



**SRI LANKA ACCREDITATION BOARD**  
**for CONFORMITY ASSESSMENT**

**SPECIFIC CRITERIA FOR  
ACCREDITATION OF NONDESTRUCTIVE  
TESTING INSPECTION BODIES**

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| <b>SRI LANKA ACCREDITATION BOARD FOR CONFORMITY ASSESSMENT</b>             |                                  |                   |                              |                      |
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## ABBREVIATIONS

|      |   |   |
|------|---|---|
| APAC | : | Asia Pacific Accreditation Cooperation                  |
| ASTM | : | American Society for Testing and Materials              |
| IEC  | : | International Electro technical Committee               |
| ILAC | : | International Laboratory Accreditation Cooperation      |
| ISO  | : | International Organization for Standardization          |
| NDT  | : | Nondestructive Testing                                  |
| SLAB | : | Sri Lanka Accreditation Board for Conformity Assessment |

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## 1. Introduction

1.1 The Accreditation Scheme of the Sri Lanka Accreditation Board for Conformity Assessment (SLAB) for Non Destructive Inspection (NDT) is based on the requirements laid down in the international standard ISO/IEC 17020 – *Conformity assessment – Requirements for the operation of various types of bodies performing inspection*. This scheme covers a wide range of nondestructive testing and/or inspections performed in different fields in compliance with National and international Standards and the regulations stipulated by the regulatory authorities.

1.2 The requirements stipulated in ISO/IEC 17020 apply in general to bodies performing inspections in different fields. SLAB being the accreditation authority for Sri Lanka is responsible for providing accreditation services for inspection bodies in accordance with ISO/IEC 17020.

1.3 The Specific criteria and additional guidance are considered necessary to effectively operate an accreditation scheme for inspection bodies which tests to appropriate defined standards and procedures, interpretation of test results against the agreed acceptance standards/criteria and determination of conformity and determines of significance of defects found based on test results through following methods;

- (a) Radiographic testing
- (b) Ultrasonic testing
- (c) Magnetic particle testing
- (d) Liquid penetrant testing
- (e) Eddy current testing
- (f) Leak testing
- (g) Infrared testing
- (h) Visual testing
- (i) Acoustic emission testing
- (j) Concrete testing

1.4 This specific criteria document for NDT inspection (here after called as specific criteria) has been prepared by the Technical Advisory Committee on NDT Inspection and has been authorized for adoption by the Council of SLAB. The NDT Inspection bodies seeking accreditation are required to comply with all the requirements listed in ISO/IEC 17020. This document supplements ISO/IEC 17020 and provides guidance for accreditation of bodies performing NDT Inspection for both assessors and for inspection bodies preparing for accreditation.

1.5 This Specific Criteria document must be used in conjunction with ISO/IEC 17020 & ILAC P 15; Application of ISO/IEC 17020:2012 for the Accreditation of Inspection Bodies. It provides an interpretation of the latter document and describes specific requirements for those clauses of ISO/IEC 17020 which are general in nature. Corresponding reference to the Clauses in ISO/IEC 17020 is

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indicated in parenthesis in the text of the document. If any requirement in ISO/IEC 17020 is not described in this document that implies that requirement does not need further explanation. Wherever the word ‘standard’ is mentioned in the document, it implies ISO/IEC 17020.

1.6 This document should be read in conjunction with the Rules and Procedures of SLAB as applicable to inspection bodies. Further, the NDT inspection bodies shall comply with national, regional and local laws and regulations, as applicable. Further interpretation of clauses of standard whichever may be needed for statutory enforcement shall be legally accessible.

1.8 This document shall be periodically reviewed and updated based on the experience gained, developments in technology and changes in laws and regulations.

## 2 References

In the use of Specific criteria document, the following reference documents shall apply.

2.1 ISO/IEC 17011: 2004 - Conformity assessment – Requirements for the bodies accrediting conformity assessment bodies

2.2 ISO/IEC17020: 2012 - Conformity assessment – Requirements for the operation of various types of bodies performing inspection

2.3 ILAC –P15: 2014 : Application of ISO/IEC 17020:2012 for the accreditation of Inspection bodies

## 3 Definitions

The term; inspection and other related terms are defined in the standard and ILAC P15. A clarification is given below on other terms, some of which have gained common usage in NDT Inspections. Care should be taken in defining standards, policies and procedures to ensure clarity of meaning.

### 3.1 Accreditation

Procedure by which an authoritative body gives formal recognition that another body or person is competent to carry out specific tasks.

### 3.2 Client

In the context of the standard, the client is the party that commissions work from the inspection body.

### 3.3 Consultancy

Participation in an active creative manner in the development of the processes to be assessed. For example by:

(a) Preparing or producing manuals, handbooks or procedures.

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- (b) Participating in the decision making process on management system matters.
- (c) Giving specific advice towards the development of facilities and the implementation of processes.

Consultancy may prejudice the impartiality of the Inspection body in breach of clause 4 of the standard. Further guidance is given at the appropriate point in this document.

### 3.4 Internal quality audit

In the context of the standard, a planned and documented audit, conducted by or on behalf of the inspection body, of the implementation of the procedures and systems of the inspection body to verify compliance with the criteria of ISO/IEC 17020 and the effectiveness of the quality system.

### 3.5 Inspection Authority

Any organization or institution authorized by statutory body to carry out NDT inspection/ testing and submit a report.

### 3.6 Authorized Signatory

Person who have been authorized to sign and issue inspection reports/ certificates

### 3.7 Technical Manager ( refer table 01)

### 3.8 Quality Manager (refer Clause 01)

### 3.9 Visual and optical testing (VT)

The most applicable NDT method is visual examination. Visual examiners follow procedures that range from simply looking at a part to see if surface imperfections are visible, to using computer controlled camera systems to automatically recognize and measure imperfections/ defects of a product/ component.

### 3.10 Radiography (RT)

RT involves using gamma or X radiation on materials and products to look for defects or examine internal or hidden features. An X-ray generator or radioactive isotope is used as the source of radiation. Radiation is directed through a part and onto a film or other detector. The resulting shadowgraph shows the internal features and soundness of the part. Effective material thickness and density changes are indicated as lighter or darker areas on the film or stronger or weaker reception of the signals strength by a detector.

### 3.11 Magnetic particle testing (MT)

This NDT method is performed by inducing a magnetic field in a ferromagnetic material and application of iron particles either in dry or in suspended form. Surface and near-surface flaws disrupt the flow of the magnetic field within the part and force some of the field to leak out at the surface.

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Iron particles are attracted and concentrated at sites of the magnetic flux leakages. This produces a visible indication of defect on the surface of the material.

### 3.12 Ultrasonic testing (UT)

In ultrasonic testing, high-frequency sound waves are transmitted into a material to detect imperfections or to locate changes in material properties. The most commonly used ultrasonic testing technique is the pulse echo, whereby sound is introduced into a test object and reflections (echoes) due to internal imperfections or the part's geometrical changes in shape are detected by a receiver. Flaw detection, corrosion mapping including thickness measurement by A-Scan as well as digital display may be carried out depending upon the requirement of the inspection of the equipment.

### 3.13 Penetrant testing (PT)

With this testing method, the test object is coated with a solution that contains a visible or fluorescent dye. Excess solution is then removed from the surface of the object but is retained in surface defects. A developer is then applied to draw the penetrant out of the defects. With fluorescent dyes, ultraviolet light is used to get the bleed-out penetrant fluoresce brightly, thus allowing imperfections to be sharply seen. With visible dyes, a vivid colour contrast between the penetrant and developer makes the bleed-out easy to see.

