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Optics and optical instruments — Ancillary devices for geodetic instruments —

Part 1:
Invar levelling staffs

Optique et instruments d'optique — Equipements annexes pour les instruments géodésiques —

Partie 1: Mires de nivellement en invar

[Revision of first edition (ISO 12858-1:1999)]

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 12858-1 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 6, *Geodetic and surveying instruments*.

This second edition cancels and replaces the first edition (ISO 12858-1:1999) which has been technically revised.

ISO 12858 consists of the following parts, under the general title *Optics and optical instruments — Ancillary devices for geodetic instruments*:

— *Part 1: Invar levelling staffs*

— *Part 2: Tripods*

— *Part 3: Tribrachs*

Annex A of this part of IS0 12858 is for information only.

Introduction

ISO 12858 consists of a series of parts which detail specifications for ancillary devices to be used with geodetic instruments in surveying. This first part specifies requirements for Invar levelling staffs.

Additional parts, covering other ancillary devices, may be added to ISO 12858 as the need arises.

Optics and optical instruments — Ancillary devices for geodetic instruments — Part 1: Invar levelling staffs

1 Scope

This part of ISO 12858 specifies the most important requirements of Invar levelling staffs used in geodesy and industry for precise measurement of heights in combination with either an optical-mechanical level equipped with a parallel plate micrometer, or a digital level of comparable precision.

It is applicable to

— classical rods with graduation lines and numbering;

— rods used in digital levelling with code patterns.

The scales of these rods have different influence on the measuring result.

NOTE The measurement uncertainty of the height differences depend on a multitude of influencing factors of the whole measuring system including the levelling instruments.

This part of ISO 12858 is not applicable to the detailed design and construction of Invar levelling staffs (e.g. materials, handles, fixing points for the struts, fixing of the Invar strip and of the circular level), which may be selected by the manufacturer as appropriate.

2 Normative references

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

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

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 9849 and the following apply.

3.1
Invar
iron nickel alloy with low thermal coefficient of expansion

4 Design

Invar levelling staffs are normally manufactured in nominal lengths of 2 m and 3 m. However, other alternative lengths may be adopted.

The detailed design and construction are left to the manufacturer.

Examples of Invar levelling staffs are shown in Annex A.

5 Invar scale strip

The Invar strip carrying the scale is classified in Table 1.

Table 1 — Classification of Invar strip

Classification of Invar strip	A	B	C
Coefficient of thermal expansion α	$\|\alpha\| \leq 0{,}5 \times 10^{-6}\ K^{-1}$	$\|\alpha\| \leq 1{,}0 \times 10^{-6}\ K^{-1}$	$\|\alpha\| \leq 1{,}5 \times 10^{-6}\ K^{-1}$

where

K is the SI unit of temperature kelvin.

This classification may be used to specify the quality of the Invar strip.

6 Scale and scale numbering

6.1 Classical rod

The Invar scale strip on levelling staffs may be equipped with one or two parallel sets of scales. The scale marks shall be sharp, parallel and of equal thickness. The colours of the scale marks and of the scale numbering shall be of good contrast. In the case of two parallel sets of scales, they shall be offset (staff constant, equal to the difference between the two opposite scale values), the value of which shall be indicated on the staff frame or on the Invar scale strip.

The scale numbering shall be on the staff frame, adjacent to the Invar scale strip. In the case of two parallel sets of scales, the scale numbering shall be placed adjacent to the respective scales, on each side of the Invar scale strip.

The maximum deviation (MPE) of the distance between any two scale marks shall not exceed the value specified in Table 2:

Table 2 — Classification of scale

Class	A	B	C
admissible deviation	$\|\Delta l\| \leq 0{,}02 + l(2 \times 10^{-5})$	$\|\Delta l\| \leq 0{,}025 + l(2{,}5 \times 10^{-5})$	$\|\Delta l\| \leq 0{,}05 + l(5 \times 10^{-5})$
where			
Δl is the admissible deviation (MPE), in millimetres, at 20 °C;			
l is the distance, in millimetres, between any two scale marks.			

6.2 Rods for digital levels

The scale of rods for digital levels is different from classical rods; it consists of a sequence of code patterns.

This admissible deviation for the scale of code rods shall be compatible with Table 2.

where

(The admissible deviation) = (measured value under a test) – (standard value by designing of manufacturers).

The test should be accomplished by a special measuring machine.

7 Zero-point error

It is considered that the zero-point error of the levelling staff is the error of the first decimetre (of the levelling staff). The measurement to determine this difference shall be made parallel to the staff length axis and perpendicular to the baseplate, at 20 °C. The zero-point error shall not exceed 0,05 mm. Provision for adjusting the zero-point shall be made.

8 Baseplate

The baseplate shall have on its lower side a hardened stainless steel plate. The flatness deviation of the plate shall not exceed 0,02 mm. The baseplate shall be perpendicular, within ± 5', to the staff length axis.

9 Accessories

At a suitable position on the staff frame, two foldable handles and fittings for struts shall be provided. Heat insulating materials should be selected for handle or handle's jacket.

The alternative use of a centring ring at the baseplate should be possible.

10 Circular level

A circular level having an (usable) indicating range of 15' ± 5' shall be fixed to the backside of the levelling staff.

11 Designation and marking

The marking shall indicate at least the following data on the backside of the levelling staff:

— the name or trademark of the manufacturer (or responsible supplier);

— the individual identification number (serial number).