

# Gage Block

## SERIES 516

### FEATURES

Precision gage blocks are the primary standards vital to dimensional quality control in the manufacture of parts. Mitutoyo offers

a complete selection of gage blocks available in a choice of rectangular or square, metric or inch and steel or CERA (ceramic) types.

### Accuracy

Mitutoyo gage blocks guarantee such a high accuracy that users can use them without anxiety. Mitutoyo has established a traceability system for our measurement products, up to the Metrology Management Center of the National Institute of Advanced Industrial Science and Technology (AIST), and we have been certified by the Japanese government as an accredited laboratory.

### Wringing

The lapping technique is one of Mitutoyo's specialties. Our advanced lapping technique, developed for more than a half century, allows us to achieve the best flatness and surface roughness needed for gage blocks.

### Abrasion Resistance and Dimensional Stability

High-carbon, high-chrome steel is employed to sufficiently satisfy a variety of material characteristics required for gage blocks. A high degree of hardness, obtained by our heat treatment technology, as well as methodically repeated heat treatment, have successfully reduced deterioration change over time.

### CERA Blocks

CERA blocks, made of ceramic materials with superior surface quality, were developed by Mitutoyo's ultra-precision machining techniques and solve problems commonly associated with steel gage blocks.

#### 1. Corrosion-Resistant

Anti-corrosion treatment is not required when handled normally (i.e. with fingers), resulting in simple maintenance and storage.

#### 2. No Burrs Caused by Dents, etc.

Since the CERA Block is very hard it will not scratch and is highly resistant to burrs. If a burr is formed, it can easily be removed with a ceramic deburring stone (Ceraston).

#### 3. Abrasion Resistant

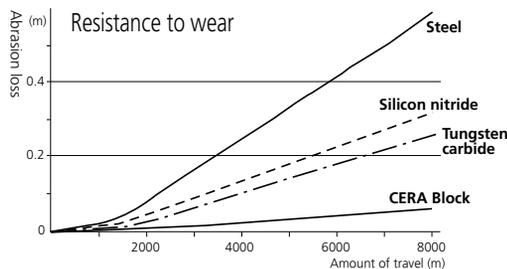
CERA Blocks have 10 times the abrasion resistance of steel gage blocks.

#### 4. Dimensional Stability

CERA Blocks are free from dimensional change over time.

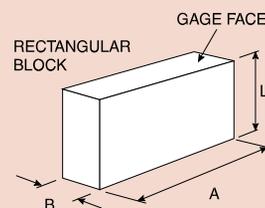
#### 5. Marking

The black characters, indicating the nominal length, are inscribed by laser and are clearly visible against the white surface of the block.



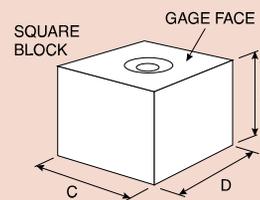
### Selecting Gage Blocks

- Select gage blocks in accordance with the combination range required. If a large length is required, add a long block set.
- Select gage blocks in accordance with the minimum length step required. Add wear block sets if necessary.
- If a set containing a large number of gage blocks is selected, the number of combination gage blocks required for a length is reduced and the number of combinations is increased. The accuracy will be retained and damage will be reduced.
- The specific gage block set for micrometer inspection and caliper inspection is available.
- If using only one length repeatedly, it is a good idea to purchase discrete gage blocks.
- The 2mm-based gage blocks, which take the base of the minimum length step as 2mm, are easy to handle and will not warp, as compared to the 1mm-based gage blocks.



### Rectangular Block

Gage Size	Face Width (A)	Face Depth (B)
Up to 2"	1.181"	.355"
Over .2" up to 40"	1.378"	.355"
Up to 10mm	30mm	9mm
Over 10mm up to 1000mm	35mm	9mm



### Square Block

Gage Size	Face Width (C)	Face Depth (D)
Inch (up to 40")	.95"	.95"
Metric (up to 1000mm)	24.1mm	24.1mm

## Grade and Application

Refer to the following table to select the gage block grade according to usage.

