



**SRI LANKA ACCREDITATION BOARD
FOR CONFORMITY ASSESSMENTS**

Specific Criteria for Mechanical Testing Laboratories

PREFACE

These criteria are applicable to laboratories, which perform in the field of mechanical testing and desire accreditation from SLAB.

These criteria provide guidelines for use by laboratories and those who are associated with the program of accreditation of mechanical testing laboratories e.g. experts, assessors, officials engaged with day-to-day activities of accreditation. These criteria cover all areas/ fields of mechanical testing.

This document provides the laboratories with necessary information on the requirements for assessment/ surveillance and to assist them in carrying out internal audit of their system.

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1 Introduction

- 1.1 The field of Mechanical Testing covers analysis and related testing of materials and products. It also includes a number of testing areas that are not mechanical in nature but are customarily performed by analysts /technicians in mechanical laboratories
- 1.2 This document has been produced by the Council of Sri Lanka Accreditation Board (SLAB). It supplements ISO/ IEC 17025 standard and provides specific guidance on the accreditation of Mechanical laboratories for both assessors and laboratories preparing for accreditation. It gives detailed guidance for those undertaking quantitative and qualitative examination of the physical properties of materials, products and substances.
- 1.3 This document should be read in conjunction with the terms and conditions for maintaining Accreditation.
- 1.4 Testing and Calibration Laboratories that wish to obtain and maintain SLAB accreditation must comply with the requirements of ISO/ IEC 17025“General Requirements for the Competence of Testing and Calibration Laboratories”.
- 1.5 This booklet in Mechanical Testing is explaining the application of the ISO/ IEC 17025 general criteria for accreditation to applicable products groups/fields given in “Annex A”.
- 1.6 To establish that laboratories are complying with the requirements of ISO/ IEC 17025. SLAB conducts formal assessment at the laboratories using expert assessors.
- 1.7 At present, accreditation is granted to three disciplines of testing (Biological, Chemical, and Mechanical) by SLAB.
- 1.8 This publication sets out the criteria SLAB uses the operation of the Mechanical Testing Laboratories.
- 1.9 This publication will regularly be reviewed and the changes may have to be incorporated because of:
 - Any modification/ changes of ISO/ IEC 17025
 - The feedback from the accreditation mechanical testing laboratories
 - The feedback from the laboratory assessors/ experts
 - The decision of the council and accreditation committee of SALB
 - The decisions of the Technical Advisory Committee on Mechanical Testing

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2 Scope of the Document

- 2.1 This Guide sets out the general requirements in accordance with which a laboratory must demonstrate that it operates, if it is to be accredited to carry out specific tests. The general requirements for demonstrating competence in testing are found in the ISO/ IEC 17025 “General Requirements for the Competence of Testing and Calibration Laboratories”. The present document follows the format of the ISO/ IEC 17025 and refers to each section with interpretation of these general requirements to provide specific requirements for assessors and mechanical testing laboratories preparing for accreditation.
- 2.2 This guide is for the development of quality system of mechanical testing laboratories. It may also be used by accrediting bodies and others concerned with the mechanical testing laboratories.
- 2.3 This document gives specific directions on operating a mechanical testing laboratory.
- 2.4 Annexure are given as informative annexure. It may also be used to interpret the activities of the Mechanical testing laboratories.

3 SCOPE OF THE LABORATORY

- 3.1 The Scope of accreditation of a laboratory is the formal statement of the range of activities for which the laboratory has been accredited; the scope is recorded in detail on a laboratory’s accreditation certificate. A laboratory’s scope should be defined as precisely as possible so that all parties concerned know accurately and unambiguously the range of tests and/or analyses covered by that particular laboratory’s accreditation. The schedule format should typically define the laboratory’s accreditation in terms of:
- (a) The range of products, materials or sample types tested or analyzed
 - (b) Types of tests or analysis carried out
 - (c) The specification or method/technique used
 - (d) The concentration range and accuracy/precision/uncertainty
- 3.2 Where non-routine testing is carried out, it is recognized that a more flexible approach to scope may be necessary, but the scope must be as specific as is feasible and the quality assurance system maintained by the laboratory must ensure that the quality of the results is under control. Frequently, a single measurement technique may be used for different measurements /samples in a wide variety of samples. This measurement stage may be covered by a single method. However, the methods used to prepare the samples for subsequent analysis may vary considerably according to the nature of the sample. Thus several methods may be required to cover each different sample.
- 3.3 Where a laboratory uses special analytical tools, it may be appropriate to use the terms qualitative and/or quantitative mechanical testing under the type of test heading. However, the onus will be on the laboratory to demonstrate to the assessors that in using these techniques, it is meeting all of the criteria for accreditation. In particular, the experience, expertise and training of the staff carrying out the tests and those interpreting the data involved will be a major factor in determining whether or not such testing can be accredited.