### 3.14 Eddy current testing (ET)

In eddy current testing, electric currents (eddy currents) are generated in a conductive material by a varying magnetic fields. The strength of these eddy currents can be measured. Material defects cause interruptions in the flow of the eddy currents which alerts the inspector of the presence of a defect or other imperfections in the material. Eddy currents are also affected by the electrical conductivity and magnetic permeability of a material, which makes it possible to sort some materials based on these properties.

### 3.15 Leak testing (LT)

1.34 Several techniques are used to detect and locate leaks in pressure containment parts, pressure vessels, and structures. Leaks can be detected by using electronic listening devices, pressure gauge measurements, liquid and gas penetrant techniques, or simple soap-bubble tests.

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### 3.16 Acoustic emission testing (AE)

When a material is subjected to an external stimulus ( changes in pressure , load, temperature) the localized sources of acoustic emission ( cracks . slips, dislocation movements, melting , twinning and phase transformation of metals ) trigger the release of energy called acoustic emission . As in ultrasonic testing, acoustic emissions can be detected by special receivers. Imperfections of the emission sources can be evaluated and detected through the study of their intensity and arrival time of the emission signal to the detector to collect information.

### 3.17 Concrete testing (CT )

Non Destructive Testing (NDT) methods are used to determine the condition and quality of in-situ concrete without damaging the structure. The range of parameters that can be assessed using non destructive tests includes surface hardness and reinforcement location, it's size and distance from the surface. It is also possible to check the quality of workmanship, structural integrity and detect voids, cracking and delamination in concrete structures.

The following test methods can be used for the NDT of concrete:

1. Visual inspection, a qualified civil or structural engineer could be able to establish the possible cause(s) of damage to a concrete structure and hence identify which of the various NDT methods available could be most useful for any further investigation.
2. Schmidt/rebound hammer test, used to evaluate the surface hardness of concrete.
3. Carbonation depth measurement test, used to determine whether moisture has reached the depth of the reinforcing bars and hence whether corrosion and spalling may be occurring.
4. Cover-meter testing, used to measure the distance of steel reinforcing bars beneath the surface of the concrete and also possibly to measure the diameter of the reinforcing bars.
5. Radiographic testing, used to detect voids in the concrete and the position of stressing ducts.
6. Ultrasonic pulse velocity testing, mainly used to measure the sound velocity of the concrete and hence the quality of the concrete (including determination of strength, quality of workmanship and defects).
7. Sonic methods using an instrumented hammer providing both sonic echo and transmission method, mainly used to check the structural integrity of concrete structures.

## 4 General requirements (Clause 4, ISO/IEC 17020)

### 4.1 Impartiality and independence

4.1.1 Under NDT inspection, the provision of consultancy and training services will be a significant factor that affects the impartiality of the inspection body. Bodies shall have adequate separation of activities or staff to be able to demonstrate that inspection is not prejudiced by conflicts of interest.

Inspection bodies may normally carry out the following activities without them being considered as

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consultancy or being potential conflicts of interest:

- a) Normal inspection activities including planning & information sharing meetings, examination of documents, auditing and follow up of non-compliances.
- b) Arranging and participating as a lecturer in training courses, provided that where these courses relate to quality assurance, inspection standards and any topic related to the NDT inspection services should confine to provision of generic information that is in the public domain.
- c) Making available or publishing information on the Inspection Body's interpretation of the requirements of the inspection standard.
- d) Activities prior to inspection are aimed solely at determining readiness for inspection. Such activities should not result in the provision of recommendations or advice that would contravene the requirements. The inspection body should be able to confirm that such activities do not contravene these requirements and that they are not used to justify a reduction in duration of the eventual inspection.
- e) Performing inspections according to standards or regulations other than those being part of the scope of accreditation.
- f) Adding value during inspection visits, for example by identifying opportunities for improvement as they become evident during inspection, but without recommending specific solutions.

4.1.2 Inspection must remain and be seen to remain impartial. Consultancy by a related body must never be marketed together with inspection services and there should be no indication in marketing material (written or oral) to give the impression that the two are linked. It is the duty of the inspection body to ensure that no client is given the impression that the use of both consultancy and inspection services would confer an advantage. There should be no suggestion by an inspection body that a successful inspection outcome would be cheaper or facilitated by the use of any specified consultancy or training services.

4.1.3 The above deals with possible compromise of impartiality by other activities of the inspection body or a related body. In some circumstances, the activities of personnel may cause a similar conflict. Two situations in particular are considered. Firstly, the personnel of the inspection body may not necessarily be full-time personnel; their other employment shall not be such as to compromise their impartiality. Secondly, full time employees who have recently joined an inspection body may have a potential conflict of interest as a result of previous employment. In either case, an individual should not perform an accredited inspection on a business where such a conflict may exist, within a period of at least 2 years.

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4.1.4 In both cases, the following three elements shall be included in the inspection body's procedures so that impartiality may properly be assessed by both the inspection body and SLAB.

a) Job descriptions for the actual inspection role detailing the nature of the task.

b) A declaration of inspector interests detailing all other interests that may impact on their impartiality.

c) A procedure whereby an Inspection body gathers information of inspectors and identifies any conflict of interest to inspection being performed.

4.1.5 The inspection body has a responsibility to identify and evaluate such situations and assign responsibilities and tasks so as to ensure that impartiality is not compromised.

4.1.6 The inspection body shall identify the potential sources of relationships with related bodies and any individuals time to time and such relationships shall be evaluated and plans shall be drawn to eliminate or minimize any risks associated with relationships leading to conflict of interest. Possible sources that effect impartiality may be ownership, governance, management, personnel, shared resources, finances, contracts, marketing, sales commissions, or other inducement etc.

4.1.7 Inspection bodies carrying out NDT inspection may be accredited as Type A, B or C bodies (Annex A of the standard), provided they meet the necessary requirements.

4.1.8 A Type A body shall be an independent third party engaged in inspection only. Bodies which are involved in consultancy too are unlikely to meet all the independence criteria in A.1 of Annex A of ISO/IEC 17020. A Type A body shall not engage in providing first party inspections or second party inspections or both after repair, adjustment or maintenance of any items/ facilities subject inspect by the inspection body.

## 4.2 Confidentiality

4.2.1 Each inspection body shall enter into a contractual agreement with the all personnel involved in inspections, decision making, committees and administrative activities in addition to their commitment for continuity and effectiveness of providing their services related to NDT inspection that the staff of inspection body and its personnel protect the confidentiality of all information generated during the inspection process. This agreement shall be legally enforceable. Safeguarding confidentiality is applicable for monitoring authorities and persons acting on behalf of inspection body, except as required by law.

4.2.2 Each inspection body shall maintain a website and other means of communication to inform the clients in advance of what it provides or intends to provide to the clients.

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## 5 Structural requirements (clause 5, ISO/IEC 17020)

### 5.1 Administrative requirements

5.1.1 The inspection body and its inspection centers including buildings and premises shall be established in entities which are legally registered for all inspection activities under the national, provincial or local government regulations.

5.1.2 NDT Inspection is to be performed for the determination of compliance with the National / International standards and Regulations issued time to time and enforced by the relevant regulatory authorities.

