

Mitutoyo technology enhances gauge block quality

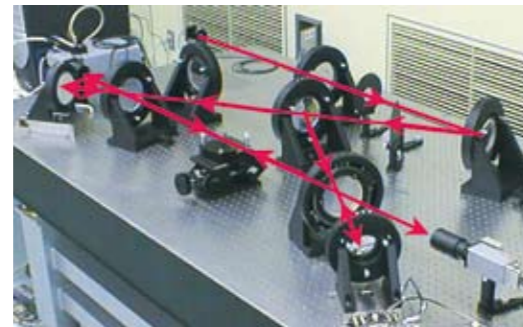
World-class calibration capability

The Japanese Calibration Service System (JCSS) became operational in 1993 and the very next year Mitutoyo was accredited as a calibration laboratory for interferometric and comparative gauge block measurement. Since then, Mitutoyo has striven continuously to reduce the uncertainty in gauge block measurement. As a result, in 2004, Mitutoyo was credited by NITE, a JCSS accreditation organization, as having a calibration capability among the best in the world (measurement uncertainty: 20 nm for a 25 mm block (k=2)).



Interferometric measurement technology for coefficient of thermal expansion (patent pending)

Mitutoyo has developed a highly accurate system for measuring the coefficient of thermal expansion by virtue of ceaseless enthusiasm for measuring gauge blocks. In this system, advanced temperature- and interferometric-measurement technology combine to measure, simultaneously, dimensional change at each end of a gauge block. This system provides Mitutoyo with the capability to measure coefficients of thermal expansion within a very small uncertainty value ($0.035 \times 10^{-6}/K$ (k=2)).

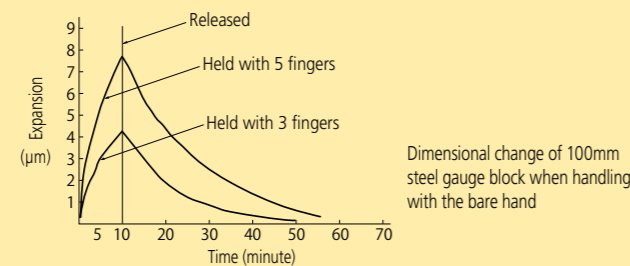


Gauge blocks are available whose coefficient of thermal expansion has been measured. These are otherwise standard gauge blocks supplied with individual calibration certificates specifying the actual coefficient of thermal expansion.

For details, please refer to publication "A Gauge Block with calibrated coefficient of thermal expansion".

Tips What is "coefficient of thermal expansion"?

The coefficient of thermal expansion (or coefficient of linear expansion) means how much an object expands for one kelvin/centigrade degree of temperature increase. For example, the coefficient of thermal expansion of steel is approximately $11 \times 10^{-6}/K$. This means that a one-meter long steel bar will expand (or shrink) by approximately 11 μm in length for every 1 K of temperature change. The value varies with temperature but can be treated as constant, for calculation purposes, over a small temperature range.



Export permission by the Japanese government may be required for exporting our products according to the Foreign Exchange and Foreign Trade Law. Please consult our sales office near you before you export our products or you offer technical information to a nonresident.

- Coordinate Measuring Machines
- Vision Measuring Systems
- Form Measurement
- Optical Measuring
- Sensor Systems
- Test Equipment and Seismometers
- Digital Scale and DRO Systems
- Small Tool Instruments and Data Management

30 0903 1 C (CH) NE, Printed in Japan

Catalog No.E4331

Length Standard ZERO CERA BLOCK AN ULTRA LOW EXPANSION CERAMIC GAUGE BLOCK



Advanced ceramic gives new gauge block amazing stability

Mitutoyo Corporation
20-1, Sakado 1-Chome,
Takatsu-ku, Kawasaki-shi,
Kanagawa 213-8533, Japan
T +81 (0) 44 813-8230
F +81 (0) 44 813-8231
<http://www.mitutoyo.co.jp>

Note: All information regarding our products, and in particular the illustrations, drawings, dimensional and performance data contained in this pamphlet, as well as other technical data are to be regarded as approximate average values. We therefore reserve the right to make changes to the corresponding designs, dimensions and weights. The stated standards, similar technical regulations, descriptions and illustrations of the products were valid at the time of printing. Only quotations submitted by ourselves may be regarded as definitive.

An innovative length standard offers high thermal and secular stability :
ZERO CERA BLOCK™

- ◇ Thermal expansion at 20±1°C less than 1/500 that of steel
- ◇ Almost no secular change both in dimension and coefficient of thermal expansion
- ◇ Complementary ultra-low thermal expansion and high specific rigidity (Young's modulus/specific gravity)

Almost no thermal expansion!

ZERO CERA BLOCK is a highly stable length standard suitable for calibrating the temperature compensation of machine tools and measuring instruments in a non-20°C environment. ZERO CERA BLOCK can also improve calibration work efficiency by eliminating the need for temperature compensation of itself, leaving only the thermally induced dimensional change of the calibration target to be considered.

Almost no secular deterioration!

Unlike a glass material, the ceramic material used for ZERO CERA BLOCK has a poreless structure without an amorphous state. This provides excellent long-term stability, both for the length and the (extremely small) coefficient of thermal expansion.

Light and easy to handle!

The rigidity and flexural strength is 50% better than glass and the low specific gravity (1/3 that of steel) make ZERO CERA BLOCK easy to handle. The only care needed to prevent damage is to avoid dropping or knocking the blocks.

Rust free!