It is accepted that sometimes it is not practicable for laboratories to use a (fully documented) standard method in the conventional sense, which specifies each sample type and determinant. In this case, the laboratory must have its own method or procedure for the use of the instrument in question, which includes a protocol defining the approach to be adopted when different sample types are analyzed. Full details of the procedures, including instrument parameters, used must be recorded at the time of each analysis such as to enable the procedure to be repeated in precisely the same manner at a later date. Where a particular analysis subsequently becomes routine, a full method as required by SLAB must be written and followed. The statement in the column of the methods schedule will normally take the form of “Documented In-House Methods” using GC-coupled mass spectrometry/NMR/FTIR, ICP-MS, etc. (Refer ISO/IEC 17025 Para 5.4.2, 5.4.3, 5.4.4 and 5.4.5). Whenever there are deviations from standard method or inadequate clarification in Standard Method, the laboratory needs to develop effective procedure for validation ensuring the quality of results.

- 3.4 The approach to extending or amending the scope of accreditation should be as flexible as possible. Normally the laboratory will give written notice to SLAB of the tests, which it wishes to add to its scope, quoting Standard method references (where applicable) and providing copies of documented validated in-house methods before surveillance and re-assessment.

4 Applicable Fields of Accreditation

The field of Mechanical testing is divided in to several groups/fields of test. Application for accreditation may be for one or more fields of test or for one or more items or specific tests within a class of test. Consideration of an application is simplified if it is specific and in the form of the list of classes of test. Some fields are listed under chemical testing as well as in the field of Mechanical Testing. Accreditation for these tests may be granted in whichever field of testing best suits the testing authority concerned.

The tests carried by laboratory will be given accreditation on the basis of the fields of test given below.

4.1 Applicable fields of Mechanical testing under SLAB accreditation shall be as follows

- (a) Mechanical Properties of Materials
- (b) Metallographic Test
- (c) Properties of Powder Metallurgical Products
- (d) Building Materials
- (e) Plastic, Rubber and Leather
- (f) Textile Materials
- (g) Soil and Rock
- (h) Noise & Vibrations

Tentative list of test of the aforesaid groups are shown at Annexure – I.

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5 CRITERIA FOR ACCREDITATION

5.1 Organization

The testing laboratory shall be competent to perform the tests concerned. It shall be organized and shall operate in such a way that its permanent, temporary and mobile facilities meet the requirements of the standard.

5.2 The testing laboratory shall be organized in such a way as to ensure the integrity of its staff and operations for ensuring unbiased testing. The arrangement shall be such that the staffs are free from any pressure which might adversely affect the quality of the work.

5.3 The laboratory shall have a technical manager (however named) who has overall responsibility for the technical operations. Management shall also nominate a deputy who will have overall responsibility in the absence of the technical manager.

5.4 The laboratory shall have adequate security measures for ensuring the protection of proprietary rights and confidential information.

5.5 It shall have laboratory manual which shall be maintained up-to-date and be available for scrutiny. The quality control arrangements established in accordance with this document shall be periodically reviewed to ensure the continued effectiveness of the arrangements.

5.6 The testing laboratory shall nominate a suitable qualified representative who will be responsible for all quality control activities. The representative may be the technical manager himself.

6 TECHNICAL REQUIREMENTS

6.1 Personnel

The minimum qualification for the technical staff shall be
Approved Signatory

Graduates in physical science or engineering or equivalent related to the scope of accreditation with five years relevant work experience. The role of approved signatory is to ensure the ability and adequacy of the test document. Any executive who is competent to make critical evaluation to test results, and occupies a position in his organization's staff structure which makes him responsible for the adequacy of test results related, is eligible to be approved signatory for test reports/ documents.

Technical Staff / Laboratory Assistant or Technicians

Either having three passes in GCE A/L examination with Physics as a subject with two years work experience/training **or** having six passes in GCE O/L examination with ten years relevant work experience /training **or** having Diploma in Laboratory Technology in Physical testing with two years work experience.

Training of staff shall be one of the most essential requirements of laboratory accreditation.

The information on the relevant Qualifications, Training & Experience of the technical personnel shall be maintained by the laboratory.

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7 Equipment and Reference Materials

- 7.1 The testing laboratory will be furnished with all equipment/ instruments required for correct performance of the test and measurements.
- 7.2 All equipments must be maintained in good condition. Proper maintenance procedure should be available and followed.
- 7.3 Instructions for operating the equipments/ instruments shall be properly maintained and readily available for use of laboratory staff members.
- 7.4 Equipments shall be operated by staff authorized to do so.
- 7.5 Any equipment which is found defective or out of calibration shall be immediately withdrawn from services. Repaired instrument shall be used only after satisfactory calibration.
- 7.6 Records shall be maintained for each equipment/ instrument stating commissioning date, capacity, accuracy, calibration status, etc.
- 7.7 The testing laboratory shall furnish the details of all test equipment/ instruments required to perform the test which it claims to be competent to carry out.
- 7.8 Standard Reference Materials and Certified Reference Materials should be used wherever applicable and maintained properly.

