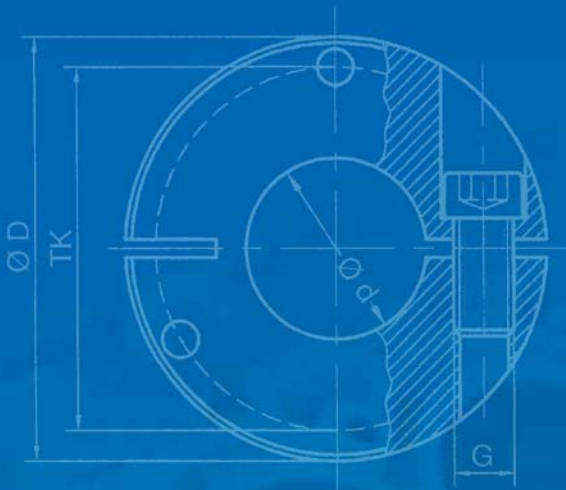




BMD PLUG GAUGES

Technical Guide Version 4



Technical description

Plug gauges (BMD) are self-indicating, self-centering, high precision measurement instruments. These easy-to-use gauges are suitable for both static and dynamic measurements. They can be used for manual detection of dimensional deviations and shape defects in bores in serial measurement at the machine but may also be installed in measuring equipment and automated systems.

A broad range of applications, ease of handling, superior precision and rugged construction are combined in a highly cost-effective system.

A wide selection of basic types in the standard programme, supplemented by useful accessories, ensures that nearly all bores encountered in actual practice can be measured precisely.

The range of display instruments includes mechanical indicators, digital displays and sensors connected to analytical equipment. Peripheral equipment provides for static data analysis, dimension-based tool control and many other useful options.

Special models

The BMD Technical Guide is intended to assist you in selecting the most suitable measurement equipment. For special measurement problems we need a detailed description of the measurement task as well as a drawing or sample in order to prepare an offer. An optimum offer depends on precise, complete information.

Please note: Deviations regarding technical aspects of specially designed BMD gauges as opposed to standard gauges are possible!

Special markings (SO-B)

Special markings data matrix code (SO-B-DMC) (extra charge)

We can provide special markings, such as customer-specific ID numbers, tolerances, etc. Please keep in mind that the possibilities for adding special markings to small plug gauges are limited. The surcharge for SO-B is calculated for each commenced 10 characters (see price list).

Design and material characteristics:

Probe: spring steel, approx. 61 HRC

Needles: carbide, approx. 1650 HV

Guide cylinder: gauge steel, approx. 60 HRC

Hard chrome coating on guide cylinders, approx. 1000 HV (standard design)

Special cylinder designs:

OCR = steel cylinders, hardened and black finished

Please note: OCR plug gauges are not suitable for rough measurement conditions.

ZHML = cylinder with carbide bars, page 14

ZKUL = cylinder with plastic bars, page 17

Technical data

All dimensions are quoted in mm unless otherwise specified.

We reserve the right to make technical modifications in order to improve performance. Minor deviations which do not impact significantly on measurement equipment performance may occur.

Information regarding technological advances and the most recent version of our documentation is also available on the Internet at www.diatest.com

