European Federation for Non-Destructive Testing

EFNDT

EFNDT GUIDELINES

"OVERALL NDT QUALITY SYSTEM"

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FOREWORD BY PRESIDENT OF EFNDT

Non-destructive testing (NDT) has a number of important roles to play in ensuring the through-life quality and reliability of many important products whose integrity is of paramount importance. The traditional role of NDT in quality control during manufacture - predominantly defect detection - has been complemented in recent years with increasingly important inspections in-service on plant and equipment at varying stages through life. The correct application of NDT can prevent accidents, save lives, protect the environment and avoid economic loss.

These Guidelines summarise the infrastructure which has grown up to assist in the achievement of reliability, identifying gaps and pointing out where users can either directly, or through their national societies or the European Federation for NDT (EFNDT), assist in achieving high quality in NDT.

In due course, the document will be extended. NDT experts from different industrial sectors are being invited to present some aspects of their strategy for good practice of NDT in their specific technical field - see Appendix 7.

J M Farley
President EFNDT

FOREWORD BY VICE PRESIDENT OF EFNDT

As Vice President, I express my thanks to my colleagues in EFNDT for their efforts in preparing this document, which has been peer-reviewed by a subgroup of the Board of EFNDT. EFNDT acknowledges the important contributions to the document by John Thompson, Hannelore Wessel-Segebade, Mike Farley, Michel Poudrai and Bernard McGrath, plus Tony Wooldridge who has reviewed the document on behalf of the Board of Directors.

G Aufricht
Vice President EFNDT

1. OBJECTIVE

This document has been prepared by European specialists to provide guidance on systems for achieving quality in NDT. The objective is to develop a better understanding, by users and purchasers of NDT services, of the various measures available for NDT during manufacture and in-service. Practices in different industry sectors (including pressure vessels, railways, nuclear power and aerospace) are compared.

Internet links are provided to other relevant information sources.

The document will be posted on the EFNDT website and periodically updated. Users are recommended to check the website for the latest version.

2. BACKGROUND

Non-destructive testing (NDT) has a number of important roles to play in ensuring the through-life quality and reliability of many important products whose integrity is of paramount importance. The traditional role of NDT in quality control during manufacture - predominantly defect detection - has been complemented in recent years with increasingly important inspections in-service on plant and equipment at varying stages through life. The correct application of NDT can prevent accidents, save lives, protect the environment and avoid economic loss.

Non-destructive testing and inspection are vital functions in achieving the goals of efficiency and quality at an acceptable cost. In many cases, these functions are highly critical: painstaking procedures are adopted to provide the necessary degree of quality assurance. The consequences of failure of engineering materials, components and structures are well known and can be disastrous.

It is an increasing requirement of quality assurance systems that a company's engineers, technicians and craftsmen are able to demonstrate that they have the required level of knowledge and skill. This is particularly so since NDT and inspection activities are very operator dependent and those in authority have to place great reliance on the skill, experience, judgement and integrity of the personnel involved. Indeed, during fabrication, NDT and inspection provides the last line of defence before the product enters service, whilst once a product or structure enters service, in-service NDT often provides an even more crucial line of defence against failure.

3. ACHIEVEMENT OF QUALITY IN NDT

There are three important factors to achieve the necessary quality and reliability of inspection:-

1. The responsible engineer must specify his requirements very clearly in terms of the regions to be inspected and the types of flaws or deterioration to be looked for (all-encompassing combinations would be prohibitively expensive).
2. The NDT methods, equipment and personnel must be capable of the purpose for which they are being employed.
3. The selected NDT process must be implemented thoroughly.

Many of the necessary controls are available through the "NDT infrastructure" which has been established in many countries. These infrastructures are quite sophisticated and most complete in the manufacturing quality control sphere of NDT, particularly in those geographical areas where ISO 9001 certification of quality assurance demands comprehensive systems to be in place. For the newer applications of NDT or in-service inspection, some of the infrastructure is being developed. As world trade rapidly becomes more liberalised, and equipment is sourced more widely, the NDT infrastructures which were originally national in their coverage, need to become international.

Quality in execution of NDT operations demands attention to a series of interlinked aspects extending from research and development, codes and standards, equipment, personnel training and certification to the effects of human reliability and the influence of auditing and surveillance. These aspects can be represented as links in a chain as shown in Figure 1.

Figure 1: NDT Quality Chain

The chain will only be as strong as its weakest link. Extra attention to one link in the chain cannot compensate for lack of attention to another - just as a strong link in a chain cannot compensate for a weak link.

National and international standards for quality systems such as ISO 9001 require management to establish systems to control all activities which affect quality including NDT. The quality system must address each of the links in the NDT quality chain - to ensure that all the links are in place and properly joined.

Other legislation, codes and practice, and good professional conduct all oblige users of NDT and suppliers of NDT to address how to achieve reliability.

4. OVERVIEW OF NDT INFRASTRUCTURE IN EUROPE

An NDT infrastructure has gradually grown up which provides some of the foundation stones and frameworks with which NDT quality systems can be constructed. A plethora of interested organisations exist, each of which concentrates on its own

elements of the infrastructure. Some are specific to NDT, others have a much wider remit. These organisations include Codes and Standards organisations, Qualification Bodies, Inspection Bodies, Notified Bodies, Certification Bodies, Accreditation Bodies as well as national, regional and international NDT societies.

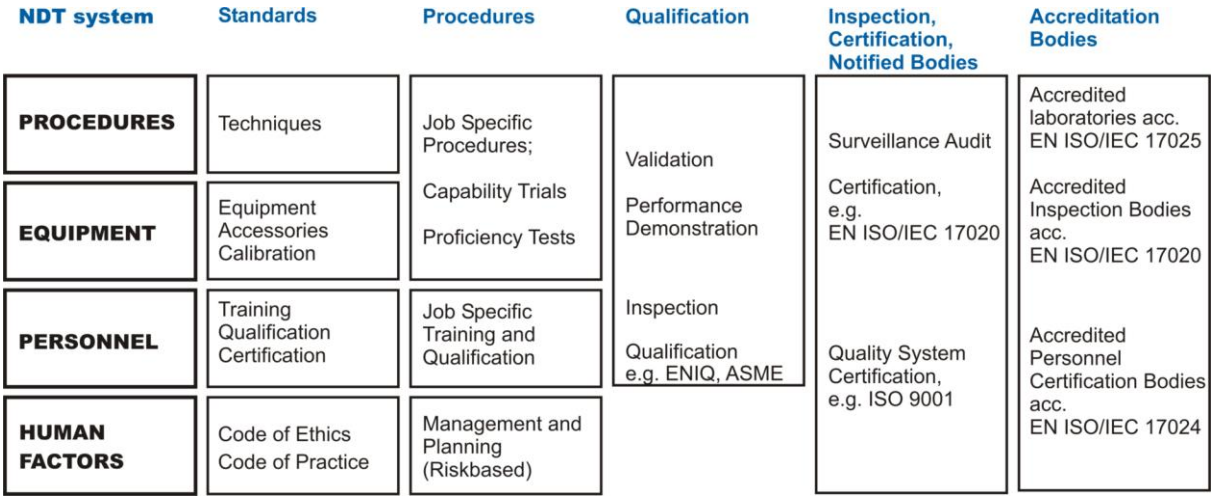

Fig. 2 The NDT quality infrastructure

Figure 2 attempts to represent the infrastructure. In this figure the heavy boxes indicate the "doing activities" that make up NDT operations, ie Procedures, Equipment, Training and Certification, Human Factors, whilst the lighter boxes represent the various measures designed to achieve quality. Individual users and suppliers of NDT services are able to influence the development of the NDT quality infrastructure through participation in advisory committees, eg, of notifying and accreditation bodies, management committees and national, European and international standards organisations. National NDT societies are in a position to take an overview of NDT quality and the more active seek to influence the whole quality chain. It is clear from the experience gained in recent years that much greater influence can be achieved by the societies working together in their regional groups (e.g. EFNDT) and the International Committee (ICNDT). See Appendix 1

Standards for NDT are discussed in Section 5 with further details in Appendix 2. Such standards generally cover a reasonably wide range of applications, and for any particular inspection it is usually necessary to prepare a specific inspection procedure. Such procedures should be consistent with the standards on which they are based but are more prescriptive about component geometry, inspection technique, reporting criteria etc.. Inspection procedures may be prepared by personnel certificated to Level 2 but must be approved by a certificated Level 3. NDT equipment and accessories should be specified in detail in the procedures together with the equipment standards applicable. Further details of typical arrangements for controlling inspection procedures are given in the exemplars of good practice in Appendix 7.

Certification arrangements are described in Section 6 and training syllabuses and guidelines are covered in Section 7.

Section 8 covers the overall assessment of inspection capability which is variously referred to as inspection qualification, performance demonstration or validation.

Section 9 describes the accreditation of NDT organisations.

Human factors can have a major impact on NDT quality and this is discussed in Section 10 whilst Section 11 provides guidance on the overall management for NDT.

Finally, Section 12 and Appendix 7 give examples of good practice in control of NDT quality from a variety of industries.

5. STANDARDS

5.1 European and international NDT standards

In Appendix 2 an overview on European and International NDT standards is given. They are grouped according to product sectors as defined in EN 473 "*Non-destructive testing - Qualification and certification of NDT personnel - General principles"* (Annex A "*Sectors*") which are:

- "c" casting
- "f" forging
- "w" welded product
- "t" tubes and pipes
- "wp" wrought products

Furthermore, comprehensive industrial sectors access to several product sectors:

- Metal manufacturing sector — see c, f, t, w, wp
- Pre and in-service testing of equipment, plant and structure — see c, f, t, w, wp
- Railway maintenance sector — see additionally f, t and wp.
- Aerospace sector — see additionally f, t and wp

General standards which apply for all product sectors are listed in the first table.

Finally, the last table shows NDT standards which define ***terms*** used in non-destructive testing within the different NDT methods or generally.

Standards which cover ***personnel qualification and certification*** and define the minimum requirements for related bodies are not listed in Appendix 2 as chapter 6 deals with them.

Normative references in standards

It is important when working with European or International standards to consider the normative references which are listed at the beginning of a standard. They bring together the basis of the NDT quality chain, consisting of NDT procedures, NDT personnel, NDT equipment and the human factors (see Fig.2 above).

Example:

The general standard EN 444 for RT (radiographic testing) "*Non-destructive testing; general principles for the radiographic examination of metallic materials using X-rays and gamma-rays*" (see Table App 2.1) refers to

- EN 462 "*Non-destructive testing; image quality of radiographs*" (parts 1-5) which are also listed in Table 5.1 under "*others*";
- EN 473 "*Non destructive testing - Qualification and certification of NDT personnel - General principles*" (see Chapter 6 below);
- EN 584-1 "*Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography*" which is listed in Table App 2.1 under "*equipment, materials*";
- EN 25580 "*Non-destructive testing; industrial radiographic illuminators; minimum requirements*" which is listed in Table App 2.1 under "*equipment, materials*".

Standards organisations

More information about standards can be found on the webpages

- for European standards
  Committee for European Standardisation (CEN) www.cen.eu
- for International standards
  International Organisation for Standardisation (ISO) www.iso.org

or on the webpage of national standard organisations (especially those that are members of the above mentioned organisations).

See Chapter 6.7 for details on the processes of preparing standards.

Information platform on standardisation

The information platform for standardisation is accessible for members of EFNDT on the EFNDT webpage: www.efndt.org.

This platform offers various information on technical committees of national, European and International standards institutes with respect to non-destructive testing and related areas (eg welding, destructive testing).

It presents results of actual European and International standards work. All new standards or revisions of existing standards are listed on the first page of the information platform to provide a quick overview. Information about the committee responsible for the standards and a summary of the content is given.

Withdrawn standards are kept within the database to show the history of standards development. They are marked to show the withdrawn status.

5.2 Explanation of ISO processes

The process for development and revision of International standards follows the Directives of the International Organization for Standardization (ISO). The Technical Management Board is responsible for the establishment of Technical Committees (TC's), including TC-135 Non-destructive Testing.

A Technical Committee can establish and dissolve Subcommittees (SC's). Thus TC-135 established SC-7, Non-destructive Testing - Personnel Certification. The parent Subcommittee can establish and dissolve Working Groups (WG's). Thus, SC-7 established WG-6, responsible for the development and revision of ISO 9712:2005. A Working Group comprises a restricted number of technical experts.

All national bodies (member bodies of ISO) have the right to participate in the work of Technical Committees and Subcommittees. A national body may be a P-member with an obligation to vote on all questions within a Technical or Subcommittee and to participate in meetings. A national body may be an O-member with the right to submit comments and to attend meetings. A national body may be neither a P-member nor an O-member but still has the right to vote on draft International Standards (DIS) and on final draft International Standards (FDIS).

An ISO Standard is developed through several project stages:-

Stage	Work	Time Line
Preliminary	New work items are developed against no time deadlines	
Proposal	New work item proposal is submitted to the TC or SC	0 months
Preparatory	Work to prepare a working draft (WD)	6 months
Committee	Work to prepare a committee draft (CD)	12 months
Enquiry	Work to prepare a draft international standard (DIS)	24 months
Approval	Work to prepare final draft international standard (FDIS)	33 months
Publication	Work to prepare a published standard	36 months

Thus development of a new standard may take far more than 36 months, since the time clock does not begin until a new work item proposal is submitted. A major revision of an existing standard, starting at the Preparatory Stage, could require 36 months.

5.3 Explanation of CEN processes for European Standards

The processes for preparation and approval of European Standards are explained in Appendix 3.

A European Standard (EN) is a normative document made available by the European Standards organisations CEN/CENELEC in the three official languages. The elaboration of a European Standard includes a public enquiry (six months), followed by an approval by weighted vote of CEN/CENELEC national members (two months) and final ratification. The European Standard is announced at national level, published or endorsed as an identical national standard and every conflicting national standard is withdrawn. The content of a European Standard does not conflict with the content of any other EN. A European Standard is periodically reviewed.

Standards may be prepared by adoption of International Standards or when necessary by Technical Committees. Voting and approval procedures are described in Appendix 3.

When consensus has been reached, the text agreed by the technical body is forwarded by the Technical Committee secretariat to the Central Secretariat, to be allocated a prEN number and distributed to the CEN/CENELEC national members for public comment. This procedure is called the "CEN/CENELEC enquiry". The period allowed for the CEN/CENELEC enquiry shall normally be six months.

NDT standards are prepared both by the CEN Technical Committee TC138 Non-destructive Testing (which prepares general methods standards, including certification of personnel) and by Product-related Technical Committees (eg TC121 NDT of Welds).