	Applications	Grade
Workshop use	• Mounting tools and cutters	AS-1 or AS-2
	• Manufacturing gages • Calibrating instruments	0 or AS-1
Inspection use	• Inspecting mechanical parts, tools, etc.	0 or AS-1
	• Checking the accuracy of gages • Calibrating instruments	00 or 0
Calibration use	• Checking the accuracy of gage blocks for workshop • Checking the accuracy of gage blocks for inspection • Checking the accuracy of instruments	K or 00
Reference use	• Checking the accuracy of gage blocks for calibration • For academic research	K

### Grade AS-1:

These gage blocks are intended for shop-floor use to set and calibrate fixtures, as well as precision instruments.

### Grade 0:

This grade is used within an inspection area to verify the accuracy of plug and snap gages, as well as for setting electronic measuring devices.

### Grade 00:

These higher accuracy gages are intended for use within a controlled environment by skilled inspection staff. Mainly used as reference standards for setting high-precision measuring equipment and for the calibration of lower grade gage blocks.

### Grade K:

Gage blocks of this accuracy are intended for use within a temperature-controlled inspection room or calibration laboratory. They should be used as masters with certificates against other gage blocks which are calibrated by comparison.

### Combination of a Required Length

Multiple combinations of gage blocks can be used to make a required length. Care should be exercised in the following points.

1. Use as few gage blocks as possible to obtain the required length. (Select thick gage blocks whenever possible.)
2. Select gage blocks starting with the one that has the least significant digit required, and then work up to ones with more significant digits.
3. There are multiple combinations for the integer part of a length. To prevent wear as much as possible, do not always use the same gage blocks.

Example combination

Required length = 45.6785mm

#### For the 1mm-based gage block set (112 pcs.)

```

1.005
1.008
1.17
17.5
+ 25
-----
45.6785mm
    
```

#### For the 2mm-based gage block set (112 pcs.)

```

2.005
2.008
2.17
14.5
+ 25
-----
45.6785mm
    
```

## 6. Anti-magnetic Nature Keeps Away Steel Powders

## 7. High Wringing Force

An even, dense tissue can maintain a strong wringing force.



## 8. Material of CERA block

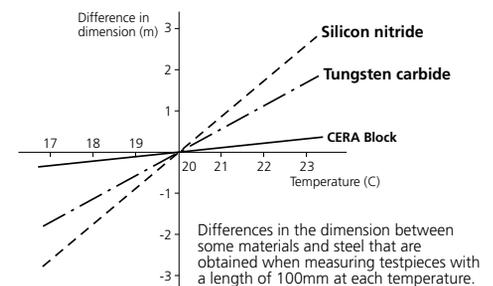
Property	Material	CERA Block (ZrO <sub>2</sub> )	Steel (Fe)	Carbide (WC-Co)	Silicon nitride (Si <sub>3</sub> N <sub>4</sub> )
Hardness (HV)		1350	800	1650	1500
Coefficient of thermal expansion (10 <sup>-6</sup> /K)		9.3±0.5	10.8±0.5	5.5±1.0	2
Flexural strength by 3-point bending (MPa)		1270	1960	1960	580
Fracture toughness K1c (MPa•m <sup>1/2</sup> )		7	120	12	6.5
Young's Modulus x104 (MPa)		20.6	20.6	61.8	28.4
Poisson's Ratio		0.3	0.3	0.2	0.3
Specific gravity		6.0	7.8	14.8	3.2
Thermal conductivity (W/m•k)		2.9	54.4	79.5	16.7

## 9. Closest Expansion Coefficient to Steel

The thermal expansion coefficient of a CERA Block is similar to that of a steel gage block.

## 10. Highly Resistant Against Drops and Other Shocks

The CERA block material is one of the toughest ceramics materials. It is extremely difficult to crack under normal use.



## Features of Square Gage Blocks

### 1. Perfect wringing is possible using the center hole.

After wringing the square gage blocks, an optional tie rod can be inserted through the center hole to fix the blocks using a screw.

### 2. A height reference standard can easily be made.

A precision height reference standard can be made easily and inexpensively using accessories such as the plain jaw and block base.

