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Control of Inspection, Measuring and Test Equipment

1 PURPOSE OF PROCEDURE

Ensure that the measuring equipment used in standard tests is efficient and its metrological characteristics ensure test results with the intended accuracy.

2 SCOPE

Laboratory in which the ITTC procedures related to experimental hydromechanics are implemented.

3 NORMATIVE REFERENCES

ISO 10 012 : 1992

“Quality assurance requirements for measuring equipment”

ISO/IEC 17025 : 2000

“General requirements for the competence of testing and calibration laboratories.”

4 DEFINITIONS

(absolute) error of measurement: The result of a measurement minus the true value of the measurand.

accuracy of measurement: The closeness of the agreement between the result of measure-

ment and the (conventional) true value of the measurand.

adjustment: The operation intended to bring a measuring instrument into a state of performance and freedom from a bias suitable for its use.

calibration: The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values of a quantity represented by a reference standard.


correction: The value which, added algebraically to the non corrected result of a measurement, compensates for an assumed systematic error.

drift: The slow variation with time of a metrological characteristic of a measuring instrument.

influence quantity: A quantity which is not the subject of the measurement but which affects the value of the measurand or the indication of the measuring instrument.

limits of permissible error (of a measuring instrument): The extreme values of an error permitted by specifications, regulations, etc. for a given measuring instrument.

measuring equipment: All of the measuring instruments, measurement standards, reference

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materials, auxiliary apparatus and instructions that are necessary to carry out a measurement. This term includes measuring equipment used in the course of testing and inspection, as well as that used in calibration.

measurement: The set of operations having the object of determining the value of a quantity.

metrological confirmation: Set of operations required to ensure that an item of measuring equipment is in compliance with requirements for its intended use.

Metrological confirmation normally includes calibration, any necessary adjustment or repair and subsequent recalibration, as well as any required sealing and labelling.

measurand: A quantity subjected to measurement.

measuring instrument: A device intended to make a measurement, alone or in combination with supplementary equipment.

(measurement) standard: A material measure, measuring instrument, reference material or system intended to define, execute, preserve or reproduce an unit or one or more values of a quantity in order to transmit them to other measuring instruments by comparison.

national (measurement) standard: A standard recognised by an official national decision to serve in the country, as the basis for fixing the value of all other standards of the quantity concerned.

(quality) audit: A systematic and independent examination carried out in order to determine

whether quality activities and the related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve the intended objectives.

reference conditions: Conditions of use for a measuring instrument prescribed for performance of tests, or to ensure valid mutual comparison of the measurement results.


resolution (of an indicating device): A quantitative expression of ability of an indicating device permitting a significant distinguishing between immediately adjacent values of the quantity indicated.

specified measuring range: The set of values for a measurand for which the error of a measuring instrument is intended to lie within specified limits.

stability: The ability of a measuring instrument to maintain its metrological characteristics constant.

traceability: The property of the result of a measurement whereby it can be related to appropriate measurement standards, generally international or national standards, through an unbroken chain of comparisons.

uncertainty of measurement: A result of the evaluation intended for determining the range within which the true value of a measurand is estimated to be found, generally with a given likelihood.

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5 RESOURCES OF MEASUREMENT EQUIPMENT

An important aspect of the efficient operation of Quality System according to measuring equipment is a full identification of devices used for the tests. In relation to definition presented in chart 3 the term „measuring equipment” is taken to encompass „measuring instruments” and „measuring standards”. Moreover the term „measuring instruments” is taken to encompass measuring instruments which are used in tests and other items called „auxiliary apparatus,, which may be used for indications only.

A system for storage, transport and handling should be established for measuring equipment, except instruments used for indication only, in order to prevent abuse or misuse.

For each item of measuring equipment, the Laboratory Quality Manager shall designate a competent member of staff as authorised officer to ensure that confirmations are carried out in accordance with the system and that the equipment is in satisfactory condition.

In case where any measurement equipment is supplied from an outside source, the laboratory shall ensure that their metrological characteristics and confirmation data comply with requirements of the own confirmation system .

5.1 Records

Measuring equipment instruments shall have their individual cards in which the following data shall be placed:

- name of equipment
- manufacturer
- model
- series
- laboratory identification number (optionally)
- status (verified, calibration, indication)

Moreover the information about the date of last and next calibration or verification shall be placed on this card (see Appendix1). All the data shall be signed by authorised officer.