5.1.3 The technical scope of inspection body and terms of conditions shall be as prescribed in a documented contract agreed upon with the clients and relevant authorities, if required as per regulation and the evidence for authorization and competence for inspection shall be available with the inspection body.

5.1.4 The range of inspection services offered by a body may be wider than those which are accredited. In this case, the limits of accreditation shall be made clear. Services that are outside the scope of accreditation shall be distinguished from those that are accredited.

5.1.5 The SLAB accreditation is location specific and valid only for the inspection body and its inspection centers that are indicated in the Schedule of Accreditation. These centers shall be conveniently located and readily accessible.

5.1.6 The liability insurance shall include all employers' liability, public liability and professional Indemnity. If a reserve is allocated, that amount should be sufficient to cover the above liabilities. Type B inspection bodies engaged only for 'in-house' inspections may not require professional indemnity insurance.

5.1.7 There shall be a sound and documented Occupational Health and Safety Programme implemented for all employees. Possible risks to inspection personnel during the course of inspection and mitigation measures shall be documented and it shall be reviewed within defined period. Individual organization may follow internationally accepted safety standards such as OSAS 18001.

### 5.2 Organization and Management

5.2.1 The organizational structure of an inspection body is such that it may have a central office affiliated with one or more inspection centers of which operations may or may not be linked to the central office through automated systems. If inspection centers are available, they are to be organized and managed as each inspection center is capable to perform inspection activities. These inspection centers shall be identified in an organizational structure or attachment with the identity of location.

5.2.2 The role of the technical manager is to oversee the technical content and competence of the inspections and to ensure that SLAB requirements are met. The technical manager shall be a

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permanent member of staff and will normally be different from the person responsible for quality assurance indicated in ISO/IEC 17020, although the extent to which different staff members can hold several functions can vary with the size of the organization. The position of technical manager(s) in the organization, however named, shall be shown clearly in the organizational chart.

5.2.4 The inspection body shall be able to demonstrate that the work of staff performing inspections is properly supervised by a person familiar with the inspection methods and procedures and the scope and objectives of the inspection. The level of supervision shall be commensurate with the skills and experience of the inspector. The supervision shall also include regular review of inspection reports to ensure that work has been carried out in accordance with the requirements of regulatory bodies and the inspection body's procedures.

5.2.5 It is permissible to deputize upwards in the management structure as well as downwards and doing so is essential when any key person appointed for such responsibility is absent.

5.2.6 Inspection body shall issue job descriptions to all personnel with the agreement of employee and employer.

## **6 Resource requirements (Clause 6, ISO/IEC 17020)**

### **6.1 Personnel**

6.1.1 The minimum requirements for education, training, technical knowledge, skills and experience of all personnel involved in inspection activities shall be defined and documented in accordance with the ISO/IEC 17020, clause 6.1.3 and specific competency requirements defined by the regulatory bodies. Please refer Annex A (**Table 01**) for minimum competence criteria.

6.1.2 The inspection body shall have a sufficient number of permanent staff, at least one permanent member for each function. The staff under contract or part time is permitted provided that they have signed a contract with the inspection body. The staff retained on contract and deployed part time are regarded as permanent staff provided that, when they work for the inspection body, they work under the inspection body's quality systems and procedures. The inspection body shall ensure that staff of this type does not cause any conflict with other requirements of the standard.

In particular, the inspection body shall ensure that other work in which these staff engages does not prejudice their impartiality and integrity in breach of ISO/IEC 17020. The potential for conflict with the confidentiality requirement should also be considered.

6.1.3 The inspection staff shall have qualifications, training and/or experience to match the specific inspection tasks in which they are employed. The minimum criteria for qualifications, training and experience are given below. The inspection body shall be able to demonstrate procedures to ensure the competence of inspection process.

6.1.4 The inspection body shall ensure that all personnel receive necessary training to operate and

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maintain the inspection programme. The inspection body provide training; induction and on-going and retraining which shall be sufficient to perform duties and the training programmes shall cover as applicable NDT Inspection Programme orientation, regulations, procedures, test equipment operation, maintenance, quality control, calibration, customer care and occupational health and safety.

6.1.5 Initially after induction training under sufficient supervision, all personnel involved in inspection activities shall be evaluated for competence and authorized for the assigned task. Thereafter, they are to be continuously monitored for satisfactory performance and reevaluated periodically for competence as defined by the inspection body. The evaluation methods may be one or a combination of the following; interviews, written examinations, simulation inspections and supervisory observations. The Inspection body shall maintain records on each activity above mentioned.

6.1.6 The payments made to inspectors shall not create any internal or external pressure that compromise impartiality of the inspection activity. They shall not be remunerated in a manner that influences the results of inspections, such as any bonus, incentive or allowance paid calculated on piece rates.

6.1.7 The records shall indicate the competency of every member of staff engaged in specific inspection tasks in the fields, types and ranges of inspection covered by the scope of accreditation and the date of their authorization.

6.1.8 Inspectors shall be given an annual vision examination, to assure natural or corrected near-distance acuity exists in at least one (1) eye. The eye examination may be a part of requirement of personnel certification body to maintain the inspector status. The color vision examination shall demonstrate the capability of distinguishing and differentiating contrast among colors used in the method. This shall be conducted every five years upon initial certification or renewal /recertification and recorded Vision examinations shall be administered in accordance with Jaeger reading card and Ishihara eye chart of 24 tablet or shades of gray and approved by an NDT Level-III designated by the employer. Or Registered Medical practitioner –Ophthalmologist may administer visual examination for acuity and color differentiation and contrast using Jaeger card and Ishihara chart respectively as per written practice and recorded/certified.

## 6.2 Facilities and equipment

6.2.1 The inspection body shall acquire and install all necessary equipment meeting the provisions of regulations and use them in testing/inspection as required by the Inspection scheme and agreed upon with the Authorities. There shall be a sufficient number of back up units in order to ensure continuous inspection service.

6.2.2 The equipment log regarding the current equipment shall be available with the inspection body. These documents shall include but are not limited to specifications of materials and equipment, catalog data sheets, performance curves, diagrams and similar descriptive materials, equipment

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layout, and installation drawings and procedures.

6.2.3 The inspection body shall implement a calibration programme to assure proper functioning of equipment. The measurements subject to calibration shall be traceable to SI units.

6.2.4 The measuring equipment shall be subject to intermediate checks or verifications between periodic recalibrations. Equipment records shall clearly define calibration intervals, which have to be in accordance with the calibration programme. The required actions shall be taken when the calibration results show a calibration results show an exceeding of the pre-determined limits of the accuracy of the instrument under calibration. Records on in-house calibrations shall be maintained.

6.2.5 The inspection body shall maintain an inventory of spare parts, supplies, equipment and reference standards required for inspection / testing activities. There shall be a procedure available with the inspection body to order and reorder any of the spare parts, supplies, equipment and reference standards.

6.2.6 The inspection body shall implement a procedure for preventive maintenance of equipment and a preventive maintenance programme which includes provisioning for spare parts and repair or replacement of defective or worn out equipment.

6.2.7 The inspection body shall appoint a competent person or body to provide continuous equipment maintenance service and ensure that all equipment installed at inspection centers do operate accurately and reliably meeting the quality control and quality assurance requirements.

