

Centre for Basic, Thermal and Length Metrology
National Physical Laboratory

MOY/SCMI/95

**SPECIFICATION OF ACCURACY FOR A
NPL DESIGNED SMALL-ANGLE GENERATOR**

A Small-Angle Generator of NPL design, Drawing Nos. 1820 and 2107, intended primarily for calibrating "Microptic" type autocollimators and having a range of ten minutes of arc.

Note: This specification was previously entitled '*Specification of Accuracy for a Small Angle Generator*'.

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 (Metrology/Specification Certification Measuring Instruments) 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/95 has been updated as part of a project financed by the DTI (MPU 8/61.3) concerned with Good Practice Guides and Equipment Specifications.

SCOPE

A Small-Angle Generator of NPL design, Drawing Nos. 1820 and 2107, intended primarily for calibrating "Microptic" type autocollimators and having a range of ten minutes of arc.

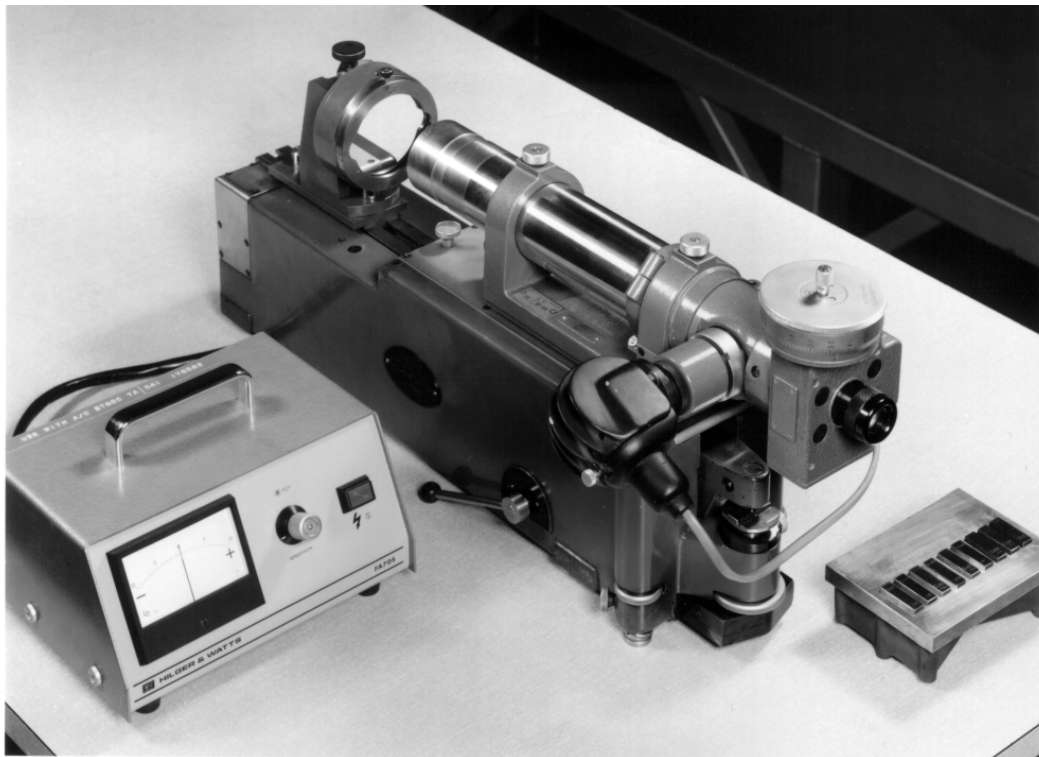


Figure 1 Small-Angle Generator with photo-electric autocollimator

CONTENTS

| | Page |
|---------------------------------|------|
| 1 GENERAL | 3 |
| 2 HYDRAULIC CONTROL | 3 |
| 3 REFLECTOR | 3 |
| 4 SINE ARM | 4 |
| 5 PERFORMANCE | 4 |
| 6 DIAGRAMS | 5 |
| 7 UNCERTAINTIES | 5 |
| 8 REPORTING OF COMPLIANCE | 5 |

1 GENERAL

1.1 The workmanship and finish shall be in conformity with a precision instrument of this class.

1.2 The instrument shall be marked with:

- (i) An identification number
- (ii) The maker's name or trademark
- (iii) "Based on NPL Design"

2 HYDRAULIC CONTROL

The mechanism for raising, lowering and adjusting the rate of fall of the sine arm shall function satisfactorily.