6. PERSONNEL QUALIFICATION AND CERTIFICATION

6.1 Background

It is an increasing requirement of quality assurance systems that a company's engineers, technicians and craftsmen are able to demonstrate that they have the required level of knowledge and skill. This is particularly so since NDT and inspection activities are very operator dependent and those in authority have to place great reliance on the skill, experience, judgement and integrity of the personnel involved. Indeed, during fabrication, NDT and inspection provides the last line of defence before the product enters service, whilst once a product or structure enters service, in-service NDT is often the only line of defence against failure.

The training, qualification and certification of NDT personnel are therefore very important. Training is necessary both before and subsequent to qualification examinations. Attention must be given to job-specific training before an operator is asked to carry out jobs which may be outside the scope of his certificate. Section 6 focuses on Qualification and Certification whilst Section 7 covers training.

In the field of personnel certification there are two types of standards: those which cover central, independent certification and those for in-house certification. Central

independent certification as defined in standards such as the International Standard ISO 9712 and its European equivalent EN 473 is increasingly being accepted internationally, including in the United States. For in-house qualification and approval (certification, by definition, involves a third party ‘certification body’) the American ASNT document SNT-TC-1A is widely used in place of a standard in, for example, the pressure equipment sector, where ASME codes are often applicable. In the aerospace sector, there are sector specific standards, such as EN 4179 and AIA NAS 410 for the qualification and and approval of personnel by the employer (see Section 6.3).

6.2 Central independent certification

In most European countries there is a ‘national certification scheme’ which provides NDT personnel certification to the EN 473 standard in each main NDT method at three levels (Level 1, 2 and 3). The majority of these bodies have gained independent accreditation to EN 45013, or to EN ISO/IEC 17024:2003 which superseded EN 45013 in 2005, by national accreditation bodies (such as the United Kingdom Accreditation Service - UKAS). This enables them to participate in the EFNDT Multilateral Recognition Agreement (MRA). In order to extend the availability of the EFNDT MRA to certification bodies in countries where there is presently no national system for independent accreditation, the EFNDT offers assessment and approval of certification schemes against the referenced standards.

Globally, the ISO 9712 standard has been adopted in a large number of countries (including China, India, Canada, Japan, Australia, South America, Korea) and Certification Bodies are providing independent third party certification accordingly. A group of Certification Bodies in the Asia-Pacific region are developing a multilateral recognition agreement based on the EFNDT model. In the USA, Standard ANSI/ASNT CP-106:2008 (ISO 8712:2005, modified) is being developed. The International Standard ISO 9712:2005 is adopted with national modifications as an American national Standard. The national foreword describes the method for making modifications and how they are identified in the text.

The International Committee for NDT (ICNDT) and the International Atomic Energy Agency (IAEA) continue to promote ISO 9712 as a basis for global harmonisation of central certification.

Under the Vienna Agreement, ISO and CEN are committed to the adoption of common standards to serve the needs of the European and wider international communities and it remains an ambition of the ICNDT to see ISO 9712 and EN 473 converge into a common standard, perhaps at the next revision of ISO 9712 (this process is expected to commence in 2009).

Although there has been a steady increase in the level of detail in ISO 9712 and EN 473, there are still NDT applications that are not covered under national certification schemes adopting these standards and there may be a need for additional in-house job-specific training and assessment. This should be addressed in a company’s NDT personnel qualification and authorisation procedure (commonly known as a written practice).

6.3 Company-based approvals/certification

In the USA, and countries using American standards, there continues to be widespread reliance on in-house certification in accordance with SNT-TC-1A, "Recommended Practice No. SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing (2006)" (available from www.asnt.org) albeit with increasing reliance on independently certified Level 3s. SNT-TC-1A allows companies to tailor training and approval more closely to the specific needs of a company but lacks the benefits of independent certification examinations by a central body.

This deficiency has lead to a number of schemes which combine in-house training and approvals with external third party controls, notably in the aerospace sector:

In the European civil aerospace maintenance sector, SNT-TC-1A is increasingly being rejected because it allows the employer too much latitude, and the typical national or regional regulatory requirement for maintenance organisations (in Europe, European Aviation Safety Agency (EASA) regulation part 145) is to implement EN 4179. This standard refers to bodies – National Aerospace NDT Boards (NANDTB) - that control NDT personnel qualification examinations at the national level. The examinations may be provided centrally or by outside agencies or employer administered examinations.

In the civil aerospace manufacturing sector, controlled in Europe by EASA Regulations part 21, there is no specific requirement to apply a specific certification standard but, again, EN 4179 is the predominantly applied standard. This is further emphasised by the NUCAP program (which evolved from the North American Defence Contractors Accreditation Program – known as NADCAP), in which the whole NDT process, including qualification of personnel, is audited and accredited under arrangements controlled and agreed by the major prime contractors (e.g., Boeing, Airbus, etc.).

6.4 Responsibilities of employer

The employer has important responsibilities when using either company or third party qualification and certification systems. These should be reflected in the employer's quality procedure for the qualification and authorisation of NDT employees (the written practice).

This Section of the Guidelines clarifies the employer's responsibilities within the framework of EN 473 and gives guidance on how the employer should fulfil these. The requirements of EN 4179 in this area are clear, and employers seeking to develop a procedure for controlling the internal qualification and authorisation of their NDT employees may derive benefit from a careful review of this standard.

In this context the employer (the 'responsible agency') is defined as 'the organisation for which the NDT technician works on a regular basis'. If the NDT technician is self-employed he should assume all responsibilities specified in the standard for the employer or responsible agency.

The responsibilities of the employer are:

a. to accept overall responsibility for the results of NDT operations;

b. for uncertificated employees, to introduce the candidate to the Certification Body or the Authorised Qualifying Body and endorse the validity of the

personal information provided, including the declaration of education, training and experience needed to establish the eligibility of the candidate;

c. to accept full responsibility for the authorisation to operate, including checking that NDT tasks to be carried out are within the scope of the individual’s scope of certification and, if they are not, organise additional job-specific training and/or qualification examinations;

d. to ensure annually that employees meet the visual acuity requirements and all other conditions of validity of certification as defined in the standard;

e. to maintain records of work experience necessary as a basis for confirming continuity of satisfactory work activity (to support renewal/recertification).

To fulfil these responsibilities the employer must prepare a quality procedure (or written practice) and maintain adequate records.

The quality procedure should cover all aspects of employing NDT technicians, including general induction training, health and safety, familiarity with the company’s equipment and procedures, familiarity with the products to be tested and the applicable acceptance standards; in short, the correct administration and control of NDT personnel in order to meet the quality requirements of the company, its customers and relevant national or international regulations.

It will also include reference to:

a) applicable codes and standards;

b) general responsibilities of Levels 1, 2 and 3;

c) scope of certification required (method, level, sector …);

d) persons designated by the employer to be responsible for issuing the authorisation to operate;

e) control of in-house training and examination supplementary to that carried out during the EN 473 qualification and certification process. This will include job specific training for tasks outside the scope of the individual’s certification and updating with respect to new equipment or techniques;

f) responsibility for maintenance of records.

The employer must arrange to maintain records for each of his NDT personnel including records of:

- education
- externally and internally provided training
- work experience
- vision tests
- qualification examination results

If these are complete and acceptable, then the employer issues the necessary authorisation to discharge the duties of Level 1, 2 or 3 in a defined area of competence.

The best way for this to be done is through a ‘Certificate of Authority to Work’ and this should be signed by an appropriately designated person on behalf of the employer. EN 473 provides an example of such an authorisation.

6.5 Best Practice in certification

Whereas several years ago the two approaches to approval and certification (central, independent, third party and in-company) were seen as very different there now seems to be a gradual convergence of the two. Users of central certification are increasingly aware of the need for the central certification to be used in the correct way - as part of an organisation’s quality systems for NDT or written practice - and the guidelines for in-house, company based certification are bringing in requirements for external assessment e.g. independently certified Level 3s.

6.6 Standards for central/third party certification (ISO 9712/EN 473)

The current editions of the referenced standards are:

ISO 9712:2005	Non-destructive testing - Qualification and certification of personnel
EN 473:2000	Non-destructive testing - Qualification and certification of NDT personnel – General principles (presently undergoing revision to a third edition)

6.6.1 ISO 9712 – background

Work began in 1987 to produce an international standard covering the criteria for education, training, experience and certification of NDT personnel, and the draft ISO 9712 was based upon guidelines produced by ICNDT and published in 1985 as a series of documents with the WH85 prefix. The demand for such a standard arose primarily from a lack of confidence in employer-based certification systems, necessitating regular and expensive audits of suppliers’ in-house certification procedures which were subject to abuse arising from commercial pressures. After more than three years of meetings, amendments and numerous drafts, made necessary in order to satisfy the diverse interests of the nations involved, the standard was given approval and published in 1991 (but designated ISO 9712:1992). It specified independent central certification at all three levels of qualification, and a certificate validity of five years. This first edition lacked detail and substance, but it was nevertheless a good beginning which provided the opportunity for global harmonisation that had not previously existed.

6.6.2 EN 473 – background

EN 473 was developed (using ISO 9712 as a ‘base line’) because of a frustration with a lack of progress in the development and approval of ISO 9712. This lack of progress was largely caused by adoption of a 15 year implementation period built in to the international standard. In Europe, the treaty of Rome necessitated a mandatory standard to ensure common levels of NDT personnel competence when trading safety critical products within the European Economic Community, and ISO 9712 was not considered to fulfil this need.

*[1] See ISO 9712 introduction: "Any country adopting this international Standard will be expected to *comply immediately with level 3 requirements for qualification and certification, but is permitted a transition period of up to 15 years to implement level 1 and 2."*

The CEN (European Committee for Standardisation) members were dissatisfied with the flexibility that ISO 9712:1992 allowed and, recognising the European need for a standard that included criteria with mandatory compliance, work began on the drafting of EN 473, based upon the content of ISO 9712:1991, but taking the opportunity to improve upon it and add the detail that it lacked. The first edition was published in 1993, and was supplemented in 1994 by a CEN Technical Report (N211) which added further substance (and which was subsequently incorporated into the second edition of the standard). EN 473:1993 required certification bodies to comply with EN 45013, which emphasised the need for independence, impartiality and freedom from control of the certification process by vested interests – a development which, together with differences in qualification criteria, effectively made it impossible for EN 473 certification bodies to recognise the certification issued by ISO 9712 certification bodies.

6.6.3 Further development of the 3rd party personnel certification standards

ISO was quick to recognise the significance of the improvements incorporated into EN 473, and work to revise ISO 9712 commenced in 1994 through a working group, under the convenorship of the USA delegate to ISO TC/135/SC7. This resulted in the publication of the second edition - ISO 9712:1999 - which quite closely reflected the content of EN 473:1993.

However, even as the ISO revision was taking place, a review of EN 473 began with a meeting in Vienna early in February 1996, and the process was completed during 1998, resulting in publication of the present second edition – EN 473:2000. Thus the first revisions of the European and International Standards were issued at approximately the same time and were considered to be more or less harmonised. Certainly, it was the case that a certification body could easily simultaneously fulfil the requirements of both standards, thus providing the opportunity for mutual recognition of certification on a global scale.

It was with the prospect of fusion under the Vienna Agreement of these two standards in mind that in 2001 ISO TC135/SC7/WG6 began work to revise ISO 9712:1999, and the group that set out to achieve this was comprised of experts with a 50/50 balance of representatives of CEN member and ISO member countries. The work was completed in 2004, and the resulting third edition, ISO 9712:2005, which incorporated some fairly radical thinking, also included a number of substantial normative and informative appendices designed to bring total harmonisation of certification schemes closer.

At the time of writing, EN 473 is undergoing revision to a third edition. Some notable features of the prEN circulated to 5 month enquiry in August 2006 are described in Appendix 4.

6.6.4 Comparison EN 473 / ISO 9712

(This sub-section will be added to the document when the new version of EN 473 is published.)

6.7 EFNDT Certification Executive Committee activities

Beginning in 1990, EFNDT (previously ECNDT) considered several ways to harmonise qualification and certification of NDT personnel in Europe with the help of the newly published European Standard EN 473 (Non-Destructive Testing – Qualification and Certification of NDT Personnel – General Principles). This EFNDT project, originally known as “ECP” (European Certification Process) aimed at a full and detailed description of the qualification provisions adding to EN 473 to provide interpretation of, for instance: conduct of examination, examination questions and test pieces.

Successive revisions of EN 473 and the development of accreditation of certification bodies by accreditors who are members of EA (European co-operation for Accreditation) and IAF (International Accreditation Forum) implementing harmonised international standards (EN 45013, ISO 17024) reduced the initial scope of ECP to three items, the management of which was delegated to a Certification Executive Committee (CEC) by the EFNDT Board.

The 3 items are:

- **EFNDT approval of NDT Personnel Certification Bodies (see 6.9)**:

  EN 473 or ISO 9712 require compliance to EN ISO/IEC 17024 which provides general requirements for bodies providing certification of personnel.

  In Europe, this compliance is usually assessed by national accreditors. But certain Certification Bodies may not easily have access to the service of accreditors (absence of such service in their country or countries outside Europe). In addition, the accreditation bodies are using IAF Guide 24 which is an interpretation document for EN ISO/IEC 17024, but may not always be well adapted to the particular case of NDT personnel certification.

  To resolve these two issues, EFNDT has acted by:

  - setting up a complete professional documented system of approval which may be used by Certification Bodies when appropriate accreditation is not available;
  - preparing a document similar to IAF Guide 24, but taking into account the particularities of NDT personnel certification (essentially due to the existence of the standards EN 473 and ISO 9712). This work has been transmitted to CEN with the aim of becoming a CEN Technical Report and of being used (together or in lieu of IAF Guide 24) by the accreditors assessing NDT personnel certification bodies.

- **EFNDT Multilateral Recognition Agreement (MRA) (see 6.9)**

  Members signing this agreement recognise mutually certificates issued by Certification Bodies registered under the agreement.

Today, the EFNDT MRA has 28 signatories and nearly 20 registered Certification Bodies, all of which are accredited or approved as complying with International Standard EN ISO/IEC 17024 and issuing certification in compliance with EN 473 (and/or ISO 9712).

Since Version 8 of the Agreement (26 October 2002), participation is open to schemes outside Europe providing either EN 473 or ISO 9712 Certification. A copy of the Agreement, the list of signatories and the list of recognised Certification Bodies is published on the EFNDT Website (www.efndt.org).

