Centre for Basic, Thermal and Length Metrology
National Physical Laboratory

MOY/SCMI/18

SPECIFICATION OF ACCURACY FOR A SET OF COMBINATION ANGLE GAUGES

This specification relates to NPL type Combination Angle Gauges and Accessories as shown on NPL Drawing No. 1588, British Patent No. 569002 and those Combination Angle gauges covered by Patent No. 559748.

Note: Specifications previously numbered 18 (Issue 5) and 45 (Issue 3) have been reviewed and combined to form this specification.

FOREWORD

In the 1940s and 1950s, NPL was involved in drafting a special series of Specifications of Accuracy that covered a wide range of precision measuring apparatus. This series has been built on first hand experience gained in the design and construction of prototype measuring equipment at NPL and in the design and calibration of measuring equipment of British and foreign manufacture. Each specification in the series originally conformed to a general pattern and was allocated a permanent serial number which, in addition to its title, serves as its identity.

The MOY/SCMI standards are complementary to the Standards issued by the British Standards Institute (BSI). The majority relate to measurement equipment of a proprietary kind designed either at NPL or by British manufacturers which, in the ordinary way, would not fall within BSI's terms of reference. In some cases, in which the equipment is of a more general nature, the Specification has provided a useful basis for formulating a British Standard. The specifications are to enable manufacturers to base their inspection on mutually agreed specifications of accuracy both in workmanship and performance.

MOY/SCMI/18 and 45 have been updated as part of a project financed by the DTI (MPU 8/61.3) concerned with Good Practice Guides and Equipment Specifications.

SCOPE

The MOY/SCMI covers the following two types of combination angle gauges.

NPL type Combination Angle Gauges and Accessories as shown on NPL Drawing No. 1588, British Patent No. 569002.

The set consists of the following gauges: 1º, 3º, 9º, 27º, 41º, 0.1', 0.3', 0.5', 1', 3', 9' and 27'. The set may, in addition, include a 0.05' gauge.

A set of combination angle gauges (Patent No. 559748 as supplied in the following alternative sets:

(i) A set that permits any angle up to 90^o in 1^o increments to be realised. This set consists of four gauges of angles 1^o, 3^o, 9^o and 14^o and one gauge comprising angles of 30^o, 60^o and 90^o.

(ii) A set covering the same range in 5' increments. This set consists of four gauges of angles 1^o, 3^o, 9^o and 14^o and one gauge comprising angles of 30^o, 60^o and 90^o with the addition of three gauges having angles of 5', 15' and 30'.

CONTENTS

1 NPL TYPE COMBINATION ANGLE GAUGES

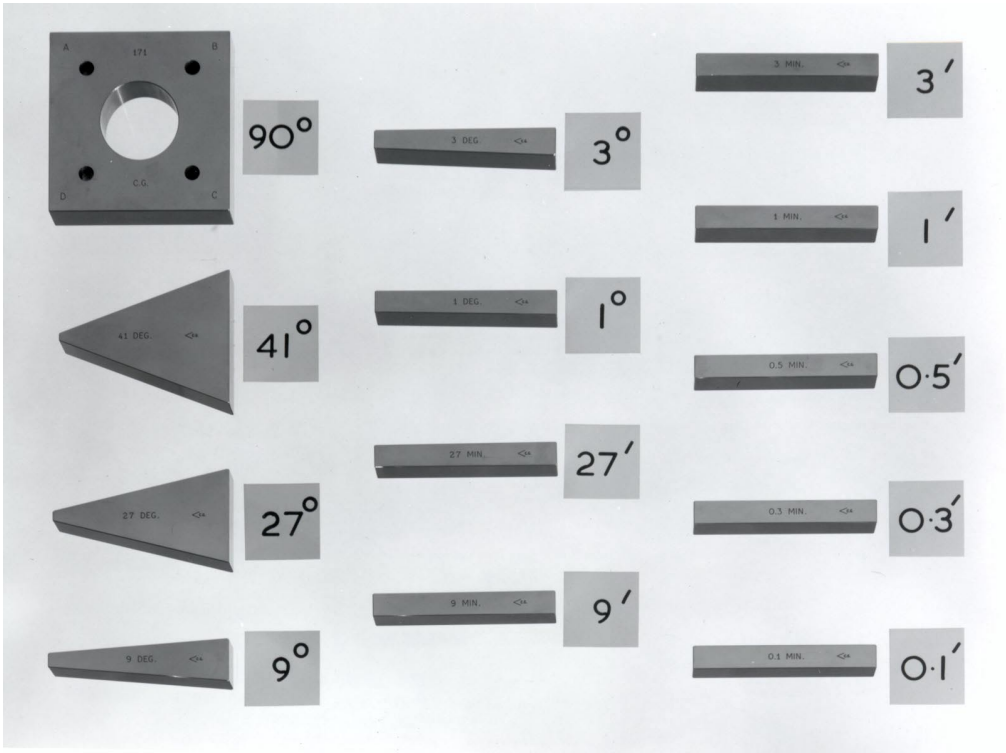

Figure 1 NPL type combination angle gauges (12 gauges plus square block)

1.1 GENERAL

1.1.1 The composition of the set of gauges, the general dimensions and marking of the pieces shall be in accordance with NPL Drawing No. 1588.

