



# **CALIBRATION SYSTEM REQUIREMENTS**

**ESCC Basic Specification No. 21500**

Issue 4	February 2014
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DCR No.	CHANGE DESCRIPTION
838	Specification upissued to incorporate editorial changes per DCR.

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## 1 GENERAL

### 1.1 SCOPE

This document establishes requirements for a calibration system to be designed, established and maintained by the contractor for the purpose of ensuring that measuring equipment and standards are properly calibrated.

### 1.2 APPLICABILITY

This document applies when referenced in a contract, purchase order or specification.

### 1.3 DEFINITIONS

The following definitions of terms apply to this document:

- Accuracy  
The degree of correctness with which a method of measurement yields the true value of a quantity, usually expressed in terms of error.
- Calibration  
A comparison between a standard or measuring equipment, instrument or items of equipment and a standard of higher accuracy, to detect, correlate, adjust and document the accuracy of the instrument or equipment item being compared or tested.
- Measuring Equipment  
All devices used to measure, gauge, test, inspect or otherwise quantify the characteristics of an article.
- Precision  
A measure of consistency or reproducibility of measurements among themselves.
- Standard  
An instrument, device or material of known characteristics and higher precision used to establish and maintain the accuracy of a measurement system or device.

## 2 REQUIREMENTS

### 2.1 GENERAL

The contractor shall maintain an effective system for the control and calibration of all measuring equipment and standards used in fulfilment of his contractual requirements whether located at the contractor's plant, a subcontractor's plant or at another location. The system shall be designed to ensure that all measuring equipment provided by the contractor has the capability to perform within designated limits. It shall provide for the prevention of inaccuracy by prompt detection of deficiencies and timely action for their correction. This document does not require the contractor to establish or maintain a complete in-plant calibration capability if calibration services are obtained from sources which meet the requirements of this document. Objective evidence that the calibration system is effective shall be readily available to the ESCC Executive. Staff employed in calibration work shall have received adequate training.

## 2.2 EQUIPMENT AND STANDARDS REVIEW

The contractor shall conduct, during the earliest practical phase of contract performance, a sufficiently extensive review of the technical requirements of the contract to ensure that measuring equipment and standards necessary for the fulfilment of the contract are available and are of the required accuracy, stability and range for the intended application. The contractor shall identify and report to the ESCC Executive any measurement requirement involving accuracy that exceeds the known state of the art.

## 2.3 TRACEABILITY

All measuring equipment shall be calibrated using standards whose accuracy is traceable to national or international standards except where the standards have been derived from accepted values of natural physical constants or derived by the ratio type of self-calibration techniques. Contractor standards need not be referred directly to national standards but may be calibrated against intermediate standards, providing the requirement for traceability to national standards is satisfied. However, the number of echelons in the calibration structure must be limited to the minimum consistent with the need for accuracy and precision. All standards used in the calibration system shall be supported by certificates, reports or data sheets attesting to the date, accuracy and conditions under which the results were obtained.

## 2.4 CUMULATIVE EFFECTS OF ERRORS

The cumulative effect of the errors in each component of a calibration chain shall be taken into account for each successive measuring equipment or standard calibrated. When the total is such as to significantly compromise the ability to make measurements within the permitted product tolerances, corrective action shall be taken. The basis for the calculation of the cumulative effect shall be recorded and be satisfactory to the ESCC Executive.

## 2.5 ENVIRONMENTAL CONTROLS

Measuring equipment and standards shall be calibrated and utilised in an environment controlled to the extent necessary to assure continued measurements of the required accuracy and precision. Due consideration shall be given to temperature, temperature rate of change, humidity, lighting, vibration, dust control and cleanliness and other controllable factors affecting precision measurement. When pertinent, these factors shall be continuously monitored and recorded. When essential, compensating corrections shall be applied to measurement data obtained in a non-controlled environment. Records shall contain both the original and the corrected data.

## 2.6 INTERVALS OF CALIBRATION

Measuring equipment and standards shall be calibrated at periodic intervals established on the basis of their stability, purpose or degree of usage. Intervals shall be shortened when required to ensure continued accuracy dependent on the results of preceding calibrations, and may be lengthened when the results of previous calibrations provide definite indications that such action will not adversely affect confidence in the accuracy of the measurement device. The system shall provide for immediate removal or, if not movable, conspicuous identification to prevent use of any equipment for which the calibration validity date has passed. In addition, the contractor shall provide for immediate removal or identification of measuring equipment and standards which have failed in operation in one or more measurement parameters, show evidence of physical damage, or are determined to be, or suspected of being, outside of required performance limits. The ESCC Executive shall be notified of any such event so that previous results may be re-examined, to

ascertain whether re-testing is necessary. New or repaired measuring equipment and standards shall be calibrated before use.

2.7 CALIBRATION LABELLING

Depending on the size of functional characteristics, measuring and test equipment and measurement standards shall be labelled or coded to indicate the date of last calibration, by whom it was calibrated and the scheduled date for the next calibration. Any limitation of calibration shall be clearly indicated. When neither labelling nor coding is practicable, procedures shall be established to assure adherence to calibration schedules.

2.8 DOCUMENTED CALIBRATION PROCEDURES

Documented procedures shall be prepared and used for calibration of all measuring equipment and standards used in the performance of the contract. The procedures may be a compilation of published standard practices or contractor's or instrument Manufacturer's written instructions.

Calibration procedures shall include those step-by-step instructions necessary to enable personnel performing calibration functions to determine that the devices are within their prescribed limits.

2.9 RECORDS

The contractor shall develop and maintain a comprehensive and complete set of records that documents the accuracy, calibration methods, precision and history of all measuring equipment and standards. The records shall include, as appropriate, the type or description of the measuring equipment, Manufacturer's name, model number and rated accuracy, the contractor's identification, calibration interval, date calibrated, calibration procedure, source of calibration, measured values obtained in calibration and details of any repair, adjustment or maintenance. When measuring equipment and standards must be adjusted or reworked, the results of calibration before and after such work shall be included. Records shall be available for review, as required, by the ESCC Executive.

2.10 SEALING FOR INTEGRITY

Access to adjustable devices which are fixed at the time of calibration shall be sealed or otherwise safeguarded to prevent tampering by unauthorised personnel. Seals shall be so designed that tampering will destroy them.

2.11 SUBCONTRACTOR CALIBRATION

The contractor shall ensure that his subcontractors employ a calibration system which meets the requirements of this document.

2.12 STORAGE AND HANDLING

A system shall be established and maintained for handling, transporting and storing all measuring equipment and standards that prevents abuse, misuse, damage or change in dimensional or functional characteristics.

### 2.13 TECHNICAL MEASUREMENT EVALUATION

The ESCC Executive has the right to conduct, at unscheduled intervals, a technical measurement evaluation for the purpose of determining that the techniques followed, and the personnel employed, in the contractor's calibration system demonstrate a continuing capability to make measurements of the required precision and to determine uncertainties associated with these measurements.