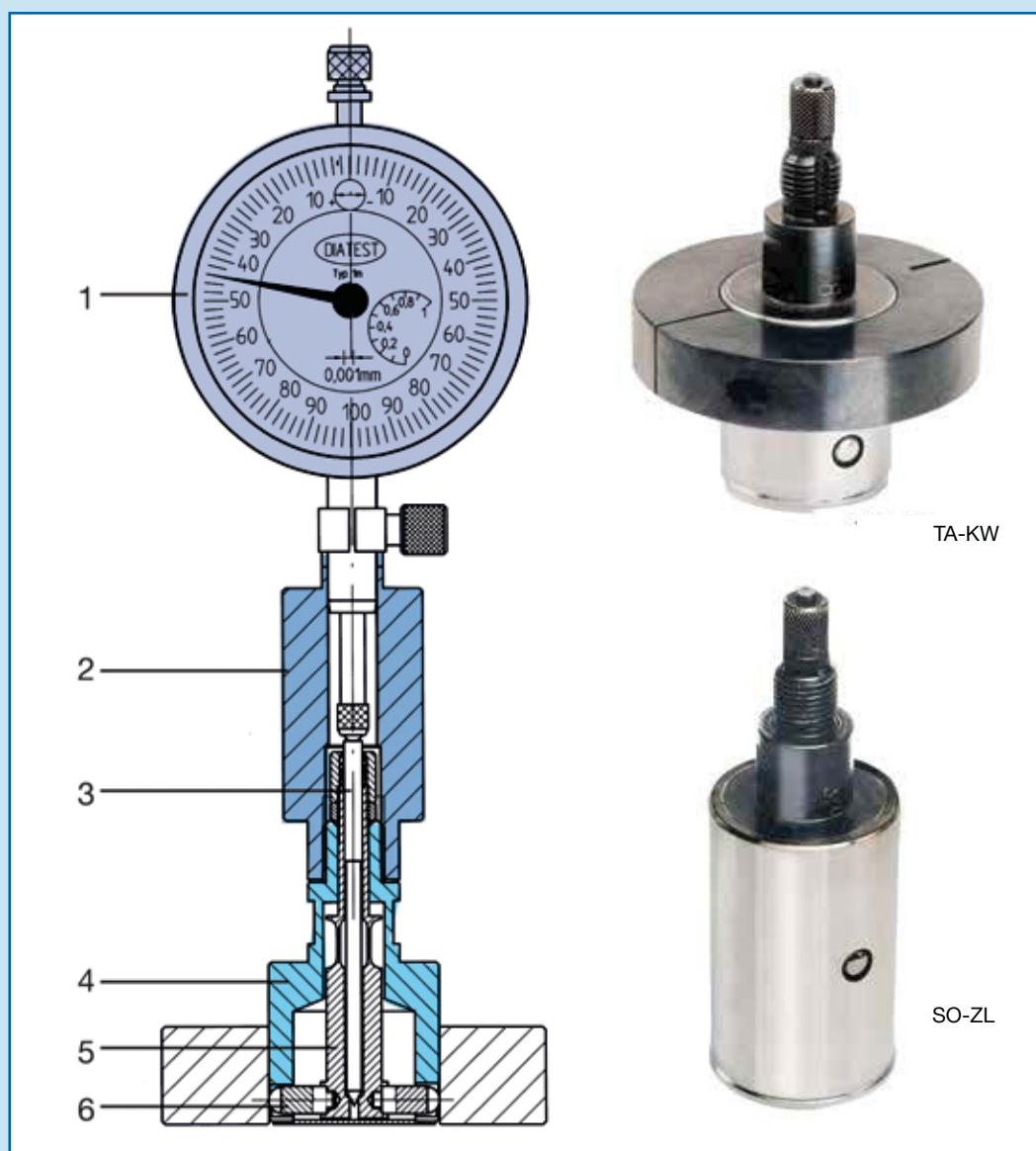
Zero setting

Zero setting should be performed with the aid of a setting ring that corresponds precisely to the minimum bore size. This ensures that the risk of radial and axial errors is largely eliminated during the calibration process.

The most suitable setting rings are those which comply with the specifications of DIN 2250-C. Setting rings with larger dimensions or for minimum, medium and maximum dimensions are generally not required.

Function

The guide cylinder (4) centers the probe gauging contacts (6) fixed to the split ball probe (5) axially and radially in the bore. The lapped cone of the needle (3) translates the distance travelled by the gauge contacts 1:1 to the indicator (1) clamped in the holder (2).



Production times

Production times are quoted ex factory, as shown in the table below.

Service life

Service life depends upon such conditions as work piece surface quality (roughness, coating), material, length of measured bore, dirt accumulation, gauging pressure etc. Up to a few million measurements are possible under optimum conditions.

Repair Service

DIA TEST offers a fast and cost-effective repair service for standard BMD.

Service 1: Exchange of gauging unit and functional testing. Approx. 10 days, ex works.

Service 2: Exchange of gauging unit, fully re-chromed cylinder and functional testing. Approx. 15 days, ex works.

A cost estimate for special BMD plugs will be provided (on request).

Maintenance

No special maintenance is required. If cleaning is needed, remove the needle and clean the plug gauge and the needle carefully with compressed air and a cleaning solution.

