These requirements are always applicable to the specific qualification system, NDT method, level, and the industry sector, and may vary significantly.

In practice, however, there is a fundamental difference in approach of various certification bodies for responsibly of granting the certificate to suitably qualified persons. In addition, there is no contractual relationship between the independent certification body and the employer when using services of contractual relationship. This is primarily to ensure independence that could be compromised by a contractual relationship. It does, however, also mean that there is no legally enforceable transfer of responsibility for the professional competence of NDT personnel to an independent certification body.

### 3.2 Employer qualification systems

Employer qualification systems (e.g. SNT-TC-1A, CP-189, EN4179 / NAS410) are based on the fact that the employer always bears the ultimate responsibility for the safety of his products and hence the only competent to determine which qualification, in which technical range and time extent sufficient to carry out specific tasks. The employer is responsible for the entire training, examining and certification process. He implements it either by own resources or by external contractors (outside agency). Outside agencies must be verified for compliance with the employer requirements (SNT-TC-1A paragraph 7.4, EN4179 paragraph 4.4).

The performance of the qualification must be carried out in accordance with the employer's clearly defined internal procedure, which ensures sufficient qualification of the personnel carrying out the NDT tasks (i.e. the resulting sufficient professional competence). This document is called Written Practice and is mandatory for each company which adopts employer qualification system. This ensures that personnel qualifications always and fully reflect the needs of the employer.

In order to simplify the definition of sufficient qualification for achieving proficiency, every qualification system submits its recommendations for legislation defining the minimum qualification requirements in individual methods, levels or NDT techniques (e.g. SNT-TC-1A tables 6.3.1A/B and table 8.3.4, EN 4179 tables 1 to 5). At the same time, this document defines the minimum requirements for obtaining a certificate on the basis of satisfying the requirements of education, practice, training, successful passing of examination and visual acuity.
Industrial areas that require limitation to degree of freedom in qualification of NDT personnel because of the extreme danger which arises from operation of the devices, can further customize these rules and even restrict them to some extent limit, e.g. the approval of allowable external suppliers. However, this is defined by either the state or the customer.

3.3 Responsibility of the employer

Irrespective of the "independence" of the certification body, the employer always bears the ultimate responsibility for the operational safety of his products and therefore the corresponding qualifications of the personnel who ensure the achievement of the product quality requirements.

3.4 Process completeness

A process is a set of interrelated or interacting activities that transforms inputs into outputs (ISO 9000[5]). None of the qualification systems, however, provide much attention to the training, which is one of only two activities able to provide knowledge, understanding and change the mindset of the participant. The following chapters will therefore continue to discuss exclusively this topic.

4. Objectives for the high quality training center

In order to prepare the trainee for his future industrial practice as much as possible, the training center needs to satisfy the following objectives:

- skilled lecturers,
- carefully designed courses,
- good training materials,
- variety of representative samples,
- wide range of standard equipment.

4.1 Lecturers

Too often it can be heard, that “every professor can teach NDT”, because “well, NDT is really not difficult physics”. But teaching NDT as the professional (not university) course has its requirements that majority of the professors cannot satisfy. Lecturers are not just those with the biggest list of diplomas or Level 3 certificates, as some may be fooled to think, but:

- he/she must deeply understand the topic, not just know the physics behind,
- he/she should have long-time real-life experience from his own industrial practice,
- he/she must have good teaching skills to be able to transfer the knowledge to trainees,
- he/she should have good people skills to assess the situation and drive the trainees into the problematics.
These traits are not mutually replaceable or interchangeable and must be all present to provide lecturer capable of delivering only the right content in the given limited time, such a way the trainee will understand it and be able to replicate it successfully in the future. This might lead to a conclusion only NDT Level 3 in the given method is suitable to teach. Nevertheless, neither qualification system requires mandatory Level 3 qualification for the lecturers (ISO 9712 paragraph 3.20 and 7.2, SNT-TC-1A paragraph 7.1, EN 4179 paragraph 3.13 and 3.16) except ASME ANDE-01 (paragraph 1-4.5).

4.2 Courses structure

Course structure is a written general concept of each course. Its goal is to provide guideline for delivery of consistent quality among a large group of trainees and training events even when provided by various lecturers. The courses structure is usually represented by syllabuses and programs. They demonstrate the organizations’ vision how to teach the trainees in such matter that they will get all necessary knowledge. The contents should enlist:

- relevant physics background,
- relevant norms, standards, specifications, manuals etc.,
- appropriate practice assessment.

Courses structure is very often omitted by training organizations due to being responsibility of the certification body (ISO 9712 paragraph 5.2.2b) and disregarded by the human resources department of the employer. Others just check the checkbox if provided but nobody checks their content. Trainees later may find themselves surprised that the content of the training is not relevant (too difficult physics that doesn’t reflect the knowledge necessary for industrial practice), course contains inappropriate selection of standards (usually too few, that are rather read to the audience than interpreted how to utilize them) and completely failed practice that doesn’t match with their needs (e.g. training of aerospace inspectors on gas pipelines samples).

4.3 Training materials

Good handbook is a cornerstone of any qualification training. It doesn’t ensure the quality of the center itself, but it provides the trainee with tangible result of the training that can be assessed whenever it is needed, even after the end of the training course. Such a training handbook needs to be linked with the course and at its best, extend it by additional information that may not fit in to the discussed topics, but improves the knowledge of the reader.

