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GENERAL REQUIREMENTS
for MATERIALS TESTING MACHINES

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TERMINOLOGY

For the purpose of this Recommendation the following terms and definitions shall apply.

1. Testing machine

A device (or assembly of devices) for testing of specimens of materials to determine one or more of their mechanical properties.

2. Mechanical property

A property of a material associated with elastic and inelastic behavior when force or deformation is applied.

3. Test specimen

A sample of material which is subject to force or deformation in a testing machine to determine one or more mechanical properties of the material.

GENERAL REQUIREMENTS

for MATERIALS TESTING MACHINES

Chapter I

GENERAL

1. Scope

1.1. This Recommendation deals with the machines and their essential accessories which are used for legal metrology purposes to determine the mechanical properties of materials.

Accessories include those components, instruments, fixtures and devices which are necessary to perform the required tests for the determination of the mechanical properties of materials. Equipment the use of which is optional may also be considered to be included in the accessories.

1.2. This Recommendation gives the requirements for the general technical and metrological characteristics of materials testing machines and for the metrological controls concerning their use.

1.3. The requirements for machines to determine particular kinds of mechanical properties of materials are the subject of separate Recommendations.

1.4. The requirements for the auxiliary measuring devices and instruments used with materials testing machines are the subject of separate Recommendations.

2. Fields of application

2.1. This Recommendation applies to the fields of technology and industry where the control of the performance of the testing machines used to determine the mechanical properties of materials is subject to national metrological regulations.

Chapter II

TECHNICAL AND METROLOGICAL REQUIREMENTS

3. Units of measurement

3.1. The units used to express the performance of materials testing machines shall be the appropriate SI units except when alternative units are explicitly allowed.

4. Principal parts and essential accessories

4.1. For the purpose of this Recommendation, a materials testing machine shall have a frame, a force producing system and a force measuring device or devices. The machine may include control devices, indicating devices and recording devices.

Note : some tests do not require the measuring device to be an integral part of the testing machine.

4.2. Accessories will vary depending on the intended uses for the machine. Examples of accessories include the means for supporting, holding or gripping the test specimens, controlling the rates of applying force, measuring the duration of an event, performing the calculations on test data, and measuring the displacement or extension.

Certain accessories are essential for the use of the testing machine for particular measurements which are the subjects of the tests (for example, compression platens, tension grips or flexure supports).

5. Performance characteristics

5.1. The machines with their associated measuring devices, indicating devices and recording devices shall be designed and constructed to perform the required functions of determining the mechanical properties of materials.

5.1.1. The testing machines shall be designed and constructed to ensure that :

- the required accessories can be attached or removed without undue effort,
- there are suitable provisions for attaching control devices and panels, indicating or recording devices and auxiliary instrumentation, as required,
- the force or displacement measuring devices can be serviced and verified over the measuring range of the machine,
- the machine operator can manipulate the controls for electric power supply, applied force and positioning the moveable parts,
- there is reasonable access to the electric power supply and the transmission system for maintenance and adjustment.

5.2. The force producing system may be of a mechanical, hydraulic, pneumatic, or electrical type or appropriate combinations of these types.

- 5.3. The force or displacement control devices shall be provided for the functions assigned to the testing machine. The components by which an operator adjusts and controls the testing machine shall be arranged logically and conveniently for normal operations.
- 5.4. The force measuring devices shall meet the requirements of applicable Recommendations and shall have inherent stability with time.
- 5.5. The displacement measuring devices which are an integral part of the testing machine shall measure length or change in length (angle or change in angle) within prescribed limits.
- 5.6. The force or displacement indicating devices and recording devices shall be analogue or digital or both. Each device shall be appropriate in terms of scale for the unit and value of the measurand.
- 5.7. The accessories for supporting, holding or gripping the test specimens shall be easily accessible to the operator, and sufficiently strong and durable to resist permanent deformation during properly performed tests.