- **EFNDT Question Bank (see 7.4)**

  The bank brings together more than 8000 multiple choice examination questions. It is available for those certification bodies that are currently registered in compliance with the EFNDT Multilateral Recognition Agreement (MRA), or which plan such registration.

6.8 Accreditation/Approval of NDT Certification Bodies providing certification to ISO9712 and/or EN473

Both standards require that the certification system should be controlled and administered by a certification body which conforms to the requirements of the EN ISO/IEC 17024:2003 (Conformity assessment - General requirements for bodies operating certification of persons). This standard is designed to ensure that a Certification Body is adequately qualified for its role and is independent of any single interest. In many countries of the world Certification Bodies demonstrated their compliance with this requirement by obtaining accreditation by independent agencies – many of which are government sponsored – generally known as Accreditation Bodies.

There are associations of accreditation bodies at international and European levels, the International Accreditation Forum (IAF) and the European Accreditation of Certification (EAC) group. Some Accreditation Bodies operate outside their national boundaries.

At the time of writing, EAC have a Multilateral Agreement (MLA) covering accreditation of personnel certification bodies, and the IAF do not, but are discussing whether there is a need for one. The accreditation process is intended to increase the confidence of users in the status of a Certification Body and its certificates.

Accreditation reduces risk for business and its customers by assuring them that accredited bodies are competent to carry out the work they undertake within their scope of accreditation. Accreditation bodies which are members of the International Accreditation Forum, Inc. (IAF) are required to operate at the highest standard and to require the bodies they accredit to comply with appropriate international standards, and IAF Guidance to the application of those standards (in 2003, the IAF drafted guideline G24 for the application of the standard by accreditation and certification bodies).

Recognising that the lack of availability of accreditation in some countries/regions makes it difficult for certification bodies in those countries/regions to participate in its Multilateral Recognition Agreement (MRA), the European Federation for NDT has developed and implemented a system for assessment and EFNDT approval of NDT

personnel certification bodies. This system is described in EFNDT document CEC/P/05-001, dated 6th September 2005, the introductory text from which is replicated below for information.

> Purpose and eligibility
>
> The purpose of the approval process is to provide for international recognition of NDT personnel certification bodies where there is presently no national system of accreditation.
>
> Management
>
> The EFNDT Approval process is managed by a Certification Executive Committee (CEC) constituted by the EFNDT Board of Directors.
>
> The CEC is responsible to the EFNDT for setting, maintaining and reviewing criteria for applicant and approved Certification Bodies and, if requested, will advise the EFNDT BoD on the justification for approval of any particular Body.
>
> Scope of approval
>
> Approval may cover the qualification and certification activities of any particular Certification Scheme in whole or in part.
>
> Validity of approval
>
> The Approval is valid for a period of three years. After three years, in order to renew EFNDT Approval, a full quality system and technical compliance audit (reassessment) will be carried out against the criteria of the applicable standard(s).
>
> Conditions
>
> The EFNDT Approved Certification Body shall:
>
> > Be nominated by an NDT Society in Full or Associate Membership of the EFNDT.
> >
> > Conduct qualification examinations in conformity with the current edition of the applicable standard(s), i.e., EN 473 or ISO 9712.

6.9 Mutual Recognition of Certification to ISO 9712/EN 473

6.9.1 Background

The publication ICNDT WH 85, included a model agreement (WH 23 - 85), adopted 7th November 1985, on the mutual recognition of qualification and certification schemes for NDT personnel.

It was envisaged that what was initially a model *bilateral agreement* for use by two Certification Bodies might, due to the extension of such agreements between parties, effectively develop into a *multilateral agreement between several bodies*

.6.9.2 Bi-lateral Agreements

A number of bilateral recognition agreements, based upon the model in WH 23 – 85, emerged in the late 1980s and early 1990s. Some of these are still in force and those known at the point of publication are listed in the register of agreements below.

6.9.3 EFNDT Multi-lateral Recognition Agreement (MRA)

In early 1993, an ad hoc meeting was arranged in Brussels with the intent of harmonising the implementation of the European Standard EN 473 (Non-Destructive Testing – qualification and Certification of NDT Personnel – General Principles) through three CEC funded projects:

i) establishing a European bank of multiple choice questions

ii) documentation of a system for administering examinations

iii) interpretation of EN 473

At a subsequent meeting in Berlin on 21 October 1993, the European Committee on NDT (ECNDT) established a Working Group of European Union national NDT societies and their associated certification bodies. This was given a remit to establish a European-wide multilateral agreement on mutual recognition of certification. The group involved in this meeting became known as the European Working Group on Qualification and Certification.

At a meeting in Paris on 27 April 1994, the first draft of the European Multilateral Agreement was tabled. It was subsequently amended and ratified at the 6th European Conference on NDT in Nice, France, in October 1994. On this auspicious occasion the first 20 or so of the eventual 30 plus ECNDT members signed the very first truly multi-lateral agreement to recognise mutually certificates issued by Certification Bodies registered under the agreement.

Today, the European Federation for NDT (EFNDT) MRA has 28 signatories and nearly 20 registered Certification Bodies, all of which are accredited or approved as complying with International Standard EN ISO/IEC 17024 and issuing certification in compliance with EN 473 (and/or ISO 9712).

Since Version 8 of the Agreement (26 October 2002), participation is open to schemes outside Europe providing either EN 473 or ISO 9712 Certification. A copy of the Agreement is published on the EFNDT Website (www.efndt.org), and a synopsis of the content is reproduced here for information purposes:

Objectives

The objectives of this Agreement are:

- To promote harmonisation of the operations of the independent NDT personnel certification schemes nominated by the national NDT societies of European Union (EU) and European Free Trade Association (EFTA) countries.
- To facilitate recognition of qualifications and certification of NDT personnel in Europe and internationally in order to facilitate the free movement of plant, equipment and personnel and to avoid uneconomic re-inspection.

Who is eligible to participate?

The Agreement is open to NDT Personnel Qualification and Certification schemes which are:

- Nominated by national NDT Societies that have signed the agreement.

- Accredited by an EFNDT recognised accreditation agency or government department.

Each scheme which is party to and a signatory of this Agreement accepts that each party registered under the Agreement meets the requirements of European Standards and associated technical documents for which they hold current accreditation.

Procedure for registration

A scheme meeting the criteria which wishes to become registered under the Agreement submits to the EFNDT Working Group Secretariat:

- A letter of nomination from the national NDT Society of the country in which the scheme is based.
- A certificate of accreditation.
- A schedule detailing the scope of its accreditation (e.g., EN 45013, EN 473, ISO 9712, EN 4179 etc.).

The acceptance of the new party is ratified by a simple majority of the participants in the Agreement at the next appropriate WG meeting or by postal ballot.

What are the obligations following registration?

Being signatory to the MRA involves discharging a number of obligations. Each party to the Agreement has agreed to:

- publish in its own national language(s) a notice advising of this Agreement and listing the participant certification schemes
- publish details of certification requirements which are additional to those of the European Standards
- commit itself to the pursuance of the objectives of the group
- assist the others in their effort to give a clear overview of the certification activities in its own country.

Who is bound to recognise registered certification?

Nearly 30 national NDT Societies, listed below in Schedule 1 (1 January 2008), have *signed* the EFNDT Agreement on Multilateral Recognition of NDT Personnel Certification schemes and have thereby *agreed to recognise* certificates issued by the particular Certification Schemes registered by EFNDT in accordance with the Agreement. The updated version of Schedule 1 is available on the EFNDT website (www.efndt.org).

SCHEDULE 1			
Country	**National NDT Society**	**Name of signatory**	**Place and date of signing**
Australia	AINDT	P Sheedy	By post, 13th May 2003
Austria	ÖGZfP	G Aufricht	Nice 25th Oct 1994
Belgium	BANT	P de Meester	Nice 25th Oct 1994
Belorus	BANK & TD	I Stabzovskaya	Berlin 21st June 1997
Bosnia Herzegovina	SNDT		Copenhagen 27th May 1998
Bulgaria	BSNT		
Croatia	CrSNDT	V Krstelj	Copenhagen 27th May 1998
Czech Republic	CNDT	J Obraz	Berlin 21st June 1997
Denmark	Danish Society for NDT	B Larsen	Nice 25th Oct 1994
Finland	Finnish Society for NDT	J Sillanpää	Nice 25th Oct 1994
France	COFREND	M Poudrai	Nice 25th Oct 1994
Germany	DGZfP	D Schnitger	Nice 25th Oct 1994
Great Britain	BINDT	J M Farley	Nice 25th Oct 1994
Greece	HSNDT	M Fytos	Nice 25th Oct 1994
Hungary	HONDT	F Fücsök	Berlin 21st June 1997
Ireland	IIWIP	M Prendergast	Copenhagen 27th May 1998
Israel	The National Israeli Society of NDT	G Shoef	Rome 19th October 2000
Italy	AIPnD	G Nardoni	Nice 25th Oct 1994
Netherlands	KINT	J Boogaard	Nice 25th Oct 1994
Norway	Norwegian NDT Society	R H Sövik	Nice 25th Oct 1994
Poland	Polish Society for NDT and Technical Diagnostics - SIMP	Z Pawlowski	Berlin 21st June 1997
Romania	AroENd	A Stanciu	29th August 1998
Russia	RONKTD	V V Klyuev	Berlin 21st June 1997
Slovakia	SSNDT		
Slovenia	Slovenian Society for NDT	J Grum	Ljubljana, 20th July 2004
Spain	AEND	E Romero	Nice 25th Oct 1994
Sweden	Swedish NDT Society	C Eriksson	Nice 25th Oct 1994
Switzerland	SGZP	P Krebs	Nice 25th Oct 1994
Ukraine	USNDT	V A Troitskij	Berlin 21st June 1997

Which certification bodies have registered?

The NDT Personnel Certification Schemes/Bodies which have been accepted by the EFNDT Qualification and Certification Working Group as complying with the criteria set out in the EFNDT Agreement on Multilateral Recognition of NDT Personnel Certification Schemes and thus are recognised by the signatories to the Agreement are listed in Schedule 2 to the MRA, which is published at www.efndt.org. The version current at 1 January 2008 is given below, Schedule 2.

Accredited Certifacation Body	ISO/IEC 17024 compliance	EN 473 compliance	ISO 9712 compliance	Expiry of registration of MRA	Code of practice
SKO	RvA on 01-07-2004 Expiring 25-06-2008	RvA on 01-07-2004 Expiring 25-06-2008		25-06-2008	A. Ph. Stibbe 20-02-2006
SSNT	SAS on 18-09-2005 Expiring 17-09-2010	SAS on 18-09-2005 Expiring 17-09-2010	SAS on 18-09-2005 Expiring 17-09-2010	17-09-2010	Gunter Blumhofer 25-01-2006
CIICPND	Sincert on 24-01-2006 Expiring 24-01-2010	Sincert on 24-01-2006 Expiring 24-01-2010	Sincert on 24-01-2006 Expiring 24-01-2010	24-01-2010	Mirko Crepaldi 16-01-2006
CERTIAEND	ENAC on 11-03-2005 *Accreditation certificate does not exhibit an expiry date*	ENAC on 11-03-2005 *Accreditation certificate does not exhibit an expiry date*		11-03-2010	Rodolfo Rodriguez 08-02-2006
COFREND	Cofrac on 01-06-2005 Expiring 30-06-2009	Cofrac on 01-06-2005 Expiring 30-06-2009	Cofrac on 01-06-2005 Expiring 30-06-2009	30-06-2009	Patrick Fallouey 09-03-2006
Jidnostka Ceryfikujaca UST-CERT	Polish Centre for Accreditation On 24-02-2006 Expiring 26-02-2010	Polish Centre for Accreditation On 24-02-2006 Expiring 26-02-2010	Polish Centre for Accreditation On 24-02-2006 Expiring 26-02-2010	24-02-2010	Marek Walczak 09-03-2006
DPZ	ZLS on 21-07-2005 Expiring 30-11-2009	ZLS on 21-07-2005 Expiring 30-11-2009	ZLS on 21-07-2005 Expiring 30-11-2009	30-11-2009	Matthias Purschke 03-03-2006
SEC "KACHESTVO"	DAR on 27-01-2006 Expiring 26-01-2011	DAR on 27-01-2006 Expiring 26-01-2011	DAR on 27-01-2006 Expiring 26-01-2011	26-01-2011	Dr. N. Biryukova 23-03-2006

ÖGfZP	Bundesgesetzblatt (Ministry of Economic Affairs) on 01-04-2005 *Accreditation certificate does not exhibit an expiry date*	Bundesgesetzblatt (Ministry of Economic Affairs) on 01-04-2005 *Accreditation certificate does not exhibit an expiry date*	Bundesgesetzblatt (Ministry of Economic Affairs) on 01-04-2005 *Accreditation certificate does not exhibit an expiry date*	01-04-2010	Artur Salcher 22-03-2006
Czech Association for Personnel Certification (APC),	Czech Accreditation Institut On 28-04-2006 Expiring 31-05-2011	Czech Accreditation Institut On 28-04-2006 Expiring 31-05-2011	Czech Accreditation Institut On 28-04-2006 Expiring 31-05-2011	31-05-2011	Petr Janeck 31-03-2006
Australian Institute for NDT	JAS-ANZ On 17-08-2005 *Accreditation certificate does not exhibit an expiry date*		JAS-ANZ On 17-08-2005 *Accreditation certificate does not exhibit an expiry date*	17-08-2010	Peter A. Sheedy 02-05-2006
British Institute of NDT	UKAS on 17-01-2005 Expiry 30-04-2010	UKAS on 17-01-2005	UKAS on 17-01-2005	30-04-2010	John Thompson 13-03-2006
HSNT	Hellenic Accreditation System on 09-03-2005 Expiry 08-03-2009	Hellenic Accreditation System on 09-03-2005 Expiry 08-03-2009	Hellenic Accreditation System on 09-03-2005 Expiry 08-03-2009	08-03-2009	Ioannis N. Prassianakis 20-07-2006
ABENDE	Inmetro 03-11-2004		Inmetro 03-11-2004	03-11-2004	Joao Antonio Conte 24-05-2006
BANT	Cofrac on 01-04-2004 Expiring 31-03-2009	Cofrac on 01-04-2004 Expiring 31-03-2009	Cofrac on 01-04-2004 Expiring 31-03-2009	31-03-2009	Raymond De Graeve 11-09-2006
Testing & Diagnostics Volgogradsky Prospect	DAR on 18-07-2006 Expiring 24-08-2007	DAR on 18-07-2006 Expiring 24-08-2007	DAR on 18-07-2006 Expiring 24-08-2007	24-08-2007	Alexander Mullin 13-04-2006
SPEKTRCert	EFNDT approval on 04-04-2007 Expiring 04-04-2010	EFNDT approval on 04-04-2007 Expiring 04-04-2010	EFNDT approval on 04-04-2007 Expiring 04-04-2010	04-04-2010	Prof. M. V. Korolev 10-04-2007
CrSNDT	HAA on 23-09-2004 Expiring 30-09-2009	HAA on 23-09-2004 Expiring 30-09-2009	HAA on 23-09-2004 Expiring 30-09-2009	30-09-2009	Ana Lypolt 02-02-2007

6.9.4 Register of Agreements

Bi-lateral Agreements

NDT Society or Certification Body & date of information	Agreements with	Normative references
Australian Institute for Non-Destructive Testing National Certification Board January 2003	Unilateral decision to recognise PCN certification	EN 45013:1989 ISO 9712:1999
ABENDE – Brazilian Society of Non-Destructive Testing January 2003	Natural Resources, Canada (NR Can)	EN 45013:1989 ISO 9712:1999
Association of Personnel Certification (APC) Czech Republic	Sector Cert GmbH (Germany)	EN 473:2000 ISO 9712:1992 EN 45013:1989
JSNDI (The Japanese Society for Non-Destructive Inspection)	NR Canada	(1) NDIS 0601:2000 Qualification and Certification of NDT Personnel (2) NDIS J001:1999 NDT - Qualification and certification of personnel (3) JIS Z 2305:2001 NDT - qualification and certification of personnel

Note: please check the up to date status of the above Agreements directly with the Certifying Bodies.

