

Invar rods for precise levelling are examined on the comparators at the Geodetic Institute of the Technical University in Munich. The distances between the single lines on the invar tape are tested with a laser interferometer. The lines are observed with an opto-electronic double-diode (TU Karlsruhe). The observation process itself on these advanced comparators is therefore completely automated.

Determination of the scale factor in vertical position

1. Invar rod with bar-code scale

The positions of 170 lines with a width of 2 mm are determined in the forward and reverse directions. The observed lines are fairly distributed along the whole invar tape.

The nominal position and the real position are compared and the results are related to a straight line. The gradient of this regression straight line is the scale factor m_0 at the temperature of measurement, approximately 20 °C.

2. Invar rod with line graduation

In this case, the position of all lines on the tape are examined and the scale factor m_0 is determined for both scales.

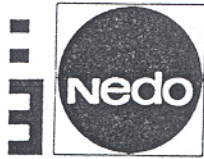
A certificate of the residuals of the individual lines is supplied and a delivery on disc is also possible.

Determination of the coefficient of expansion

For the evaluation of the coefficient of expansion the graduations of the invar rods are tested at different temperatures on a horizontal comparator (only one scale for line graduation). The measurements are done in the forward and reverse directions. The respective scale factors depend of the temperatures, they are related to a regression straight line. Its gradient α_T is the coefficient of expansion.

The observations are accomplished in a cycle of 30-0-20-40-10°C. The great differences of temperature between the single observations ensure that malfunctions of the tension module and the influence of friction between the invar tape and the housing of the rod can be detected.

Endabnahme NEDO Invarlatten



Nestle & Fischer GmbH & Co. KG

Vermessungsgerätefabrik

72280 Dornstetten/Württ.

Datum: 24. 6. 96

Prüfer: Max Bittenbinder

Nummer: 027730

Teilung: ☐ cm-Doppelteilung ☐ 1/2-cm-Doppelteilung ☒ BC.

Länge: ☐ 1 m ☒ 2 m ☐ 3 m

Prüfung

geprüft und für in
Ordnung befunden

Geradheit des Lattenkörpers



Nullpunkteinstellung



Libellenjustierung



Winkligkeit der Aufsetzfläche



Ebenheit der Aufsetzfläche



Teilungsgenauigkeit nach DIN 18717



Funktionsfähigkeit der Handgriffe



Lackierung des Invarbandes



Lackierung des Lattenkörpers



M Sonderausführung



Strebe



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Calibration Report

Invar rod (type, No.): LEICA-GPCL2 27730

Date : 11.07.96 - 18.07.96

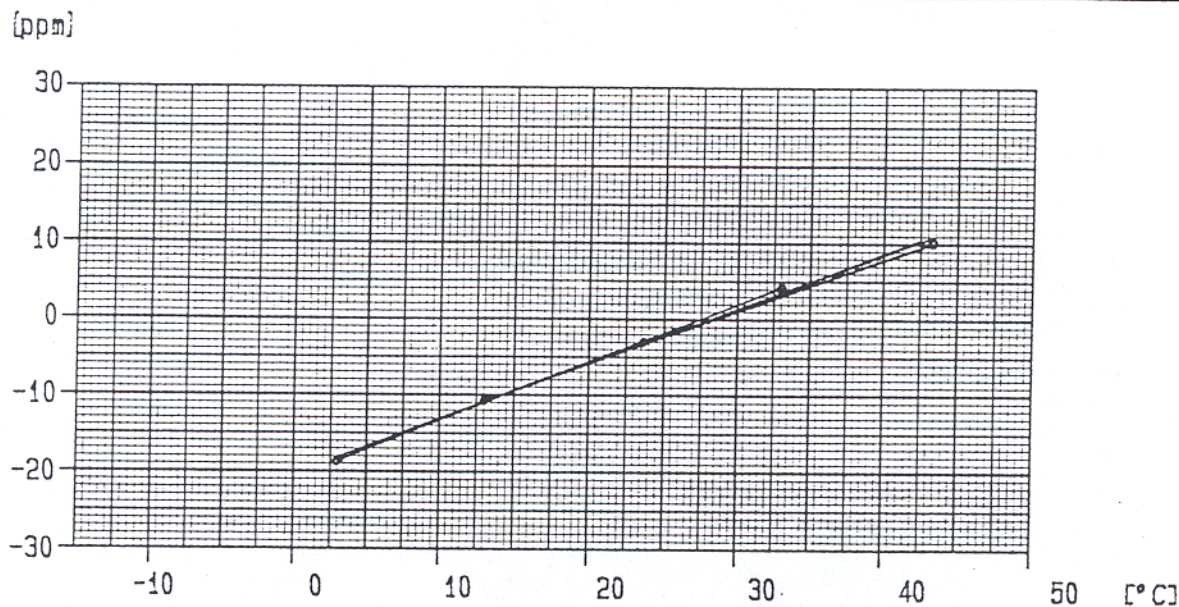
No. of graduations measured: 105

Order No: 96-60-408583

Determination of the coefficient of expansion

Horizontal calibration position

Measurement cycle: 30 → 0 → 20 → 40 → 10 [°C]

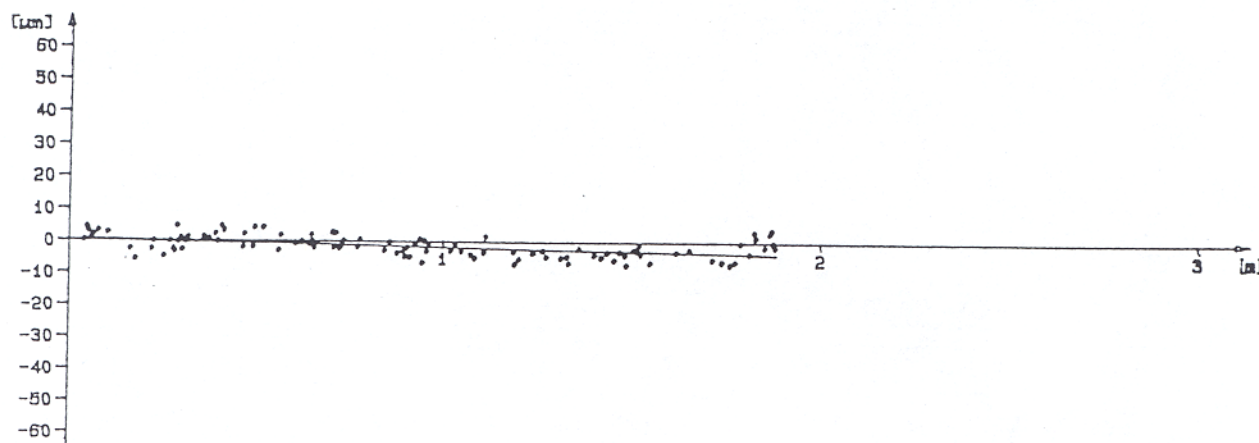


Coefficient of expansion:

$$\alpha_T = 0.74 \pm 0.02 \text{ ppm/}^\circ\text{C}$$

Determination of the scale factor

Vertical calibration position



Scale factor:

$$m_0 = -2.37 \pm 0.49 \text{ ppm at } T_0 = 20.1 \text{ }^\circ\text{C}$$

Length adjustment for vertical position of use

$$L = L' [1 + (m_0 + \alpha_T(T - T_0)) \cdot 10^{-6}]$$

L' [m] = observed rod length

T [°C] = temperature

Technical specialist:

Schreyer

Munich,

18.07.96

Laboratory director:

Dr. U. Hauke

Institute director:

i. A. Dr. U. Hauke

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