Please note: The needle taper should be greased prior to installation (e.g. Vaseline). When installing needles for Series 6 and 10, please ensure that springs are remounted (no springs in Series 4).



Gauging accuracy

Maximum allowed deviations with new plug gauges:

Repeatability

2-point design

$fw \leq 0.001 \text{ mm}$

3-point design

$fw \leq 0.002 \text{ mm}$

Measuring range transmission error (Linearity)

2-point models

$fe = 1\%$ of gauging distance

min. 0.001

3-point models

$fe = 3\%$ of gauging distance

min. 0.002

FB design

$fe = 2\%$ of gauging distance

min. 0.001

Measurement range extension (MB-SO) and special designs may lead to a reduced measuring accuracy.

Axial and radial centering errors

The plug gauge guide cylinder positions the gauging contacts in the bore and ensures high repetition accuracy. Short guide paths and/or excessive clearance between the bore and the guide cylinder result in lower repeat-

ability due to tipping and lateral shifting.

Nominal dimensions and standard measurement ranges

Plug gauge order dimension (nominal dimension) = minimum bore dimension

Example:

$\varnothing 35 \text{ D7} = \varnothing 35 +0.08/+0.105$

BMD nom. dimension = 35.08

$\varnothing 35 \text{ H7} = \varnothing 35 +0/+0.025$

BMD nom. dimension = 35.0

Measuring range extension (MB-SO) (extra charge)

The standard measuring range can be extended for applications requiring measurement of larger bore tolerances. Please note: Some plug gauges with MB-SO have smaller contact point radii. This poses the danger of axial and radial errors. Please enquire before using diamond measurement contacts.

A measuring range extension of e.g. MB-SO+0.4 indicates that the entire measurement range of the plug gauge is 0.4 mm, based on the nominal plug gauge dimension.

Measurements taken in horizontal direction may lead to smaller measuring ranges.

Standard production times

Plug gauge type	working days
S, D, PK, OR, 2R, S-FB up to nom. dim. 100 mm	10
S, D, PK, OR, 2R, S-FB above nom. dim. 100 mm	15
FB, 3P, L, PK-2Z, MZ, AT0	15
SO-TA, UM, PA, SO-GL, SO-W10, T-BMD	25
SO-KO, SO-ZL, SO-2Z, ZHML, SO-PA etc.	30

Saturdays, Sundays, public holidays and company holidays are not counted as production days and will extend delivery times accordingly.

Express production times (extra charge)

Plug gauge type	working days
S, D, PK, OR, 2R, S-FB up to nom. dim. 100 mm	5-8
S, D, PK, OR, 2R, S-FB above nom. dim. 100 mm	8-10
FB, 3P, L, PK-2Z, MZ, AT0	8-10
SO-TA, UM, PA, SO-GL, SO-W10, T-BMD	15
SO-KO, SO-ZL, SO-2Z, ZHML, SO-PA etc.	15

Delivery times for all other plug gauges, including multiplane gauges, etc, will be quoted on request.

Measuring range, based on nominal BMD dimension

BMD series	Application range	Measuring range
4	$\varnothing 2.98 - 9.0$	+ 0.1 mm
6	$\varnothing 7.0 - 20.0$	+ 0.15 mm
10	$\varnothing 15.0 - 270.0$	+ 0.2 mm
FB6	$\varnothing 7.0 - 16.0$	+ 0.15 mm
FB10	$\varnothing 15.0 - 150.0$	+ 0.15 mm
3P (Series 6)	$\varnothing 8.0 - 20.0$	+ 0.15 mm
3P (Series 10)	$\varnothing 15.0 - 100.0$	+ 0.2 mm
T-BMD	$\varnothing 2.25 \text{ (PA 1.0)} - 2.98$	+ 0.15 mm

Measuring range extension (MB-SO)

BMD series	max. meas. range (order suffix)
Series 4 $\varnothing 2.98 - 4.0$	max. MB-SO + 0.15
Series 4 $\varnothing > 4.0$	max. MB-SO + 0.2
Series 6	max. MB-SO + 0.4
Series 10 to $\varnothing 120 \text{ mm}$	max. MB-SO + 0.8
Series 10 $\varnothing > 120$ to 180 mm	max. MB-SO + 0.6
Series 10 $\varnothing > 180$ to 220 mm	max. MB-SO + 0.4
Series 10 $\varnothing > 220$ to 270 mm	max. MB-SO + 0.3
Series FB10 + FB6	max. MB-SO + 0.3
BMD-3P (Series 6)	max. MB-SO + 0.3
BMD-Series 10 3P	max. MB-SO + 0.4

For option MB-SO we recommend option PG in addition (page 8).

