SKIM AKREDITASI MAKMAL MALAYSIA (SAMM)
LABORATORY ACCREDITATION SCHEME OF MALAYSIA

SC 1.5 – SPECIFIC CRITERIA FOR ACCREDITATION OF MECHANICAL TESTING AND NON-DESTRUCTIVE TESTING (NDT)

Issue 2, 30 April 2020

(Supplementary to MS ISO/IEC 17025)

MS ISO/IEC 17025

JABATAN STANDARD MALAYSIA
Department of Standards Malaysia

TABLE OF CONTENTS

Introduction

The SC 1.5 document sets out the specific requirements for a mechanical testing and/ or Non-Destructive Test (NDT) laboratory need to comply with.

This document shall be read in conjunction with MS ISO/IEC 17025, *Skim Akreditasi Makmal Malaysia* (SAMM) policies and other relevant requirements published by Department of Standards Malaysia (Standards Malaysia).

The clause numbers in this document correspond to those of MS ISO/ IEC 17025 but since not all clauses require additional requirements, the numbering may not be continuous.

1 Scope

Standards Malaysia accreditation does not constitute a blanket approval of all laboratory's activities. Therefore, it is necessary to identify those activities for which accreditation are granted. The classes of test provide the framework within which the scope of accreditation is expressed.

These classes and subclasses do not constitute any restriction on the work that a laboratory can perform, but provide a convenient means of expressing a laboratory's recognised capability.

Classes of test appropriate to mechanical testing and NDT laboratories are listed in **Appendix 1**. These classes are an arbitrary subdivision of the potential range of activities involved in mechanical testing and NDT laboratories on the basis of the types of samples being tested, the scientific disciplines involved, and the test methods employed.

2 Normative reference

MS ISO/IEC 17025 - General requirements for the competence of testing and calibration laboratories.

The undated references indicate the latest edition of the referenced documents, including any amendments.

3 Terms and definitions

None.

4 General requirements

Same as in MS ISO/IEC 17025.

5 Structural requirements

Same as in MS ISO/IEC 17025.

6 Resource requirements

6.1 General

Same as in MS ISO/IEC 17025.

6.2 Personnel

6.2.1 Mechanical and/or NDT testings shall be performed by competent personnel or supervised by authorised personnel.

6.2.2 On-going competence should be monitored on regular basis. Records on competency shall be available. Where a method or technique is not in regular use, verification of personnel performance before testing is necessary.

6.2.3 Particular attention shall be given to the following aspects:

(a) There shall be clearly defined and recognisable lines of authority and responsibility within the organisation, with each personnel being aware of both the extent and the limitations of their own responsibility.

(b) Laboratory personnel shall only be allocated duties that commensurate with their knowledge and experience. They shall be provided with the direction or supervision needed for effective performance of their duties. Authorisation and up to date competency records (training records) shall be available for all personnel carrying out testing work.

(c) Competency of personnel is assessed by peer review during practical demonstrations. Some areas of expertise, where tests involve technical judgement e.g. NDT, shall meet standard or regulatory requirements as prerequisites.

6.2.4 Approved Signatory

Same as requirements in clauses 4 and 5 of SAMM Policy (SP6) - Requirements for SAMM Approved Signatory. In addition,

(a) The laboratory shall have at least one laboratory personnel who is qualified as approved signatory in the testing being undertaken. Requirements for Approved Signatories are detailed in SAMM Policy 6.

(b) The signatories for NDT shall be qualified, have 2 years of relevant supervisory experience and certified to **minimum**:

i) NDT certification Level II of *Sijil Kemahiran Malaysia* by ***Jabatan Pembangunan Kemahiran*** (Department of Skills Development) or equivalent NDT certification schemes by any qualification bodies certified to ISO 9712, such as Personnel Certification in Non-Destructive Testing (PCN) by British Institute for Non-Destructive Testing (BINDT) or ASNT Central Certification Program (ACCP) by American Society for Non-destructive Testing (ASNT) or Australian

Institute for Non-Destructive Testing (AINDT), etc.

ii) In addition to i) above, personnel performing radiographic testing shall obtain approval from the Atomic Energy Licensing Board (AELB).

Note:
The requirements of AELB may be referred in http://www.aelb.gov.my/malay/dokumen/notis-pemberitahuan/Bil032013.pdf. The latest edition of the referenced document, including any amendments applies.

6.3 Facilities and environmental conditions

Same as requirements in MS ISO/IEC 17025.

6.3.1 When highly precise measurements are to be made, the following factors may assume greater importance:

(a) Isolation from sources of mechanical vibration and shock likely to have a detrimental effect on sensitive instruments (e.g. high accuracy balances).

(b) Adequate ventilation when fumes are created by the tests such as in bitumen testing.

(c) Temperature and humidity control of the laboratory as specified in the relevant test method (e.g. paper testing).

(d) Protection from excessive levels of dirt and dust.

(e) Suitable equipment and areas for the preparation of test specimens such as in tensile testing and metallography.

(f) Isolation from stray electric and magnetic fields, particularly for thermocouples, strain gauges and other sensitive low output devices.

(g) Electromagnetic interference between items of test equipment and computers.

6.3.2 Safety

Some types of tests have very specific safety requirements, which shall be met, e.g. radiographic, and these may be subject to regulatory requirements.

Other tests will have less specific but otherwise significant safety concerns, e.g. compression tests on concrete. It is expected that accredited laboratories will have considered, and provide appropriate safety procedures to cover items such as:

(a) Noise - from equipment such as mechanical sieve shakers and compaction hammers.

(b) Ventilation - adequate air flows in controlled environments - protection from corrosive or toxic fumes.

(c) Personal Protection - safety clothing, etc.

(d) Physical Protection - safety screens on equipment such as compression testers.