Multi-lateral Agreements (MLA)

NDT Society/Certification Body (date of information)	Agreements between	Normative References
European Federation of NDT Mutual Recognition Agreement October 1994 – to date Contact: J R Thompson, EFNDT via BInstNDT	Around 30 NDT Societies in Europe and beyond recognise the Certification of circa 20 accredited Certification Bodies recognised by EFNDT. See Schedules 1 and 2 above and updated at www.efndt.org	EN 473 and ISO 9712
Asia Pacific Region Mutual Recognition Agreement in preparation 2003. Contact: D Barnett AINDT	Around 10 NDT Societies plan to recognise each others Certification	ISO 9712

6.10 European Pressure Equipment Directive

Introduction

The Pressure Equipment Directive - 97/23/EC - was formally adopted by the European Parliament and Council on 29th May 1997, and was published in the Official journal of the European Communities No. L181 of 9th July (ISBN 011 916 0927). It entered into force on 29th November 1999 and compliance with its requirements is mandatory since 29th May 2002.

The purpose of the directive is to harmonise national laws regarding design, manufacture and conformity assessment of pressure equipment and assemblies (vessels, storage containers, heat exchangers, shell and water tube boilers, industrial pipe work, safety devices and pressure accessories) subject to an internal pressure greater than 0.5 bar above atmospheric.

Equipment is categorised within four levels (I to IV) according to degree of hazard: category III and IV equipment will require conformity assessment by 'notified bodies' and 'recognised third party organisations'.

Non-destructive Testing

For pressure equipment, non-destructive tests of permanent joints must be carried out by 'suitably qualified personnel'. For pressure equipment in categories III and IV, NDT personnel must be approved by a 'Third Party Organisation' recognized by a member state pursuant to Article 13.

Certificates of competence in compliance with EN 473 and covering the testing of permanent joints (in effect, welds) are presumed to satisfy the requirements of the directive *because EN 473 is a harmonised standard.* But, there are alternative acceptable methods of fulfilling the requirements, as detailed in the Guideline 6/13 and the CEN document referred to below.

References

97/23/EC: The Pressure Equipment Directive

WPG6/13 Guideline for RTPO approving NDT personnel - final version adopted 2004-03-17

CEN/TR 15589 (October2006) Non-Destructive Testing - Code of practice for the approval of NDT personnel by Recognised Third Party Organisations under the provisions of Directive 97/23/EC

Documents are available at www.efndt.org under the section "Pressure Equipment".

6.11 European Aviation Safety Agency (EASA)

Introduction

European standard EN 4179:2005 (Aerospace series; Qualification and approval of personnel - non-destructive testing) defines, at clause 3.17, a National Aerospace NDT Board (NANDTB) as an "an independent national aerospace organization representing a nation's aerospace industry that is chartered by the participating prime

contractors and recognized by the nation's regulatory agencies to provide or support NDT qualification and examination services in accordance with this standard*".*

The responsibilities of such a Board are briefly described in the standard as follows:

- … may include participation in certification (3.17)
- When used, the NANDTB shall administer procedures for qualification and certification of NDT personnel according to the requirements of this standard. It is entitled, in conjunction with the employer, to recognize equivalencies of qualification and certification, and may be requested to provide general guidelines in accordance with this standard regarding facilities for NDT training, course outlines, examination questions and exam procedures. For countries where no NANDTB exists, the employer may use the services of other NANDTBs (4.5.2)
- … training shall be conducted in accordance with a detailed course outline approved by the responsible Level 3 or NANDTB (6.1.1)

There are further references, throughout the standard (as above), to the activities of the Responsible Level 3 or the NANDTB.

6.12 Forum for National Aerospace NDT Boards

A proposal to establish a Forum for NANDTBs was presented and agreed at the 9th European Conference on NDT, Berlin, in September 2006. The aims and objectives, constitution and method of working of the Aerospace NDT Board Forum which is supported by the European Federation of NDT are set out in Appendix 6 along with the Forum's current action plan.

The Forum has its own web pages at (www.efndt.org).

7. TRAINING SYLLABUSES/GUIDELINES

7.1. Introduction

There has been a progressive development of training guidelines/syllabuses which attempt to define the body of knowledge and recommended training hours needed by NDT personnel. The earliest versions were produced by ASNT (1966) and the ICNDT (1985). Later training guidelines were produced by the IAEA (1986, updated 2002) and more recently, a joint working group of CEN TC 138/AHG8 and ISO TC135/WG2 has produced document CEN TR 25107 Guidelines for Training Syllabuses and ASNT has published ASNT CP-105-2006 ASNT Standard Training Outlines for Qualification of Nondestructive Testing Personnel.

In addition CEN has produced TR 25108 "Guidelines for NDT personnel training organizations" which sets out the criteria to be met by training organisations and will facilitate assessment and approval of such organisations by certification bodies.

Further information on the content of these documents is given below.

(i) ISO/TR 25107
"Non-destructive testing - Guidelines for NDT training syllabuses".

This document covers the following NDT methods at Levels 1, 2 and 3:-

- Eddy current testing - ET
- Magnetic testing - MT
- Penetrant testing - -PT
- Radiographic testing - RT
- Ultrasonic testing - UT

(ii) ASNT CP-105-2006
"Standard Training Outlines for Qualification of Nondestructive Testing Personnel".

This document takes the NDT Method Training Outlines (Bodies of Knowledge) that historically have been appended to both *ASNT Recommended Practice No. SNT-TC-1A* and *ANSI/ ASNT CP-189* and creates a separate proposed American National Standard.

The committees of the Technical and Education Council of ASNT have the responsibility to review comments on and objections to this proposed American national Standard and to submit the draft standard and responses to the Standards Development Committee (SDC). The CP-105 Review Subcommittee, a subcommittee of the SDC, has the responsibility to develop the training outlines for public comment using SDC procedures.

Advice on updates will be posted on the ASNT website (www.asnt.org / publications/standards).

7.2 Normative status of Guidelines on Training Syllabuses

As a result of the standards defining Training Syllabuses being published out of synchronisation with the standards for certification of personnel there is a discrepancy between "normative status" and best practice. Many European Certification Bodies are therefore working on the basis of TR 25107 whilst also covering the lesser requirements of the IAEA Training Guidelines of 2002.

The formal "normative status" as follows:

ISO 9712 (2005) references only the IAEA Training Guidelines of 2002. (It was published before TR 25107 was agreed.)

EN 473: revised version in preparation in 2008 references both TR 25107 and TR 25108 may include some further commentary on the minimum (versus recommended) training hours.

CP 105-2006 is referenced in ASNT documents including SNT-TC-1A (2006), CP106-2007 and CP189 (2006).

7.3 IAEA TECDOC-628 (2002)

The International Atomic Energy Agency (IAEA) has been actively involved in developing training materials for some considerable time. These serve as guides to the IAEA experts involved in training programmes to achieve a uniform level of training materials and competence of personnel.

This process was initiated in the late 1970s with the compilation of syllabuses for the more common NDT methods prepared by a Working Group under a project in the Latin American and Caribbean Region. Later, these syllabuses were also accepted for use in the Asia and Pacific Region.

Recognizing their need and usefulness, an IAEA consultants meeting in May 1986 recommended that the IAEA publish these guidelines. Consequently, they were first issued as IAEA-TECDOC-407, Training Guidelines in Non-Destructive Testing, in1987.

A revised and enlarged version was issued as IAEA-TECDOC-628 in 1991, both in Spanish and English. This latter version included the development work carried out by the International Committee for Non Destructive Testing (ICNDT) and many national NDT societies. It has been one of the documents referred to in ISO Standard 9712, which is an internationally accepted standard for the qualification and certification of NDT personnel. To date, this publication has been used by many countries supported by the IAEA in formulating their national NDT training programmes. The industrial sectors benefiting from these programmes include steel making, power generation, oil and gas, aviation, chemical, petrochemical and many others.

Since the publication of IAEA-TECDOC-628 in 1991, NDT and product technology has undergone numerous changes. Advancements in materials science have lead to changes in the applicable NDT codes, standards and specifications. In addition, new NDT techniques and equipment have been developed which are widely accepted by the engineering community. To accommodate the latest developments, a revision of the 1991 version of IAEA-TECDOC-628 was considered essential to meet the demands of end-user industries. Modifications were made during an Advisory Group Meeting, held in Vienna from 25-29 June 2001, and the present publication, revision 1 dated 2002, is an updated version of IAEA-TECDOC-628. The details of the topics on each subject have been expanded to include the latest developments in the technology of NDT and materials.

This publication, like the previous version, will continue to play an important role in international harmonization in the field of NDT, and the incorporated changes will help end-user industries to update their NDT qualification and certification schemes and training course materials.

Reference:

IAEA-TECDOC-628 Revision 1 (2002 edition): Training Guidelines in Non-destructive Testing Techniques. International Atomic Energy Agency, Wagrammerstrasse5, P.O. Box 100, A-1400 Vienna, Austria, telephone +43-1-20601, telex 112645 Atom A, Facsimile +43-1-20607, e-mail IAEO@IAEA1.IAEA.OR.AT

7.4 Question Banks

7.4.1 Introduction

Banks of questions are available from several sources, for use either by students, trainers, or examiners. Questions may be classified by NDT method, by level (1, 2, or 3) and sector. They may be validated or not.

Users should check if the questions being used are designed to match the requirements of a particular training or examination syllabus and should select questions accordingly.

7.4.2 ASNT Specimen questions

ASNT publish Question and Answer (Q&A) Books as supplements to SNT-TC-1A. The books are available for each test method and provide specimen questions and answers for Levels 1, 2 and 3.

7.4.3 EFNDT Question Bank

BINDT, DGZfP and COFREND, have developed a confidential question bank, containing around 4000 questions (3 levels, 5 methods). This is used by the Certification bodies of BINDT, DGZfP and COFREND and by several other Certification Bodies which participate in the EFNDT MRA (see Section 6.9.3). It is being made available to other Certification Bodies which are preparing to join the MRA.

7.4.4 Others

The German Society for NDT (DGZfP e.V.) manages a Certification Body for Personnel Certification (DPZ), accredited in line with EN ISO/IEC 17024 and notified by Zentralstelle der Länder für Sicherheitstechnik (Central Authority of the Federal State for Safety, ZLS) within the Bavarian State Ministry for Environment, Health and Consumer Protection. DPZ maintains a database of general, specific and practical examination questions for each NDT method and each level. The database is updated and reviewed regularly by technical committees which have been established for this purpose. Members of these technical committees are experienced NDT experts from industry, science and research. Use of this database is only possible for qualification centres which are recognised and surveyed by DPZ.

7.5 Leonardo Project

The European Programme of Training for the Qualification of Non-Destructive Testing Personnel is one of the projects of the Leonardo Da Vinci programme of the European Union in the field of professional training.

The Promoter of the project is the National Centre of Vocational Training Cartagena (CNFPO, Murcia, Spain). Participating partners are the Spanish Society for Non-destructive Testing (AEND, Madrid), the German Society for Non-destructive Testing (DGZfP, Berlin), the British Institute of Non-destructive Testing (BINDT, Northampton) and the French Society for Non-destructive Testing (COFREND, Paris).

The project, which commenced in 2005 with the objective of developing comprehensive training materials for students and trainers, published in English, Spanish, German and French, has produced a series of training handbooks in these languages at levels 1, 2 and 3 in five NDT methods: Penetrant Testing, Magnetic Particle Testing, Eddy Current Testing, Ultrasonic Testing and Radiographic Testing.

The teacher's guide provided separately is designed to assist the teacher in the performance of theoretical and practical training sessions as well as in the performance of evaluations.

The intention is to provide a common document for education and study, reinforcing the harmonisation obtained through the certification standards ISO 9712 and EN 473.

Further details of the availability of the Handbooks will be announced soon via the EFNDT and individual societies' websites and other media.

7.6 Need for integration of training guidelines, standards, training materials and question banks

There is arguably a need for more complete integration of the NDT quality chain in this area by better linking of the necessary body of knowledge and practical skills (ie the training syllabus) to the training materials (notes, reference books, hand-outs, sample questions) to the examinations (questions, practical samples). Employers must be able to understand the content of courses and examinations in order that they can decide if the company's specific needs are covered and decide if additional job specific training is necessary.

8. INSPECTION QUALIFICATION

The process of Inspection Qualification, also referred to as Validation or Performance Demonstration was first developed as a result of the need to assure the quality of inspections of nuclear power plant by a systematic programme of analysis and trials. The process covers the whole inspection activity including the procedure, equipment and personnel. Hence it is quite distinct from the personnel qualification referred to in Section 6.1.

8.1 History

Processes have been developed in the USA through ASME and others, and in Europe through ENIQ and CEN. An ISO standard is in preparation.