### 3. A dedicated inspection jig can be easily made.

A dedicated inspection jig for periodic inspection of instruments can be made easily and inexpensively.

### 4. A wide measuring surface with cross section dimensions of [24.1 x 24.1mm / .95 x .95"] is available.

A square gage block can retain stable orientation both longitudinally and laterally. A wide range of application measurements can be made, including cutting tool positioning, angle measurement with a sine bar, taper measurement with a roller, and inspection of depth micrometers.



## Long and Ultra-Thin Gage Blocks

Mitutoyo offers extra thin gage blocks from 0.10 mm to 0.99 mm (increments of 0.01 mm), as well as long gage blocks up to 1,000 mm as standard products.

# Gage Block

## SERIES 516

### Accuracies of Mitutoyo Gage Blocks

All Mitutoyo gage blocks meet or exceed all known specifications. The flatness, parallelism and surface finish necessary to achieve the required accuracies are the same as or better than government requirements.

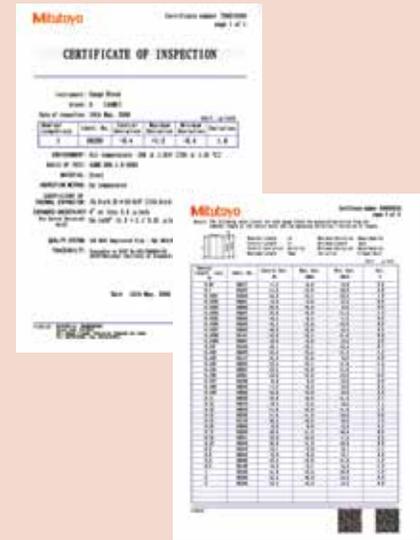
### ASME (American Society of Mechanical Engineers) Deviations and Tolerance on Length for Metric and inch Gage Blocks: ASME B89.1.9-2002 (USA)

Nominal Length Range l <sub>n</sub> in inches	Calibration Grade K		Grade 00		Grade 0		Grade AS-1		Grade AS-2	
	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μin.	Tolerance for the Variation In Length l <sub>v</sub> μin.	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μin.	Tolerance for the Variation In Length l <sub>v</sub> μin.	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μin.	Tolerance for the Variation In Length l <sub>v</sub> μin.	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μin.	Tolerance for the Variation In Length l <sub>v</sub> μin.	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μin.	Tolerance for the Variation In Length l <sub>v</sub> μin.
l <sub>n</sub> ≤ .05	12	2	4	2	6	4	12	6	24	12
.05 l <sub>n</sub> ≤ .4	10	2	3	2	5	4	8	6	18	12
.45 l <sub>n</sub> ≤ 1	12	2	3	2	6	4	12	6	24	12
1 l <sub>n</sub> ≤ 2	16	2	4	2	8	4	16	6	32	12
2 l <sub>n</sub> ≤ 3	20	2	5	3	10	4	20	6	40	14
3 l <sub>n</sub> ≤ 4	24	3	6	3	12	5	24	8	48	14
4 l <sub>n</sub> ≤ 5	32	3	8	3	16	5	32	8	64	16
5 l <sub>n</sub> ≤ 6	32	3	8	3	16	5	32	8	64	16
6 l <sub>n</sub> ≤ 7	40	4	10	4	20	6	40	10	80	16
7 l <sub>n</sub> ≤ 8	40	4	10	4	20	6	40	10	80	16
8 l <sub>n</sub> ≤ 10	48	4	12	4	24	6	48	10	104	18
10 l <sub>n</sub> ≤ 12	56	4	14	4	28	7	56	10	112	20
12 l <sub>n</sub> ≤ 16	72	5	18	5	36	8	72	12	144	20
16 l <sub>n</sub> ≤ 20	88	6	20	6	44	10	88	14	176	24
20 l <sub>n</sub> ≤ 24	104	6	25	6	52	10	104	16	200	28
24 l <sub>n</sub> ≤ 28	120	7	30	7	60	12	120	18	240	28
28 l <sub>n</sub> ≤ 32	136	8	34	8	68	12	136	20	260	32
32 l <sub>n</sub> ≤ 36	152	8	38	8	76	14	152	20	300	36
36 l <sub>n</sub> ≤ 40	160	10	40	10	80	16	168	24	320	40