8 Measurement Traceability and Calibration

- 8.1 Measuring and testing equipment shall be calibrated appropriately before being put into service and thereafter according to an established programme.
- 8.2 The overall programme of a calibration of equipment shall be designed and operated so as to ensure that wherever applicable measurements made in the testing laboratory are traceable to National/ International Standards of measurements.
- 8.3 It shall provide the measurement results and associated uncertainties of the measurement wherever the determination of uncertainty is possible.
- 8.4 Reference materials shall be traceable to National or International Standard Reference Materials.
- 8.5 Reference standards employed by the testing laboratory in its calibration programme shall be used for the calibration of working equipment / analytical instruments only.

9 Accommodation and Environment

- 9.1 The laboratory lay out shall be in such a way as to provide adequate working space at each work centre to enable unrestricted movement during working. Entrance to the laboratory shall be such that it protects the area from dust and does not destroy the required environmental condition. Adequate measure shall be taken to ensure good house keeping in the testing laboratory. Entry to the laboratory area shall be restricted.

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- 9.2 The laboratory shall have adequate environmental control so that it does not invalidate the results or adversely affect the required accuracy of measurements. The arrangement of lighting, heating and ventilation shall be such as to facilitate proper performance of tests.
- 9.3 The testing premises shall be protected as required from extreme conditions such as heat, dust, moisture, steam, noise, vibration and electro-magnetic disturbance or interferences.
- 9.4 Proper safety measures during experimentation should be arranged while conducting the tests.
- 9.5 Ambient conditions and instructions regarding the control of those conditions shall be displayed.

10 Safety

- 10.1 There shall be evidence of all necessary measures including display of safety instructions.
- 10.2 Adequate protective clothing, eye and ear protection devices and safety helmets for staff shall be provided. Statutory safety requirements are to be recorded & met.
- 10.3 Adequate arrangements for the control of following shall be available in order to be conformed to the requirements where applicable:
- (a) Fire safety, Fire alarm.
 - (b) Shock due to electric current.
 - (c) Safety guards during load testing.
 - (d) Disposal of toxic materials of effluents.
 - (e) Laser Safety
 - (g) Radiation Safety

11 Handling of Test Items, Storage and Disposal

- 11.1 The full identification, status and condition of every item received for test or examination shall be recorded either through documents or through marking or coding according to a specified system to ensure that there can be no confusion regarding the identity of the samples or test item and the results of the measurement made. Samples should be marked with indelible ink/ punch marking.
- 11.2 A procedure shall exist for safe custody of samples/ specimens before and after test. Tested samples may be retained for an appropriate period defined by the laboratory for re-testing or re-examination.
- 11.3 At all stages of storing, handling and mounting, precautions shall be taken to prevent damage of the items, e.g., contamination, deterioration, corrosion or any of which could invalidate the results.
- 11.4 There shall be clear guidelines for the receipt, retention and disposal of samples or items. Tested samples should be retained for at least three months.

12 Records

- 12.1 The testing laboratory shall maintain a record system to suit its particular requirements and comply with any existing regulations.

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12.2 It shall retain on record all original observations, calculations and derived data, calibration record and final test reports for an appropriate period preferably not less than 2 years. Storage of data and records in computers is preferable with appropriate measures for safety and confidentiality.

The records shall include the identity of personnel involved in testing.

13 Test Report

13.1 The work carried out by the testing laboratory shall be covered by a comprehensive Test Report which accurately, clearly, unambiguously and objectively presents the test results and all relevant information.

13.2 A test report shall include the following information,

- (a) Name and address of testing laboratory;
- (b) Unique identification of report (such as serial number) and of each page of the report;
- (c) Name and address of client and his reference;
- (d) Description and identification of test item;
- (e) Date of receipt of test item and date (s) of completion of test, as appropriate;
- (f) A statement to the effect of that the test result relate only to the item tested;
- (g) Description of sampling procedure, identification of test method where relevant;
- (h) Any deviations, additions to or exclusion from the test specifications and any other information relevant to a specific test;
- (i) Declaration of any non-standard test method or procedure utilized;
- (j) Measurement, examinations and derived results, supported by tables, groups, sketches and photographs as appropriate, and any failure identified;
- (k) A statement on measurement uncertainty (where relevant);
- (l) A signature and title(s) of person accepting responsibility for the test report, date of issue, limit of acceptance where applicable;
- (m) A statement that the report shall not be reproduced except in full without the approval of the testing laboratory.

14.3 Particular care and attention shall be paid to the arrangement of the test report, especially with regard to presentation of the test and ease of assimilation by the reader.

It is essential to have the name & signature of the approved signatory in all the reports.