Better doesn’t mean more complex and more precise equations for less important topics. Handbooks consisting integrals and differential equations are not suitable for NDT personnel qualification. The minimal level of education of trainees is restricted to only elementary school (except ANDE-01, paragraph 1-5.2), thus university level mathematics is completely inappropriate.
The handbook needs to be acceptable for the lecturer to follow during lectures, because he/she is the one facing requests for explanation. Enforcing utilization of standardized handbooks for training provided by third parties that themselves don’t have any responsibility to the end user for the content correctness is not a correct way to go. At minimum, author needs to be known and be responsible for the content. Handbook cannot declare only the personal opinions or unknown authors.

4.4 Training samples

Training should prepare the operator for his specific practice, therefore it should provide as much relevant industrial samples as possible. This requires having enough samples for each application: NDT method (MT, PT, UT, ..), technique (P-E, PA, TOFD, …), industrial sector (welds, castings, forgings, tubes … if applicable) with wide range of possible defects types in various sizes, shapes, and orientations (ISO 9712 paragraph 7.2.2, 8.2.3, and 8.2.4, EN4179 paragraph 6.1.5). Only then the trainee has enough opportunities to learn how to detect, evaluate and record defects of various nature.

Having enough appropriate samples is rather costly. It is not easy to find parts with relevant defects, because many organizations (e.g. in aerospace) require complete traceability and return to manufacturer. Also samples with too many defects that are obviously a scrap, or samples with so small defects that they are extremely difficult to spot, are not good because they don’t test the trainee to recognize, find and evaluate real defects (ISO/TS 22809 and ANDE-01 paragraph 2-2.3.2c).

Some organizations thus solve the lack of adequate samples by providing samples that are not relevant to the qualification system/method/technique/sector and they justify their approach by arguing the concept of inspection is still the same. This usually ends up with misunderstanding of the inspection concept and unsuitable result of qualification.

4.5 Training equipment

Despite it is highly descriptive to use, say, old analogue UT devices to demonstrate the utilization of the equipment the training course should follow the real-world applications assessment. It is just not enough to qualify by dye penetrant sprays and say that such a trainee is ready to operate a huge FPI line. The training must provide the trainee with standard equipment of various sorts (e.g. techniques etc.) to assess all the applications he/she is going to face in foreseeable future of his career. This is even a requirement of the employer qualification systems as SNT-TC-1A (paragraph 7.2, 8.4.1, 8.5.4, 8.5.5) and EN4179 (paragraph 6.1.5).

Be equipped for several techniques and various scales of applications (small scale inspection or mass testing for e.g. automotive production facility) requires investment that needs to be paid off. Such equipment is usually not cheap and it shall be somehow reflected in the price of such training.
4.6 Requirements for training center

It is always possible to measure the quotation/business proposal just by the lowest price, but with low price always ultimately comes low quality of service. The real quality does not come cheap, especially in the training process. Therefore, it is necessary to understand that preparation of a good handbook takes hundreds of man/days, equipment require significant direct investment that may easily exceed tens of thousands of USD and even collecting relevant samples may be a daunting task that many fail to fulfill. Collecting excellent lecturers, however, may turn to be something that cannot be even paid by the money, because a real expert will never be satisfied with providing just a mediocre job.

5. Approach of ATG Ltd.

ATG is a qualification agency with 25 years of experience in the Central Europe, Middle East and CIS countries. ATG doesn’t merely focus to increase the success rate of its trainees, but ensure that a person that passes its courses shall have all the necessary knowledge to do his job correctly.

ATG has a team of skilled NDT inspectors, that equally split their activities among lecturing, consulting (Level 3 services) and inspection activities in order to always stay fully aware of industrial practice and trends and development of NDT, continually improving their experience.

The training courses follow detailed syllabuses that ensure the same high quality of training by various lecturers. In recent years ATG spent significant effort to redesign their handbooks and other teaching materials in order to make them for use when unsure how to proceed while working on inspection site. The materials are completely internally-prepared, created by teams of experienced inspectors and carefully regularly reviewed. They are provided in Czech, English and Russian.

Figure 1  ATG training handbooks for all standard NDT methods.

Among the list of training materials belong also carefully selected standards and specifications that represent well the assessment for each method, sector or even whole qualification system. It is explained how to look upon them, find relevant information inside and utilize it in given scenarios.
There are currently 1107 samples in the ATG warehouse just for purpose of training, listing real parts from automotive, oil&gas, railways, aerospace and other industries. Production sectors are also handled accordingly as well as types of defects enlisted. Many of the samples are collected from long-time partners from production or operation, not artificial pieces created on order.

Equipment enlists handheld equipment as well as ATG-made industrial testing lines to give the trainees chance to see and practice on the various devices reflecting the techniques implemented in their own facility.

![Example of ATG equipment for MT and PT.](image)

**6. Conclusion**

This document focused on explanation of the role of each step in the qualification process., where the training center plays a role of tutor, examination center a validator and certification body a guarantor of achieved qualification of the personnel. In second part of the document the requirements for high quality training, the often overlooked part of the qualification process, is explained in detail. It sums up that quality of training means to provide quality in course design, course documentation, samples, equipment and lecturers that perform the training, which needs to be provided always together.

**7. References**