8.2 ENIQ (European Network for Inspection Qualification)

In the countries of Europe a network of the nuclear electricity utilities and inspection companies known as ENIQ, (the "European Network for Inspection Qualification") have co-operated to draw up a document which deals with the objectives and role of inspection qualification. This includes the principles for the derivation of basic qualification requirements and how to organise the process. (Reference http://safelife.jrc.nl/eniq/publications/meth.php for different language versions). Many utilities and regulators in Europe are utilising the ENIQ guidelines (eg France has embodied the ENIQ methodology in the 1997 edition of the RSE-M code, Belgium has recognised it as an acceptable alternative to other rules).

In addition to the guidelines, ENIQ also publishes a number of supporting recommended practice documents on various aspect of the qualification process eg Influential/Essential Parameters; Recommended Contents for a Technical Justification; Strategy Document for a Technical Justification. See http://safelife.jrc.nl/eniq/publications/rec_prac.php.

8.3 ASME X1 Appendix 8 - Performance Demonstration Initiative

In the USA, following analysis of the results of the PISC II round-robin trials, the ASME Section XI committee adopted the principles of performance demonstration and introduced Appendix 8 to Section XI of the ASME code to define how performance demonstration trials should be conducted. Performance demonstrations to these code requirements are now being implemented through the Performance Demonstration Initiative (PDI) managed by the Electrical Power Research Institute (EPRI).

8.4 ASME Section V

ASME V includes non-destructive examination methods that are applicable to most component geometries and materials that are encountered in fabrication under normal conditions. Where conditions dictate that modifications are required to the standard methods and techniques special procedures are to be produced. These special procedures are required to be proved by demonstration.

Article 14 of ASME V gives the provisions for qualifying non-destructive examination (NDE) systems which are mandatory when specifically invoked by the referencing Code Section. The qualification process uses three levels of rigour involving the use of a technical justification and when required blind or non-blind performance demonstration. A glossary of terms is also provided in the appendix.

8.5 CEN Technical Report TR 14748:2004

CEN Technical Committee TC 138 established a working group to draft a general standard for qualification of inspections. This has been published as PD CEN/TR14748:2004, Non-destructive testing – methodology for qualification of non -destructive tests. It was developed from the European Network for Inspection Qualification (ENIQ) version – which was specific to nuclear applications – to provide a more general methodology applicable to a wide range of industries.

8.6 NADCAP Aerospace NDT approvals

Many aerospace manufacturing companies use an international scheme known as NADCAP (see www.pri-network.org) in which the whole NDT process, including qualification of personnel, is audited and "accredited" under arrangements controlled and agreed by the major prime contractors (eg Boeing, Airbus, Rolls Royce, etc).

9. ACCREDITATION OF NDT ORGANISATIONS

9.1 Background

In a growing number of countries in Europe (including former Soviet Union countries such as Russia and Belorussia) NDT service company operations are being accredited by Accreditation Bodies such as the United Kingdom Accreditation Service (UKAS). For critical inspections of nuclear power plant in Sweden such accreditation by Swedish Board for Accreditation and Conformity Assessment (SWEDAC) is mandatory. Initially such accreditation referenced the European Standard EN 45001 “General criteria for the operation of testing laboratories” but this is now superseded by the ISO/IEC Standard 17025 “General requirements for the competence of testing and calibration laboratories”. When the NDT company’s operations extend to those of an Inspection Body (see below) the reference standard is EN 45004 “General criteria for the operation of various types of bodies performing inspection”, now superseded by ISO Standard 17020. UKAS has published guidelines for accreditation of NDT operations to each of these standards in the form of a document entitled “RG07: Accreditation for Inspection Bodies Performing Non-destructive Testing” (10). These guidelines explain the UKAS view of the difference between NDT Laboratory Accreditation and Inspection Body Accreditation, the latter including “determination of significance of defects found, based on test results”.

Accreditation assessments are much more comprehensive and searching than a ‘quality systems’ audit to ISO 9001 with greater emphasis on the inherent technical capability of the organisation.

9.2 Laboratories

A distinct way to prove the competence of a laboratory to perform testing and/or calibration procedures according to referenced European and/or International standards or defined working procedures is accreditation of the laboratory according to EN ISO/IEC 17025 “General requirements for the competence of testing and calibration laboratories”. This international standard describes the requirements for accreditation which are to be fulfilled by a laboratory.

The development from the European Standard EN 45001 “General criteria for the operation of testing laboratories” to the International Standard in 1999 reflects the worldwide interest in a common competence level of laboratories which supports the global market interests.

The standard was drafted by ISO/CASCO “Committee on Conformity Assessment” and CEN/CENELEC TC1 “Criteria for Conformity Assessment Bodies”. The benefit of this cooperation is that the standard covers also requirements from ISO 9001 ”Quality management systems; Requirements”. The implementation of a surveyed quality management system is nowadays essential for a competent laboratory. So, if laboratories comply with the requirements of ISO/IEC 17025, “they will operate a quality management system for their testing and calibration activities that also meets the principles of ISO 9001” (ISO/IEC 17026, chapter. 1.6).

As the scope of laboratories is quite broad and test specific details cannot be covered by the standard which states requirement in a more general sense, accreditation bodies sometimes provide additional guidance, e.g., DAP (German

Accreditation System for Testing) provides a guide summarising the “Technical accreditation criteria for NDT”.

At the European level exists an organisation named “EUROLAB aisbl” which was created in Brussels on April 27, 1990 on the basis of a memorandum of understanding, signed by delegations representing the private and public laboratories of 17 out of the 19 countries of the EEC and EFTA.

EUROLAB is since October 1998 a legal entity setting it as the European Federation of National Associations of Measurement, Testing and Analytical Laboratories.

The European Federation for NDT (EFNDT) is member (International Affiliate) of EUROLAB since 2002. Other members are national EUROLAB associations and international organisations.

EUROLAB supports its member´ interests - interfacing with accreditors - and helps them in technical, regulatory and quality management matters, aiming at simplification and international harmonisation of regulations concerning competence and performance of laboratories. For more information refer to www.eurolab.org.

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9.3 Inspection Bodies

Requirements for inspection bodies are laid down in the international standard ISO/IEC 17020 “General criteria for the operation of various types of bodies performing inspection”. In 1998, this standard replaced ISO/IEC Guide 39 “General requirements for the acceptance of inspection bodies” and five years later the European standard EN 45004 without any alteration. It was drafted by ISO/CASCO “Committee on Conformity Assessment” and taken over by CEN/CENELEC TC1 “Criteria for Conformity Assessment Bodies” as a European standard. It takes into account requirements and recommendations of the ISO 9000 series of standards and ISO/IEC Guide 39.

The IAF/ILAC A4:2004 Guide titled “Guidance on the application of ISO/IEC 17020” supports the implementation of the standard through further explanations.

The Guide describes three different categories of inspection bodies which reflect the level of their independence. Whereas type A and B inspection bodies perform testing as “third party” separated from design, manufacture, supply, installing, purchasing, ownership, usage or maintenance, a type C inspection body may be involved in design, manufacture, supply, installing, purchasing, ownership, usage or maintenance.

By this means the Guide supports the requirement of the European pressure equipment directive (see chapter 11.3.1 of the standard).

The non-profit organisation “CEOC International” represents independent inspection and certification organisations in 20 countries. CEOC promotes safety, quality and the environment through independent inspection and certification. CEOC contributes to better regulation through participation in the work of EU institutions and bodies such as EA and EUROLAB. Further it contributes to the standardisation work of CEN, ISO and ISO-CASCO - the ISO policy development committee on conformity assessment.

CEOC International has 31 members from 20 countries which are accredited by public authorities to provide inspection and other conformity assessment services for a large variety of equipment. See also www.ceoc.org.

A representative from EFNDT is member of the Joint Technical Committee (of CEOC and EUROLAB) on Product Testing and Certification.

10. HUMAN FACTORS

Human factors is the study of how humans behave physically and psychologically in relation to particular situations. There are three main factors which influence behaviour at work: the job or task; the organisation; the individual.

The ‘job’ covers the nature of the work including the physical characteristics, the workplace and working environment. The individual includes personal attitude, skills, habits and personalities. The organisation includes such things as planning, safety, communication, management and culture (see Section 11).

These “human factors” which influence the reliability of implementation of NDT may in some instances be the weakest link in the NDT quality chain and the NDT quality infrastructure is least developed in this regard.

Attention is required to human motivation to achieve quality. In fact the motivation and commitment to quality of NDT personnel is of prime importance in the quest for total quality in NDT operations. It is most unlikely that quality can be achieved by quality system certification, standards and validation unless the individuals executing NDT are properly motivated.

It should be noted that research has shown that the factors which motivate staff are different to those that provide de-motivation. So it is necessary to take steps to avoid de-motivating staff as well as implementing actions to provide motivation.

In some organisations the NDT staff are salaried, work regular hours and are included with other staff in personnel training schemes, staff development schemes, quality circles etc., i.e. they are fully integrated, have the means of achieving a satisfying and worthwhile career and can call upon technical and managerial support. In contrast, in other cases NDT is carried out by agency staff or by temporary personnel, often self-employed. In many cases payment is by the hour or even by the metre of weld tested. Extended shifts and long periods without a day off are common. There are no paid holidays, no sick-leave and no technical or safety support by the employer. This situation has probably arisen because of the portability of personal NDT certificates on the one hand and commercial pressures on the other. It is not conducive to high quality.

The effect of human factors on ultrasonic testing has been researched in the course of the PISC II and III programmes and more recently in Sweden. The PISC project illustrated how an operator’s performance can vary over the duration of a day. It also showed how poor scanning technique can be improved by targeted training.

The problem with human factors is that what would appear to be a logical cause and effect is often turned on its head. Enkvist et al attempt to explain some of the results

obtained by reference to a model of human performance in which "the attention ability of a person is determined by his or her level of arousal". "The arousal level also determines the amount of attention resources that are available." In practical terms, this means that stress and pressure may initially lead to improved performance, but after a time this effect reverses. Boredom equates to lack of arousal and can have a very negative impact on performance.

The UK's PANI (**P**rogramme for the **A**ssessment for **N**DT in **I**ndustry) projects have shown the variability in performance between ultrasonic operators of similar experience and qualification. PANI 2 showed that improvements in reliability can be obtained by the use of targeted procedures, job specific training and independent repeat inspections. PANI 3 which is due to be published has found a correlation between good ultrasonic performance and operators with good mechanical comprehension. There is also a correlation between good ultrasonic performance and operators with an average level of cautiousness and lower levels of original thinking. This project has also highlighted the importance of ensuring that the inspection procedure is written in a way that assists the operator in the task and that the operator follows the procedure.

There is a need for a code of practice on employment conditions for NDT staff. It is necessary to set down guidelines based on research as to what are appropriate employment conditions and working arrangements (time, pressure, noise, and environment) for personnel engaged on quality critical activities.

11. OVERALL MANAGEMENT OF NDT TO ACHIEVE QUALITY

11.1 Overall Management

It is clear from the results of various round-robin exercises and trials that there is often an over-reliance on use of standards and personnel certification as a guarantee of quality in NDT. All too often purchasers and suppliers of NDT services may fail to recognise when they are moving outside the normal scope of standard inspections, training and certification. More emphasis should be placed on the use of all relevant elements of the NDT quality infrastructure.

Contractual arrangements should be clear in the definition of who takes responsibilities. Users should think in terms of employing an accredited service company capable of accepting technical responsibilities and providing back-up rather than employing operators as individuals. Either the purchaser of the service retains the key responsibility and simply 'hires a pair of hands' to operate under the purchaser's quality system or the purchaser buys a service and specifies clearly his requirements. The supplier of the service may then have to qualify his offer if the demands are more onerous than he can guarantee. The time allowed for preparation and then for execution of an inspection is crucial. Sufficient time must be allowed for both and the contractual arrangements must allow the inspection company to recover its costs.

Further guidance is given in the guidebook "Non-destructive Testing: A Guidebook for Industrial Management and Quality Control Personnel" published by the IAEA in 1999 and in the HSE Guideline Documents (see below).

11.2 Guidance on best practice

In Section 4 the various elements of the quality infrastructure have been summarised. The question arises "Which elements of the infrastructure should be used when?" Or "What constitutes Best Practice?". In the UK, the Health and Safety Executive, through a joint HSE-Industry Working Group has developed a number of documents entitled "Best Practice for the Procurement and Conduct of Non-destructive-Testing". The documents covering the use of manual ultrasonics and surface techniques - MPI and dye penetrant - are available to the public via the UK HSE web-site (http://www.hse.gov.uk/comah/sragtech/ndt1.pdf & ndt2.pdf). Other documents covering radiography and ultrasonic sizing and engineering critical assessment have been produced and will be published progressively.

The publication of the first guideline was a follow-up to the PANI project which was designed to investigate the reliability of manual ultrasonics for in-service inspection on component geometries relevant to pipework, oil, gas and petrochemical plant. The conclusions are more widely relevant. The results were disappointing with detection rates varying between 26% and 98%. Some operators achieved 75% detection, the worst achieved only 35%. The PANI project was carried out to current practice in manual ultrasonics in the UK, ie relevant standards were employed, procedures were written and approved by a Level 3 and operators certificated to EN 473 were used. But this was not sufficient. It is clear that the "general" procedures were inappropriate and the operators were not adequately trained on the specific geometries or types of defect. These problems were considered faults in the way inspection is normally managed rather than solely the fault of the operators and could be equally applicable to other methods as well as ultrasonics.

The more recent PANI 3 project has highlighted the need to ensure that the procedure is written appropriately to assist the operator and that the inspection is planned and managed in a way that the operator is able to concentrate on the inspection task. NDT vendors identified the biggest risk to the quality of an inspection as the lack of information from the plant owner.

The UK HSE Guideline document has many recommendations including:-

- Use an organisation accredited for NDT operations with necessary technical management, ie don't hire a man, hire a competent organisation
- Define the purpose of inspection and the various responsibilities for the involved organisations clearly
- Use relevant standards
- Prepare specific procedures - specific to the material and geometry
- Carry out capability trials when necessary - if outside previous experience
- Use certificated operators,
- Carry out job specific training - when inspection is not within scope of standard certification examinations
- Carry out inspection qualification if the risks are high
- Carry out Audit and Surveillance of site operations to ensure operator performance

The Best Practice guidelines recommend the use of all of the infrastructure with increased emphasis on job specific procedures, job specific training and technical management of the inspection wherever high quality inspection is needed. However, the guidelines recognise that not all inspections justify the use of all the measures and guidance is given on how to select appropriate ones.