Note:
Occupational Safety and Health Act 1994 (Act 514) and Factories and Machinery Act 1967-revised 1974 (Act 139) places specific legal obligations on all employers, including laboratories. Safety is outside the scope of accreditation and will not be assessed during an on-site laboratory accreditation assessment. If, in the opinion of the assessment team, a safety issue is observed during an assessment, it will be reported to the laboratory, as required by the Acts. The reporting of a safety issue will not indicate that a comprehensive safety assessment has been carried out.

6.4 Equipment

Same as in MS ISO/IEC 17025.

6.4.1 Guidelines on calibration requirements and recalibration intervals for equipment are detailed in **Appendix 2**. The guidelines set out **maximum** periods of use before equipment must be recalibrated. Further details are in ILAC-G24 Document.

6.4.2 Reduced or extended calibration intervals may be accepted based on factors such as history of stability, accuracy required and ability of personnel to perform regular checks. It is the responsibility of the laboratory to provide clear evidence that its calibration system, and any changes to an existing system, will ensure that confidence in the equipment can be maintained.

6.4.3 Equipment that is sensitive to movement, such as force, impact, hardness testing machines, heat enclosures and balances, will generally require full recalibration if they are moved.

6.4.4 A laboratory, which uses a computerised testing system, shall comply with the following criteria:

(a) The optimum calibration procedure for physical testing systems will depend upon the accessibility of individual components of the system, especially their input or output signals.

If a testing instrument **cannot be** isolated from the data processing system, the system as a whole shall be calibrated either statically or dynamically. Calibrating the complete system is the preferred alternative.

If the testing instrument **can be** isolated from the data processing system, each component of the system can be calibrated or verified separately. The testing instrument can be calibrated (again, statically, or dynamically) in the conventional manner and a separate verification of the data processing system, including any interfacing systems, can be undertaken.

(b) The computer programme should be comprehensive in its coverage of the testing process and should have been checked at points covering the

whole range of likely inputs and outputs.

(c) The programme should allow the operator to detect errors in data input and to monitor the progress of the test.

(d) The system should be capable of being checked for error-free operation with respect to data capture, data processing, and freedom from sources of external interference. Where appropriate, manually checked data sets (or artefacts) should be available for regular system checks.

6.5 Metrological traceability

Same as in MS ISO/IEC 17025 and SAMM Policy (SP2) - Policy on the Traceability of Measurement Results.

6.6 Externally provided products and services

Same as in MS ISO/IEC 17025.

7 Process requirements

7.1 Review of requests, tenders and contracts

Same as in MS ISO/IEC 17025.

7.2 Selection and verification of methods

(a) Accreditation is normally granted only for internationally or nationally accepted standard test methods or non-standard methods (in-house methods) that have been appropriately verified/validated, and which are performed regularly. Refer to **Table 1**. The extent of a laboratory's scope of accreditation will therefore vary with the range of work performed, the scope and complexity of the tests involved, the competence and organisation of laboratory personnel and the level of technology available in the laboratory.

(b) In-house methods could include but are not restricted to:

i) methods developed in the laboratory;

ii) methods developed by customer/manufacturer;

iii) methods developed for an industry group;

iv) modified standard test methods; and

v) method published in the scientific literature with/without any performance data.

(c) Validation of test methods shall involve, as appropriate, the use of certified reference materials, participation in inter-laboratory comparison/ proficiency test programmes, comparison with standard test methods, determination of method precision, limits of detection, uncertainties of

measurement, etc.

(d) Standard test methods should be used whenever possible in order to ensure comparability of test results among laboratories.

(e) For NDT, the procedures shall be approved and authorised by NDT level III personnel. The NDT instructions shall be approved by either a Level II or a Level III personnel.

7.3 Sampling

Same as in MS ISO/IEC 17025.

7.4 Handling of test and calibration items

Same as in MS ISO/IEC 17025.

7.5 Technical Records

Same as in MS ISO/IEC 17025.

7.6 Evaluation of measurement uncertainty

Same as in MS ISO/IEC 17025 and SAMM Policy (SP5) - Measurement Uncertainty Requirements for SAMM Testing Laboratories.

Evaluation of measurement uncertainty is not required where test results are qualitative (i.e. nonnumeric such as pass/fail or fracture/no fracture), unless it is required by a testing standard or customer's specification.

7.7 Ensuring the validity of results

Same as in MS ISO/IEC 17025 and SAMM Policy (SP4) - Policy for participation in proficiency testing activities.

7.8 Reporting the results

Same as in MS ISO/IEC 17025.

7.9 Complaints

Same as in MS ISO/IEC 17025.

7.10 Nonconforming work

Same as in MS ISO/IEC 17025.

7.11 Control of data and information management

Same as in MS ISO/IEC 17025.

8 Management system requirements

Same as in MS ISO/IEC 17025.

Table 1: Validation or Verification requirements based on methods selected

<table>
<tr><th colspan="2">Test Method Description</th><th>Validation or Verification requirements</th><th>Method Reference No/ID (Example)</th></tr>
<tr><td colspan="2">Standard published method</td><td>Confirmation of published performance characteristics</td><td><Method>, <year/edition>,
<section no.> e.g.:
MS 1: 1996 Clause 12.2 ASTM A370-03a</td></tr>
<tr><td colspan="4">In-house test method</td></tr>
<tr><td colspan="2">Method developed by laboratory</td><td>Full validation</td><td><In-house method>, <ref. no.> e.g.:
In-house method: 1234-A</td></tr>
<tr><td colspan="2">Method developed by customer/manufacturer</td><td>Full validation</td><td><In-house method>, <ref. no.><based on xxxx >

In House Method e.g.:

In-House Method MGT/001/ES-X 60210
Based on MS 30: Part 5: 1995, Section 2</td></tr>
<tr><td rowspan="2">Method developed for an industry group</td><td>Absence of performance characteristics</td><td>Full validation</td><td><Method>, <year/edition> e.g.:
ASME VIII UCS (56)</td></tr>
<tr><td colspan="2">Confirmation of published performance characteristics</td><td><Method>, <year/edition>,
<section no.> e.g.:
API 2H-1993 Annex S-4 ASME B30.20: 2006
Section 20-1.3.8</td></tr>
<tr><td colspan="2">Modified standard methods</td><td>Full validation</td><td><In-house method>, <ref. no.>, <based on std. method>,
<technique (sample preparation & detection, where applicable)> e.g.:
In-house method QMCL/014/2007 based on MS 522: Part 2:2005 Clause 3</td></tr>
<tr><td colspan="2">Method published in the scientific literature with any performance data</td><td>Confirmation of published performance characteristics</td><td rowspan="2"><In-house method>, <ref. no.>, <based on xxxx >
e.g.:
In house method ABC, based on Practical Guidebook for Radioisotope-based Technology in Industry, IAEA/RCA RAS/8/078 March 1999.</td></tr>
<tr><td colspan="2">Method published in the scientific literature without any performance data</td><td>Full validation</td></tr>
</table>

Appendix 1

Classes of Testing: Mechanical and NDT

A. Mechanical Testing

Mechanical and physical testings of material/ products that include metallurgical tests to determine the elemental analysis and microstructures.

Note: * All tests referring to relevant products standard

1. Metals and metal products
- Bend and re-bend
- Brinell hardness
- Charpy impact
- Compression, transverse and shear
- Drop-weight
- Fracture toughness
- Micro hardness
- Rebound hardness
- Rockwell hardness
- Stress-rupture
- Superficial Rockwell hardness
- Vickers hardness
- Tensile
- Others

2. Welds and welded test specimens
- Bend
- Corrosion
- Cracking
- Drop-weight
- Fillet-break
- Fracture toughness
- Hardness
- Impact
- Macroscopic examinations
- Nick-break
- Shear
- Tension
- Others

3. Lifting gear, chain, wire rope and fittings
- Breaking Load
- Proof load
- Tension
- Others

4. Fibre rope and cordage
- Tension
- Others

5. Springs and energy absorbing devices
- Compression
- Tension
- Torsion
- Others

6. Threaded fasteners
- Dimension
- Drive
- Proof load
- Stripping
- Tensile
- Tension-torque
- Torsion
- Others

7. Ceramic products
- Abrasion
- Crazing
- Dimensional
- Flushing
- Glazing
- Loading
- Marking
- Staining
- Tolerance
- Warpage
- Others

8. Concrete (fresh and hardened)
- Abrasion resistance
- Air content
- Cement content
- Creep
- Compression
- Density
- Drying shrinkage
- Flexural strength
- Flow table
- Initial surface absorption (ISAT)
- Modulus of elasticity
- Rapid chloride permeability (RCPT)
- Sampling
- Setting time
- Slump
- Splitting tensile
- Standard consistence
- Water absorption
- Water permeability
- Others

9. Cement / concrete based products
- Abrasion
- Breaking
- Compressive strength
- Dimension
- Dynamic
- Fire propagation / resistance
- Flexural
- Load
- Sampling
- Shrinkage
- Splitting
- Water absorption
- Others

10. Refractories
- Cold crushing strength
- Density and porosity
- Durability
- Hydrogen diffusivity
- Modulus of elasticity
- Modulus of rupture
- Particle Size Determination (PSD)
- Others

11. Rocks
- Compressive strength
- Elastic moduli
- Petrographic examination
- Point load strength
- Strength
- Others

12. Cements and pozzolanic materials
- Air content
- Compressive strength
- Fineness
- Flexural
- Sampling
- Setting time
- Soundness
- Standard consistence
- Water absorption
- Others

13. Bituminous materials and Bituminous pavement (solid and liquid)
- Abrasion
- Bitumen extraction
- Bitumen short term aging
- Brittleness
- Ductility
- Elastic recovery
- Flash and fire point
- Float
- Fraass breaking point
- Long term aging (pressure aging vessel)
- Loss on heating
- Marshall stability
- Penetration
- Polish stone value
- Rheology
- Sampling
- Softening point
- Specific gravity
- Thickness
- Viscosity
- Water content
- Others

14. Soils
- California Bearing Ratio (CBR)
- Classification
- Compaction (Proctor)
- Consolidation
- Density
- Field density (FDT)
- Linear shrinkage
- Liquid limit
- Moisture content
- Outdoor weathering reactivity
- Plastic limit
- Sampling
- Specific gravity
- Strength
- Others

15. Timber and timber products
- Bending strength
- Block shear
- Compression strength
- Delamination
- Density
- Flexural strength
- Modulus of elasticity
- Moisture content
- Reaction to fire
- Rolling shear strength and stiffness
- Shear strength
- Specific gravity
- Stress grading timber
- Tensile strength
- Torsion
- Others

16. Building boards and plywood
- Adhesion of plies
- Bonding
- Density and moisture content
- Fire resistance
- Flexural strength
- Joint strength
- Load
- Shear strength
- Tensile strength
- Water resistance
- Others

17. Glass and glass products
- Acid and alkaline
- Annealing point and strain point
- Boil
- Dimension and shape
- Drop ball
- Emissivity
- Fragmentation
- Opacity
- Pendulum impact
- Softening point
- Sound
- Static puncture
- Surface compression
- Visible light/solar transmittance
- Weathering
- Others

18. Clays and clay products
- Abrasion
- Breaking strength
- Performance
- Chemical and staining
- Modulus of Rupture
- Compression
- Crushing
- Dimension
- Flexural
- Porosity and shrinkage
- Water absorption
- Water leakage
- Others

