Abstract. Non-destructive testing is very much a practical orientated occupation with the technician’s practical skills forming the foundation of his / her occupation.

Thorough assessment of the student’s practical skills should form the foundation of the qualification examination, company based authorisation assessment and professional designation evaluation.

The practical examination (at all levels) should address the responsibilities related to the various qualification levels and would depend on the scheme entity performing the assessment, viz. Authorised Qualification Body (ISO 9712 - Qualification Examination), Company level 3 (Company based Authorisation assessment) or Professional Body (Professional designation / ‘license to operate’ evaluation)

Practical skills form the cornerstone of not only a National NDT qualification and certification scheme, but also of International harmonisation of NDT personnel qualifications.

To this extent, the ICNDT – International Committee of Non-Destructive Testing (ICNDT) has embarked on establishing a ‘Guideline for administering practical examination’, under the chairmanship of Mr. S. K. Babu (APCNDT).

The intent of this paper is to complement the work that has already been conducted, by providing input from a South African point of view.

The following aspects are being addressed:
1) Examination Resources : Management and maintenance
2) Document control
3) Records
4) Operating procedures
5) Grading

Introduction

The qualification examination performed by the personnel certification body or authorised qualification body (if applicable) consist of three independent examinations viz. general theory, specific applications theory and a practical examination. The practical examination is thus a very important component of the qualification examination. While the basic requirements as to the number and type of samples to be provided during the examination is clearly stipulated by ISO 9712, certain periphery issues are left open for interpretation. The intent of this paper is to reflect on some of these peripheral issues from a SAIW Certification (the South African personnel certification body registered under the ICNDT MRA Schedule 2) point of view.
1 Resources

1.1 Examination Samples

The minimum number of practical samples required during a practical examination are stipulated in ISO 9712 Annex B. In addition to this, ISO 22809, provides relevant information regarding the number of samples, discontinuities per sample as well as the minimum size of discontinuities. Relevant details combined with the SAIW perspective are discussed below and shown on the poster.

1.1.1 Minimum number of Samples

ISO 22908 refers to a minimum number of samples \( n_{\text{min}} \) as being calculated by using the formula \( n_{\text{min}} = n_{\text{sp}} \times n_{\text{cmax}} \) where \( n_{\text{sp}} \) is the number of specimens required in the practical examination as per ISO 9712 Annex B and \( n_{\text{cmax}} \) is the maximum number of candidates allowed to simultaneously attempt the practical exam.

Thus based on table B.1 in ISO 9712 and subject to the fact that most qualification examinations performed by SAIW Certification falls within the pre-and in-service industrial sector, three samples consisting of a weld, casting and forging is applicable. Considering that maximum number of student per examination is 10, that means that the minimum number of examination samples required per method should be 30 samples.

These samples should consist of various shapes and sizes to fully assess the students basic practical skills and need not necessarily reflect the complex samples found on industrial sites, since the mastering of practical skills and the consequent assessment and performance demonstration relating to typical components found on site, forms part of the in-service mentoring / experience as well as the end-user approval phases as incorporated within the professional designation system as implemented within the South African NDT industry.

1.1.2 Number of discontinuities per sample

While the maximum number of discontinuities within a sample depends on the geometry and shape complexity of the sample, a standard number of indications per sample should be discouraged. The number of indications per test area (defined as the area of a specimen, either the whole or just a portion, which is to be tested by a candidate during the practical examination) should vary between 1 to 5, keeping in mind that the intent of the examination should be to identify and interpret at least 9 discontinuities per examination.

1.1.3 Minimum size of discontinuities

In order to maintain fairness within the examination (as required by ISO 17024) the minimum size of discontinuities as stipulated within ISO 22809 provides satisfactory guidelines to be followed.

1.2 Sample maintenance

Examination samples shall be cleaned after each examination and surface corrosion protection applied. The method of cleaning shall be based on performance demonstration to ensure that all testing consumables or relevant surface contamination is suitably removed. No uncleaned samples shall be placed back in the storage area.
The sample shall be placed in a ‘quarantined area’ should additional cleaning be required based on a visual assessment or on the performance during the examination, and should proper cleaning not be possible on the day of the examination.

NOTE: The poster indicates a typical cleaning assessment process and shows the quarantine area implemented by the SAIW Certification.

1.3 Sample storage

Examination samples are stored within a strictly controlled environment with access limited to authorised certification body personnel only. Neither students nor lectures should have access to the storage area.

Examination samples are randomly selected by the examiner, removed from the storage area, placed within the examination venue and once the examinations are completed and the samples suitably cleaned, are they placed back in the storage area under direct control of the examiner. No examination sample shall be left unattended and the return of all samples, in a suitable condition, shall be verified by the examiner before the examination process is regarded as being complete.

