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Mitutoyo Quality

Length Standard ZERO CERA BLOCK

AN ULTRA-LOW EXPANSION CERAMIC GAGE BLOCK

SMALL TOOL INSTRUMENTS
AND DATA MANAGEMENT



Bulletin No. 2234

An innovative length standard offers high thermal and long-term stability

ZERO CERA BLOCK™

Ultra-low 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 leaving only the thermally induced dimensional change of the calibration target to be considered.

Excellent long-term stability

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

Lightweight

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 needed to prevent rust during storage.

Magnetization free

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



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

** Available by special order

Specifications

Appearance	Rectangular, black
Material	Ultra-low thermal expansion fine ceramic
Standards	ASME, JIS/ISO/DIN and BS
Grade^{*1}	K
Coefficient of thermal expansion^{*2}	$0 \pm 0.02 \times 10^{-6}/K$ (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

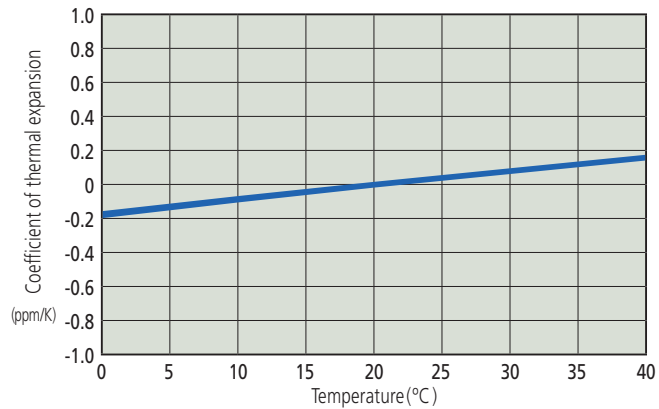
*1) If you require a grade other than K, please contact Mitutoyo.

*2) Value claimed by the material supplier

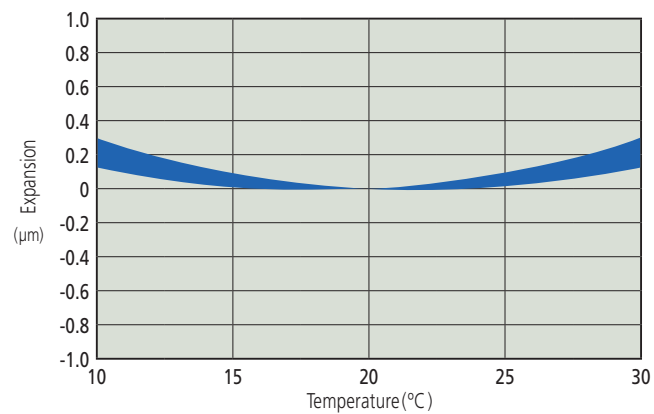
- ◇ Thermal expansion at $20 \pm 1^\circ\text{C}$ less than 1/500 that of steel
- ◇ Almost no stability change in both dimension and coefficient of thermal expansion
- ◇ Complementary ultra-low thermal expansion and high specific rigidity (Young's modulus/specific gravity)



■ Coefficient of Thermal Expansion vs. Temperature



■ Thermal Expansion vs. Temperature (for 500 mm block)



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

Temperature compensation value error for standard ISO/JIS products: $\pm 1.5 \mu\text{m}$

Temperature compensation value error for standard Mitutoyo gage block: $\pm 0.75 \mu\text{m}$

Temperature compensation value error for standard Mitutoyo gage block

with a calibrated coefficient of thermal expansion: $\pm 0.075 \mu\text{m}$

Maximum thermal expansion of ZERO CERA BLOCK: $0.045 \mu\text{m}$

Thermal expansion of steel gage block: $16.2 \mu\text{m}$

Thermal expansion of CERA BLOCK: $13.95 \mu\text{m}$

Mitutoyo technology enhances gage block quality

■ World-class calibration capability

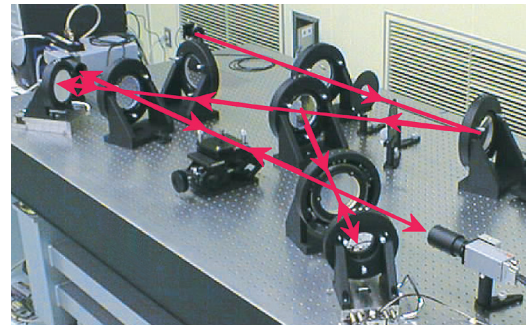
Mitutoyo America Corporation's calibration laboratory utilizes state-of-the-art technology to calibrate virtually any metrology tool. A2LA accredited (Certificate #750-01) to ISO/IEC 17025 for testing and calibration labs, this facility employs professional calibration technicians to provide NIST-traceable accuracy certification, as well as calibration services for Mitutoyo and other manufacturer's gages and gage blocks.



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

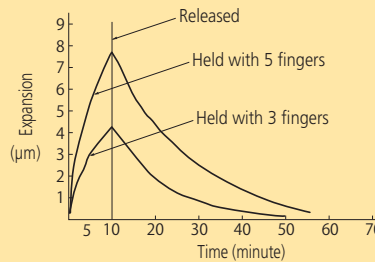
Mitutoyo has developed a highly accurate system for measuring the coefficient of thermal expansion for gage blocks. In this system, advanced temperature- and interferometric-measurement technology combine to measure, simultaneously, dimensional change at each end of a gage block. This system provides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

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



Tips What is "coefficient of thermal expansion"?

The coefficient of thermal expansion (or coefficient of linear expansion) refers to 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.



Dimensional change of 100mm steel gage block when handling with bare hands



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 Mitutoyo supports you from start to finish.**

Mitutoyo is not only a manufacturer of top-quality measuring products but one that also offers qualified support for the lifetime of the equipment, backed by comprehensive services that ensure your staff can make the very best use of the investment.

Apart from the basics of calibration and repair, Mitutoyo offers product and metrology training, as well as IT support for the sophisticated software used in modern measuring technology. We can also design, build, test and deliver measuring solutions and even, if deemed cost-effective, take your critical measurement challenges in-house on a sub-contract basis.



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