19. Aggregates
- Aggregate crushing value (ACV)
- Aggregate impact value (AIV)
- Angularity number
- Bulk density and water absorption
- Sieve analysis
- Chloride content
- Clay, silt and dust content
- Degradation tests
- Elongation
- Fine particle size distribution
- Flakiness index
- Friable particle
- Light weight particle
- Los Angeles value
- Methylene blue
- Moisture content
- Organic impurities
- Petrographic examination
- Polished stone value
- Potential alkali reactivity by mortar bar
- Sampling
- Sand equivalent
- Shell content
- Soundness
- Sulphur content
- Ten percent fines value (TFV)
- Wet/dry strength ratio
- Others

20. Pulpwood, pulp, paper, paperboard and products
- Adhesives
- Burst
- Compression
- Liquid absorption
- Mechanical properties
- Optical properties
- Permeability
- Sampling
- Surface properties
- Tear
- Tension
- Others

21. Rubber and related products
- Abrasion
- Ageing and environmental
- Belting
- Brittleness
- Compression
- Curing characteristics with oscillating disc Rheometer
- Density and specific gravity
- Elastomeric bearings
- Electrical resistivity
- Flammability
- Flexing
- Hardness
- Low temperature
- Mooney Accelerated Storage Hardening Test (MASHT)
- Mooney viscosity
- Ozone resistance
- Plasticity retention index (PRI)
- Sampling
- Shear
- Swelling in liquids
- Tear
- Tension
- Tension set
- Viscosity
- Vulcanisation characteristics
- Wallace Accelerated Storage Hardening Test (WASHT)
- Others

22. Gypsum and gypsum products
- Adhesion
- Compressive strength
- Core cohesion at high temperature
- Dimension
- Flexural strength
- Flow table
- Hardness
- Setting time
- Shear strength
- Water absorption
- Others

23. Textiles and related products
- Colour fastness
- Flammability
- Sampling
- Tension
- Tear burst
- Wear
- Others

24. Tyres
- Bead unseating resistance
- Dimensional
- Endurance
- High speed performance
- Load/speed
- Plunger energy
- Strength
- Treadwear indicators
- Others

25. Automative parts
- Accelerated exposure
- Adhesion of coating
- Cleanliness
- Damp heat, cyclic
- Damp heat, steady state
- Dry heat
- Heat aging
- Heat resistance
- Humidity resistance
- Low temperature resistance
- Random vibration
- Rapid change of temperature
- Resonance frequency detection
- Salt Spray
- Scoring and condensation
- Solvent resistance friction
- Solvent resistance immersion
- Temperature cycle
- Vibration Endurance
- Vibration Function (sinusoidal)
- Others

26. Seat belts and similar devices
- Abrasion
- Adjusting force
- Breaking strength
- Corrosion resistance
- Durability
- Dust resistance
- Dynamic
- Exposure to water
- Microslip
- Releasing force
- Retracing force
- Strength
- Temperature conditioning
- Tilt lock
- Vehicle sensitivity
- Webbing sensitivity
- Others

27. Personal Protective Equipment (PPE)

a. Safety Footwear & Occupational Footwear
- Abrasion resistance
- Behaviour of toecaps
- Breaking strength of shoelace
- Compression resistance
- Construction
- Flexing resistance
- Heat insulation
- Height of the upper
- Hydrolysis
- Impact resistance
- Insole thickness material
- Interlayer bond strength outsole
- Internal length of toecaps
- Leakproofness
- Outsole thickness
- Penetration resistance
- Seat region (design B, C, D, E)
- Sole adhesion
- Specific ergonomic features
- Tear strength
- Tensile properties
- Thickness
- Upper flexing resistance-Bally flex
- Upper/outsole bond strength
- Water absorption/desorption
- Water vapour permeability and coefficient

b. Protective Helmet for Motorcyclist
- Chin Strap Micro-slip
- Detaching
- Dynamic
- Impact absorption
- Impact Energy Attenuation
- Penetration
- Projection and surface friction
- Resistance to abrasion
- Retention
- Rigidity

c. Protective Visor for Motorcyclist
- Light diffusion
- Luminous transmittance
- Mechanical characteristics
- Mist retardant
- Optical quality and scratch resistance
- Recognition of signal light
- Refractive powers
- Spectral transmittance

28. Packages and containers
- Aperture and Closure
- Compression
- Dynamic
- Fill Line Indicator
- Free fall drop
- Hydraulic pressure
- Internal pressure (hydraulic)
- Leakproofness
- Mechanical – shock test
- Penetration
- Random vibration
- Righting
- Stability
- Stacking
- Strength of handle
- Tear
- Top Lift
- Topple
- Others

29. Environmental Tests
- Conditioning
- Erosion
- Noise
- Vibration
- Others

30. Plastics and related products
- Ageing and environmental
- Bend
- Burst
- Compression
- Elongation at break
- Flammability
- Flow properties
- Hardness
- Heat deflection temperature
- Heat distortion
- Hydrostatic internal pressure
- Impact strength
- Longitudinal/heat reversion
- Low temperature
- Melt mass-flow rate (MFR)
- Sampling
- Shear
- Specific gravity
- Tear
- Tensile strength and Yield strength
- Wear and abrasion
- Others

31. Leather and leather products

32. Gasket, seals and packing
- Fire
- Gasket material
- High pressure /temperature
- Others

33. Adhesive and sealers
- Adhesion of the coating (hot water soak test)
- Cure
- Peel strength
- Others

34. Adhesive tapes
- Peel adhesion strength
- Adhesive bond strength
- Others

35. Pipes and pipelines, hoses, valves and fittings
- Acoustic
- Adhesion
- Burst
- Cryogenic
- Dimension
- Endurance
- Fire
- Flow rate
- Fugitive emission
- Head loss
- Holiday detector
- Hydrostatic pressure
- Leak tightness
- Pneumatic pressure
- Others

