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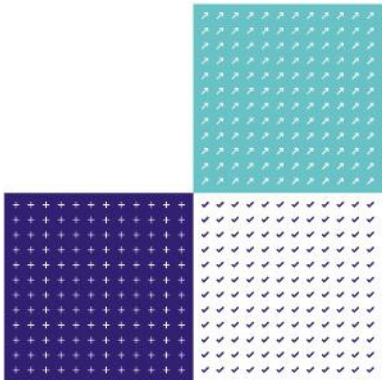
Laboratory Accommodation and Environment in the Measurement of Length, Angle and Form



Contents

Changes since last edition

3.1 - Reference to glass fibre insulation removed

3.4 - Reference to Technical Manager, admin functions and filing being close to the laboratory removed

4.1 - Addition of comment relating to LED lighting and changes to recommended illumination levels - updated in line with latest recommendations

5.9 - Reference to dataloggers added; mercury-in-glass replaced with liquid-in-glass

5.10 - The word “thermalise” added to the text

5.11 - Minor changes to wording

6.1 - Minor change to wording

1. Introduction

1.1 Laboratories that have been assessed by UKAS as meeting the requirements of ISO/IEC 17025 *General Requirements for the Competence of Testing and Calibration Laboratories* may be granted UKAS accreditation. Several guidance publications on the application of these requirements, providing extra information, detail and limitations are listed in UKAS Publications list, available from UKAS website (www.ukas.com).

1.2 This publication provides guidance on the application of specific requirements for laboratories carrying out dimensional calibration. It does not cover all the requirements of ISO/IEC 17025, which remains the authoritative document. By following the guidance given laboratories will be able to demonstrate at assessment that they meet the requirements. Alternative methods may be used provided they are shown to give an equivalent outcome.

1.3 Measurements of length, angle and form can be, influenced significantly by the environment in which they are made. The purpose of this publication is to provide general guidance for laboratories performing these types of measurement, to help ensure the provision of satisfactory accommodation and environmental conditions.

1.4 Although these guidelines are specifically intended for calibration laboratories, they can also be applied to laboratories performing dimensional tests.

1.5 The environmental conditions may be relaxed where, in exceptional circumstances, it can be demonstrated that the nature of the calibrations or tests performed by a laboratory do not require such stringent controls.

2. Location

2.1 The location of the laboratory is important because of its possible effect on the environmental conditions within the laboratory. The laboratory should be preferably be sited away from sources of mechanical vibration and shock, and from sources of electrical and electromagnetic interference. The acoustic noise level should not exceed that of a quiet office. A ground floor or basement may be advantageous from the point of view of reduced vibration and ease of temperature control. Where the laboratory siting is not ideal, local isolation can sometimes be employed to eliminate the effects of unsuitable external conditions.

2.2 The area (or areas) occupied by the laboratory should be separate and identifiable, and shared only with other compatible activities.

3. Construction

3.1 The laboratory construction should be compatible with the degree of environmental control necessary for the measurements to be undertaken. Exterior walls, and roofs of single-storey buildings, may require additional thermal insulation. Windows in external walls should be double-glazed.

3.2 It is desirable that there should be no direct sunlight, nor any other sources of radiant heat, within the laboratory, and it is essential that sunlight should not fall on standards, instruments or components being measured, or due to be measured. If solar radiation is a problem, special glass, reflecting film on existing glass, or venetian blinds may be used. If sun-blinds are used, they should be mounted externally to prevent a build-up of dust within the laboratory.

3.3 The entrance to the laboratory should be by means of an air-lock, so that one door is closed before the other is opened. The air-lock should be provided with a ‘tacky’ or electrostatic mat. The laboratory should be reasonably, but need not be clinically, dust-free. Walls, floors and ceilings should be of a finish that will not make or harbour dust. Untreated concrete floors, for example, are unsuitable and can be dangerous.

3.4 Adequate cupboard space should be provided within the laboratory to hold standards and calibration equipment. Storage space is also necessary for accessories and tools (see paragraph 5.10).

4. Services

4.1 Lighting should be adequate for the purpose. Illumination levels of 500 and 2000 lux are recommended for offices and work-places. Fluorescent illumination is generally satisfactory but tungsten illumination is useful for viewing. Care must be taken to ensure that local heating by bench lighting does not result in calibration errors from, in the case of optical measurements, variation in the refractive index of the air in the light path. LED lighting should be considered, as it can be more energy efficient and emits less heat.

4.2 Good regulation of the voltage of the electricity supply, particularly freedom from switching surges, can be important especially for autocollimators, instruments using photoelectric devices, and some inductive and electronic devices, even where voltage stabilisers are built-in. Where necessary, local auxiliary voltage stabilisers should be provided.