6.2.8 The defective equipment shall be properly labeled and kept away from inspection activities.

6.2.9 The Measuring equipment shall be calibrated, checked, or/and verified according to an established procedure after every repair or maintenance before being put in to service. The calibration of reference standards or measuring equipment used for in-house calibration or function check of NDT instruments, shall also be traceable to national or international standards and whenever possible , shall be evidenced by certificates issued by an ISO/IEC 17025 accredited calibration laboratory ,accredited reference material producer or a National Metrology Institute (NMI) in line with ILAC P10 : The policy of metrological traceability or SLAB policy on Metrological traceability (AC-RG(P)-04).

Note: Function check is a measurement of at least one point in a range of a measuring instrument or system or material against a known value to confirm that is has not deviated significantly from its original calibrated value. It is also an examination of the condition of an artifact to determine that it has not been adversely affected by constant use.

Where in-house calibration or function check methods are adopted, the inspection body shall have the necessary resources consistent with the accuracy required, and with any standard specifications relevant to the calibration/ function check concerned.

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Procedures for in-house calibration shall be adequately documented by work instructions. These work instructions thoroughly describe step by step the calibration procedure and shall be directly related to international or national calibration standards.

Calibration of NDT instrument and probes are often prescribed/ advised by normative requirements such as ISO 3059 ( Non-destructive testing-Penetrant testing and magnetic particle testing- Viewing conditions) or EN12668-1 (Non-destructive testing- Characterization and verification of Ultrasonic examination equipment – Part 1: Instruments). If there are no given requirements, intervals shall be defined by the user. Adjustment of calibration intervals should be possible in order to optimize the balance of risks and costs due to a number of reasons, for example:

- Instrument may be less reliable than expected
- The usage may not be anticipated
- It may be sufficient to carry out a limited calibration of certain instrument instead of a full calibration
- The drift determined by the recalibration of the instruments may show that longer calibration intervals may be possible without increasing risks.

6.2.10 The inspection body shall install a data-handling programme and the software used for data compilation, collection, transmission, processing, reporting, storing and retrieval in the Inspection programme shall be validated before functioning of the test system and periodically thereafter or after any repair in the test system. The inspection body shall implement a documented procedure to validate the computerized programmes and to protect the database from tampering or unauthorized access. This data handling system shall be capable of tracking all inspection certificates issued and be accessible to the relevant authorities, if required. The inspection body shall ensure the data backups in order to safeguard the data.

6.2.11 Inspection body shall be capable of offline operations in a system breakdown. The inspection body shall provide means for backup equipment power supply to minimize offline testing.

6.2.12 The inspection body shall implement Good Engineering and House Keeping practices during its inspection activities and within and outside each facility to ensure cleanliness and safety. Any waste shall be disposed as per the Atomic Energy Authority and Central Environmental Authority regulations.

**6.2.13 Preparation for Site work:**

- a) Prior to going to site, the Inspection Body shall ensure that all needed Personnel Protective equipment that ensures safety of personnel on site is taken to site.
- b) The Inspection Body shall allocate inspection activities based from the work program for each

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inspector in the form of Work Orders. Work Orders to be used by inspectors on site shall contain the following information as minimum:

- Identifiable number traceable to the client request/contract;
  - Type of the equipment and related information about critical items to be inspected;
  - Site Location (site map is recommended to be provided)
  - Instructions for inspections
  - Contact person on behalf of the IB's client.
- c) Upon arriving at any inspection site, there shall also be an obligation from the IB for the inspector to enquire the following information:
- Information about previous inspections.
  - If the Inspector cannot obtain sufficient information, the inspection shall be treated like a first inspection and therefore proceed with the 'normal' inspections.
  - Manufacturing Operations Manual, Operator or Maintenance Manuals of the equipment, safe working limits indication in English and/or Arabic language, and in case not available and not possible to provide, the IB shall ensure that an independent competent person be engaged by the owner to provide advice and documentation to support the continued use of the equipment.

d) Reporting Discontinuity/ Defects in equipment under inspection

Inspectors are required to be capable of making identification of all types of Discontinuity/Defects found in the equipment under inspection; if the equipment is found unsafe and represents an imminent danger, the IB shall advise the owner to cease use of the equipment and report this incident immediately to the relevant regulatory authority immediately.

### 6.3 Subcontracting

6.3.1 The subcontracting shall not be allowed.

## 7 Process requirements (clause 7, ISO/IEC 17020)

### 7.1 Inspection methods and procedures

7.1.1 The inspection body shall ensure that inspection methods to be used are documented and consistent with the scope of the inspection and the inspection methods prescribed in the relevant

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regulations.

7.1.2 The inspection frequency shall be as given in the regulations.

7.1.3 The scope of each inspection shall be transparent to the client and be documented in a work order.

7.1.4 The inspection body shall have a detailed procedure manual including standard operating procedures and inspection criteria documented and validated especially when published methods are not used. These criteria shall be made available at the location of Inspection.

## **7.2 Handling inspection items /requests**

7.2.1 Each inspection request/ item shall be uniquely identified as per the Inspection body's own procedures.

7.2.2 Each inspection shall consist with pre inspection of inspection activities requests in inspection request for suitability and safety as per the pre inspection procedures. For this purpose, inspection body shall develop a pre inspection form relevant to the type of inspection.

7.2.3 The inspections which have failed one or more of the applicable cut off points or requirements shall be documented and which shall be indicated in the inspection report.

## **7.3 Inspection records**

7.3.1 Procedures shall define the records to be kept and the form in which they are to be kept. The period of retention of documents by the inspection body shall be defined; for inspection and complaint records at least 5 years would normally be appropriate and 3 – 5 years for quality system records.

## **7.4 Inspection reports and inspection certificates**

7.4.1 The scope of the inspection shall be included in a serially numbered inspection report or certificate in order to allow proper understanding and interpretation. The inspection report or certificate should include conclusion on inspection.

7.4.2 The inspection body should have procedures to ensure that inspection report or certificate is delivered to the client in accordance with contractual or legal requirements.

7.4.3 The inspection body shall identify authorized persons fulfilling the minimum qualification criteria given in table one and any other requirements defined by the relevant regulatory body for issuance of inspection reports or certificates. If the inspection report or certificate is issued generated by the computerized system, it is ensured that the inspection report or certificate is verified by the authorized persons.

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## 7.5 NDT Final Report

7.5.1 After having completed NDT evaluation and found no significant issues, the Inspection Body shall issue an Inspection certificate on the inspection to fulfill the client's needs, the related regulatory authority requirements and the applicable clauses of relevant standards.

7.5.2 The certificate shall include the following information as a minimum;

- Designation of the document (i.e. as an inspection report or an inspection certificate, as appropriate);
- Identification of the document (i.e. date of issue and document control number);
- Identification of the issuing Inspection Body - name and address of the IB issuing/endorsing the certificate;
- Identification of equipment(s) Owner's/ Contractor's name and address;
- Description of the inspection work ordered;
- Date(s) of inspection and type of inspection;
- Information on where the inspection was carried out (address of the premises at which the Inspection was made);
- Manufacturer or supplier of equipment name and address;
- Identification of the object(s) inspected and, where applicable, identification of the specific components that have been inspected;
- Unique identification numbers (i.e. certificate/report number);
- Identification or brief description of the inspection method(s) and procedure(s) used, mentioning the deviations from, additions to or exclusions from the agreed methods and procedures;
- Identification of equipment(s)/tool(s) used for measuring / testing;
- Applicable Reference Standard(s)/ Code(s);
- Details of any major repairs/alterations carried out on the equipment, provided that the clients inform IB's inspector of any modifications or structural repairs;
- Details of latest Inspection/Tests previously performed, including any NDT if possible;
- Measuring units (for Capacity/Volume) shall be in either/both Metric System (m3) or

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Imperial System (gallon);

- Information on environmental conditions during the inspection, if relevant;
- The results of the inspection including a declaration of conformity and any defects or other non-compliances found (results can be supported by tables, graphs, sketches and photographs);
- A statement that the inspection results relate exclusively to the work ordered or the object(s) or the lot inspected;
- A statement that the inspection certificate/report shall not be reproduced except in full without the approval of the Inspection Body and the client;
- The inspector's mark or seal, if any;
- Names (or unique identification) of the staff members who have performed the inspection and, in cases when secure electronic authentication is not undertaken, their signature (see also clause 13.3 of ISO/IEC 17020);
- Name, Signature and Designation of signing Authority of IB (if different from the inspector who performed the test);
- Clearly defined Liability Clause of the IB. Certificates issued by third party IB that fail to give any of the above details will be liable to rejection by the relevant regulatory Authority.