36. Mechanical tests on assemblies
- Shear resistance of framed walls
- Static test for lumber
- Strength test of panels for building construction
- Structural performance of exterior windows / doors / curtain walls, etc.
- Wind load resistance
- Others

37. Plumbing and drainage fittings
- Internal pressure (hydrostatic pressure)
- Longitudinal reversion
- Noise test
- Pendulum impact strength
- Thermal cycling
- Others

38. Furniture
- Dimension
- Durability
- Impact
- Safety
- Stability
- Strength
- Others

Metallurgical

39. Microstructural tests on metallic & non-metallic alloys
- Anodizing thickness
- Case depth of surface defects
- Depth of cladding
- Depth of surface defects
- Grain size
- Hydrogen embrittlement
- Macroscopic examination of steel
- Macroscopic examination of wrought products
- Non-metallic inclusion content
- Proportion of size
- Resistance to stress-corrosion cracking
- Susceptibility of brass to dezincification
- Others

40. Coatings
- Abrasion
- Acoustic
- Adhesion strength
- Alkaline resistance
- Compressive strength
- Corrosion resistance
- Impact and scratch resistance
- In-situ concrete lining
- Salt spray
- Surface area
- Tensile strength
- Thickness
- Water absorption
- Water pressure
- Others

41. Ferrous, non-Ferrous and metallic materials Elemental Analysis (non-chemical method)
- Corrosion
- Ferrite count
- Metallography
- Microstructure identification
- Thermal Conductivity Detector Method (TCD Method)
- Others

42. Mechanical equipment / toys and games/ sporting and recreational equipment / respiratory protective devices
- Functional and performance
- Endurance

43. Catalysts and catalyst carriers
- Surface area
- Pore size
- Others

44. Other Tests

B. Non-Destructive Testing (NDT)

Examination of material, component and assembly to detect discontinuities without damaging the material, component or assembly.

Note: * All tests referring to relevant products standard

1. **Metals and metal products**
   - Acoustic emission testing (AET)
   - Eddy current testing (ET)
   - Infrared thermographic testing (IRT)
   - Liquid penetrant testing (PT)
   - Magnetic particle testing (MT) (ferromagnetic only)
   - Radiographic testing (RT)
   - Ultrasonic testing (UT)
   - Visual testing (VT)
   - Others

2. **Welds and welded test specimens**
   - Acoustic emission testing (AET)
   - Eddy current testing (ET)
   - Infrared thermographic testing (IRT)
   - Liquid penetrant testing (PT)
   - Magnetic particle testing (MT) (ferromagnetic only)
   - Radiographic testing (RT)
   - Ultrasonic testing (UT)
   - Visual testing (VT)
   - Others

3. **Lifting gear, chain, wire rope and fittings**
   - Liquid penetrant testing (PT)
   - Magnetic flux leakage (MFL) (ferromagnetic only)
   - Magnetic particle testing (MT) (ferromagnetic only)
   - Radiographic testing (RT)
   - Ultrasonic testing (UT)
   - Visual testing (VT)
   - Others

4. **Fibre rope and cordage**
   - Visual testing (VT)
   - Others

5. **Springs and energy absorbing devices**
   - Liquid penetrant testing (PT)
   - Magnetic particle testing (MT) (ferromagnetic only)
   - Others

6. **Threaded fasteners**
   - Liquid penetrant testing (PT)
   - Magnetic particle testing (MT) (ferromagnetic only)
   - Others

7. **Ceramic products**
   - Liquid penetrant testing (PT)
   - Visual testing (VT)
   - Others

8. **Concrete (fresh)**
   - Ultrasonic pulse velocity (UPV)
   - Others

9. **Concrete (hardened)**
   - Carbonation test
   - Electromagnetic bar locator
   - Ground penetrating radar (GPR)
   - Infrared thermographic testing (IRT)
   - Radiographic testing (RT)
   - Rebound hammer
   - Ultrasonic pulse velocity (UPV)
   - Others

10. **Cement / concrete based products**
    - Rebound hammer
    - Ultrasonic pulse velocity (UPV)
    - Others

11. **Refractories**
    - Rebound hammer
    - Ultrasonic pulse velocity (UPV)
    - Others

12. **Rocks**
    - Ultrasonic pulse velocity (UPV)
    - Discontinuity mapping
    - Terrain laser scanning (TLS)
    - Others

13. **Cements and pozzolanic materials**
    - Ultrasonic pulse velocity (UPV)
    - Others

14. **Bituminous materials and Bituminous pavement (solid)**
    - Ground penetrating radar (GPR)
    - Ultrasonic pulse velocity (UPV)
    - Others

15. **Soils**
    - Nuclear density moisture gauge
    - Others

16. **Timber and timber products**
    - Ultrasonic pulse velocity (UPV)
    - Others

17. **Building boards and plywood**
    - Nuclear density moisture gauge
    - Others

18. **Glass and glass products**
    - Ultrasonic pulse velocity (UPV)
    - Others

19. **Rubber and related products**
    - Radiographic testing (RT)
    - Ultrasonic testing (UT)
    - Others

20. **Tyres**
    - Radiographic testing (RT)
    - Ultrasonic testing (UT)
    - Others

21. **Automative parts**
    - Eddy current testing (ET)
    - Liquid penetrant testing (PT)
    - Magnetic particle testing (MT) (ferromagnetic only)
    - Radiographic testing (RT)
    - Ultrasonic testing (UT)
    - Others

22. Plastics and related products
- Liquid penetrant testing (PT)
- Ultrasonic testing (UT)
- Others

23. Pipes and pipelines, hoses, valves and fittings
- Liquid penetrant testing (PT)
- Magnetic particle testing (MT) (ferromagnetic only)
- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Others