The UK Health and Safety Executive also provides guidance on NDT and the NDT process for its COMAH (Control of Major Hazards regulations) inspectors for when NDT is used in support of continued safe operation of plant. (http://www.hse.gov.uk/comah/sragtech/techmeasndt.htm). This website contains useful background information that will assist engineers who are not NDT specialists in the management of NDT and the use of NDT results.

12 EXEMPLARS OF GOOD PRACTICE

Several NDT experts from European industry have been invited to present some aspects of their strategy for good practice of NDT in their specific technical fields. These experts are encouraged to reference Sections 1 to 11 to these Guidelines in order to demonstrate the extent to which use is made of the various elements of the NDT Quality Infrastructure. These contributions will be published in Appendix 7. Contributions are welcome and should be sent to EFNDT.

APPENDIX 1 - EFNDT AND ICNDT

A1.1 European Federation for NDT (EFNDT)

To increase their influence at the European level where, increasingly, decisions are taken, the national NDT Societies have combined to form the European Federation for NDT (EFNDT). EFNDT is a non-profit legal entity registered in Brussels. National NDT Societies within the United Nations definition of Europe are eligible for membership. Each is represented on the General Assembly which elects a President and Board of Directors. A Secretariat is provided by one of the member national societies, currently the British Institute of NDT (BINDT). EFNDT has established a series of working groups covering topics such as

Qualification and Certification Forum

European Certification

NDT for Public Security and Safety

Forum for National Aerospace NDT Boards

These groups seek to support and complement (rather than compete with) the European committees/working groups of EA (European co-operation for Accreditation), CEN, etc. and support national societies in their work at local level. Details and news of the EFNDT can be found on its website (www.efndt.org).

A1.2 International Committee for NDT (ICNDT)

At international level, the ICNDT has revised its constitution with a view to improving its influence and effectiveness. The International Committee for NDT was formed in 1960. For most of its existence ICNDT's main role was to organise the World Conference. Since the mid 90s the more active members of ICNDT have been seeking to strengthen the organisation and make it more active. This culminated in the adoption of a new constitution at the ICNDT meeting in Rome by the member national NDT Societies (currently 50+). The national societies each nominate two representatives to the ICNDT Committee. The committee then elects a chairman, general secretary and a treasurer each for four years. It also elects Honorary Members. These people along with nominees by each of the regional groups (Europe, Asia-Pacific, Americas) form the Policy and General Purposes Committee. A secretarial service is provided by an NDT Society (currently until September 2008 the Canadian Society). Separately, the ICNDT chooses the society to hold the next World Conference and that society nominates the World Conference President. The next World Conference will be held in Shanghai in 2008. Details and news of the ICNDT can be found on the ICNDT website (www.icndt.org).

APPENDIX 2 - EUROPEAN AND INTERNATIONAL NDT STANDARDS

Table App.2.1: General standards for different NDT methods

NDT method	General principles		Equipment, Materials		Others	
	EN	ISO	EN	ISO	EN	ISO
General					CEN/TS 15053 Non-destructive testing - Recommendations for discontinuities-types in test specimens for examination CEN/TR 14748 Non-destructive testing – Methodology for qualification of non-destructive testing	
ET	EN 12084 Non-destructive testing - Eddy current testing - General principles and basic guidelines	ISO/DIS 15549 Non-destructive testing - Eddy current examination - General principles	EN 13860-1 Non-destructive testing - Eddy current examination; Equipment characteristics and verification - Part 1: Instrument characteristics and verification EN 13860-2 Non-destructive testing - Eddy current examination; Equipment characteristics and verification - Part 2: Probe characteristics and verification	EN ISO 15548-1 Non destructive testing - Eddy current examination - Equipment characteristics and verification - Part 1: Instrument characteristics and verification EN ISO 15548-2 Non-destructive testing - Eddy current examination; Equipment characteristics and verification - Part 2: Probe characteristics and verification		

			EN 13860-3 Non-destructive testing - Eddy current examination - Equipment characteristics and verification - Part 3: System characteristics and verification	EN ISO 15548-3 Non-destructive testing - Eddy current examination - Equipment characteristics and verification - Part 3: System characteristics and verification		
MT	EN ISO 9934-1 Non-destructive testing - Magnetic particle testing - Part 1: General principles	ISO 17638 Non-destructive testing of welds - Magnetic particle testing	EN ISO 9934-3 Non-destructive testing - Magnetic particle testing - Part 3: Equipment EN ISO 9934-2 Non-destructive testing - Magnetic particle testing - Part 2: Detection media		EN ISO 3059 Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions	
PT	EN 571-1 Non-destructive testing - Penetrant testing - Part 1: General principles	EN ISO 3452-5 Non destructive testing - Penetrant testing - Part 5: Penetrant testing at temperatures higher than 50 °C EN ISO 3452-6 Non destructive testing - Penetrant testing - Part 6: Penetrant testing at temperatures lower than 10 °C		EN ISO 3452-2 Non-destructive testing - Penetrant testing - Part 2: Testing of penetrant materials EN ISO 3452-3 Non-destructive testing - Penetrant testing - Part 3: Reference test blocks EN ISO 3452-4 Non-destructive testing - Penetrant testing - Part 4: Equipment		EN ISO 3059 Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conditions

RT	EN 444 Non-destructive testing; general principles for the radiographic examination of metallic materials using X-rays and gamma-rays	ISO 5579 Non-destructive testing - Radiographic examination of metallic materials by X- and gamma-rays - Basic rules ISO 11537 Non-destructive testing - Thermal neutron radiographic testing - General principles and basic rules	EN 25580 Non-destructive testing; industrial radiographic illuminators; minimum requirements EN 12679 Non-destructive testing - Determination of the size of industrial radiographic sources - Radiographic method EN 13068-1 Non-destructive testing - Radioscopic testing - Part 1: Quantitative measurement of imaging properties EN 13068-2 Non-destructive testing - Radioscopic testing - Part 2: Check of long term stability of imaging devices EN 13068-3 Non-destructive testing - Radioscopic testing - Part 3: General principles for the radioscopic testing of metallic materials by X- and gamma rays	EN ISO 584-1 Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography EN ISO 584-2 Non-destructive testing - Industrial radiographic film - Part 2: Control of film processing by means of reference values ISO 11699-1 Non-destructive testing - Industrial radiographic films - Part 1: Classification of film systems for industrial radiography ISO 11699-2 Non-destructive testing - Industrial radiographic films - Part 2: Control of film processing by means of reference values	EN 462-1 Non-destructive testing; image quality of radiographs; part 1: image quality indicators (wire type); determination of image quality values EN 462-2 Non-destructive testing; image quality of radiographs; part 2: image quality indicators (step/hole type); determination of image quality value EN 462-3 Non-destructive testing - Image quality of radiogrammes - Part 3: Image quality classes for ferrous metals EN 462-4 Non-destructive testing - Image quality of radiographs - Part 4: Experimental evaluation of image quality values and image quality tables EN 462-5 Non-destructive testing - Image quality of radiographs - Part 5: Image quality of indicators (duplex wire type), determination of image unsharpness value	ISO 10675-1 Non-destructive testing of welds - Acceptance levels for radiographic testing - Part 1: Steel, nickel, titanium and their alloys ISO 19232-1 Non-destructive testing - Image quality of radiographs - Part 1: Image quality indicators (wire type) - Determination of image quality value ISO 19232-2 Non-destructive testing - Image quality of radiographs - Part 2: Image quality indicators (step/hole type) - Determination of image quality value ISO 19232-3 Non-destructive testing - Image quality of radiographs - Part 3: Image quality classes for ferrous metals ISO 19232-4 Non-destructive testing - Image quality of radiographs - Part 4: Experimental evaluation of image quality values and image quality tables

						ISO 19232-5 Non-destructive testing - Image quality of radiographs - Part 5: Image quality indicators (duplex wire type) - Determination of image unsharpness value
Neutron Radiography		ISO 11537 Non-destructive testing - Thermal neutron radiographic testing - General principles and basic rules		ISO 12721 Non-destructive testing - Thermal neutron radiographic testing - Determination of beam L/D ratio		
X-ray Diffraction			EN 13925-1 Non-destructive testing - X-ray diffraction from polycrystalline and amorphous material - Part 1: General principles			
Film Digitisation	EN 14096-1 Non-destructive testing - Qualification of radiographic film digitisation systems - Part 1: Definitions, quantitative measurements of image quality parameters, standard reference film and qualitative control		EN 14096-2 Non-destructive testing - Qualification of radiographic film digitisation systems - Part 2: Minimum requirements			

Digital Radiography	EN 14784-2 Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 2: General principles for testing of metallic materials using X-rays and gamma rays EN 13068-1 Non-destructive testing - Radioscopic testing - Part 1: Quantitative measurement of imaging properties EN 13068-3 Non-destructive testing - Radioscopic testing - Part 3: General principles for the radioscopic testing of metallic materials by X- and gamma rays		EN 14784-1 Non-destructive testing - Industrial computed radiography with storage phosphor imaging plates - Part 1: Classification of systems EN 13068-2 Non-destructive testing - Radioscopic testing - Part 2: Check of long term stability of imaging devices			
UT	EN 583-1 Non-destructive testing - Ultrasonic examination - Part 1: General principles EN 583-3 Non-destructive testing - Ultrasonic testing - Part 3: Transmission technique		EN 12223 Non-destructive testing - Ultrasonic examination – Specification for calibration block no 1 EN 12668-1 Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 1: Instruments	ISO 7963 Non-destructive testing - Ultrasonic testing - Specification for calibration block No. 2 ISO 12710 Non-destructive testing - Ultrasonic inspection - Evaluation electronic characteristics of ultrasonic test instruments	EN 583-2 Non-destructive testing - Ultrasonic examination - Part 2: Sensitivity and range setting EN 583-4 Non-destructive testing - Ultrasonic examination - Part 4: Examination for discontinuities perpendicular to the surface	

	EN 583-6 Non-destructive testing - Ultrasonic examination - Part 6: Time-of-flight diffraction technique as a method for detection and sizing of discontinuities		EN 12668-2 Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 2: Probes EN 12668-3 Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 3: Combined equipment	ISO 18175 Non-destructive testing - Evaluating performance characteristics of ultrasonic pulse-echo testing systems without the use of electronic measurement instruments	EN 583-5 Non-destructive testing - Ultrasonic examination - Part 5: Characterization and sizing of discontinuities	
Wall Thickness Measurement	EN 14127 Non-destructive testing - Ultrasonic thickness measurement		EN 15317 Non-destructive testing - Ultrasonic testing - Characterization and verification of ultrasonic thickness measuring equipment			
TOFD					EN 15617 Non-destructive testing of welds - Time-of-flight diffraction technique (TOFD) - Acceptance levels	
VT	EN 13018 Non-destructive testing - Visual testing - General principles		EN 13927 Non-destructive testing - Visual testing - Equipment			

Table App.2.2: NDT standards Casting Sector "c"

NDT method	General principles for casting		Discontinuities	Comparators
	EN	ISO		
General	EN 1559-1 Founding - Technical conditions of delivery - Part 1: General EN 1559-2 Founding - Technical conditions of delivery - Part 2: Additional requirements for steel castings EN 1559-3 Founding - Technical conditions of delivery - Part 3: Additional requirements for iron castings EN 1559-4 Founding - Technical conditions of delivery - Part 4: Additional requirements for aluminium alloy castings EN 1559-5 Founding - Technical conditions of delivery - Part 3: Additional requirements for magnesium alloy castings EN 1559-6 Founding - Technical conditions of delivery - Part 3: Additional requirements for zinc alloy castings			
ET				
MT	EN 1369 Founding - Magnetic particle inspection	ISO 4986 Steel castings; magnetic particle inspection		

PT	EN 1371-1 Founding - Liquid penetrant inspection - Part 1: Sand, gravity die and low pressure die castings EN 1371-2 Founding - Liquid penetrant inspection - Part 2: investment castings	ISO 9916 Aluminium alloy and magnesium alloy castings; liquid penetrant inspection		EN 1370 Founding - Surface roughness inspection by visualtactile comparators
RT	EN 12681 Founding - Radiographic examination	ISO 4993 Steel castings; Radiographic inspection		
UT	EN 12680-1 Founding - Ultrasonic examination - Part 1: Steel castings for general purposes EN 12680-2 Founding - Ultrasonic examination - Part 2: Steel castings for highly stressed components EN 12680-3 Founding - Ultrasonic examination - Part 3: Spheroidal graphite cast iron castings	ISO 4992-1 Steel castings - Ultrasonic examination - Part 1: Steel castings for general purposes ISO 4992-2 Steel castings - Ultrasonic examination - Part 2: Steel castings for highly stressed components		
VT			EN 12454 Founding - Visual examination of surface discontinuities - Steel sand castings	EN 1370 Founding - Surface roughness inspection by visual-tactile comparators BNIF 359 Caracterisation d'Ètats de surface des pièces moulées SCRATA Comparators for the surface definition of surface quality of steel castings

Table App.2.3: NDT standards Forging Sector "f"

NDT method	General principles for forging
ET	
MT	EN 10228-1 Non-destructive testing of steel forgings – Part 1: Magnetic particle inspection
PT	EN 10228-2 Non-destructive testing of steel forgings – Part 2: Penetrant testing
RT	
UT	EN 10228-3 Non-destructive testing of steel forgings – Part 3: Ultrasonic testing of ferritic or martensitic steel forgings EN 10228-4 Non-destructive testing of steel forgings – Part 4: Ultrasonic testing of austenitic and austenitic-ferritic stainless steel forgings
VT	

Table App.2.4: NDT standards Welding Products Sector "w"

NDT method	General principles for welds		Classification of imperfections	Acceptance levels	
	EN	ISO		EN	ISO
General	EN 12062 Non-destructive testing of welds - General rules for metallic materials		EN ISO 5817 Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections EN ISO 6520-1 Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding EN ISO 6520-2 Welding and allied processes - Classification of geometric imperfections in metallic materials – Part 2: Welding with pressure		
ET	EN 1711 Non-destructive examination of welds - Eddy current examination of welds by complex plane analysis	ISO 17643 Non-destructive testing of welds - Eddy current testing of welds by complex-plane analysis	-	-	-
MT	EN 1290 Non-destructive testing of welds - Magnetic particle testing of welds			EN 1291 Non-destructive testing of welds - Magnetic particle testing of welds - Acceptance levels	ISO 23278 Non-destructive testing of welds - Magnetic particle testing of welds - Acceptance levels
PT				EN 1289 Non-destructive testing of welds - Penetrant testing of welds - Acceptance levels	