5.2 Labelling

The laboratory shall ensure that all measuring equipment is securely and durably labelled, coded or otherwise identified to indicate its status (verified, calibrated or indication). Any confirmation labelling shall clearly indicate date of last confirmation and when the date of the next confirmation according with the Supplier’s or own system requirements. The labelling shall also permit ready identification of person responsible for meeting this deadline.

Measuring equipment that is deemed not to require confirmation shall be clearly identified as such, so that it may be distinguished from equipment that requires confirmation but which label has become mislaid or detached.

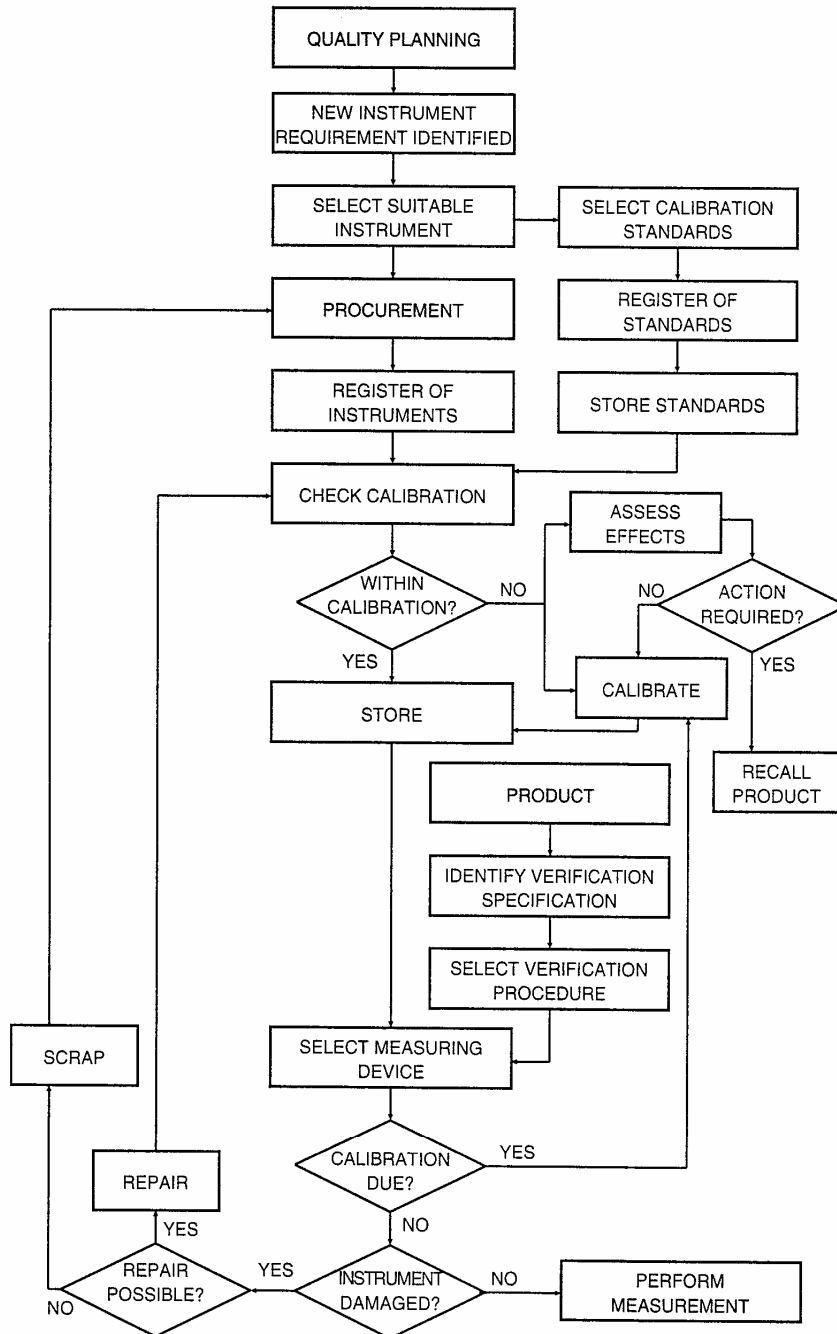



Fig.1 Inspection measuring and test equipment control function

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6 CONFIRMATION SYSTEM

The intention of the confirmation system is to ensure that the risk of measuring equipment producing erroneous results remains within acceptable limits.

6.1 Measuring standards

Measuring standards used in laboratory for calibration purposes, shall be confirmed (verified) by Weights and Measures Office at appropriate intervals (defined by the Weights and Measures Office).