24. Mechanical assemblies
- Eddy current testing (ET)
- Liquid penetrant testing (PT)
- Magnetic particle testing (MT) (ferromagnetic only)
- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Others

Metallurgical

25. Coatings
- Eddy current testing (ET)
- Others

26. Elemental Analysis (Non-chemical Method)
- Eddy current testing (ET)
- X-ray Fluorescent (XRF)
- Others

27. Metal powders and sintered test
- Liquid penetrant testing (PT)
- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Others

Mechanical Equipment

28. Cylinders and other pressure vessels
- Acoustic emission testing (AET)
- Infrared thermographic testing (IRT)
- Liquid penetrant testing (PT)
- Magnetic particle testing (MT) (ferromagnetic only)
- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Visual testing (VT)
- Others

29. Fans and blowers
- Vibration analysis
- Others

30. Compressors
- Vibration analysis
- Others

31. Pumps
- Vibration analysis
- Others

32. Engines & generators
- Vibration analysis
- Others

33. Gas equipment & related products
- Liquid penetrant testing (PT)
- Magnetic particle testing (MT) (ferromagnetic only)
- Radiographic testing (RT)
- Ultrasonic testing (UT)
- Others

Appendix 2

Equipment Calibration Intervals

Table 2 sets out the normal periods between successive calibrations for a number of reference standards and measuring instruments. It must be stressed that each period is generally considered to be the maximum appropriate in each case providing that the other criteria as specified below are met:

a) The equipment is fit for purpose, and
b) The laboratory has both the equipment capability and personnel expertise to perform adequate internal checks, and
c) If any suspicion or indication of overloading or mishandling arises, the equipment is checked immediately and thereafter at frequent intervals until it can be shown that stability has not been impaired.

Where the above criteria cannot be met, appropriately shorter intervals may be necessary. It is possible to consider submissions for extension of calibration intervals based on factors such as history of stability, frequency of use, accuracy required and ability of personnel to perform regular checks. Application of the requirements of ISO 10012, Parts 1 and 2, need to be considered when seeking an extension of intervals. Where calibrations have been performed as above, adequate records of these measurements must be maintained.

Note: *Checks or calibrations indicated * can be done internally by a laboratory providing they possess the necessary reference equipment, documented procedure and technical competence*.

Table 2 a): Calibrations interval for reference standards and measuring instruments in mechanical testing

No.	Item of equipment	Calibration interval	Checking interval	General comments
1.	Accelerometers	One year		
2.	Anemometers	One year		
3.	Balances and Weighing Scales	Three years		By an accredited calibration authority. Twelve months service recommended
			*Each weighing	Zero check
			*One month	One-point check.
			*Six monthly	Repeatability check.
4.	Barometers	Three months (single point)		
5.	Dial Gauges	*Two years		
6.	Dies & Cutters			
7.	**Extensometers**			
	a) Level & mirror types	5 years		
	b) Micrometer screw type	5 years		
	c) Dial indicator type	2 years		
	d) Recording type (with electrical output)	2 years		

No.	Item of equipment	Calibration interval	Checking interval	General comments
8.	**Force Testing Machines**			
	Tension, Compression, & Universal	One year		Some Standards specify the recalibration period
	TYPE 1 – Mechanical Force Measuring System			
	a) Dead weight	Five years		
	b) Knife edge, lever and steelyard	Five years		
	c) Pendulum dynamometer	Two years		
	d) Chain testing and similar machines in frequent use	One year		
	TYPE 2 – Hydraulic or Pneumatic Force Measuring Systems			
	a) Mechanical system incorporating a pneumatic or hydraulic link, e.g. proportional cylinder	Two years		
	b) Bourdon Tube or diaphragm pressure gauge as force indicator	Six months		
	c) Type (b) fitted also with a master gauge which can be disconnected during normal testing	One year		Frequent checks by user of working gauge against master gauge
	d) Bourdon tube or diaphragm gauge used only as a null detector for a mechanical system	Two years		
	e) Bourdon tube with Measuring System	Two years		
	TYPE 3 – Electrical Force Measuring Systems	Two years		
9.	**Gauge Blocks**			
	a) Used as reference standards	Five years		
	b) Used as working equipment	Two years		More frequent as appropriate to usage.
10.	**Hardness Testers for Metals**			
	a) Brinell, Vickers and Rockwell machines	One year (partial) Three years (complete)	Daily check when in use	BS EN 10003 (Brinell), BS EN ISO 6507 (Vickers), BS EN 10109 (Rockwell)
	b) Portable Brinell microscopes	One year		with calibrated graticule
	c) Diamond indenters	*One year (inspection)		
11.	**Hardness Testers for Rubber Plastics and Ebonite**			
	a) Dead weight testers for rubber	Three years		BS 903 Methods N, A, L, M
	b) Dead weight testers for plastics	Three years		
	c) Meters (durometers) for rubber		Frequent checks by user on reference hardness blocks	
12.	Hydrometers	*Five years (one point)		BS 718

