BS ISO 17123-8:2015

BSI Standards Publication

Optics and optical instruments — Field procedures for testing geodetic and surveying instruments

Part 8: GNSS field measurement systems in real-time kinematic (RTK)

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National foreword

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Optics and optical instruments — Field procedures for testing geodetic and surveying instruments —

Part 8: GNSS field measurement systems in real-time kinematic (RTK)

Optique et instruments d'optique — Méthodes d'essai sur site des instruments géodésiques et d'observation —

Partie 8: Systèmes de mesure GNSS sur site en temps réel cinématique

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 6, *Geodetic and surveying instruments*.

This second edition cancels and replaces the first edition (ISO 17123-8:2007), which has been technically revised.

ISO 17123 consists of the following parts, under the general title *Optics and optical instruments — Field procedures for testing geodetic and surveying instruments*:

— *Part 1: Theory*

— *Part 2: Levels*

— *Part 3: Theodolites*

— *Part 4: Electro-optical distance meters (EDM measurements to reflectors)*

— *Part 5: Total stations*

— *Part 6: Rotating lasers*

— *Part 7: Optical plumbing instruments*

— *Part 8: GNSS field measurement systems in real-time kinematic (RTK)*

Annex A, Annex B, and Annex C of this part of ISO 17123 are for information only.

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Introduction

This part of ISO 17123 specifies field procedures for adoption when determining and evaluating the uncertainty of measurement results obtained by geodetic instruments and their ancillary equipment, when used in building and surveying measuring tasks. Primarily, these tests are intended to be field verifications of suitability of a particular instrument for the immediate task. They are not proposed as tests for acceptance or performance evaluations that are more comprehensive in nature.

The definition and concept of uncertainty as a quantitative attribute to the final result of measurement was developed mainly in the last two decades, even though error analysis has already long been a part of all measurement sciences. After several stages, the CIPM (Comité Internationale des Poids et Mesures) referred the task of developing a detailed guide to ISO. Under the responsibility of the ISO Technical Advisory Group on Metrology (TAG 4) and in conjunction with six worldwide metrology organizations, a guidance document on the expression of measurement uncertainty was compiled with the objective of providing rules for use within standardization, calibration, laboratory, accreditation, and metrology services. ISO/IEC Guide 98-3 was first published as the Guide to the Expression of Uncertainty in Measurement (GUM) in 1995.

With the introduction of uncertainty in measurement in ISO 17123 (all parts), it is intended to finally provide a uniform, quantitative expression of measurement uncertainty in geodetic metrology with the aim of meeting the requirements of customers.

ISO 17123 (all parts) provides not only a means of evaluating the precision (experimental standard deviation) of an instrument but also a tool for defining an uncertainty budget, which allows for the summation of all uncertainty components, whether they are random or systematic, to a representative measure of accuracy, i.e. the combined standard uncertainty.

ISO 17123 (all parts) therefore provides, for defining for each instrument investigated by the procedures, a proposal for additional, typical influence quantities, which can be expected during practical use. The customer can estimate, for a specific application, the relevant standard uncertainty components in order to derive and state the uncertainty of the measuring result.

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Optics and optical instruments — Field procedures for testing geodetic and surveying instruments —

Part 8: GNSS field measurement systems in real-time kinematic (RTK)

1 Scope

This part of ISO 17123 specifies field procedures to be adopted when determining and evaluating the precision (repeatability) of Global Navigation Satellite System (GNSS) field measurement systems (this includes GPS, GLONASS, as well as the future systems like GALILEO) in real-time kinematic (GNSS RTK) and their ancillary equipment when used in building, surveying, and industrial measurements. Primarily, these tests are intended to be field verifications of the suitability of a particular instrument for the required application at hand and to satisfy the requirements of other standards. They are not proposed as tests for acceptance or performance evaluations that are more comprehensive in nature.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 9849, *Optics and optical instruments — Geodetic and surveying instruments — Vocabulary*

ISO 12858-2, *Optics and optical instruments — Ancillary devices for geodetic instruments — Part 2: Tripods*

ISO 17123-1, *Optics and optical instruments — Field procedures for testing geodetic and surveying instruments — Part 1: Theory*

ISO 17123-2, *Optics and optical instruments — Field procedures for testing geodetic and surveying instruments — Part 2: Levels*

ISO 17123-5, *Optics and optical instruments — Field procedures for testing geodetic and surveying instruments — Part 5: Total stations*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM: 1995)*

ISO/IEC Guide 99:2007, *International vocabulary of metrology — Basic and general concepts and associated terms (VIM)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3534-1, ISO 9849, ISO 17123-1, ISO 17123-2, ISO 17123-5, ISO/IEC Guide 98-3, and ISO/IEC Guide 99 apply.

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4 General

4.1 Preamble

The real-time kinematic positioning method is a relative measuring procedure using reference (base) and moving (rover) receivers. For utilization of network RTK applications, a separate reference receiver is not required. Both receivers perform the observations simultaneously and merge their results by wireless transmission. Thus, the rover can display the instantaneous coordinates of the antenna in any appropriate datum, e.g. International Terrestrial Reference Frame (ITRF). For practical use, they are transformed to horizontal coordinates and ellipsoidal heights. Subsequently, only these types of coordinate are treated as original observables.

4.2 Requirements

Before commencing surveying, it is important for the operator to ensure that the equipment, the GNSS receiver and antenna, has sufficient precision for the task required.

The test should apply typically to a set of GNSS receivers and antennae listed in the manufacturer's reference manual. In case of using network RTK, consistency of antenna models (e.g. antenna correction parameters) shall be ensured.

The receiver, antenna, and their ancillary equipment for rover points shall be checked to be in acceptable condition according to the methods specified in the reference manual.

The operator shall follow the guidelines in the manufacturer's reference manual for positioning requirements such as the minimum number of satellites, maximum Position Dilution Of Precision (PDOP) value, minimum observation time, and possibly other required pre-conditions.

The operator shall initialize the receiver by resetting its power prior to every measurement and collect the data after the integer ambiguity fixing has been completed.

The following is the guideline for achievable centring precision expressed in standard deviation:

— centring: 1 mm;

— measuring the antenna height: 1 mm.

The results of the test are influenced by several factors, such as satellite configuration visible at the points, ionospheric and tropospheric conditions, multipath environment around the points, precision of the equipment, and quality of the software running in the rover equipment or in the system generating the data transmitted from the base point.

This part of ISO 17123 describes two different field procedures, namely the simplified test procedure and the full test procedure, as given in Clauses 5 and 6, respectively. Therefore, the observation time of test procedure shall be so arranged to cover such variations.

The operator shall choose the procedure that is most appropriate to the requirements of the project.

4.3 Concept of the test procedures

The test field consists of a base point and two rover points. The location of the rover points shall be close to the area of the task concerned. The separation of two rover points shall be a minimum of 2 m and shall not exceed 20 m. The positions of two rover points may be selected at convenience in the field (see Figure 1).

The horizontal distance and height difference between two rover points shall be determined by methods with precision better than 3 mm other than RTK. These values are considered as nominal values and are used in the first step of both test procedures. The horizontal distances and height differences calculated from the measured coordinates in each set of measurements shall be compared with these values in

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