7.5.3 Professional Judgment that is included in the certificate will form part of the assessment and will be subject to accreditation.

7.5.4 If the NDT evaluation commissioned by the client could not be carried out in full or in part, a written notification to that effect shall be given to the client.

7.5.6 In the case of an accident involving an equipment inspected by accredited Inspection Body and as a result of the official investigation it was determined that the accredited IB was responsible, SLAB shall immediately suspend the IB's Accredited related scope and exclude the inspector who performed the concerned inspection from the authorization. List of approved inspectors. An immediate detailed special assessment will be carried out by SLAB related to Quality Management System and technical competence of the Inspection Body under suspension and subsequently relevant clauses of IB-RG (P)- related to suspension & withdrawal of accreditation will be applicable.

7.5.8 In case the accident involved serious injuries or was fatal, Director /CEO reserves the right to withdraw the accreditation for the related scope with immediate effect.

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## **7.6 Complaints and appeals (sub clauses 7.5 & 7.6, ISO/IEC 17020)**

7.6.1 Inspection body shall have a documented procedure for handling of complaints received at each inspection center and appoint a person(s) who is independent from the inspection process to resolve any complaints against inspections.

7.6.2 Inspection body shall have a documented procedure for handling of appeals and appoint an appeals committee comprising of persons who are independent from the inspection process and decisions to resolve any appeals against the results of inspections.

7.6.3 The inspection body's procedure for handling of complaints and appeals shall be available at the inspection body or each inspection center upon request.

## **8 Management system requirements (clause 8, ISO/IEC 17020)**

### **8.1 Management system**

8.1 The management system established and maintained by the inspection body shall be either complied with the requirements of ISO 9001 or developed addressing the requirements given in clause 8.1.2 of the standard. It is preferable that the management system of the inspection body covering its inspection centers is certified against ISO 9001 for the scope sector under purview.

8.2 The policy statement shall include a commitment to comply with the standard and any legal requirements.

8.3 A quality manager or a person designated otherwise shall be identified in the inspection body who may have other duties but shall have direct reporting access to the top management for quality and inspection matters. This is a different function to that of the technical manager described in sub clause 5.2.5 of the standard.

8.4 In case of a network of inspection centers, the inspection body shall describe how the quality assurance of inspections is carried out and depending on the number of inspection centers a sufficient number of persons shall be appointed to take care of quality assurance activities.

8.5 The Inspection body shall participate in inter-comparison programmes with other accredited inspection bodies to standardize its testing and inspection process.

8.6 The purpose of internal quality audits is to verify that the documented operational procedures of the inspection body are being implemented. Internal audit shall include the on-site assessment of staff conducting inspections. This assessment shall be carried out by personnel with relevant technical qualifications and experience, who have been trained in internal auditing and who are sufficiently independent to carry out the audit objectively.

8.7 The internal audit programme for on-site inspections shall be designed so that every year it shall include at least one inspection of every field, type and range for which the body is accredited. At the

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same time, the plan shall ensure that every inspector is assessed on-site initially and at least once in two years for every field, type and range of inspection for which he/she is considered to be competent.

8.8 The management review should take place at least once a year.

8.9 The inspection body shall develop and implement a public information programme which will include a programme information brochure and important information handout.

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**Annex A**

**Table 01- Minimum competence requirements**

| <b>Employee Category</b> | <b>Minimum Qualification</b>  | <b>Main responsibilities</b>  | <b>Training</b>  | <b>Experience ( on the job training )</b>                                 |
|--------------------------|---|---|--|---|
| Operator                 | <p>1. Three passes in G.C.E. (A/L) including Physics and Chemistry</p> <p>2. Minimum six passes in G.C.E. (O/L) with credit passes for Science and Mathematics</p> <p>and<br/>successful completion of a vocational Training ( NVQ Level 05 ) related to Science / Engineering or</p> <p>3. Any other qualification equivalent to that stipulated in above</p> <p><b><u>With</u></b><br/>Level 01 qualification as per ISO 9712</p> | <p>An individual certified to level 1 shall have demonstrated competence to carry out NDT according to NDT instructions and under the supervision of level 2 or Level 3 personnel. Within the scope of the competence defined on the certificate, Level 1 personnel may be authorized by the employer to perform the following in accordance with NDT instructions:</p> <ul style="list-style-type: none"> <li>• Set up NDT equipment;</li> <li>• Perform the tests;</li> <li>• Record and classify the results of the tests;</li> <li>• Report the results.</li> </ul> | <p>Shall have completed a training course on the relevant NDT method in <b>level 01</b> as per 7.2.2 of ISO 9712:2012.</p> | <p>03 months for ET, RT,CT and UT and<br/>01 month for MT, PT and VT.</p> |

**Table 01- Minimum competence requirements Contd.**

| Employee Category | Minimum Qualification                  | Main responsibilities  | Training   | Experience ( on the job training )  |
|-------------------|--|--|--|---|
| Inspector         | Level 02 qualification as per ISO 9712 | <p>An individual certified to level 2 shall have demonstrated competence to perform NDT according to NDT procedures. Within the scope of the competence defined on the certificate, Level 2 personnel may be authorized by the employer to:</p> <ul style="list-style-type: none"> <li>• Select the NDT technique for the testing method to be used;</li> <li>• Define the limitations of application of the test methods;</li> <li>• Translate NDT codes, standards, specifications and procedures into NDT instructions adapted to the actual working conditions;</li> <li>• Set up and verify equipment settings;</li> <li>• Perform and supervise tests;</li> <li>• Interpret and evaluate results according to applicable standards, codes, specifications or procedures;</li> <li>• Carry out and supervise all tasks at or below Level 2;</li> <li>• Provide guidance for personnel at or below Level 2;</li> <li>• Report the results of NDT.</li> </ul> | <p>Shall have completed a training course on the relevant NDT method in <b>level 02</b> as per 7.2.2 of ISO 9712:2012.</p> | <p>09 months for ET, RT,CT and UT and<br/>03 month for MT, PT and VT.</p> |