No.	Item of equipment	Calibration interval	Checking interval	General comments
13.	**Hygrometers**			
	a) Assman hygrometers and sling type	*Six months Five years (complete)		Compare thermometers at ambient with wick dry.
	b) Recorders accurate to ±1% RH	Two years		ASTM E77
	c) Other recorders including hair types	Weekly (with Assman hygrometer)		
	d) Digital instruments	One year		
14.	**Impact Testing Machines (Pendulum type)**			
	a) Charpy, Izod and Universal testers for metals	One year (complete calibration)	Frequent inspection by user.	BS EN 10045-2 Include verification using standard test pieces appropriate to required operating range(s).
	b) Charpy and Izod testers for plastics	One year (partial calibration) Five years (complete calibration)	Frequent inspection by user.	
	c) Notching tools		Check regularly and whenever reground.	
15.	**Length Measuring Devices**			
	a) Linearly Variable Differential Transformers		Daily or whenever used	Check against length standard such as a micrometer setting bar.
	b) Micrometers (hand)			
	i) For measurement of diameters smaller than 2.5mm and thickness less than 1.3mm	*Five years (complete)		
	ii) For measurement of diameters down to 2.5mm and thickness down to 1.3mm	*Five years (reference)		
	c) Rules	*Five years (reference)		
	d) Calipers – Vernier/Dial			
	i) Reference	*Three years (reference)		
	ii) Working	*Annual		Against a reference length standard such as gauge bars.
16.	**Masses**			
	a) Reference masses of integral construction stainless steel or nickel-chromium alloy	Five years		
	b) Masses of screw knob or sealed plug construction, made of stainless steel, nichrome, plated brass or other non-corrodible highly finished material	Three years		
	c) Masses of cast iron, carbon steel, or unplated brass	*One year *Five years		if calibrated to 1 in 10^4 if calibrated to 1 in 10^3

No.	Item of equipment	Calibration interval	Checking interval	General comments
17.	Nuclear Densometers	Two yearly	*Daily	Standard count (comparison against rolling average).
			*Six monthly	Drift and stability checks.
18.	Orifice Plates	Initial		PD ISO/TR 15377
			*Six months	Visual inspection for damage wear or contamination.
		Ten years		For orifice plates being used in window testing, a full recalibration is required after ten years.
19.	**Ovens**			
	a) Drying	*Five years	*Daily	For laboratories drying soils, a daily record of oven temperature is required. For laboratories drying aggregates, records showing temperature stability are required.
	b) Ageing	*Five years or less depending on permissible tolerances (temperature variations, recovery time, rate of ventilation)	Both drying and ageing ovens require full recalibration after major servicing.	
20.	**Pressure Gauge Testers**			
	a) Dead weight	Five years		
	b) Manometers i) liquid in glass ii) digital	Five years One year		
21.	**Pressure and Vacuum Gauges**			
	a) Test gauges for calibration of working gauges	One year		
	b) Working gauges subject to shock loading	*Six months or less depending on use		
	c) Working gauges not subject to shock loading	*One year		
22.	**Manometers**			
	a) Reference	Five years		Check against reference. Check fluid every three years.
	b) Working	*Three years		
	c) Digital	*One Year		

No.	Item of equipment	Calibration interval	Checking interval	General comments
23.	**Proving devices for calibration of force testing machines**			
	TYPE 1 – Elastic devices			
	a) Dial gauge for deflection measurement	Two years		
	b) Micrometer screw for deflection measurement (mechanical or optical indication)	Five years		
	c) Electrical deflection measurement	Two years		
	TYPE 2 – Proving levers	Two years		
	TYPE 3 – Weights	Five years		
24.	**Sieves**			
	a) Reference	* Initial		
	b) Working	*One year or less dependent on usage		
25.	**Soil Testing Machines**			
	a) Force measurement	Two years		
	b) Displacement measurement	As for appropriate instrument (e.g. dial gauge, micrometer, LVDT)		
	c) Pressure measurement	As for pressure and vacuum gauges (hardness of rubber base)		
26.	Thickness Gauges (for compressible materials)	Two years		Dial gauge, dimensions and pressure of foot
27.	**Squares**			
	a) Reference	Five years		Against a reference square
	b) Working	*Annual		
28.	**Stop Watches and Clocks**			
	a) Electric	*Twelve months		
	b) Mechanical	*Three months		
29.	**Straight Edges**			
	a) Reference	Five years		
	b) Strain rate meters	*Six months		using stop watch
30.	a) Tachometer calibrators (Tuning devices)	Five years		
	b) Tachometers	One year		

No.	Item of equipment	Calibration interval	Checking interval	General comments
31.	**Thermometers**			
	a) Reference liquid-in-glass	Five years (complete)	*Six months	Check ice point immediately after initial calibration then at least every six months
	b) Working liquid-in-glass or alternatively	Five years (complete)	*Six months	Check ice point immediately after initial calibration then at least every six months Inter-compare with reference thermometer at points in the working range every six months
	c) Electronic (sensors that are thermocouples, thermistors, or other integrated circuit devices)	One year (full calibration)		
	d) Resistance	Five years (full calibration), or when ice point drift is more than five times the uncertainty of calibration.	Six months	Check at ice point before use or at least every six months. Working hand-held resistance thermometers can be checked using the alternative procedure above for glass thermometers.
32.	**Volumetric glassware**			
	a) Flasks, pipette, burettes and measuring cylinders used for reference purposes	*Five years		
	b) Working flasks, pipettes burettes, measuring cylinders	*On commissioning		Cross check by weighing with distilled water
	c) Density bottles	*Two years		

Table 2 b): Calibrations interval for reference standards and measuring instruments in non-destructive testing (NDT)

No.	Item of equipment	Calibration interval	Checking interval	General comments
	A. Ultrasonic Testing			
1.	Probe and sensory electronics (setting up the assembly)		Each time before use	Ultrasonic standard calibration blocks
2.	Standard calibration blocks (material properties)		Initial	As per specific standard method (e.g. EN 27963, AWS, ASME or equivalent.
3.	Standard calibration blocks (surface conditions)		Each time before use	Visual examination for deterioration such as corrosion or mechanical damage.
4.	Reference standard calibration blocks (radius and other dimensional checks)	Every 5 years		By an accredited calibration laboratory or National Metrology Institute (NMI).
5.	Working standard calibration blocks (radius and other dimensional checks)		Intermediate checks every 2 years	By comparison with reference standard calibration block. If no reference standard calibration block is available, then by an accredited calibration laboratory or National Metrology Institute (NMI).
6.	Ultrasonic test sets • linearity of time base • linearity of equipment gains • sensitivity and signal to noise ratio • pulse duration.		Verified weekly or each time the equipment is used	
7.	Ultrasonic probes and systems • probe index • probe beam angle • visual checks for damage		The performance characteristics checked at least once per day or before use	
8.	Ultrasonic flaw detectors • linearity of time base • linearity of amplifier • accuracy of calibrated attenuator		Verified at intervals not exceeding twelve months	