4.3 If compressed air is used, a pressure regulator and means for removing moisture, dirt and oil should be provided.

5. Environment: Temperature

5.1 It is important that the working volume of the laboratory is free from excessive draughts. The temperature should be reasonably stable and uniform and any temperature gradients, measured vertically or horizontally should be small. In order to achieve these conditions, at the standard temperature of 20°C, good thermal insulation and air-conditioning with automatic temperature control is generally necessary.

5.2 The temperature control necessary depends, to some extent, on the items to be calibrated and the uncertainties required. For general gauge work the temperature of the working volume should be maintained within 20 ± 2°C. Variations in temperature at any position should not exceed 2°C per day and 1°C per hour. These are minimum expectations for UKAS accreditation.

5.3 For higher grade calibrations demanding smaller uncertainties, such as the calibration of gauge blocks by comparison with standards, the temperature of the working volume should be maintained within 20 ± 1°C. Variations in temperature at any position should not exceed 1°C per day and 0.5°C per hour (see paragraph 5.11).

5.4 For the calibration of gauge blocks by interferometry, the temperature within the interferometer should be maintained within 20°C ± 0.5°C. Variations in temperature shall not exceed 0.1°C per hour.

5.5 Automatic temperature control may consist simply of on/off control of heating and cooling providing that the requirements for variation in temperature are not exceeded (see paragraphs 5.2 - 5.4). However, proportional control is preferred, as this should result in smaller temperature variations.

5.6 In order to minimise draughts and temperature variations, good distribution of the incoming air from the air-conditioning system is essential. To achieve satisfactory conditions, it may be necessary to fit trunking to provide extra outlets or grilles to control the direction of the air from existing outlets. The air outlets into the laboratory should not be less than 2.3 m from the floor and the air velocity within the working volume should not exceed 15 cm/s.

5.7 Controlled temperature conditions should be maintained in the laboratory overnight and at weekends. If the heating is turned off in the remainder of the building overnight, it may be necessary to provide additional insulation and double-glazing for the internal walls and windows respectively (see paragraph 3.1). When a laboratory is closed for a period of more than 2 days, the temperature control conditions may be relaxed (see paragraph 6.1). However, temperature controlled conditions will have to be restored for at least 24 hours before the measuring equipment can be expected to be within the control limits and calibration can be resumed.

5.8 For some calibrations, e.g. comparison of length bars with standards, where the uncertainties required are very small relative to the length, or where dissimilar coefficients of expansion are involved, a closer control of temperature may be required. A temperature survey of the laboratory using, for instance, calibrated recording thermometers (thermographs) will frequently reveal local areas where this closer controlled temperature is achieved. These areas may be used for calibration requiring the more exacting conditions; alternatively, calibrations can be carried out within an instrument case or special enclosure.

5.9 Records of temperature need to be made and retained as required by ISO/IEC 17025. Recording thermometers or data loggers, are preferred for this purpose, but liquid-in-glass thermometers, made to BS 593, will suffice. Calibrated thermometers, capable of measuring to 0.1°C or better, should be used to obtain the temperature of measuring equipment and gauges during calibration. This will enable the size of the gauge to be specified more accurately at the standard temperature of 20°C, by taking into account differences in temperature and, where appropriate, differences in the coefficients of expansion.

5.10 Within the laboratory, storage space should be provided in which items to be calibrated may be allowed to thermalise or 'soak' so as to attain the controlled temperature. It is most important that, immediately before calibration, time is allowed for further 'soaking' adjacent to, or preferably on, the measuring equipment. Standards, gauge blocks and similar items should be laid flat and side by side on a metal plate for a minimum of 30 minutes before being compared. Large items should be set up and left overnight. This is to ensure that temperature differences between equipment, standards and the item being measured are as small as possible (see paragraph 5.9).

5.11 It should be noted that a temperature difference of only 0.1°C between a 100 mm steel gauge block and the steel standard with which it is compared will result in a calibration error of approximately 0.11 µm. Where the temperature of the gauge blocks and standard is identical but differs from the standard temperature of 20°C, calibration errors can still occur due to small unknown differences in the coefficients of expansion. For a 100 mm steel gauge this could result in a difference of about 0.11 µm per °C difference from the standard temperature.

6. Environment: Humidity

6.1 Generally, it is sufficient that the relative humidity of the air in the calibration laboratory does not exceed 55% rh, but more closely defined limits may be stipulated for specific calibration tasks.

6.2 It is necessary to keep the temperature of the laboratory above the dew point, and it is therefore unwise to let rooms chill, for example, by shutting off heating at weekends or holidays. If high humidity conditions arise, steps should be taken to prevent rusting.