3 REFLECTOR

3.1 When an autocollimator is mounted on the instrument and the sine arm is in its mid-position it shall be possible, by means of the adjustment, to set the reflected image centrally in the field of view.

3.2 The reflecting surface shall be flat to within **0.000 08 mm (0.000 003 in)**.

4 SINE ARM

- 4.1 The hinge roller shall be hardened and, when finished, shall have a hardness of not less than **800 HV**, when tested in accordance with BS EN ISO 6507-1:1998.
- 4.2 The tungsten-carbide bearing pads for the hinge roller shall be lapped
- 4.3 The ball contact shall be well finished and shall have a hardness of not less than **800 HV**, when tested in accordance with BS EN ISO 6507-1:1998.
- 4.4 When the sine arm is set on a gauge block stack of 3.3 mm (0.130 in.) and the gauge block support is adjusted vertically until the index line on its stem is just visible (i.e. the mid-measuring position of the instrument), the plane passing through the centres of the ball contact and the hinge roller shall be parallel with the plane of the three-ball slip gauge support to within **0.05 mm per 25 mm (0.002 in. per in.)**
- 4.5 The distance between the centres of the hinge roller and the ball contact shall be **515.65 mm ± 0.05 mm (20.626 in. ± 0.002 in.)**

NOTE: This requirement ensures that a change of 0.002 5 mm (0.000 1 in.) in the height of the ball contact is equivalent to a change in angle of the sine bar of 1 second of arc throughout the ten minutes working range.

5 PERFORMANCE

By using the relationship that one second of arc is equivalent to a change in height of the ball contact of 0.002 5 mm (0.000 1 in.) it shall be possible to generate angles up to 10 minutes of arc to within 0.1 second of arc.

- 5.1 The instrument shall function satisfactorily when used to calibrate an independently calibrated autocollimator with a resolution of 0.2 second of arc over ± 5 minutes range from the mid-measuring position of the instrument. The calibrations shall agree to within the combined uncertainties. It shall also be possible to obtain repetition of setting of the sine arm to within **0.05 second of arc**.

6 DIAGRAMS

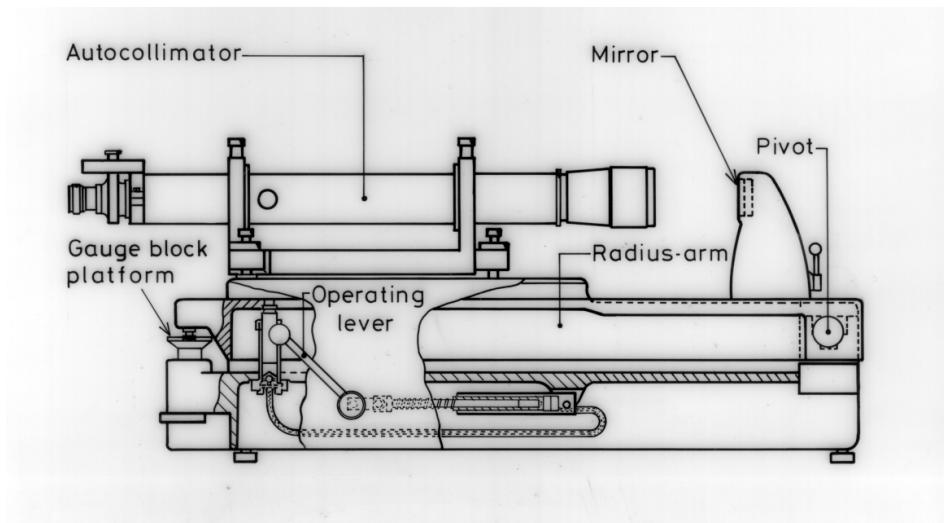


Figure 2 Diagram of NPL-designed small-angle generator with autocollimator

7 UNCERTAINTIES

- 7.1 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.

8 REPORTING OF COMPLIANCE

- 8.1 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.
- 8.2 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 small angle generator to which this specification relates is 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 020 8917 8400

Internet: www.ukas.com