RT	EN 1435 Non-destructive testing of welds - Radiographic testing of welded joints	ISO 17636 Non-destructive testing of welds - Radiographic testing of fusion-welded joints		EN 12517-1 Non-destructive testing of welds – Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography – Acceptance levels EN 12517-2 Non destructive testing of welds - Part 2: Evaluation of welded joints in aluminium and its alloys by radiography - Acceptance levels	
UT	EN 1714 Non-destructive testing of welds - Ultrasonic testing of welded joints EN 27963 Welds in steel; calibration block No. 2 for ultrasonic examination of welds EN ISO 22825 Non-destructive testing of welds - Ultrasonic testing - Testing of welds in austenitic steels and nickel-based alloys	ISO 17640 Non-destructive testing of welds - Ultrasonic testing of welded joints ISO 22825 Non-destructive testing of welds - Ultrasonic testing - Testing of welds in austenitic steels and nickel-based alloy		EN 1712 Non-destructive testing of welds - Ultrasonic testing of welded joints - Acceptance levels	ISO 23279 Non-destructive testing of welds - Ultrasonic testing - Characterization of indications in welds
TOFD	CEN/TS 14751 Welding - Use of time-of-flight diffraction technique (TOFD) for examination of welds				
VT	EN 970 Non-destructive examination of fusion welds - Visual examination	ISO 17637 Non-destructive testing of welds - Visual testing of fusion-welded joints			

Table App.2.5: NDT standards Tubes and Pipes Sector "t"

NDT method	General Principles for Tubes and Pipes	
	EN	ISO
General		
ET	EN1971 Copper and copper alloys - Eddy current test for tubes EN 10246-2 Non-destructive testing of steel tubes - Part 2: Automatic eddy current testing of seamless and welded (except submerged arc-welded) austenitic and ferritic-austenitic steel tubes for verification of hydraulic leak-tightness EN 10246-3 Non-destructive testing of steel tubes - Part 3: Automatic eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections	ISO 9304 Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes; eddy current testing for the detection of imperfections
MT	EN 10246-12 Non-destructive testing of steel tubes - Part 12: Magnetic particle inspection of seamless and welded ferromagnetic steel tubes for the detection of surface imperfections EN 10246-18 Non-destructive testing of steel tubes - Part 18: Magnetic particle inspection of the tube ends of seamless and welded ferromagnetic steel tubes for the detection of laminar imperfections ISO 13664 Seamless and welded steel tubes for pressure purposes - Magnetic particle inspection of the tube ends for the detection of laminar imperfections ISO 13665 Seamless and welded steel tubes for pressure purposes - Magnetic particle inspection of the tube body for the detection of surface imperfections	
PT	EN 10246-11 Non-destructive testing of steel tubes - Part 11: Liquid penetrant testing of seamless and welded steel tubes for the detection of surface imperfections	

RT	EN 10246-10 Non-destructive testing of steel tubes - Part 10: Radiographic testing of the weld seam of automatic fusion arc welded steel tubes for the detection of imperfections	ISO 12096 Submerged arc-welded steel tubes for pressure purposes - Radiographic testing of the weld seam for the detection of imperfections
UT	EN 10246-6 Non-destructive testing of steel tubes - Part 6: Automatic full peripheral ultrasonic testing of seamless steel tubes for the detection of transverse imperfections EN 10246-7 Non-destructive testing of steel tubes - Part 7: Automatic full peripheral ultrasonic testing of seamless and welded (except submerged arc welded) tubes for the detection of longitudinal imperfections EN 10246-8 Non-destructive testing of steel tubes - Part 8: Automatic ultrasonic testing of the weld seam of electric welded steel tubes for the detection of longitudinal imperfections EN 10246-9 Non-destructive testing of steel tubes - Part 9: Automatic ultrasonic testing of the weld seam of submerged arc-welded steel tubes for the detection of longitudinal and/or transverse imperfections EN 10246-13 Non-destructive testing of steel tubes - Part 13: Automatic full peripheral ultrasonic thickness testing of seamless and welded (except submerged arc welded) steel tubes EN 10246-14 Non-destructive testing of steel tubes - Part 14: Automatic ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of laminar imperfections EN 10246-15 Non-destructive testing of steel tubes - Part 15: Automatic ultrasonic testing of strip/plate used in the manufacture of welded steel tubes for the detection of laminar imperfections	ISO 9303 Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes; full peripheral ultrasonic testing for the detection of longitudinal imperfections ISO 9305 Seamless steel tubes for pressure purposes; full peripheral ultrasonic testing for the detection of transverse imperfections ISO 9764 Electric resistance and induction welded steel tubes for pressure purposes; ultrasonic testing of the weld seam for the detection of longitudinal imperfections ISO 9765 Submerged arc-welded steel tubes for pressure purposes; ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections ISO 10124 Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes - Ultrasonic testing for the detection of laminar imperfections ISO 10332 Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes; ultrasonic testing for verification of hydraulic leak-tightness ISO 10375 Non-destructive testing - Ultrasonic inspection - Characterization of search unit and sound field ISO 10543 Seamless and hot-stretch-reduced welded steel tubes for pressure purposes; full peripheral ultrasonic thickness testing

	EN 10246-16 Non-destructive testing of steel tubes - Part 16: Automatic ultrasonic testing of the area adjacent to the weld seam of welded steel tubes for the detection of laminar imperfections EN 10246-17 Non-destructive testing of steel tubes - Part 17: Ultrasonic testing of tube ends of seamless and welded steel tubes for the detection of laminar imperfections	ISO 11496 Seamless and welded steel tubes for pressure purposes; ultrasonic testing of tube ends for the detection of laminar imperfections ISO 12094 Welded steel tubes for pressure purposes - Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes ISO 13663 Welded steel tubes for pressure purposes - Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections
VT		

Table App.2.6: NDT standards Wrought Products Sector "wp"

NDT method	General Principles for Wrought Products		Acceptance Criteria, Tolerances	
	EN	ISO	EN	ISO
General				
ET				
MT				
PT				
RT				
UT	EN 10160 Ultrasonic testing of steel flat product of thickness equal to or greater than 6 mm (reflection method) EN 10306 Iron and steel - Ultrasonic testing of H beams with parallel flanges and IPE beams EN 10307 Non-destructive testing - Ultrasonic testing of austenitic and austenitic-ferritic stainless steels flat products of thickness equal to or greater than 6 mm (reflection method) EN 10308 Non-destructive testing - Ultrasonic testing of steel bars	ISO 17577 Steel - Ultrasonic testing for steel flat products of thickness equal to or greater than 6 mm		ISO 12715 Ultrasonic non-destructive testing - Reference blocks and test procedures for the characterization of contact search unit beam profiles

VT	EN 10163-1 Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 1: General requirements EN 10163-2 Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 2: Plate and wide flats EN 10163-3 Delivery requirements for surface condition of hot-rolled steel plates, wide flats and sections - Part 3: Sections		EN 10029 Hot rolled steel plates 3 mm thick or above; tolerances on dimensions, shape and mass	

App.2.7: NDT standards Metal Manufacturing Sector

See c, f, t, w, wp

App.2.8: Pre and in-service testing of equipment, plant and structure

See c, f, t, w, wp

App.2.9: Railway maintenance sector

See also f, t and wp.

NDT method	general application	
	EN	ISO
General	EN 15085 Railway applications - Welding of railway vehicles and components - Part 5: Inspection, testing and documentation	
ET		
MT		
PT		
RT		
UT	EN 12080 Railway applications - Axle boxes - Rolling bearings	ISO 5948 Railway rolling stock material - Ultrasonic acceptance testing
VT		

Table App.2.10: NDT standards Aerospace Sector

See also f, t and wp.

NDT method	general principles for Aerospace	weld	acceptance criteria
ET	EN 2002-20 Aerospace series - Test methods for metallic materials - Part 20: Eddy current testing of circular cross-section tubes		
MT			
PT	EN 2002-16 Aerospace series - Metallic materials; test methods - Part 16: Non-destructive testing, penetrant testing		
RT	EN 2002-21 Aerospace series - Metallic materials; test methods - Part 21: Radiographic testing of castings		
UT	EN 3718 Aerospace series - Test method for metallic materials - Ultrasonic inspection of tubes EN 4050-1 Aerospace series - Test method for metallic materials; ultrasonic inspection of bars, plates, forging stock and forgings - Part 1: General requirements EN 4050-2 Aerospace series - Test method for metallic materials; ultrasonic inspection of bars, plates, forging stock and forgings - Part 2: Performance of test	EN 4050-3 Aerospace series - Test method for metallic materials; ultrasonic inspection of bars, plates, forging stock and forgings - Part 3: Reference blocks	EN 4050-4 Aerospace series - Test method for metallic materials; ultrasonic inspection of bars, plates, forging stock and forgings - Part 4: Acceptance criteria
VT			

Table App.2.11: NDT standards Terminology

Standards which define the terms used in non-destructive testing within the different NDT methods or generally are also important:

NDT method	Terminology	
	EN	ISO
General	EN 1330-1 Non-destructive testing - Terminology - Part 1: List of general terms EN 1330-2 Non-destructive testing - Terminology - Part 2: Terms common to the non-destructive testing methods	ISO/TS 18173 Non-destructive testing - General terms and definitions
AE	EN 1330-9 Non-destructive testing - Terminology - Part 9: Terms used in acoustic emission testing	
ET	EN 1330-5 Non-destructive testing - Terminology - Part 5: Terms used in Eddy Current testing	EN ISO 12718 Non-destructive testing - Terminology - Terms used in eddy current testing
LT	EN 1330-8 Non-destructive testing - Terminology - Part 8: Terms used in leak tightness testing	
MT	EN 1330-7 Non-destructive testing - Terminology - Part 7: Terms used in magnetic particle testing	
PT		EN ISO 12706 Non-destructive testing - Terminology - Terms used in penetrant testing
RT *X-Ray diffraction*	EN 1330-3 Non-destructive testing - Terminology - Part 3: Terms used in industrial radiographic testing EN 1330-11 Non-destructive testing - X-ray diffraction from polycrystalline and amorphous materials - Part 11: Terminology	

UT	EN 1330-4 Non-destructive testing - Terminology - Part 4: Terms used in ultrasonic testing	ISO 5577 Non-destructive testing - Ultrasonic inspection - Vocabulary
VT	EN 1330-10 Non-destructive testing - Terminology - Part 10: Terms used in visual testing	EN ISO 8785 Geometrical Product Specifications (GPS) - Surface imperfections - Terms, definitions and parameters

More information about standards can be found on the webpages of the

- Committee for European Standardisation (CEN) for European standards www.cen.eu
- International Organisation for Standardisation (ISO) for International standards www.iso.org

or on the webpage of national standard organisations (especially those that are members of the above mentioned organisations).

APPENDIX 3 - PREPARATION OF EUROPEAN STANDARDS

(edited extract from part 2 of the CEN Regulations)

General

A European Standard (EN) is a normative document made available by CEN/CENELEC in the three official languages. The elaboration of a European Standard includes a public enquiry (six months), followed by an approval by weighted vote of CEN/CENELEC national members (two months) and final ratification. The European Standard is announced at national level, published or endorsed as an identical national standard and every conflicting national standard is withdrawn. The content of a European Standard does not conflict with the content of any other EN. A European Standard is periodically reviewed.

As the basis for the European Standard, it shall first be established whether

a) there is published international work in the field and that international work would be acceptable as a European Standard;

b) the work can be developed within the framework of the international agreements that CEN and CENELEC have with ISO and IEC respectively.

For case a) the „Questionnaire procedure" allows a published international document to be assessed for suitability for progressing to a formal vote as a European Standard.

For case b) the work may be offered to the international organizations for work to be carried out within the international organization with parallel approval conducted by the European organization under the terms of the Vienna Agreement (for CEN and ISO) or the Dresden agreement (for CENELEC and IEC).

A European Standard may result from the application of the ISO/CEN and IEC/CENELEC co-operation agreements, from the questionnaire procedure, from Technical Committee work or from a combination of these processes. Documents may also be processed under the Unique Acceptance Procedure.

Questionnaire procedure

The questionnaire procedure permits the Technical Board to find out,

- whether enough interest exists in harmonization on the subject proposed,
- the existing degree of national harmonization with the reference document in question, and
- whether that document would be acceptable as EN.

The questionnaire procedure serves the same purpose as the CEN/CENELEC enquiry.

The questionnaire procedure has two applications:

- for an entirely new reference document, using the Primary Questionnaire (PQ);
- for a revised reference document the previous edition of which has already been adopted as an EN, using the Updating Questionnaire (UQ).

A UQ is sent out automatically by the Central Secretariat where no Technical Committee is involved, whereas each PQ requires the authority of the Technical Board. A PQ may also be suggested to the Technical Committee where considered necessary for the progress of the Technical Committee's work. If the Technical Board decides to launch a PQ without a preceding formal proposal, the letter accompanying the PQ shall refer to the Technical Board decision.

Both PQ and UQ shall be circulated to members by the Central Secretariat with three months as a normal time limit for replies. Members shall include in their replies the fullest information relating to proposals for common modifications, special national conditions, requests for national deviations and so on. The results of the PQ/UQ, together with any comments received, shall be circulated by the Central Secretariat without delay.

Evaluation of the replies and comments to the PQ and UQ shall result in an appropriate decision, by the Technical Committee or the Technical Board.

Technical Committee procedure

Successive working drafts shall be circulated to the responsible technical body for comments. In CEN at least one working draft shall be circulated to the parent body for information but not for technical enquiry.

When consensus has been reached, the text agreed by the technical body is forwarded by the Technical Committee secretariat to the Central Secretariat, to be allocated a prEN number and distributed to the CEN/CENELEC national members for public comment. This procedure is called the "CEN/CENELEC enquiry". The period allowed for the CEN/CENELEC enquiry shall normally be six months.

The results of the CEN/CENELEC enquiry, together with any comments received, shall be circulated by the Technical Committee secretariat without delay. If the results show sufficient agreement, preferably unanimity, on the content of the draft, a final text shall be prepared by the Technical Committee secretariat for approval, subject to review by the Technical Committee of any technical comments received.

If the results of the CEN/CENELEC enquiry show that insufficient agreement has been reached, a second enquiry lasting normally two but a maximum of four months may be decided by the Technical Committee. Further enquiries shall not be allowed. The Technical Committee may also consider the possibility of publishing another CEN/CENELEC publication.

Approval

Approval of the final text of a prEN (abbreviated FprEN) shall be effected by a formal vote of members. The voting period shall be two months. A request for an extension of one month may be accepted during the two-month period.