14 Confidentiality

14.1 The personnel of all disciplines of mechanical testing shall be bound to observe professional secrecy to all information gained in carrying out its testing.

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14.2 The testing laboratory shall formulate methodology to provide confidentiality and security of its practices as required by the users of its services.

15 Sub-Contracting

15.1 In case testing laboratory subcontracts any part of the testing, this work shall be placed with another testing laboratory which is accredited lab or complying with these requirements. In case non accredited lab is used, the signatory shall be satisfied with the subsequent lab is complying with these requirements.

15.2 The testing laboratory shall ensure that its subcontractor is competent to perform the services in questions and complies with same criteria of competence as the testing laboratory in respect of the work being sub-contracted.

15.3 The testing laboratory shall record and retain details of its performances regarding competence and compliance of its subcontractors and maintain a register of all subcontracting.

16 Outside Services

16.1 Where the laboratory procures outside services in support of calibration or tests, the laboratory shall use only those outside support services and supplies that are of adequate quality to sustain confidence in the laboratory's calibration or tests.

16.2 Where no independent assurance of the quality of outside support services or supplies is available, the laboratory shall have procedures to ensure that purchased equipment, materials and services comply with the specific requirements. The laboratory should ensure that purchased equipment and consumable materials are not used until they have been inspected, calibrated or otherwise validated as complying with any standard specifications relevant to the calibration or tests concerned.

16.3 The laboratory shall maintain records of all suppliers from whom it obtains support services or suppliers required for calibrations/ tests.

16.4 Services pertaining to A/C, other utilities etc. should be properly maintained.

17 Proficiency Testing

17.1 The objective of proficiency testing is to have uniform test procedures with respect to National or International Standards, and to improve the quality of testing where appropriate.

17.2 Testing laboratories are required to participate in relevant Proficiency Testing programmes coordinated by SLAB or any other authorized national or international bodies.

17.3 Laboratories failing a Proficiency Testing programme must take corrective actions and report to SLAB within 60 days from the date of receipt of unsatisfactory results from SLAB.

17.4 During Surveillance assessment the laboratory should demonstrate its performance on Proficiency Testing to the assessment team.

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18 Complaints

- 18.1 The laboratory shall have documented policy and procedures for and addressing the complaints received from the clients within a months. A record shall be maintained of all complaints and of the actions taken on them by the laboratory.
- 18.2 Where a complaint on verification raises doubt concerning the laboratory's competence, the laboratory shall ensure that the areas of activity and responsibility pertaining to that test are promptly audited and necessary corrective action are taken.

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Annexure I

20 Groups of Mechanical Testing

20.1 Group - Mechanical Properties of Materials

- 1 Tensile test (% elongation, Y.S., T.S., Modules of Elasticity, Reduction of area)
- 2 Compression Test
- 3 Adhesion Strength Test
- 4 Bonding Strength
- 5 Shear Test
- 6 Torsion Test
- 7 Hardness Test;
 - a) Rockwell
 - b) Brinell
 - c) Vickers
 - d) .Knoop
 - e) .Shore
- 8 Hardenability Test
- 9 Bend Test
- 10 Formability Test
- 11 Drawability Test
- 12 Impact Test
 - a) Izod Impact
 - b) Charpy Impact
- 13 Machinability Test
- 14 Stress-rupture Test
- 15 Creep Test; Stress Relaxation
- 16 Lapping, Wrapping, Coiling Test
- 17 Fatigue Test
 - a) Axial Fatigue
 - b) Flexural Fatigue
 - c) Rotating Bending Fatigue

- 18 Fracture Toughness Test
 - a) Plain Strain Fracture Toughness Test
 - b) Crack Opening Displacement Test
 - c) Crack Growth Rate Test
 - d) Nil Ductility Transition Test
 - e) Drop Weight Test
- 19 Spring Test
 - a) In Compression
 - b) In Tension
- 20 Tube Testing
 - a) Bulging Test
 - b) Flattening Test
 - c) Crushing Strength Test
 - d) Drift Expansion Test
- 21 Weldability Test
 - a) Impact Cold Cracking Test
 - b) Y-groove Cracking Test
 - c) Hot Cracking Test
 - d) Circular Patch Test
 - e) Diffusible Hydrogen Measurement by Hg Method & Gas Chromatography
 - f) Thermal Cycle Reheat Cracking Test
 - g) Thermal Hot Ductility Test
 - h) Delta Ferrite Measurement
- 22 Spot/ Projection/ Seam Weld Tests
 - a) Cross Tension Test
 - b) U-Tension Test
 - c) Peel Off Test
 - d) Tensile Shear Test
- 23 Coated Welding Electrode Testing
- 24 Residual Stress Measurement
 - a) X-ray Diffraction Stress Analyser
 - b) Hole Drilling Method Torsional Fatigue