Nominal Length Range l <sub>n</sub> in mm	Calibration Grade K		Grade 00		Grade 0		Grade AS-1		Grade AS-2	
	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μm	Tolerance for the Variation In Length l <sub>v</sub> μm	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μm	Tolerance for the Variation In Length l <sub>v</sub> μm	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μm	Tolerance for the Variation In Length l <sub>v</sub> μm	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μm	Tolerance for the Variation In Length l <sub>v</sub> μm	Limit Deviations of Length at any Point From Nominal Length ± l <sub>e</sub> μm	Tolerance for the Variation In Length l <sub>v</sub> μm
l <sub>n</sub> ≤ 0.5	0.30	0.05	0.10	0.05	0.14	0.10	0.30	0.16	0.60	0.30
0.5 l <sub>n</sub> ≤ 10	0.20	0.05	0.07	0.05	0.12	0.10	0.20	0.16	0.45	0.30
10 l <sub>n</sub> ≤ 25	0.30	0.05	0.07	0.05	0.14	0.10	0.30	0.16	0.60	0.30
25 l <sub>n</sub> ≤ 50	0.40	0.06	0.10	0.06	0.20	0.10	0.40	0.18	0.80	0.30
50 l <sub>n</sub> ≤ 75	0.50	0.06	0.12	0.06	0.25	0.12	0.50	0.18	1.00	0.35
75 l <sub>n</sub> ≤ 100	0.60	0.07	0.15	0.07	0.30	0.12	0.60	0.20	1.20	0.35
100 l <sub>n</sub> ≤ 150	0.80	0.08	0.20	0.08	0.40	0.14	0.80	0.20	1.60	0.40
150 l <sub>n</sub> ≤ 200	1.00	0.09	0.25	0.09	0.50	0.16	1.00	0.25	2.00	0.40
200 l <sub>n</sub> ≤ 250	1.20	0.10	0.30	0.10	0.60	0.16	1.20	0.25	2.40	0.45
250 l <sub>n</sub> ≤ 300	1.4	0.10	0.35	0.10	0.70	0.18	1.40	0.25	2.80	0.50
300 l <sub>n</sub> ≤ 400	1.80	0.12	0.45	0.12	0.90	0.20	1.80	0.30	3.60	0.50
400 l <sub>n</sub> ≤ 500	2.20	0.14	0.50	0.14	1.10	0.25	2.20	0.35	4.40	0.60
500 l <sub>n</sub> ≤ 600	2.60	0.16	0.65	0.16	1.30	0.25	2.60	0.40	5.00	0.70
600 l <sub>n</sub> ≤ 700	3.00	0.18	0.75	0.18	1.50	0.30	3.00	0.45	6.00	0.70
700 l <sub>n</sub> ≤ 800	3.40	0.20	0.85	0.20	1.70	0.30	3.40	0.50	6.50	0.80
800 l <sub>n</sub> ≤ 900	3.80	0.20	0.95	0.20	1.90	0.35	3.80	0.50	7.50	0.90
900 l <sub>n</sub> ≤ 1000	4.20	0.25	1.00	0.25	2.00	0.40	4.20	0.60	8.00	1.00

### Mitutoyo Gage Blocks and Inspection Certificates

A Certificate of Inspection is furnished with all Mitutoyo gage blocks with a serial number on the case and an identification number on each block. The deviation of each block is registered. For this inspection, each gage block is measured relative to the upper level master using a gage block comparator. Grade K gage blocks are manufactured by absolute measurement using an interferometer. The gage block set and discrete gage block are supplied with a Certificate of Calibration. The Certificate of Calibration specifies the deviation from the nominal length. (Comparative measurement, however, is performed for all square gage blocks.)



A Certificate of Accuracy, traceable to the NIST, is furnished with each gage block set and individual block.

### Mitutoyo America Corporation Calibration Laboratory:

ISO 17025-2005 accredited calibration available  
Calibration capability up to 1000mm/40" length  
Low measurement uncertainty

### Contact Information:

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