

Measuring instruments for building construction —

Part 4: Methods for determining accuracy in use of theodolites

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee (BDB/-) to Technical Committee BDB/4, upon which the following bodies were represented:

- Association of County Councils
- Brick Development Association
- British Standards Society
- Building Employers' Confederation
- Chartered Institution of Building Services Engineers
- Concrete Society
- Department of Education and Science
- Department of the Environment (Building Research Establishment)
- Incorporated Association of Architects and Surveyors
- Institute of Clerks of Works of Great Britain Inc.
- Institution of Civil Engineers
- Institution of Structural Engineers
- Institution of Water and Environmental Management
- Royal Institute of British Architects
- Royal Institution of Chartered Surveyors
- Society of Chief Architects of Local Authorities

The following body was also represented in the drafting of the standard, through subcommittees and panels:

- Chartered Institute of Building

This British Standard, having been prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 March 1992

© BSI 08-1999

The following BSI references relate to the work on this standard:
Committee reference BDB/4
Draft for comment 88/10402 DC

ISBN 0 580 20620 3

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
1 Scope	1
2 Normative references	1
3 General	1
4 Procedures for theodolites	3
Figure 1 — Flow diagram for accuracy-in-use tests	2
Figure 2 — Layout of four targets	3
Table 1-A — Measurement of horizontal angles, gon-system — Example of field observations and calculation	6
Table 1-B — Measurement of horizontal angles, gon-system — Field observations and calculation	7
Table 2-A — Measurement of horizontal angles with sexagesimal theodolite — Example of field observations and calculation	8
Table 2-B — Measurement of horizontal angles with sexagesimal theodolite — Field observations and calculation	9
Table 3-A — Measurement of vertical angles, gon-system — Example of field observations and calculation	10
Table 3-B — Measurement of vertical angles, gon-system — Field observations and calculation	11
Table 4-A — Measurement of vertical angles with sexagesimal theodolite — Example of field observations and calculation	12
Table 4-B — Measurement of vertical angles with sexagesimal theodolite — Field observations and calculation	13
Publication(s) referred to	Inside back cover

National foreword

This Part of BS 7334 has been prepared under the direction of the Basic Data and Performance Criteria for Civil Engineering and Building Structures Standards Policy Committee. It is identical with ISO 8322-4:1991 “*Building construction — Measuring instruments — Procedures for determining accuracy in use — Part 4: Theodolites*” published by the International Organization for Standardization (ISO), and gives the testing procedures to be adopted for theodolites.

The series of Parts comprising BS 7334 will assist in ascertaining whether particular measuring equipment is appropriate to intended measuring tasks; they are also intended for assessing the accuracy in use of measuring instruments in general use on construction sites. The Parts are referred to in BS 5606:1990 “*Guide to accuracy in building*”.

ISO 8322 consists of the following parts, under the general title “*Building construction — Measuring instruments — Procedures for determining accuracy in use*”:

- *Part 1: Theory*;
- *Part 2: Measuring tapes*;
- *Part 3: Optical levelling instruments*;
- *Part 4: Theodolites*;
- *Part 5: Optical plumbing instruments*;
- *Part 6: Laser instruments*;
- *Part 7: Instruments when used for setting out*;
- *Part 8: Electronic distance-measuring instruments up to 150 m*;
- *Part 9: Electronic distance-measuring instruments up to 500 m*;
- *Part 10: Testing short-range reflectors*.

Cross-references

International standard	Corresponding British Standard
ISO 3534:1977 ^a	BS 5532 <i>Statistical terminology</i> Part 1:1978 <i>Glossary of terms relating to probability and general terms relating to statistics</i> (Identical)
ISO 4463-1:1989	BS 5964 <i>Building setting out and measurement</i> Part 1:1990 <i>Methods of measuring, planning and organization and acceptance criteria</i> (Identical)
ISO 7078:1985	BS 6953:1988 <i>Glossary of terms for procedures for setting out, measurement and surveying in building construction (including guidance notes)</i> (Identical)

^a ISO 3534 is also related to BS 4778 “*Quality vocabulary*” — Part 2:1979 “*National terms*”.

The Technical Committee has reviewed the provisions of ISO 7077, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This part of ISO 8322 specifies test procedures to be adopted when determining and assessing the accuracy in use of theodolites for measurement of horizontal and vertical angles in the gon and degree system.

The procedures given in this part of ISO 8322 apply when these theodolites are used in building construction for surveying, check and compliance measurements and also when obtaining accuracy data.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8322. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8322 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3534:1977, *Statistics — Vocabulary and symbols*.

ISO 4463-1:1989, *Measurement methods for building — Setting-out and measurement — Part 1: Planning and organization, measuring procedures, acceptance criteria*.

ISO 7077:1981, *Measuring methods for building — General principles and procedures for the verification of dimensional compliance*.

ISO 7078:1985, *Building construction — Procedures for setting out, measurement and surveying — Vocabulary and guidance notes*.

3 General

3.1 Before commencing surveying, check and compliance measurements, when obtaining accuracy data or setting out, it is important that the operator investigate whether the accuracy in use of the measuring equipment is appropriate to the intended measuring task. This International Standard recommends that the operator carry out test measurements under field conditions to establish the accuracy achieved when he uses a particular measuring instrument and its ancillary equipment.

To ensure that the assessment takes account of various environmental influences, two series of measurements need to be carried out under different conditions. The particular conditions to be taken into account may vary depending on where the tasks are to be undertaken. These conditions will include variations in air temperature, wind speed, cloud cover and visibility. Note should also be made of the actual weather conditions at the time of measurement and the type of surface over which the measurements are made. The sets of conditions chosen for the tests should match those expected when the intended measuring task is actually carried out. See ISO 7077 and ISO 7078.

The procedures are designed so that the systematic errors are largely eliminated and assume that the particular instruments are in known and acceptable states of user adjustment according to methods detailed in the manufacturers' handbooks.

Accuracy-in-use procedures require repeat tests to be made with the same instrumentation and the same observer, within a short interval of time. These are "repeatability conditions" as defined in ISO 3534.

The accuracy in use is expressed in terms of the standard deviation.

3.2 Figure 1 indicates schematically the decisions to be made when establishing that the accuracy associated with a given surveying method and particular measuring equipment is appropriate to the intended measuring task. In particular, the decisions apply when adopted by a particular operator under a range of environmental conditions which are likely to occur when the task is actually carried out. Where the contract documentation specifies the required tolerance for the intended measuring task, it is recommended that this tolerance, which is normally given in terms of the permitted deviation P ($P = 2,5 \sigma$) of the measuring task, be compared with the accuracy-in-use data obtained either from previous accuracy-in-use tests or from general data A which indicate the expected accuracy in use of given measuring equipment. On those occasions that the previously obtained data indicate that the accuracy in use associated with the given measuring equipment does not meet the specified permitted deviation of the measuring task, consideration should be given to either selecting a different method and/or a more precise instrument or discussing with the designer the need for such a small permitted deviation. See ISO 4463-1.