- 25 Tests on Fasteners:
 - a) Proof Test
 - b) Thread Slip Measurement
- 26 Corrosion Tests:
 - a. Salt Spray Test
 - b. Cu-accelerated Acetic Acid-Salt Spray Test (CASS)
 - c. Stress Corrosion Cracking Test
 - d. Hydrogen Embrittlement (Stress Durability Test)
- 27 Wear/ Abrasion Resistance Test

20.2 Group - Metallography Test

- 1 Macrostructural Analysis
 - 2 a) Microstructural Analysis
 - b) Microstructural Analysis by Replica
- 3 Estimation of grain size by microscopic method
- 4 Determination of Case Depth by Microscopic Method
- 5 Determination of Case Depth by Hardness Method
- 6 Determination of Inclusion Rating
- 7 Determination of Depth of decarbonised Layer
- 8 Microscopic Measurement of Band Thickness
- 9 Measurement of Coating Thickness by Microscopy
- 10 Determination of Microhardness
- 11 Determination of Graphite Flakes (Types and Sizes) in Cast Iron
- 12 Macro-Etch Testing of Steel Bars, Billets & Blooms

20.3 Group - Properties of Powder Metallurgical Products

- 1 Density
- 2 Porosity
- 3 Flow Rate
- 4 Transverse Rupture Test

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- 5 Hardness Test
- 6 Coefficient of Friction (Dynamic)
- 7 Coefficient Friction (Static)
- 8 Fracture Toughness
- 9 Abrasive Wear Resistance
- 10 Radial Crushing Strength of Sintered Bearing
- 11 Compressive Yield Strength
- 12 Strength Test for Sintered Gear
- 13 Sieve Analysis
- 14 Particle Size Distribution
- 15 Compatibility
- 16 Case Depth Measurement

20.4 Group - Buildings Materials

- 1 Cement /Cement products
 - a) Fineness by wet sieving
 - b) Fineness by dry sieving
 - c) Fineness by air permeability
 - d) Consistency
 - e) Setting Time (initial, final)
 - f) False Setting
 - g) Soundness by Le Chatelier Test
 - h) Soundness by Autoclave Test
 - i) Compressive Strength
 - j) Tensile Strength
 - k) Compressive & Flexural Strength Using Prism Moulds
 - l) Drying Content
 - m) Air Content
 - n) Water Retention
 - o) Specific Gravity

Heat of Hydration

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- p) Whiteness Index
- q) Bleeding of Cement Paste Mortars
- r) Expansion of Portland Cement Mortars Exposed to Sulphate
- s) Potential Expansion of Portland Cement Mortars Exposed to Sulphate
- t) Restrained Expansion of Expansive Cement Mortars
- u) Length Change of Hardened Hydraulic Cement Mortar and Concrete
- w) Length Change of Hydraulic Cement Mortar Exposed to a Mixed Sodium and Magnesium Sulphate Solution

2 Pozzolana

- a) Density
- b) Fineness (+45 μ Sieve)
- c) Fineness by Blaine Air Permeability Method
- d) Cement Reactivity
- e) Lime Reactivity
- f) Soundness
- g) Drying Shrinkage
- h) Air-entrainment of Mortar

3 Gypsum Board Products and Gypsum Lath

- a) Flexural Strength
- b) Humidified Deflection
- c) Core, End and Edge Hardness
- d) End Squareness
- e) Nail Pull Resistance
- f) Nominal Thickness
- g) Recessed or Tapered Edge Depth
- h) Width, Length
- i) Water Resistance Off Core-treated Gypsum Board
- j) Surface Water Resistance of Gypsum Boards with Water-Repellent Face Paper

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4 Joint Treatment Materials for Gypsum Board Construction

Joint Compound Test

- a) Consistency
- b) Shrinkage
- c) Check Cracking
- d) Putrefaction

5 Joint Reinforcing Tape

- a) Tensile Strength
- b) Dimensional Stability
- c) Width, Thickness

6 Bond of Joint Reinforcing Tape to Joint Compound

- a) Bond Test
- b) Edge Cracking

Adhesives for Pasting Gypsum Wall Board to Wood Framing

- 7
- a) Open Time
 - b) Wetting Characteristics
 - c) Shear Strength
 - d) Tensile Strength
 - e) Bridging Characteristics
 - f) Ageing Properties
 - g) Freeze Thaw Stability
 - h) Vinyl – Covered Gypsum Board Compatibility
 - i) Adhesive Staining

8 Aggregates

- a) Grading (Sieve Analysis)
- b) Deleterious Substances
 - Clay Lumps
 - Finer Than 75 μ Sieve
 - Coal and Lignite
 - Soft Materials