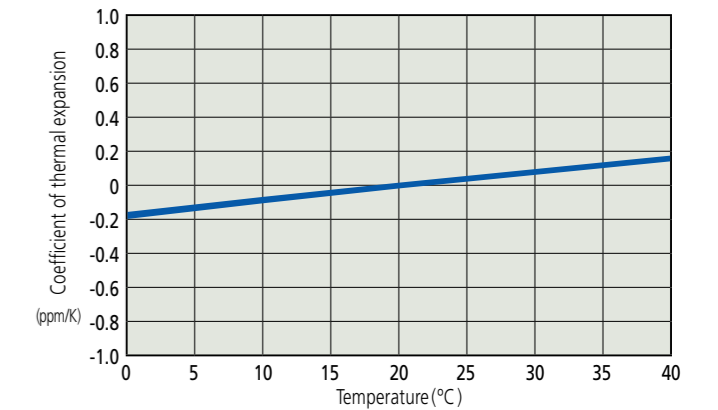
ZERO CERA BLOCK can be handled with bare hands without worrying about rust or heat conduction. Also, no treatment is necessary to prevent rust in storage.

Magnetization free!

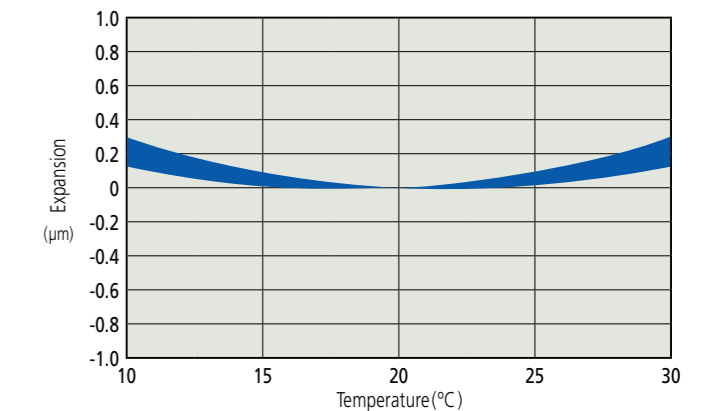
ZERO CERA BLOCK is suitable for use in clean rooms (especially a non-20°C environment) as it is nonmagnetic, so does not pick up iron dust, and is nonconductive with a low dielectric constant, so does not attract much airborne dust by becoming electrically charged.



■ Coefficient of Thermal Expansion versus Temperature



■ Thermal Expansion versus Temperature (for 500 mm block)



■ Characteristics comparison of gauge block materials

	ZERO CERA BLOCK	Low expansion glass ^{*1)}	CERA BLOCK	Steel	Tungsten carbide
Coefficient of thermal expansion(10 ⁻⁶ /K)	0±0.02 ^{*2)} ^{*3)}	0±0.02 ^{*2)} ^{*3)}	9.3±0.5	10.8±0.5	5.5±1.0
Thermal conductivity (W/m·K)	3.7	1.7	2.9	54.4	79.5
Specific gravity	2.5	2.55	6.0	7.8	14.8
Young's modulus (GPa)	130	90	206	206	618
Poisson ratio	0.3	0.25	0.3	0.3	0.2
Flexural strength (3 points) (MPa)	210	143	1270	1960	1960
Fracture toughness (MPa·m ^{1/2})	1.2	0.69 ^{*4)}	7	120	12
Vickers hardness (HV)	826 ^{*3)}	680	1350	800	1650

^{*1)} Material for Mitutoyo products
^{*2)} Value at 20°C
^{*3)} Claimed value by the material supplier
^{*4)} Value measured by the material supplier (reference)

■ Part Numbers for Ordering

Please check Part No. for required type and language of calibration certificate in the following table.

Nominal size (mm)	JIS/ISO/DIN (grade K)		BS (grade K)	ASME (grade K)
	Japanese	English	English	English
30	617673-013	617673-016	617673-116	617673-516
50	617675-013	617675-016	617675-116	617675-516
100	617681-013	617681-016	617681-116	617681-516
200	617682-013	617682-016	617682-116	617682-516
300	617683-013	617683-016	617683-116	617683-516
400	617684-013	617684-016	617684-116	617684-516
500	617685-013	617685-016	617685-116	617685-516
600	617840-013	617840-016	617840-116	617840-516
700	617841-013	617841-016	617841-116	617841-516
800	617843-013	617843-016	617843-116	617843-516
900	617844-013	617844-016	617844-116	617844-516
1000	617845-013	617845-016	617845-116	617845-516
Set of the above 12pcs.	516-771-30	516-771-60	516-771-61	516-771-66

■ Specifications

Appearance	Rectangular, black
Material	Ultra-low thermal expansion fine ceramic
Standards	JIS/ISO/DIN, BS, and ASME
Grade^{*1)}	K
Coefficient of thermal expansion^{*2)}	0 ± 0.02 × 10 ⁻⁶ /K (at 20°C)
Density^{*2)}	2.5 g/cm ³
Vickers hardness^{*2)}	826HV10 (by JIS R 1610 "Testing Method for Vickers Hardness of High Performance Ceramics")
Standard accessories	Inspection certificate, Calibration certificate, and custom-made aluminum case

^{*1)} If you require a grade other than K, please contact Mitutoyo.
^{*2)} Value claimed by the material supplier

Thermal effects on various blocks at 23°C (500 mm block)

Temperature compensation value error for standard ISO/JIS products: ±1.5µm
 Temperature compensation value error for standard Mitutoyo gauge block: ±0.75µm
 Temperature compensation value error for standard Mitutoyo gauge block with a calibrated coefficient of thermal expansion: ±0.075µm

Maximum thermal expansion of ZERO CERA BLOCK: 0.045µm

Thermal expansion of steel gauge block: 16.2µm
 Thermal expansion of CERA BLOCK: 13.95µm