The weighted voting procedure (as given in 6.1.4 and 6.2 of part 2 of the CEN regulations) shall be applied. All votes shall be unconditional. Editorial comments may however be made. All negative votes shall be accompanied by their justification.

The Central Secretariat shall prepare the voting report in consultation with the Technical Committee chairman and secretariat, if any, and circulate it to members for information and to the Technical Board for action.

If the voting result is positive and unless an appeal has been lodged, the Technical Board shall note the approval of the EN, note or establish a target date of availability (dav) and agree the dates for national implementation, i.e. date of announcement (doa) of the EN, date of publication (dop) of identical national standards or endorsements and date of withdrawal (dow) of conflicting national standards.

If the voting result is negative, the Technical Board shall decide what further action is to be taken and whether or not standstill should be released.

Before an EN can be made available, its definitive text shall have been checked in the official languages. No further alteration shall be possible except through the updating and amendment procedures.

Copies of the definitive texts in the official languages shall be circulated by the Central Secretariat.

Unique Acceptance Procedure

The Unique Acceptance Procedure (UAP) may be applied to any type of document, whatever its origin, in order to achieve rapid approval of an EN, if it is reasonable to suppose that the document is acceptable at European level. For a reference document, the UAP combines the questionnaire procedure and the formal vote. For a Technical Committee document, the UAP combines the CEN/CENELEC enquiry and the formal vote.

UAP is launched by the Central Secretariat after agreement of

the Technical Committee for a document related to an approved standards project, or

- the Technical Board in all other cases.

If, and only after agreement of the Technical Board or the Technical Committee responsible, the UAP is applied to a text available in only one of the official languages, the other two versions shall be available within a period of two months following the launch of the UAP, unless otherwise decided by the Technical Board.

The steps in the procedure are:

- submission of the document, by the Central Secretariat, to the CEN/CENELEC national members normally for a period of six months;
- voting by each member, before the end of the voting period, using the appropriate form provided by the Central Secretariat;
- preparation by the Central Secretariat of the voting report.

If the voting result is positive, the Central Secretariat shall inform Technical Board members by correspondence of the result and of proposed dates of availability and implementation, without circulating the texts. Acceptance of the result serves as the official ratification. Any editorial comments shall be examined by the Technical Committee or Reporting Secretariat, in order to prepare the final text of the EN for circulation on or before the due date of availability.

If the voting result is negative, the document shall be sent back to the Technical Committee responsible or to the Technical Board. With advice in the former case from the Technical Committee, the Technical Board shall decide what further action is to be taken and whether or not standstill should be released. After agreement of the Technical Board, the document may be submitted to a second UAP or to a formal vote.

A full set of CEN reference documents can be found by following the link:

http://www.cen.eu/boss/supporting/reference+documents/reference+documents.asp

APPENDIX 4 - prEN 473:2006

Notable content and features

The process of reviewing and revising EN 473 to a third edition is in progress and, at the time of writing, prEN 473:2000 revision, finalized during the CEN/TC 138 meeting held on 2006-07-03/04, has been circulated for a 5 months enquiry and voting.

Normative references include:

1. EN ISO/IEC 17024:2003, Conformity assessment – General requirements for bodies operating certification of persons.
2. CEN/TR 14748:2004, Non-destructive testing – methodology for qualification of non destructive tests
3. CEN/TS 15053:2006, Non-destructive testing – Recommendations for discontinuities-types in test specimens for examination
4. CEN/TR 00138123:2006, Non-destructive testing – Code of practice for the approval of NDT personnel by recognised third party organisations under the provisions of Directive 97/23/EC.
5. CEN ISO/TR 25107:2006, Non-destructive testing – Guidelines for NDT training syllabuses.
6. CEN ISO/TR 25108:2006, Non-destructive testing – Guidelines for NDT personnel training organisations.

Ref. [1] is now the internationally specified standard for personnel certification bodies, and is universally applied in accreditation systems operated by International Accreditation Forum (IAF) members.

Ref. [2] has been developed from the European Network for Inspection Qualification (ENIQ) version – which was specific to nuclear applications – to provide a more general methodology. The scope of the prEN 473 states: “The system described in this European Standard can also apply to other NDT methods provided a comprehensive scheme of certification exists and the method is covered by European, international or national, standards (see CEN/TR 14748 Table 1)”. This TR details how to go about qualifying personnel, procedures and equipment for critical applications of NDT, and the systems described within are in effect applying performance demonstration protocols (see previous ISO/TC137/SC7/WG7 work item). As a Technical Report (TR), this document provides guidelines and, even though it is a normative reference within prEN 473, the fact that it provides guidance allows some latitude. It is understood that this TR is referenced so that, in the event that a certification body uses the principles of EN 473 to qualify and certify personnel for the application of a non-standard method/technique, or for a new inspection technology, there is guidance on how to qualify the equipment and procedure prior to qualifying the personnel.

Ref. [3] was developed under both CEN and ISO to provide a specification for discontinuities-types in test specimens, thus providing a further means of harmonizing the qualification process.

Ref. [4] is included in recognition of the fact that the European Pressure Equipment Directive (97-23-EC) failed to provide detailed guidance on how Notified Bodies would go about 'approving' NDT personnel to carry out NDT of permanent joints (welds) in pressure equipment. The methodology contained within the referenced document recognises that assessment of personnel can take place within the workplace, and that approvals can be issued by a Notified Body on the strength of EN 473/ISO 9712 certificates of competence issued by other certification bodies. This system has been widely applied by, for example, the British Institute of NDT, which has arrangements with Canada and Australia under which NDT personnel holding certification issued by NRCan and AINDT are 'approved' by BINDT acting in its role as a Notified Body.

Ref. [5] provides detailed NDT training syllabuses, with recommended classroom training times. However, the sum of these times would result in a *significant* increase over and above the times presently stipulated in EN 473:2000 and ISO 9712:2005, so there has been some discussion about reducing these within the next version of the Standard.

Ref. [6] provides detailed guidelines for NDT personnel training organisations, including management, quality systems, student induction, facilities, equipment, specimens, technical library, staff qualifications and training, and training records. The draft standards states: "*If the training is realized by a training organisation, it is recommended that the NDT personnel training organisations follow the guidelines given in CEN ISO/TR 25108*". Some certification bodies, such as BINDT, have already put in place systems for assessing and accrediting training organisations against the criteria contained within this Technical Report.

APPENDIX 5 - COMPARISON EN 473 / ISO 9712

To be added to the document when EN 473 is issued.

APPENDIX 6 - FORUM FOR NATIONAL AEROSPACE NDT BOARDS

A6.1 Formation

A proposal to establish a Forum for NANDTBs was presented and agreed at the 9th European Conference on NDT, Berlin, in September 2006. The aims and objectives, constitution and method of working of the Aerospace NDT Board Forum which is supported by the European Federation of NDT are set out in this Appendix along with the forum's current action plan.

A6.2 Aims and Objectives of the ANDTBF

A6.2.1 The Aerospace NDT Board Forum (hereinafter referred to as 'the ANDTBF'), has the following aims and objectives in relation to EASA regulations (i.e., part 145 and part 21 etc.) and EN 4179:

- provide a forum for discussion of matters of common interest to all NANDTB;
- harmonisation of methodology for the control of aerospace NDT training and EN 4179 qualification examinations provided at the various national levels;
- provide formal representation of the common concerns of the ANDTBF members to EASA;
- act as an advisory body for new NANDTB implementing applicable regulations and standards;
- agree common specifications for outside agencies providing training and qualification examinations at the various national levels;
- agree and promote a common format for company written practices in conformance with EN 4179;
- provide a mechanism for interpretation in cases of dispute regarding the implementation of applicable regulations and standards.

2.2.2 The ANDTBF will seek multilateral recognition between its members, with organisations having similar aims, e.g., IAQG, and with any other pertinent body in order to benefit the Aerospace industry and to minimise duplication and multiple audit.

2.2.3 In order to obtain the widest possible representation, the ANDTBF encourages NANDTB or similar organisations outside of the European Union and Free Trade area to apply for membership or otherwise to seek involvement in it's activities.

2.2.4 Any organisation wishing to apply for membership of the ANDTBF, and to nominate a representative to attend meetings, is requested to contact the Secretary to the ANDTBF, c/o Certification Services, British Institute of NDT,

1 Spencer Parade, Northampton NN1 5AA, United Kingdom. Further information on membership is available upon request.

A6.3 Constitution

2.3.1 The ANDTBF is composed of the duly nominated representatives of the NANDTB member bodies. The bodies in current membership are listed in document reference ANDTB/02. Such other bodies as the ANDTBF may determine may be invited to join on terms which the ANDTBF shall prescribe.

2.3.2 Member organisations may at any time nominate alternates or change their representation by informing the Secretary of the ANDTBF in writing.

2.3.3 The ANDTBF shall elect a suitably qualified person as chairman. The Chairman shall take office for a term not exceeding two years and shall be eligible for re-election for one further term of office.

2.3.4 The ANDTBF shall elect a suitably qualified person as vice chairman. The Vice Chairman shall take office for a term not exceeding two years and shall be eligible for re-election for one further term of office.

2.3.5 The ANDTBF shall appoint a suitably qualified person as secretary. The Secretary shall take office for a term not exceeding two years and shall be eligible for re-appointment.

2.3.6 The ANDTBF shall have the power to co-opt individuals to attend meeting(s).

A6.4 Method of Working

2.4.1 The ANDTBF shall consider matters of policy at least one ordinary meeting per year which shall be convened on the authority of the Chairman by the Secretary with at least 30 days notice in writing.

2.4.2 Matters to be decided at a meeting should be supported by written documentation issued in advance of the meeting.

2.4.3 The quorum for a meeting shall be a minimum one third of the current voting members. In the event that a vote is necessary, representative members shall have one vote for each country represented on a National Board. Co-opted members shall not have a vote.

2.4.4 Approval of changes to the constitution, terms of reference and method of working, and invitations for other bodies to be represented on the ANDTBF shall be decided by a majority of not less than three fourths of those present at an ordinary meeting. Other matters shall be decided by a simple majority.

2.4.5 Any five voting members of the ANDTBF may request a special meeting at any time by written notification to the Secretary. Such notification must state clearly the purpose of the proposed meeting which must be convened to take place within 28 days of receipt of the notification.

2.4.6 The ANDTBF is empowered to set up working groups and committees, establish their terms of reference and set out the procedures whereby they report to the ANDTBF.

2.4.7 Neither the ANDTBF, its Chairman, individual members, the bodies they represent, nor any working party or sub-committee appointed by the ANDTBF shall carry any financial liability for any scheme operated for the ANDTBF, or be liable for any damages resulting, or claimed to have resulted, from decisions of personnel implementing the scheme, or for any consequential loss arising out of the operation of the scheme.

2.4.8 The ANDTBF shall publish an annual report covering its activities.

A6.5 Action Plan of the European Forum for National Aerospace NDT Boards

2.5.1 Introduction

The December 2006 Paris EF NANDTB meeting required the definition of an action plan, including methods of working, main objectives, qualification and certification process, planning and target dates. The following section summarises the proposals received by the Secretary, circulated to the Forum, and agreed at the 2nd meeting of the Forum in Istanbul on 29th June 2007.

2.5.2 Method of Working

From the EF NANDTB constitution clause 3.6: "The ANDTBF is empowered to set up working groups and committees, establish their terms of reference and set out the procedures whereby they report to the ANDTBF". It is proposed that, for each of the agreed action plan items, the Forum:

- determines the objective(s) and timescales for achievement,
- assigns responsibility to an individual convener who is empowered to set up a working group of experts (from within or from outside of the Forum) on the subject area, and
- reviews the report and recommendation(s) of the working group presented by the convener at an ordinary meeting.

2.5.3 Main Objectives (Agreed At 29th June 2007 Meeting In Istanbul)

EASA Regulations

Objectives:

- Establish EASA'a intentions and timescales for review and update of EASA AMC 145 (which refers to EN 4179:2000).
- Request that EASA harmonise or combine EASA Regulations parts 21 and 145.
- Offer to assist with or contribute to the work involved

Target date: 1st November 2007

Nadcap

Objectives:

- Review Nadcap activities and establish any crossover with NANDTB activities

- Establish lines of communication with Nadcap (whilst preserving the autonomy of Boards at the national level)

Target date: 1st November 2007

Harmonisation of operations of Forum members

Objectives:

- Draft ANDTBF policy document proposing harmonisation of the operations of the national Boards.
- Propose outside Agency audit criteria.
- Recommend policy on recognition of approvals issued under the control of other national Boards.

Target date: 1st November 2007

Interpretation of standards for qualification/certification of NDT personnel

Objectives:

- Provide a mechanism for interpretation of applicable qualification standards, e.g. EN 4179 and EN 473, for the aerospace sector.
- Make recommendations concerning experience – reductions in duration (EN 4179 Table 2 Note a). Survey each board concerning their understanding of this note.
- Make recommendations concerning practical examination content (initial and recertification)

Target date: 1st November 2007.

Conferences

Objectives:

- Offer to manage a half day aerospace NDT personnel qualification / certification session within the next European Conference on NDT
- Stage a one day ANDTBF workshop during 2008, open to any interested party. Topics to include
    - Guidance to employers of NDT personnel
    - Audit and control of qualification examinations (conducted by employers and outside agencies)
    - Acceptable alternatives to EN 4179 approval
    - Interpretation of regulations and AMC 21 and 145
    - Interpretation of standards (4179 and 473)

APPENDIX 7 - EXEMPLARS OF GOOD PRACTICE

Authors are invited to describe how NDT quality is controlled /achieved in their sector/company making reference to the sections of the EFNDT Guidelines document and using some or all of the following proforma headings

Industrial Sector:	Author:
Scope	General description of NDT activities covered
Achievement of Quality in NDT	General comments on how quality is achieved/controlled
NDT infrastructure (national/European/ international)	Explain geographical scope of the NDT work described
Standards	State which types (eg ISO, CEN, etc.) of standards are used. Are there gaps in the available standards?
Personnel Qualification and Certification	Please summarise what scheme(s) are used and mention any job specific training/ approval
Training Syllabi and Guidelines	Please indicate which scheme you use and mention any job specific training/ approval
Inspection Qualification	Are your NDT procedures, equipment, personnel subjected to Inspection Qualification/Performance Demonstration??
Accreditation of NDT Laboratories and Inspection Bodies	Do you use/ supply accredited NDT/ Inspection services?
Human Factors	Do you have any human factors controls to assist reliability?
Overall management to achieve quality	Who takes management responsibility for NDT Quality?