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- c) Organic Impurities in Fine Aggregates
- d) Estimation of Mica
- e) Unit Weight and Voids (Bulk Density)
- f) Soundness of Aggregate
- g) Potential Alkali reactivity of Cement - aggregate Combinations (Mortar-Bar Method)
- h) Petrographic Examination
- i) Potential Volume Change of Cement-Aggregate Combinations
- j) Abrasion Value
- k) Impact Value
- l) Crushing Value
- m) 10% Fines Value
- n) Compressive Strength of Rock Samples
- o) Surface Moisture, Total Moisture
- p) Specific Gravity and Absorption
- q) Straining Materials in Light Weight Concrete Aggregates
- r) Angularity Number
- s) Flaquiness Index
- t) Elongation Index
- u) Chert
- v) Effect of Organic Impurities in Fine Aggregate of Mortar

9 Bricks

9.1 Building Bricks

- a) Compressive
- b) Water Absorption
- c) Efflorescence
- d) Bond Strength
- e) Bulk Density

9.2 Fire and Silica Refractory Materials

- a) Cold Crushing Strength
- b) Apparent Porosity

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- b) True Density and True Specific Gravity
- c) Sizes and Shapes
- e) Bulk Density

10 Coating Material on Reinforcing Steel

- a) Resistance to Applied Voltage
- b) Chloride Permeability
- c) Adhesion of Coating
- d) Bond Strength to Concrete
- e) Abrasion Resistance
- f) Impact Test
- g) Hardness Test

11 Building Lime

Field Tests

- a) Ball Test
- b) Impurity Test
- c) Plasticity Test
- d) Workability Test
- e) Visual Examination

Mechanical Tests

- a) Fineness
- b) Unhydrated Oxide of Quick Lime
- c) Volume Yield of Quick Lime
- d) Compressive and Transverse Strength
- e) Workability
- f) Soundness
- g) Popping and Pitting
- h) Setting Time

- 12 Admixtures
 - a) Water Content
 - b) Time of Setting
 - c) Compressive Strength
 - d) Flexural Strength
 - e) Length Change
 - f) Relative Durability Factor
 - g) Dry Material Content
 - h) Ash Content
 - g) Relative Density
- 13 Concrete (Fresh)
 - a) Unit Weight, Yield, Air Content
 - b) Bleeding
 - c) Water Content
 - d) Cement Content
- 14 Workability
 - a) Flow Table
 - b) Slump
 - c) Vee Bee Test
 - d) Compacting Factor
 - e) Kelly Ball Test
 - f) K-Slump Test
 - g) Temperature
 - h) Time of Setting
- 15 Analysis of Hardened Concrete
 - a) Water Content of Set Concrete
 - b) Compressive Strength
 - c) Flexural Strength
 - d) Direct Tensile Test
 - e) Indirect Tensile Strength (Split Cylinder Test, Punch Test, Frame Method)
 - f) Static Modulus of Elasticity

- g) Poisson's Ratio
- h) Durability Test (Freezing and Thawing)
- i) Shrinkage and Moisture Movement
- j) Resistance of Concrete to Abrasion and Erosion
- k) Abrasion Resistance of Concrete by Sand Blasting
- l) Abrasion Resistance of Horizontal Concrete Surfaces
 - by Revolving Disks
 - by Dressing Wheels
 - by Ball Bearings
- m) Abrasion Resistance of Concrete/ Mortar Surfaces by Rotating Cutter Method
- n) Permeability of Concrete
- o) Absorption of Concrete
- p) Creep of Concrete
- q) Accelerated Testing of Concrete for Compressive Strength
- r) Time of Setting of Concrete
- s) Petrographic Examination of Hardened Concrete (for Alkali-Silica Gel Formation)
- t) Mechanical Properties of Hardened Concrete Under Triaxial Loads
- u) The Break-off Number of Concrete
- v) Microscopical Determination of Parameters of the Air-Void System
- w) Dynamic Modulus of Rigidity
- x) Dynamic Poisson's Ratio

16 Timber

- a) Moisture Content Using Moisture Meter
- b) Moisture Content Using Hot Air Oven Method
- c) Specific Gravity
- d) Static Bonding Test
- e) Compression Test
- f) Tension Test
- g) Nail Holding Test
- h) Screw Holding Test
- i) Impact Test
- j) Torsion Test

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- 17 Plyboard
- a) Resistance to Dry Heat
 - b) Fire Resistance
 - c) Glue Shear Strength
 - d) Adhesion of Piles
 - e) Water Resistance
 - f) Nycological Test
 - g) Fibre Diameter
 - h) Friability
 - i) Recovery After Compression
 - j) Incumbustibility
 - k) Moisture Absorption
 - l) Linear Shrinkage
 - m) Water Vapour Permeance
 - n) Dimension

- 18 Bitumen
- a) Softening Point Test
 - b) Flash Point Test
 - c) Penetration Test
 - d) Ductility Test
 - e) Viscosity Test
 - f) Marshall Stability Test

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20.5 Group – Plastics, Rubber and Leather