S Basic type – Standard

S4

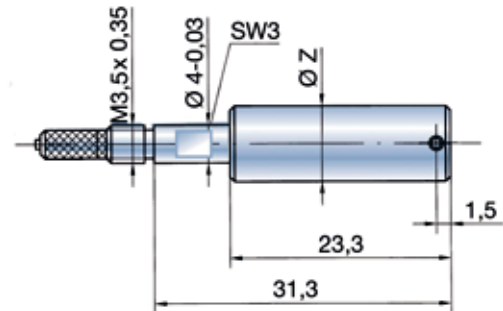
Nominal diameter range: Ø 2.98 - 9.0 mm

Ø Z = Nom. diameter - 0.02 / - 0.04

Sample order:

Bore diameter	Order Code
7 D6	BMD-S4-CR-7.04

Diameters less than 2.98 with T-BMD (page 17)



S6

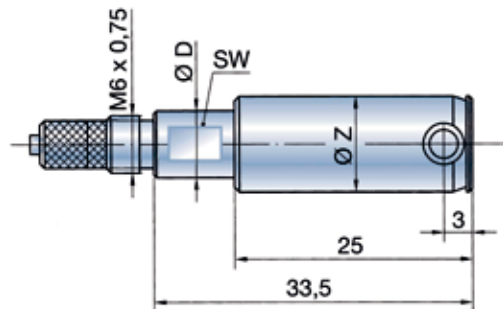
Nominal diameter range: 7.0 - 20.0 mm

Ø Z = Nom. diameter - 0.02 / - 0.04

Sample order:

Bore diameter	Order Code
10 H6	BMD-S6-CR-10.0

Nom. diameter	7.0 - 8.0	> 8.0 - 20.0
Ø D	6.8	7.9
SW	6	7



S10 Ø 15 - 44 mm

Nominal diameter range: above 15.0 - 44.0 mm

Nom. diameter Ø 15 - 32.0

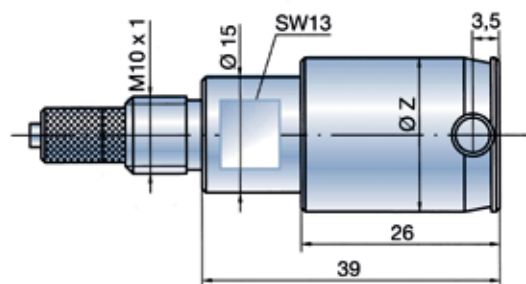
Ø Z = Nom. diameter - 0.02 / - 0.05

Nom. diameter Ø > 32 - 44.0

Ø Z = Nom. diameter - 0.03 / - 0.06

Sample order:

Bore	Order Code
40 - 0.007 / + 0.025	BMD-S10-CR-39.993



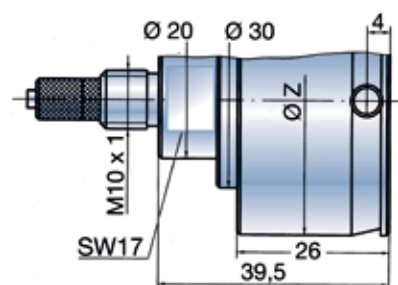
S10 Ø > 44 - 70 mm

Nominal diameter range: above 44.0 - 70.0 mm

Ø Z = Nom. diameter - 0.03 / - 0.06

Sample order:

Bore	Order Code
50 R7	BMD-S10-CR-49.95



S10 Ø > 70 - 270 mm

Nominal diameter range: above 70.0 - 270.0

Nom. diameter > 70 - 200

Ø Z = Nom. diameter - 0.04 / - 0.07

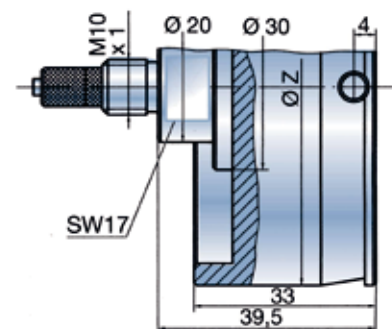
Nom. diameter > 200 - 270

Ø Z = Nom. diameter - 0.06 / - 0.10

Sample order:

Bore	Order Code
125 - 0.04	BMD-S10-CR-124.96

Nominal diameters over Ø 270 mm on request

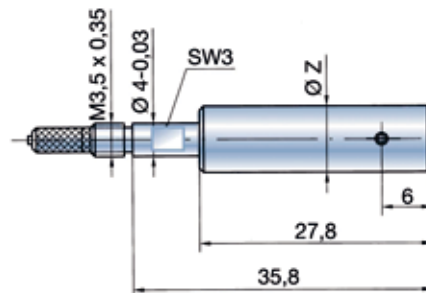


D4
Nominal diameter range: Ø 2.98 - 9.0 mm
 $\varnothing Z = \text{Nom. diameter} - 0.02 / - 0.04$

Sample order:

Bore diameter	Order Code
5 N8	BMD-D4-CR-4.98

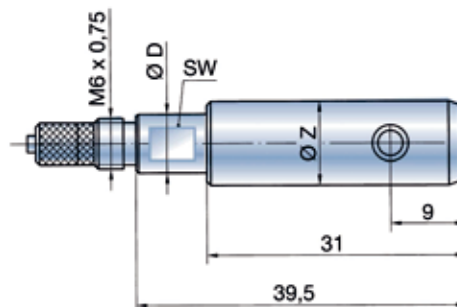
Diameters less than 2.98 with T-BMD (page 17)


D6
Nominal diameter range: 7.0 - 20.0 mm
 $\varnothing Z = \text{Nom. diameter} - 0.02 / - 0.04$

Sample order:

Bore	Order Code
10 + 0.04	BMD-D6-CR-10.0

Nom. diameter	7.0 - 8.0	8.0 - 20.0
Ø D	6.8	7.9
SW	6	7


D10 Ø 15 - 44 mm
Nominal diameter range: above 15.0 - 44.0 mm

Nom. diameter Ø 15 - 32.0

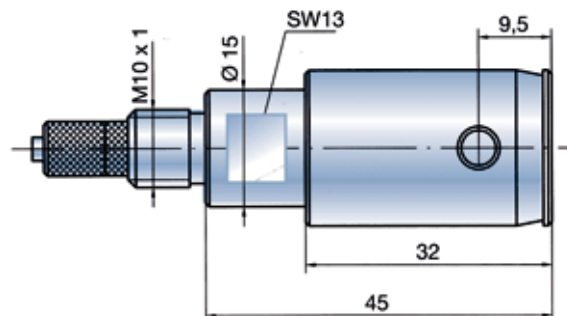
 $\varnothing Z = \text{Nom. diameter} - 0.02 / - 0.05$

Nom. diameter Ø > 32 - 44.0

 $\varnothing Z = \text{Nom. diameter} - 0.03 / - 0.06$

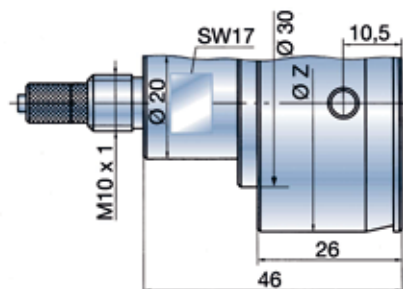
Sample order:

Bore	Order Code
42 K8	BMD-D10-CR-41.97


D10 Ø > 44 - 70 mm
Nominal diameter range: above 44.0 - 70.0 mm
 $\varnothing Z = \text{Nom. diameter} - 0.03 / - 0.06$

Sample order:

Bore	Order Code
60 JS8	BMD-D10-CR-59.777


D10 Ø > 70 - 270 mm
Nominal diameter range: above 70.0 - 270.0 mm

Nom. diameter > 70 - 200

 $\varnothing Z = \text{Nom. diameter} - 0.04 / - 0.07$

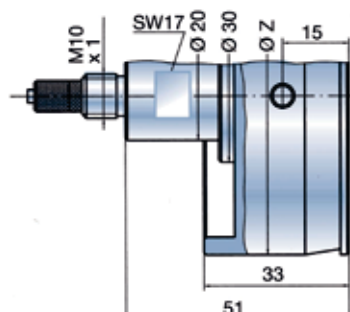
Nom. diameter > 200 - 270

 $\varnothing Z = \text{Nom. diameter} - 0.06 / - 0.10$

Sample order:

Bore	Order Code
100 H7	BMD-D10-CR-100.00

Nominal diameters over Ø 270 mm on request



FB Basic type for blind bores

We recommend version PG for BMD type FB (see page 8)

FB6 Ø 7.0 - 16.0 mm

Nominal diameter range: above 7.0 - 16.0 mm

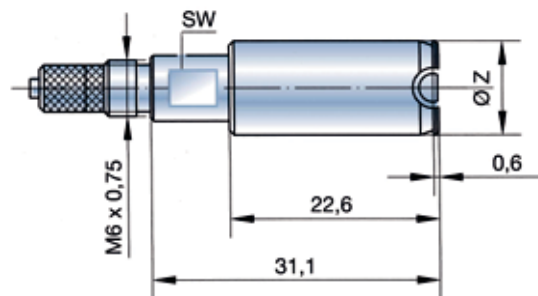
Nom. diameter Ø 7.0 - 16.0

Ø Z = Nom. diameter - 0.02 / - 0.04

Sample order:

Bore	Order Code
9 K8	BMD-FB6-CR-8.984

Contact points only available in MHM or MCR



FB10 Ø 15.0 - 44.0 mm

Nominal diameter range: above 15.0 - 44.0 mm

Nom. diameter Ø 15.0 - 32.0

Ø Z = Nom. diameter - 0.02 / - 0.05

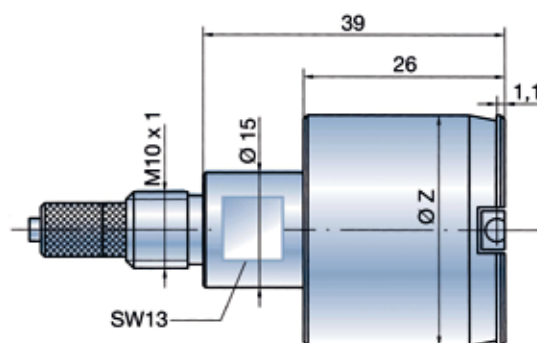
Nom. diameter Ø > 32 - 44.0

Ø Z = Nom. diameter - 0.03 / - 0.06

Sample order:

Bore	Order Code
42 K8	BMD-FB10-CR-41.973

Contact points only available in MHM or MCR



FB10 > Ø 44.0 - 70.0 mm

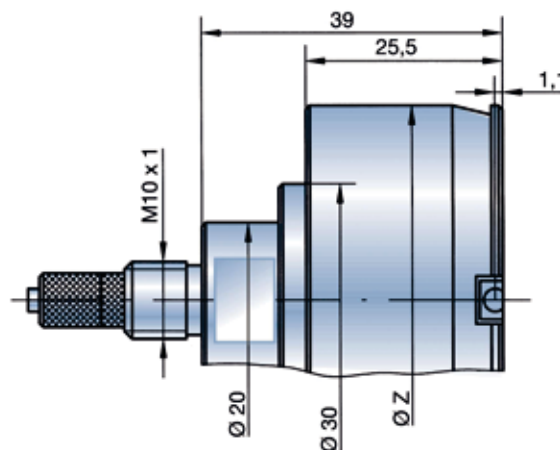
Nominal diameter range: above 44.0 - 70.0 mm

Ø Z = Nom. diameter - 0.03 / - 0.06

Sample order:

Bore	Order Code
60 JS8	BMD-FB10-CR-59.977

Contact points only available in MHM or MCR



FB10 > Ø 70.0 - 150.0 mm

Nominal diameter range: above 70.0 - 150.0 mm

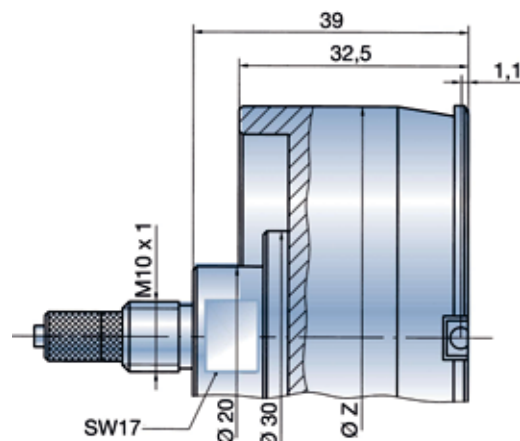
Ø Z = Nom. diameter - 0.04 / - 0.07

Sample order:

Bore	Order Code
100 H7	BMD-FB10-CR-100.00

Contact points only available in MHM or MCR

Nominal diameters over Ø 150 mm on request



DIA TEST exclusively produces plug gauges with mechanical measurement systems. Type L (air supply) gauges are designed to provide for workpiece cleaning at the contact points and to reduce

contact bore fouling. All gauges equipped with an air cleaning system are produced with covers. This increases dimension L1.

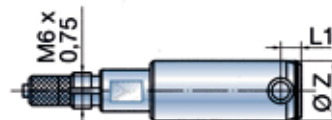
DIA TEST supplies an aluminum cover as a standard component. All dimensions not otherwise specified are the same as for basic types S and D. Required air pressure: 2-3 bar.

Accessories for BMD-L:
Holders L-MH150 (page 30),
L-EH (page 29),
Depth extensions L-TV8, L-TV15,
L-TV15-A (pages 37/38),
Right-angle attachments L-W10
(page 36), Adapter A6-10-L
(page 35)

L-S6 Ø 7.0 - 20 mm

L-D6 Nom. diameter range: 7.0 - 20.0 mm

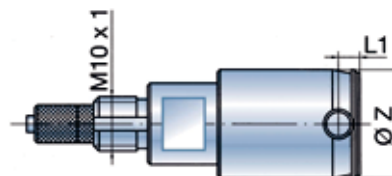
Covers for Series L-S6 are glued into place
Type S L1 = 3.5 mm
Type D L1 = 9.5 mm



L-S10 > Ø 15 - 44 mm

L-D10 Nom. diameter range: 15.0 - 44.0 mm

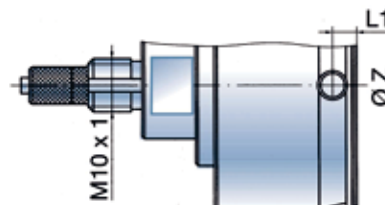
Covers for Series L-S10 up to nom. diameter of 28.0 mm are glued into place.
Type S10 > 28 mm and Type D are bolted in place
Type S Ø 15.0 - 28.0 mm L1 = 4.0 mm
Ø > 28.0 - 44.0 mm L1 = 5.5 mm
Type D L1 = 10.5 mm



L-S10 > Ø 44 - 70 mm

L-D10 Nom. diameter range: 44.0 - 70.0 mm

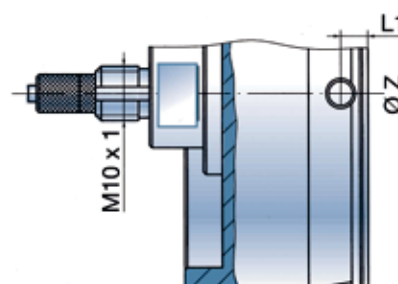
Cover bolted
Type S L1 = 6.0 mm
Type D L1 = 11.5 mm



L-S10 Ø 70 - 270 mm

L-D10 Nom. diameter range: 70.0 - 270.0 mm

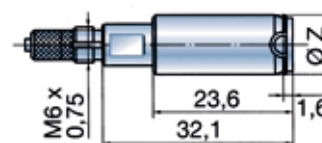
Cover bolted
Type S L1 = 6.0 mm
Type D L1 = 16.0 mm



L-FB6 Ø 7 - 16 mm

Nom. diameter range: 7.0 - 16.0 mm

Cover glued



L-FB10 Ø 15 - 150 mm

Nom. diameter range: 15.0 - 150.0 mm

Covers glued up to nom. diameter 28.0 mm, bolted above 28.0 mm.

Ø 15 - 28 L1 = 1.6 mm
Ø > 28 - 150 L1 = 3.1 mm