6. Scales, indications, and recorded representations

- 6.1. The scales, indications and recorded representations shall be clear, well defined and easily read under normal conditions of use.

In any series of scale marks, indications or recorded representations, the scale marks and units of a corresponding order of importance must be uniform in size and character. Scale marks, indications, or recorded representations of secondary order of importance shall be clearly indicated or displayed and be smaller in size or of lesser prominence than the principal indications with which they are associated.

- 6.2. When the scale divisions are specified they shall be defined by a sufficient set of numerals, words, symbols, or combinations thereof. These shall be uniformly placed with reference to the scale marks and as close thereto as practical, but not positioned so as to interfere with the clarity of the observation or recording.

- 6.3. The indications or recorded representations shall be analogue or digital or both.

- 6.4. For analogue indicating and recording devices, the scale interval shall be in the form :

1×10^n or 2×10^n or 5×10^n units of measurement,

where n is a positive or negative whole number, or zero.

The scales of indication shall have the zero and maximum values of their ranges clearly marked. The scale marks and associated numbers and symbols shall not be easily obliterated or made illegible under normal conditions of use.

- 6.5. For digital indicating devices, the least significant digit shall increment by 1×10^n or 2×10^n or 5×10^n . The scales shall include the zero and maximum values of their ranges and shall indicate the sign and value of the measurand.

7. Installation requirements

- 7.1. The testing machines and their accessories shall be installed at locations where the environmental conditions and building structures neither interfere with nor adversely affect their operation and metrological characteristics.
- 7.2. The indicating and recording devices shall be installed so that communication between the force measuring device and the indicating or recording device is not adversely affected by the operations of the materials testing machine or by adjacent activity and equipment.
- 7.3. The testing machines shall be located so that the activities needed for verification and inspection by representatives of the metrological services can be performed.

8. Metrological characteristics

- 8.1. The metrological characteristics of materials testing machines and the procedures for their verification are the subject of separate Recommendations.

9. Identification

- 9.1. Each testing machine shall bear on a permanently affixed plate or decal, in an easily visible location, the following information :
 - manufacturer's name or trademark and address,
 - type designation,
 - serial number and year of manufacture,
 - maximum capacity.

Other information as needed will be the subject of separate Recommendations.

10. Sealing

- 10.1. The mechanisms and devices by means of which changes in the scale factor or indications are accomplished shall be constructed and installed so that the opportunities for unauthorized adjustment are minimized.
- 10.2. When required by national metrological regulations, means for sealing of the appropriate adjustment mechanisms shall be provided.

Chapter III

ADMINISTRATIVE REQUIREMENTS

11. Metrological controls

11.1. When, in any country, the materials testing machines are subject to State metrological controls these controls shall include, according to the national regulations of that country, either all or some of the following operations :

- initial verification,
- subsequent (periodic) verifications.

11.2. The initial verification procedure is applicable to testing machines :

- prior to being put into service,
- when repaired or modified so as to affect the measuring or indicating devices,
- when relocated so that dismantling or reinstallation will affect the measuring or indicating devices.

Some materials testing machines are designed to be portable so that reverification after relocation is not required under normal conditions of use.

11.3. The testing machines in service are subject to subsequent verification at intervals determined by the frequency of use and the national metrological regulations.

11.4. The testing machines which are not subject to State metrological controls may be inspected using other means.

12. Certificate

12.1. The results of the verification tests or inspections shall be recorded in a certificate.

This certificate shall include :

- identification of the machine (manufacturer, type, serial number, etc.),
- date and place of verification,
- reference to the control procedure,
- results of the tests,
- name and title of the representative of the certifying authority.

12.2. The certificates shall be retained by the organization operating the materials testing machine and shall be available to parties with direct interest in the results of the tests.

12.3. When testing machines have multiple scales or have both, analogue and digital, indicating or recording devices, the certificate shall be explicit as to which scale and assembly was verified or inspected.

12.4. The fact that the machine has passed the verification tests may be indicated, in conformity with national regulations, by means of a label, a mark, etc.