20.5.1 Plastics and Rubber

- 1 Density/ Specific Gravity
- 2 Hardness
 - a) Durometer Hardness
 - b) IRHD
 - c) Rebound Value
- 3 Indentation Hardness Index
- 4 Tensile Testing
- 5 Compression Test
- 6 Flexing Test, Crystallinity Test
- 7 Impact Test
 - a) Izod Impact
 - b) Charpy Impact
 - c) Falling Weight Impact
- 8 Accelerated Ageing Test
- 9 Abrasion Test
- 10 Tear Strength
- 11 Bond Strength
- 12 Brittle Point Test
- 13 Melt Flow Index (MFI)
- 14 Melting/ Softening Point
- 15 Flammability Test/ Limited Oxygen Index Test
- 16 Dimensional Stability (VICAT/ HDT)
- 17 Coefficient of Friction
- 18 Water Absorption Test
- 19 Permeability Test
- 20 Migration & Staining Test
- 21 Swelling Test

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- 22 Shear Strength
- 23 Viscosity Test
- 24 Rheological Propriety Test
- 25 Flow Rate Test
- 26 UV Resistance and Condensation Test
- 27 Ozone Resistance Test
 - a) Static Test
 - b) Dynamic Test
- 28 Xenon/ Carbon Arc Resistance Test (Accelerated Weathering Test)
- 29 Resilience Test
- 30 Dynamic Test
 - a) Dynamic Stiffness
 - b) Loss Modulus (Tan-S)
 - c) Material Damping Coefficient
 - d) Decipation Factor
- 31 Gloss Finish
- 32 Flemible Adhesives
 - a) Open Tack Time
 - b) Gel Point
 - c) Viscosity
 - d) Total Solid
 - e) Spreadibility
 - f) Bond Strength (Initial / Aged)

20.5.2 Leather

- 1 Measurement of Width, Thickness and Area
- 2 Determination of Apparent Density
- 3 Tensile Test
- 4 Tear Strength
- 5 Double Hole Stitch Tear Strength
- 6 Tongue Tear Strength
- 7 Shrinkage Temperature
- 8 Absorption of Water (Gravimetric Method)
- 9 Cracking of Grain and Grain Index
- 10 Two Dimensional Extension
- 11 Resistance to Compression
- 12 Compressibility Test
- 13 Indentation Index
- 14 Dynamic Water Proofness of Boot and Shoe Sole Leather
- 15 Flexing Endurance
- 16 Dynamic Water Proofness Test for Upper Leather
- 17 Water Vapour Permeability
- 18 Water Proofness of Gloving Leather
- 19 Bond Strength of Laminated Leather
- 20 Thermal Conductivity
- 21 Area Stability on Immersion in Water and Oil
- 22 Spray Test for Estimating Water Repellency of Clothing Leather

20.6 Group - Textile Materials

20.6.1 Fibres

- 1 Textile Characteristics of Individual Textiles Fibres
- 2 Bundle Strength

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20.6.2

Yarns

- a) Breaking Strength of Yarn in Skein Form
- b) Tensile Properties
- c) Permanent Deformation of Elastomeric Yarn
- d) Sewing Threads
- e) Shrinkage of Yarn
- f) Coefficient of Friction

20.6.3

Fabric (Woven)

- a) Tensile Tests
- b) Abrasion Resistance Test
- c) Bursting Strength
- d) Pile Retention of Cord Fabric
- e) Piling Resistance Test
- f) Stretch Properties Test
- g) Snagging Resistance Test
- h) Stiffness Test

20.6.4

Fabrics (Non-Woven)

- a) Stiffness Test
- b) Tearing Strength Test

20.6.5

Industrial Textiles

- a) Tensile Tests
- b) Drop Test

20.6.6

Tyre Cord Fabric Test

- a) Tensile Tests
- b) Adhesion Test of Tyre Cords to Other Reinforcing Rubber Compounds
- c) Strap Peel Adhesion of Reinforcing Cords or Fabrics to Rubber Compounds
- d) Thermal Shrinkage Test

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20.6.7 Zippers and Fasteners

- a) Impact Resistance of Plastic Zips
- b) Operability of Zippers
- c) Peel Strength of Hook and Loop Touch Fasteners
- d) Resistance of Un-snapping of Snap Fasteners
- e) Shear Strength Test
- f) Strength Test of Zippers

20.7 Group - Soil and Rock Testing

20.7.1 Soil Testing

- a) Specific Gravity
- b) Grain Size Analysis
- c) Atterberg's Limit (LL, PL,SL)
- d) Unit Weight
- e) Moisture Content
- f) Direct Shear Test
- g) Unconfined Compression Test
- h) Triaxial Compression Test Oedometer Consolidation Test
- i) Permeability Test
- j) Field Moisture Equivalent
- k) Centrifuge Moisture Equivalent
- l) Linear Shrinkage Test
- m) Compaction Test
- n) Vane Shear Test
- o) Free Shear Test
- p) Free Swell Index of Soil
- q) Swelling Pressure of Soil
- r) California Bearing Ratio (CBR) Test