All measuring standards used in laboratory for the confirmation purposes shall be supported by certificates, reports or data sheets for the equipment confirming the source, uncertainty and conditions under which the results were obtained. Such document shall be signed by a person confirming the correctness of the results.

6.2 Calibration

The laboratory shall ensure that the calibration tests are carried out using certified measuring standards having a known valid relationship to international or nationally recognised standards.

The laboratory shall ensure that all confirmation of metrological characteristics (stability, range, resolution and "calibration factor" or

„calibration curve" are performed by staff having appropriate qualifications, training, experience and skill, working under proper supervision. Calibration tests shall be carried out according to the Calibration Procedure (Sample see Appendix 4).


The environmental conditions shall be controlled during the test and , if possible, correcting compensations shall be applied to the measured results. The records shall contain both the original and the corrected data.

All significant uncertainties including those attributable the measuring equipment (as well as to measuring standards) and those introduced by human and environmental factors, shall be taken into account when performing measurements and calibrations.

All relevant data including those available from any statistical process control system shall be taken into account when estimating the uncertainties.

The results of calibration in the form of "calibration reports" or „calibration certificate" shall include:

- identification of certificate for measuring standards
- description of environmental conditions
- calibration factor or calibration curve
- uncertainty of measurement
- „minimum and maximum capacity" for which the error of measuring instrument is within specified (acceptable) limits.

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The calibration results shall be recorded including necessary details so that the traceability of all the measurements can be demonstrated and so that any measurement can be reproduced under conditions close to the original conditions, thereby facilitating the detection of any anomalies.

6.2.1 Calibration Records

The recorded information shall include:

- a) description and unique identification of equipment;
- b) date on which each confirmation was completed;
- c) calibration results obtained after and, where appropriate, before any adjustment and repair;
- d) assigned confirmation interval;
- e) identification of the confirmation procedure;
- f) designated limits of permissible error;
- g) source of the calibration used to secure the traceability;
- h) relevant environmental condition and the information on necessary corrections;
- i) information on the uncertainties involved in calibrating the equipment and on their cumulative effect;
- j) details of any maintenance carried out, such as servicing, adjustment, repairs or modifications;
- k) any limitations in use;
- l) identification of the person(s) performing the confirmation;

- m) identification of person(s) responsible for ensuring the correctness of the recorded information;
- n) unique identification (such as serial numbers) of any calibration certificates and other relevant documents concerned.


The laboratory shall maintain clear documentation of measuring activities (including the duration and safeguarding of the records). The records shall be kept until it is no longer probable that they may need be referred to.

6.3 Intervals of Confirmation

The measuring equipment (including measuring standards) shall be confirmed at appropriate (usually periodical) intervals, established on the basis of their stability, purpose and wear. The intervals shall be such that confirmation is carried out again prior to any probable change in the equipment accuracy, which is important for the equipment reliability. Depending on the results of preceding calibrations, the confirmation period may be shortened, if necessary, to ensure the continuous accuracy of the measuring equipment.

The intervals of confirmation shall not be prolonged unless the results of calibrations at preceding confirmations provide definite indications that such action will not affect confidence in the accuracy of the measuring equipment.

The laboratory shall have specific objective criteria for decisions concerning the choice of intervals of confirmation.

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6.4 Non-Conforming Measuring Equipment

Any item of measuring equipment

- that has suffered damage,
- that has been overloaded or mishandled,
- that shows any malfunction,
- whose proper functioning is subject to doubt,
- that has exceeded its designated confirmation interval, or
- the integrity of whose seal has been violated,

shall be removed from service by segregation, clear labelling or cancelling.

Such equipment shall not be returned to service until the reasons for its nonconformity have been eliminated and it is confirmed again.

If the results of calibration prior to any adjustment or repair were such as to indicate a risk of significant errors in any of the measurements made with the equipment before the

calibration, the laboratory shall take the necessary corrective action.

6.5 Periodic Audit And Review Of The Confirmation System

The laboratory shall carry out, or shall arrange to be carried out, periodical and systematic quality auditing of the confirmation system in order to ensure its continuous effective implementation.

Based on the results of the quality audits and of other relevant factors, such as feedback from Purchasers, the laboratory shall review and modify the system as necessary.

Plans and procedures for the quality audit and review shall be documented. The quality audit and review and any subsequent corrective actions shall be recorded.