**Table 01- Minimum competence requirements Contd.**

| Employee Category | Minimum Qualification   | Main responsibilities  | Training   | Experience  |
|-------------------|---|--|--|---|
| Technical Manager | B Sc. in Science (as a subject of Physics) or Engineering degree or equivalent degree and Level 03 qualification in at least two conventional NDT methods as per ISO 9712 | <p>To oversee the technical content and competence of the inspections and to ensure that SLAB requirements.</p> <p>An individual certified to level 3 shall have demonstrated competence to perform and direct NDT operations for which he/she is certified. Level 3 personnel shall have demonstrated:</p> <ul style="list-style-type: none"> <li>• The competence to evaluate and interpret results.</li> <li>• Sufficient practical knowledge of applicable materials, fabrication, process and product technology to select NDT methods, establish NDT techniques, and assist in establishing acceptance criteria where none are otherwise available;</li> <li>• A general familiarity with other NDT methods.</li> </ul> <p>Within the scope of the competence defined on the certificate, level 3 personnel may be authorized to;</p> <ul style="list-style-type: none"> <li>• Assume full responsibility for a test facility or examination centre and staff;</li> <li>• Establish, review for editorial and technical correctness, and validate NDT instructions and procedures;</li> <li>• Interpret standards, codes, specifications and procedures;</li> <li>• Designate the particular test methods, procedures and NDT instructions to be used;</li> <li>• Carry out and supervise all tasks at all levels;</li> <li>• Provide guidance for NDT personnel at all levels.</li> </ul> | Shall satisfy the training requirements on the relevant NDT method in <b>level 03</b> as per 7.2.2 of ISO 9712:2012. | 18 months for ET, RT,CT and UT and 12 months for MT, PT and VT. |



**Table 01- Minimum competence requirements Contd.**

| <b>Employee Category</b> | <b>Minimum Qualification</b>  | <b>Main responsibilities</b>   | <b>Training</b>  | <b>Experience</b>   |
|--------------------------|---|--|--|---|
| Quality Manager          | B Sc. Science degree with Physics or Chemistry as a subject or Engineering Degree or equivalent | Responsible for development of implementation and maintaining of quality management system of Inspection body as per ISO/IEC 17020 | Three months on the job training in Quality management | Two years of work experience in quality control and Non Destructive Testing activities. |

**Annex B**

**COMPOSITION OF THE TECHNICAL COMMITTEE**

|           |   |           |
|-----------|---|-----------|
| <b>01</b> | Dr. C L Ranatunga<br>Senior Lecturer<br>Department of Physics,<br>University of Sri Jayewardenepura                 | Chairman  |
| <b>02</b> | Dr.C.S Lewangamage<br>Senior Lecture<br>Department of Civil Engineering<br>University of Moratuwa                   | Member    |
| <b>03</b> | Ms. S.K.K Muthurathna<br>Senior Engineer<br>National Building Research Organization                                 | Member    |
| <b>04</b> | Eng. Madhawa Perera<br>MD/Consultant Engineer<br>United Enterprises (Pvt) Ltd.                                      | Member    |
| <b>05</b> | Mr. P.D.S Niranjan Weerasinghe<br>N.D.T Engineer<br>Sri Lankan Airlines Ltd.  | Member    |
| <b>06</b> | Mr. C. Weerasekara<br>Engineering Manager (Inspection)<br>Ceylon Petroleum Corporation                              | Member    |
| <b>07</b> | Ms. Chandima Swarnamali Karunaratna<br>Deputy Director<br>Construction, Training and Development.                   | Member    |
| <b>08</b> | Mr. L H D Bandusoma<br>Deputy Director ( Accreditation )<br>Sri Lanka Accreditation Board for Conformity Assessment | Secretary |

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The Annexures C to E contain specific guidance on equipment calibration /function check and equipment calibration/ function check intervals for each of the test methods covered by this document.

The responsibility for determining calibration intervals lies with the body carrying out the tests that shall ensure that they satisfy the requirement of the test specification and any specific client requirements. Inevitably different standards have slightly differing requirements. It is the responsibility of the body responsible for performing the inspection to ensure that the detailed requirements of those standards are met in full.

It is the responsibility of the body carrying out the inspection to ensure that the calibrations or function checks are carried out against the latest version of the appropriate standard unless specifically requested otherwise by the client. In both cases the requirements shall be met in full.

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## Annex C

### Radiographic Equipment (“RT-equipment”) - calibration and calibration intervals

Focal characteristics shall be monitored for any significant changes.

The sensitivity of a radiograph shall be established by means of Image Quality Indicators (IQI) or penetrameters appropriate to the material and thickness. It is necessary to hold manufacturer’s certificates of conformity for these IQIs. The condition of IQIs and penetrameters should be monitored and damaged devices withdrawn from use.

Where digital radiographic equipment are used, the laboratory shall if relevant ensure that the computerised results are Digital Imaging and Communication in Non-Destructive Examination (DICONDE) compliant (reference to ASTM E 2339).

The type and location of the IQI or penetrometer shall be strictly in accordance with the requirements of the agreed standard or code.

Radiographic film processors should be maintained in accordance with the manufacturer’s 696 recommendations. Regular monitoring of the processor using pre-exposed film should take place to ensure the correct operation of the processor and to verify that any film classification system requirements are met. The density of radiographs shall be ascertained using densitometers. The accuracy required determines whether analogue or digital readouts are needed.

Densitometers shall be calibrated at defined intervals against a reference density strip or set of gray filters of known (calibrated) densities. Hand-held densitometers should be zeroed each time they are used, against the level of background illumination on which they are to be used. The calibration of reference measuring equipment used for in-house calibration of NDT related instruments and probes shall be traceable to (international) standards and shall be evidenced by a certificate, issued by a body in accordance with the ILAC P10 policy.

*Intermediate Checks to establish that the densitometer is still operating correctly and is in calibration shall be carried out between calibrations.*

Radiation safety meters shall be calibrated at defined intervals to ensure accuracy to check personnel, equipment and facilities for radioactive contamination or to measure external or ambient ionizing radiation fields to evaluate the direct exposure hazard to personnel.

Reference film density strips shall be uniquely identified and traceable by certificate to a (inter)national standard of measurement and should carry a manufacturer’s certificate which is less than five years old unless otherwise specified.

Working density strips should have the density of each step ascertained using a calibrated and certificated densitometer, and recorded either directly into the film or onto a card strip permanently attached to the film. The date of first calibration should be recorded on the strip. All working

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density strips which are more than three years old, or which have been subject to undue wear, should be taken out of use and destroyed. The strips have to have valid certificates.

Film density strips are subject to discoloring or fading and should be carefully maintained and stored.

*Radiographic viewers and illuminators shall be checked for intensity and evenness of illumination at such intervals to exclude any deterioration or decay that may inversely effect the inspection result.*

### **Controlling Radiographic Quality in RT**

One of the methods of controlling the quality of a radiograph is through the use of image quality indicators (IQIs). IQIs, which are also referred to as penetrameters, provide a means of visually informing the film interpreter of the contrast sensitivity and definition of the radiograph. The IQI indicates that a specified amount of change in material thickness will be detectable in the radiograph, and that the radiograph has a certain level of definition so that the density changes are not lost due to un sharpness. Without such a reference point, consistency and quality could not be maintained and defects could go undetected.

Image quality indicators take many shapes and forms due to the various codes or standards that invoke their use. IQIs come in a variety of material types so that one with radiation absorption characteristics similar to the material being radiographed can be used.

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## Annex D

### Ultrasonic Equipment (“UT-equipment”) - calibration and calibration intervals

Ultrasonic calibration blocks where applicable shall be used to set up the assembly of probe and sensory electronics, each time the equipment is used. The blocks shall be manufactured in accordance with the appropriate specification.