20.7.2 Soil Testing (Field)

- a) Field CBR Test
- b) Direct Shear Box Test for Soil Containing Gravels
- c) Standard Penetration Test
- d) Static Cone Penetration Test
- e) Modulus of Subgrade Reaction (K-Value) of Soil by Plate Load Test
- f) Pile Loading Testing
- g) Field Permeability Test

20.7.3 Rock Testing

- a) Uniaxial Compressive Strength Test
- b) Triaxial Compression Test
- c) Modulus of Elasticity and Poisson's Ratio of Rock Material in Uniaxial Compression
- d) Slake Durability Index of Rock
- e) Tensile Strength by Indirect Test on Rock Specimen
- f) Dynamic Modulus of Rock Core Specimen
- g) Point Load Test
- h) Pullout Test on Anchor Bars and Rock Bolts
- i) Hardness Testing
- j) Shear Strength of Rock Joints by Direct Shear Box
- k) Rock Mass Deformability Using a Flexible Dilatometer
- l) Hydraulic Fracture Test
- m) Flat Jet Test

20.8 Group - Noise & Vibration

- 1 Measurement of Noise Reduction of Sound Isolating Enclosures.
- 2 Measurement of Insertion Loss Ducts and Mufflers.
- 3 Vibration Characteristics of Materials, Components, Assemblies and Structures.
- 4 Measurement of Mechanical Vibrations & Performance.
- 5 Dynamic Balancing
- 6 Mechanical Shock Testing.
- 7 Vibration Test on Connection and Relay
- 8 Vibration Record on Transmission Line.

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20.9 Group - Performance Test

- 1 Proof Pressure Test on Pipes and Valves
- 2 Aluminium Milk Cans
- 3 Air Compressor
- 4 Air Blower
- 5 Test on Bicycle:
 - a) Frame
 - b) Pedal
 - c) Crank and Chain
 - d) Wheels
 - e) Handle Bar
 - f) Hub
 - g) Spoke
 - h) Tubes
- 6 Test on Burners
- 7 Test on Bip Tap and Stop Tap
- 8 Test on Ball Valves
- 9 Test on Centrifugal Pumps
- 10 Test on Commercial Cooking Range & LPG Appliances
- 11 Test on Domestic Pressure Cooker
- 12 Test on Gas Cylinders, Valves & Regulators
- 14 Proof load Tests on Chains
- 15 Compression Test for Bridge Bearings
- 16 Load Test on Draw Bar Hooks and Laminated Springs
- 17 Load Test on Coil Springs
 - a) 0-1 kg
 - b) 0-100 kg
 - c) above 100 kg.

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- 18 Load Test on Chain Pulley Block
 - a) Below 10 tons
 - b) 10 tons to 20 tons
 - c) Above 20 tons
- 19 Load Test on Hand Operated Winch
Load Test on Hydraulic Jacks:
 - a) Proofload upto 100 tons
 - b) Proofload from 100 to 150 tons
 - c) Proofload above 150 tons
- 20 Load Test on Screw Jacks:
 - a) Up to 15 tons
 - b) Between 15 to 30 tons
 - c) Above 30 tons
- 21 Load Test on Steel Wire Ropes:
 - a) Up to 1" dia
 - b) Between 1" & 1 ½ dia
 - c) Above 1 ½ dia
- 22 Proof load Test on Electrically Operated Winch
- 23 Test on Hack Saw Blade
- 24 Test on Hurricane Lanterns
- 25 Test on Hand Sprayers
- 26 Test on Steel Files
- 27 Test on Twist Drill
- 28 Test on Sieves
- 29 Torque Wrench
- 30 Water Meter
- 31 Rubber Sealing Ring
- 32 Rubber Welding Hose
- 33 Speedometer Cable

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- 34 Prototype Transmission Tower Testing
- 35 Scaled Down Model Transmission Tower Testing
- 36 Industrial Air Cleaner:
 - a) Airflow Restriction and Pressure Drop Test
 - b) Initial Efficiency Test
 - c) Dust Capacity and Accumulative Efficiency
 - f) Precleaner Performance
- 37 Performance of Steel Parts at Sub-Zero Temperature
- 38 Performance of Rubber Parts at Sub-Zero Temperature
- 39 Performance of Diesel / Petrol Engine
- 40 Performance of IC Engine at Higher Altitude
- 41 Endurance Test for Starter Motor
- 42 Endurance Test for Jacks
- 43 Performance and Life Test for Oil Seals
- 44 Life Cycle Test for AC Pumps
- 45 Performance Test of Complete Vehicle on Chassis Dynamometer
- 46 Endurance Test for Bonded Rubber Wheels
- 47 Test of Helmets
- 48 Test of Safety Glass
- 49 Test of Surgical Gloves

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