No.	Item of equipment	Calibration interval	Checking interval	General comments
	B. Magnetic Particle Testing			
9.	Magnetic particle solution (visible/fluorescence)		Each batch	Valid manufacturer's certificate with conformance to a standard (e.g. BS, ASTM or EN).
10.	Magnetic inks (for aerosols)		Each batch	Valid manufacturer's certificate with conformance to a relevant standard. Flux indicators should be used to demonstrate the direction of flux.
11.	Magnetic particle concentration check		Each shift	As per specific standard method (e.g. ASTM, BS)
12.	Visible light level intensity checks on the test surface	As per specific standard method (e.g. ASTM, BS)		Check the level of illumination using a calibrated light meter each time before use.
13.	Black light level intensity check on the test surface			
14.	UV(A) light meter (Reference)	Yearly		By an accredited calibration laboratory or by National Metrology Institute (NMI)
15.	White light meter (Reference)			
16.	Permanent magnet and magnetic yokes		6 monthly	Check by measuring the lifting power or pull-off force in accordance with a relevant standard.
17.	Reference Weights (for checking strength of magnet)		Initial	Once calibrated for life. Calibrate by means of a calibrated balance.
18.	Gauss meter	Yearly		By an accredited calibration laboratory or National Metrology Institute (NMI).
19.	Ammeter			
	C. Radiographic Testing			
20.	Gamma Ray – Source Size X-Ray – Focal Spot Size		Initial	Manufacturer's certification with official record of dimensions.
21.	Densitometer		90 days	Calibrate against a reference density strip, which is calibrated by an accredited calibration laboratory or National Metrology Institute (NMI).
22.	Film density strip	As manufacturer's recommendation, whichever is earlier.		By an accredited calibration laboratory or National Metrology Institute (NMI)' where available. Note: Date of first usage of strip to be recorded.
23.	Survey meters	Yearly		As required by the Atomic Energy Licensing Board (AELB).
24.	Gamma projector	Yearly		As required by the Atomic Energy Licensing Board (AELB).
25.	X-ray machine	Yearly		As required by the Atomic Energy Licensing Board (AELB).
26.	Digital Radiographic. * Optical Density Step Wedges * Optical Line Pair Test Pattern	Once every 5 years		By an accredited calibration laboratory or National Metrology Institute (NMI).

No.	Item of equipment	Calibration interval	Checking interval	General comments
	D. Penetrant Testing			
27.	Non-fluorescent (aerosol) penetrant dyes		Each batch	Valid manufacturer's certificate with conformance to a relevant standard. Where possible verification against Penetrant Comparator Block.
28.	Fluorescent dyes		Each batch / per work day	Manufacturer's certificate with conformance to a relevant standard. Where possible verification against Penetrant Comparator Block.
29.	Reference UV(A) light meter	Yearly		By an accredited calibration laboratory or 'National Metrology Institute (NMI)', where available.
30.	Reference White light meter			
31.	UV(A) light meter (Working)		90 days	By comparison with reference light meter
32.	White light meter (Working)			
	E. Eddy current Testing			
33.	Reference Specimen	Initial		Manufacturer's certification, customer's requirements or measurement certificate.
34.	Equipment		Before usage and subsequently after 8 hours of usage	Verified against a reference specimen

Bibliography

1. MS ISO/IEC 17025 - General requirements for the competence of testing and calibration laboratories.
2. ISO/IEC 17043 - Conformity assessment - General requirements for proficiency testing.
3. ISO 9712 - Non-destructive testing - Qualification and certification of NDT personnel.
4. ISO 10012 - Measurement management systems - Requirements for measurement processes and measuring equipment.
5. JCGM 100 - Evaluation of measurement data - Guide to the expression of uncertainty in measurement.
6. ILAC-G24 - Guidelines for the determination of calibration intervals of measuring instruments.
7. EA Document - EA-4/15 G Accreditation for Non-Destructive Testing.
8. IANZ Specific Criteria for Accreditation - Mechanical Testing.
9. IANZ Supplementary Criteria for Accreditation - Mechanical Testing Laboratories (Non- Destructive Testing).
10. SAC-SINGLAS - NDT 003 - Quality Assurance of Equipment Commonly Used in Non-Destructive Testing laboratories.

ACKNOWLEDGEMENTS

1.	Dr. Afidah Abu Bakar (Chairman)	Standards Malaysia
2.	Ms. Rosnieh Eggat (Secretariat)	Standards Malaysia
3.	Dr. Mohamad Pauzi bin Ismail	Standards Malaysia
4.	Mr. Wong Siew Kwan	Standards Malaysia
5.	Dr. Norhayati Moris	Standards Malaysia
6.	Mr. Mohamad Akhir bin Abdullah	Ikram QA Services Sdn. Bhd.
7.	Ms. Seri Banun Sujangi	MMC Gamuda
8.	Mr. Mohd Zahari Bin Shariffudin	Makmal Ujian Bahan Binaan, CIDB Holdings Sdn. Bhd.
9.	Mr. Syuhaizat Md. Ali	Lembaga Getah Malaysia (LGM)
10.	Mr. Dalha Rahmat	SIRIM QAS International Sdn Bhd.