1.1.2 The manufacturer shall submit with each set a declaration that it has been given a recognised heat treatment designed to ensure dimensional stability of the gauges.

1.1.3 The working surfaces shall be hardened and have a hardness of not less than **800 HV**, when tested in accordance with BS EN ISO 6507-1:1998.

1.2 FACES

1.2.1 The measuring faces shall be lapped to give a good wringing contact. The sides shall be finely ground or lapped.

1.2.2 The measuring faces shall be flat to within **0.000 2 mm**.

1.2.3 The measuring faces shall be parallel transversely to within **0.002 mm**.

1.2.4 The side faces shall be flat to within **0.0025 mm**.

1.2.5 The measuring faces shall be square to the side faces to within **0.002 mm** over the depth of the measuring face.

1.3 ACCURACY OF ANGLES

1.3.1 The actual angle of each gauge, including each interior angle of the square block, shall agree with its nominal size to within **± 2 seconds of arc**.

1.4 KNIFE-EDGE STRAIGHT EDGE

1.4.1 The wringing face shall be flat to within **0.000 2 mm**.

1.4.2 The side faces shall be flat to within **0.002 5 mm** and parallel to within **0.004 mm.**

1.4.3 The wringing face shall be square to the side faces to within **0.002 5 mm** over the depth of the wringing face.

1.4.4 When the knife-edge is placed on a truly flat surface against a well-illuminated background, no light shall be visible at any point along its length. This test shall apply for any angle of illumination of the straightedge to the flat surface up to 5° on either side of the normal.

1.4.5 The knife-edge shall be parallel with the wringing face to within **0.000 5 mm**.

1.4.6 The knife-edge shall be parallel with the side faces to within **0.025 mm**.

2 HILGER TYPE COMBINATION ANGLE GAUGES

Figure 2 A Set of Hilger type Angle Gauges (picture courtesy of Taylor Hobson Limited)

2.1 GENERAL

2.1.1 Each angle gauge shall be marked with an identification number.

2.1.2 The apex and nominal angle of each angle gauge shall be marked.

2.1.3 The working surfaces shall have a minimum hardness of **800 HV**, when tested in accordance with BS EN ISO 6507-1:1998.

2.1.4 The manufacturer shall submit with each set a declaration that it has been given a recognised heat treatment designed to ensure dimensional stability of the gauges.

2.2 FACES

2.2.1 The measuring faces shall be lapped to give a good wringing contact. The sides shall be finely ground or lapped.

2.2.2 The measuring faces shall be flat to within **0.000 2 mm**.

2.2.3 The measuring faces shall be parallel transversely to within **2 minutes of arc**.

2.2.4 The side faces shall be flat to within **0.003 mm**.

2.2.5 The measuring faces shall be square to the side faces to within **1 minute of arc**.

2.3 ACCURACY OF ANGLES

2.3.1 The actual angle of each gauge shall agree with its nominal size to within **± 2 seconds of arc**.

3 UNCERTAINTIES

3.1.1 It will normally be necessary to consider the uncertainty of measurement when ascertaining compliance (or non-compliance) with this specification. UKAS document M3003 '*Uncertainty and confidence in measurement'* gives guidance in Appendix J.

4 REPORTING OF COMPLIANCE

4.1.1 Certain clauses in any specifications are necessary to support manufacture and assembly but may be difficult or unnecessary to check in subsequent checks for compliance with this specification. In certain cases checking a feature may require disassembly of the item, which may be undesirable. Although it is not essential that all clauses be checked on subsequent verification, it is important that those clauses omitted do not detract from the metrological value of the test. Where applicable, a performance check should always be carried out as this may allow indirect verification of those parameters that are not easily measured individually without disassembly.

4.1.2 When making statements of compliance or non-compliance, it is recommended that this specification and the relevant clauses within it be unambiguously identified in the calibration certificate or test report.

Example wording for a set of angle gauges follows.

This set of angle gauges has been examined for compliance with the accuracy requirements of clauses 2 and 3 of NPL Specification of Accuracy MOY/SCMI/18 (Issue 5), a copy of which is attached to this certificate.

For free measurement advice and information on other specifications in this series call the NPL Help line on 020 8943 6880

E-mail: enquiry@npl.co.uk
Internet: www.npl.co.uk

National Physical Laboratory
Queens Road
Teddington
Middlesex
TW11 0LW

The angle gauges to which this specification relates are further described in *'Measurement of Angle in Engineering'* by J C Evans and C O Taylerson (Third Edition Revised by E W Palmer and S P Poole).

The standard reference temperature for industrial length measurements is defined in ISO 1:1975 *Standard reference temperature for industrial length measurements*.

United Kingdom Accreditation Service (UKAS) can be contacted at

21-47 High Street,
Feltham
Middlesex
TW13 4UN

Tel +44 (0)20 8917 8400

Internet: www.ukas.com