Those blocks, such as e.g. the International Institute of Welding (IIW, Type 1 or Type 2) block, are used to set up the assembly of probe and sensory electronics. It is used for the calibration of the 755 ultrasonic instrument to adjust linearity of timebase, linearity of equipment gain, sensitivity, S/N 756 ratio and pulse duration.

All calibration blocks shall be verified at specified intervals as follows:

Visual examination for deterioration such as corrosion or mechanical damage,

Radius and other dimensional checks using equipment traceable to national or international standards.

Where calibration blocks made from the material of the product under test are used for setting up, the final test report should indicate the calibration status of the test blocks. In all such cases the transmission velocity of the pulse through the block material shall be measured and recorded, unless the body has alternative methods to demonstrate the traceability of the block. As applicable, manufacturing history of these blocks shall be available for at least five years after the last period of use.

The correct functioning of testing units, probes and connecting cables shall be checked at regular intervals; the results shall be documented. Verification shall be against the controlling specifications.

The ultrasonic test sets shall be periodically checked by the NDT inspector for compliance with the manufacturer’s specifications, including:

Linearity of time base,

Linearity of equipment gain,

Sensitivity and signal to noise ratio,

Pulse duration.

The ultrasonic probes and systems shall be daily or before use checked by the NDT inspector for compliance with the manufacturer’s specifications, including:

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- probe index,
- probe beam angle,
- visual checks for damage.

*Note: angle beam probes that exceed 2 degrees variation of the described angle shall be replaced.*

Ultrasonic flaw detectors shall be calibrated at intervals not exceeding twelve months in accordance with the controlling specification, including:

Linearity of time base,

Linearity of amplifier and

Accuracy of calibrated attenuator

The calibration of reference measuring equipment used for in-house calibration of NDT related instruments and probes shall be traceable to (international) standards and shall be evidenced by a certificate, issued by a body in accordance with the ILAC P10 policy.

Testing units, probes and connecting cables should be carefully stored. Reference blocks, and calibration blocks should be stored in such a way as to prevent corrosion occurring.

Where automated test equipment is used, special attention shall be paid to the qualifications and training of operators, the system for the identification of defects, and data storage. Checks should be made to ensure the correct geometric position of the probe in relation to the output signal.

In ultrasonic testing, several types of calibration must be carried out.

It is usually necessary for the operator to perform a "user calibration" ("system check" acc. to e.g. EN 12668-1 to -3) of the equipment. This user calibration is necessary because most ultrasonic equipment can be reconfigured for use in a large variety of applications.

The user must "calibrate" the system, which includes the equipment settings, the transducer, and the test setup, to validate that the desired level of precision and accuracy 810 are achieved. This calibration is usually performed by the user/operator/inspector according to the operating manual, the procedure or work instruction and using a calibration standard/block.

The term calibration standard/block is usually only used when an absolute value is measured and in many cases, the standards are traceable back to the International Standard.

In ultrasonic testing, there is also a need for reference standards. There are requirements laid down in international standards for the quality/ traceability of the calibration standards/blocks and reference standards.

Reference standards are used to establish a general level of consistency in measurements and to help interpret and quantify the information contained in the received signal. Reference standards are used to validate that the equipment and the setup provide similar results from one day to the next and that similar results are produced by different systems. Reference standards also help the inspector to estimate the size of flaws. The inspector can use a reference standard with an artificially induced flaw of known size and at

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approximately the same distance away for the transducer to produce a signal. By comparing the signal from the reference standard to that received from the actual flaw, the inspector can estimate the flaw size.

There are other standards available and these specially designed standards may be required for many applications. Any other terminology as mentioned in this document used for a calibration and/or a reference standard shall be clearly explained when used.

Calibration standards/blocks and reference standards for ultrasonic testing are available in many shapes and sizes. The type of standard used is dependent on the NDT application and the form and shape of the object being evaluated. The material of the reference standard should be the same as the material being inspected and the artificially induced flaw should closely resemble that of the actual flaw.

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## Annex E

### Magnetic Particle equipment - calibration and calibration intervals

Magnetic probes, prods of alternating current must be capable and verified of lifting 10 lbs of weight

Magnetic probes, prods of direct current must be capable and verified of lifting 40 lbs of weight

There must be a procedure to “demagnetize” tested items when such magnetization will affect the products usefulness. To demagnetize a part, the current or magnetic field needed must be equal to or greater than the current or magnetic field used to magnetize the part.

The solids content of bulk magnetic inks should be checked by a method specified in the controlling standard. In the case of aerosols, certificates of conformity shall be obtained from the manufacturer for each batch.

*Note: ISO 9934-2 (Non-destructive testing – Magnetic particle testing – Part 2: Detection media) determines in service tests of aerosol material. When using fluorescent inks and powders:*

- (a) the intensity of UV(A) light at the test surface shall be checked as frequently as necessary to monitor possible deterioration of the illumination. (Where grimy, dusty or other contaminating environments are involved, checking shall be carried out each time the equipment is used.) These checks require the use of a calibrated UV (A) light meter.
- (b) the ambient white light level shall be checked at least once every three months where illumination is controlled on a long term basis, and should be checked each time the equipment is used in situations where illumination may vary from test to test (e.g. in daylight conditions). These checks require the use of a calibrated white light meter. The calibration intervals should not exceed 12 months.

When using non-fluorescent inks and powders, the level of illumination at the inspection surface should be checked at regular intervals where illumination is by artificial means, and should be checked each time the equipment is used where daylight illumination is employed. These checks require the use of a calibrated white light meter. The calibration intervals should not exceed 12 months.

The apparatus and ancillary equipment shall be checked at regular intervals.

Magnetic field meters shall be calibrated at defined intervals. The calibration intervals should not exceed 12 months.

The strength of permanent magnets and magnetic yokes shall be checked at regular intervals. Flux indicators should be used to demonstrate the direction of flux. Traceability is not required. *Tests to check the sensitivity of the indications looked for should be carried out using suitable test pieces. Such test pieces have properties like the same material composition, size,*

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(artificial) defects, magnetic properties, heat treatment, surface finish, etc. as the part to be inspected.

The calibration of reference measuring equipment used for in-house calibration of NDT related instruments and probes shall be traceable to (international) standards and shall be evidenced by a certificate, issued by a body in accordance with the ILAC P10 policy.

### **System Performance Check in MT**

#### **Particle Concentration**

The concentration of particles in the suspension is a very important parameter in the inspection process and must be closely controlled. The particle concentration is checked after the suspension is prepared and regularly monitored as part of the quality system checks. Concentration checks (the word check in this context means that the conditions are measured and when these conditions do not comply with the demands a correction or an adjustment will be carried out) may be required to be performed every eight hours or at every shift change.

The standard process used to perform the check requires agitating the carrier for a specified minimum of time to ensure even particle distribution. A sample is then taken in a pear-shaped centrifuge tube having different stems for fluorescent particles and visible particles. The sample is then demagnetized so that the particles do not clump together while settling. The sample must then remain undisturbed for a specified minimum time, unless shorter times have been documented to produce results similar to the longer settling times. The volume of settled particles is then read. Acceptable ranges for fluorescent particles and for visible particles must be specified. If the particle concentration is out of the acceptable range, particles or the carrier must be added to bring the solution back in compliance with the requirement.

Particle loss is often attributed to "dragout." Dragout occurs because the solvent easily runs off components and is recaptured in the holding tank. Particles, on the other hand, tend to adhere to components, or be trapped in geometric features of the component. These particles will be "drug out" or lost to the system and will eventually need to be replaced.