Examination samples that require additional cleaning or surface protection is placed in an isolated and controlled area outside the exam sample storage facility. These samples are then suitably cleaned and corrosion protection applied prior to the sample being placed back into the storage area, which is considered a ‘clean environment’ in which no contaminated or dirty samples shall be allowed.

2 Documents

2.1 Master reports

Each examination samples shall have a master report. While the annex on master report sheet have been omitted from ISO 9712 : 2012, the importance thereof still remains and should be mentioned. The following is a summary from ISO 9712: 2005.

Each specimen master report shall be compiled and validated by an examiner from at least two independent reports from tests carried out by appropriately certified Level 2 or Level 3 personnel with at least two years’ experience in the application of the NDT method for which the specimen is to be used.

The independent test reports from which the master report is compiled shall be retained as records. It is not necessary for the master report to be signed by the persons carrying out the independent as reports will be retained, but the master report shall be validated, signed and dated by an examiner.

The report shall contain at least the following information:

- name and logo of certification body,
- specimen details such as the identification number, type of product; material and dimensions,
- applicable NDT method, technique and related NDT procedure and written instruction,
- discontinuities contained and mandatory discontinuities to be identified, as verified through independent test reports.

NOTE: The poster shows typical examples of master report sheets utilised.
3 Records

3.1 Sample performance monitor

Examination reports are monitored to assess the performance of relevant examination samples, for example penetrant samples are repeatedly contaminated during the testing process. Insufficient pre- and post-cleaning practices, as well as corrosion protection and storage, can lead to reduced discontinuity detection and thus have an influence on the examination results.

Furthermore, by determining the probability of detection relating to the various techniques applied, and utilizing this information during the grading of examination, promotes the fairness of the examination performed.

NOTE: The poster shows typical performance monitor records

4 Operating Procedures

4.1 Masking of permanent identification numbers

The permanent ID number of the examination samples must be masked by appropriate means prior to the samples being handed over to the candidate. The examiner shall ensure traceability of the sample with the original master report.

Masking of the sample identification should not interfere with the performance of the inspection nor should it be possible to remove it during normal inspection performance. To this extent, using tape or similar means in the presence of solvent cleaners has proven to be unsuccessful.

It has been found that masking samples with temporary copper plates (at least 1 mm thick) which can either be screwed (PT, MT, ET & RT) or glued (UT) over the sample identification numbers, while taking into consideration the influence it would have on the inspection results, is the best means for temporary masking of sample identification numbers. By using a thin copper plate and with sunken screw heads, to facilitate suitable contact with the magnetic bench unit (current flow technique), does not inhibit the inspection process.

NOTE: The poster shows examples of masked samples as provided to candidates during the examination.

4.2 Test performance evaluation (based table D.1 in ISO 9712 relating to the guidance on the percentile weighting for practical examination of Levels 1 and 2)

The test performance, which includes, pretest calibrations and system verification are assessed by a suitably qualified invigilator during the practical test.

While ISO 9712 provide guidance as to the component and grading of these aspects not much detail is include as to what aspects to check and how to assess and consequently grade the candidate performance.

NOTE: The poster includes a practical examination assessment grading matrix which provides details and examples of assessment hold point relating to the six basic NDT methods viz. ECT, MT, PT, RT, UT and VT.
4.3 Written instruction

The level 2 candidate is expected to compile a written instruction for a level 1, based on the sample provided and the specific inspection standard. Again ISO 9712 provides guidance as to the components to assess, but omits relevant details pertaining to the six basic NDT methods, that can be regarded as critical for a proper inspection to be performed.

Included in the practical assessment matrix mentioned above are general considerations for the grading of written instructions based on generic method procedures created for the six basic methods. It also indicates the mark allocation for the various aspects and thus the maximum amount of marks that can be deducted should a specific critical aspect not be suitably addressed, thereby preventing an overall failed result, should a student have omitted a single critical element from the written instruction, thereby resulting in a coherent, fair and unbiased approach by the NDT examiner(s) and moderator(s).

5 Grading

5.1 Qualification level

Grading of practical examinations depends on the qualification level at which the examination is undertaken, with different tolerances being applicable for level 1 and level 2 candidates. The logic behind this approach is based on the difference in experience attained during the qualification process and the fairness towards the candidates.

To this extent a tolerance of $+/-10$mm in the case of Level 1 and $+/-5$mm in the case of Level 2 personnel, are allowed, when considering discontinuity position and sizing.

Contamination of samples, as in the case of penetrant testing, can result in above-mentioned tolerances not being achieved. Under these conditions, additional actions might be required such as taking a photograph of the samples after completion of the test and making it part of the examination records. Furthermore, random samples can be reprocessed by the examiner should over washing be suspected.

NOTE: The poster includes an example of a marking schedule for a typical practical examination.

6 Conclusion

The practical examination forms a very important component of the qualification examination. Thus by creating a set of guidelines for the conduct of practical examination and the related managing of resources would facilitate a harmonized global approach to one of the critical aspects of the ISO 9712 system.

References