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## Particle Condition

After the particles have settled, they should be examined for brightness and agglomeration. Fluorescent particles should be evaluated under ultraviolet light and visible particles under white light. The brightness of the particles should be evaluated weekly by comparing the particles in the test solution to those in an unused reference solution that was saved when the solution was first prepared. The brightness of the two solutions should be relatively the same. Additionally, the particles should appear loose and not lumped together. If the brightness or the agglomeration of the particles is noticeably different from the reference solution, the bath should be replaced.

The intended application and meet the requirements of ISO 3452- 2 (*Non-destructive testing – Penetrant testing – Part 2: Testing of penetrant materials*). A specific statement by the manufacturer is required, but this may be in the form of a letter, certificate, technical leaflet, or may be included in the labelling of the product.

When undertaking fluorescent penetrant examination, the intensity of UV (A) light illumination at the inspection surface shall be checked as frequently as necessary to monitor possible deterioration of the illumination. (Where grimy, dusty or other contaminating environments are involved, checking should be carried out each time the equipment is used). These checks require the use of a calibrated UV (A) light meter.

When non-fluorescent (i.e. colour contrast) penetrant examination is carried out, the intensity of illumination at the inspection surface shall be checked at least once every three months where illumination is controlled on a long term basis, and should be checked each time the equipment is used in situations where illumination may be variable from test to test (e.g. in daylight conditions). These checks require the use of a calibrated white light meter.

Standard flaw test pieces should be used to check the process. The use of test pieces is not normally specified for portable test kits. The temperatures of baths and water washes should be monitored. Where the temperature of the test item is close to specification limits then the temperature of that item should be measured. The pressure of water washes and compressed air blow-offs should be measured where values are specified in testing standards or procedures.

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The calibration of reference measuring equipment used for in-house calibration of NDT related instruments and probes shall be traceable to (international) standards and shall be evidenced by a certificate, issued by a body in accordance with the ILAC P10 policy.

**Liquid Penetrant Equipment, calibration and calibration intervals**

**System Performance Check in PT**

System performance checks involve processing a reference (test) specimen (panel) with known defects to determine if the process will reveal discontinuities of the size required. The specimen must be processed following the same procedure used to process production parts. A system performance check is typically required daily, at the reactivation of a system after maintenance or repairs, or any time the system is suspected of being out of control. As with penetrant inspections in general, results are directly dependent on the skill of the operator and, therefore, each operator should process a panel.

The ideal specimen is a production item that has natural defects of the minimum acceptable size. Some specifications mention the type and size of the defects that must be present in the specimen and to be detected. Surface finish affects the washability so the reference specimen should have the same surface finish as the production parts being processed.

If penetrant systems with different sensitivity levels are being used, there should be a separate reference specimen for each system specimens that can be used if a standard part is not available. The most commonly used reference specimen is the TAM or PSM panel. These panels are usually made of stainless steel that has been chrome plated on one half and surfaced finished on the other half to produce the desired roughness. The chrome plated section is impacted from the back side to produce a starburst set of cracks in the chrome. There are five impacted areas to produce range of crack sizes. Each panel has a characteristic signature and variances in that signature are indications of process variance. Panel patterns as well as brightness are indicators of process consistency or variance.

Care of system performance check reference panels is critical. Panels should be handled carefully to avoid damage. They should be cleaned thoroughly between uses and storage in a solvent is generally recommended. Before processing a panel, it should be inspected under UV light to make sure that it is clean and not already producing an indication.

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## Annex F

### Eddy Current Instrument - Calibration and calibration intervals

A list of all reference blocks, control specimens, reference pieces and calibration blocks should be kept with details of the main characteristics: (e.g. material, conductivity, manufacture, heat treatment).

For portable equipment, a reference or calibration block, dimensionally certified by the manufacturer for dimensional (including surface roughness) and material properties (such as alloy, heat treatment, electric conductivity permeability) should normally be used for checking the response of the equipment to known flaws. For specialised applications, such as tube testing, reference standards should be prepared from material of the same alloy and nominal dimensions as the product to be tested. The dimensions of holes or notches and the thickness of the calibration piece shall be certified by the manufacturer or established in-house by means which are traceable to national standards. Wear on the testing face may reduce the thickness of the sensitivity block or calibration piece and hence the slot depth.

For automatic eddy current testing of tubes, reference standards should be prepared from material of the same alloy and nominal dimensions as the tube to be tested. The dimensions of holes or notches and the thickness of the calibration piece shall be certified by the manufacturer or established in-house by means which are traceable to (inter)national standards. Wear on the testing face may reduce the thickness of the sensitivity block or calibration piece and hence the slot depth.

Where eddy current examination is used for sorting of materials or products, reference test standards shall be prepared from the same material, heat treatment and nominal dimensions as the materials or products to be tested.

The reference standards shall be carefully maintained and shall not be used as working standards. The calibration of reference measuring equipment used for in-house calibration shall be *traceable to (inter)national standards and shall be evidenced by certificate issued by body in accordance with the ILAC P10 policy.*

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Testing units, probes and connecting cables should be carefully stored. Reference blocks, control specimens and calibration blocks should be stored to prevent corrosion occurring, mechanical damage, high temperature and, if appropriate, accidental magnetization.

Any change in the probe, extension cables, eddy current instruments, recording media or any parts of the equipment shall require re-calibration.

Where automated test equipment is used, special attention shall be paid to the qualifications and training of operators, the system for the identification of defects, and data storage. Checks and if necessary corrections should be made to ensure the correct geometric position of the probe in relation to the output signal.

### **Calibration in ET**

In eddy current testing, several types of calibration must be carried out.

In eddy current testing, the use of calibration standards in setting up the equipment is particularly important since signals are affected by many different variables and slight changes in equipment setup can drastically alter the appearance of a signal.

The most useful information is obtained when comparing the results from an unknown object to results from a similar object with well characterized features and defects. In almost all cases, eddy current inspection procedures require the equipment to be configured using reference standards.

In eddy current testing reference standards are used to setup the equipment to produce a recognizable signal or set of signals from a defect or set of defects. In many cases, the appearance of a test signal can be related to the appearance of a signal from a known defect on the reference standard to estimate the size of a defect in the test component. Signals that vary significantly from the responses produced by the reference standard must be further investigated to determine the source of the signal.

The reference standard should be of the same material as the test article. If this is not possible or practical, it should be of material that has the same electrical conductivity and magnetic permeability. Component features (material thickness, geometry, etc.) should be the same in the reference standard as those in the test region of interest. If the reference standard is the type with intentional defects, these defects should be as representative of actual defects in the test component as possible. The closer the reference standard is to the actual test component, the better. However, since cracks and corrosion damage are often difficult and costly to produce, artificial defects are commonly used. Narrow notches produced with electron discharge machining (EDM) and saw cuts are commonly used to represent cracks, and drilled holes are often used to simulate corrosion pitting.

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cases the reference standard used in Eddy Current Testing is called Sensitivity block: reference block with dimensional and material relations with the part to be tested and the expected defects. In Eddy Current usually (sub) surface slots (EDM, electro discharged machined) in the block assure the possibility of adjusting the instrument-probe combination to apply the applicable inspection sensitivity.

Any other terminology as mentioned in this document used for a calibration and/or a reference standard e.g. “control specimen” shall be clearly explained when used.

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