

# Vernier callipers reading to 0,1 and 0,05 mm

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the most important dimensional, functional and quality characteristics of vernier callipers reading to 0,1 and 0,05 mm, with a maximum range of 1 000 mm. Methods for testing the accuracy of the instruments are given in an annex, for general information only.

NOTE — These vernier callipers are also commonly known as 1/10 and 1/20 vernier callipers respectively.

## 2 NOMENCLATURE AND DEFINITIONS

2.1 For the nomenclature for vernier callipers, see figures 1 and 2.

2.2 **error of measurement**: The algebraic difference between the measured size and the true size.

2.3 **measuring uncertainty**: The error margin corresponding to the inherent errors of measurement of a vernier calliper. It is defined as being equal to  $\pm 2s$ ; i.e. for a normal distribution of the readings on the instrument, about 95 % of readings will not deviate from the mean size (true value) by more than twice the standard deviation  $s$ .

## 3 SPECIFICATION

### 3.1 Design features

#### 3.1.1 *Measuring ranges*

For recommended measuring ranges, see table 1.

#### 3.1.2 *Material*

The main parts of the calliper shall be of good quality steel (plain carbon steel or stainless steel).

#### 3.1.3 *Beam*

The beam shall be long enough for the sliding jaw assembly not to overhang when measuring at the end of the measuring range.

#### 3.1.4 *Jaws*

For the minimum projection of the jaws,  $J_{min}$ , see table 1.

The maximum projection,  $J_{max}$ , shall be equal to one-third of the measuring range but with a maximum of 200 mm.

The sliding jaw shall be a good sliding fit along the beam in order to permit fine adjustment to be made.

The slider shall be provided with a suitable clamp so that it may be effectively clamped to the beam without altering the setting.

For the minimum length of the faces for internal measurement ( $l_{min}$ ), see table 1.

The jaws may be provided with knife edges as shown in figure 2.

The nominal combined width of the jaws for internal measurement shall be 0\*, 5, 10 or 20 mm. The faces for internal measurement (except the knife-edge faces) shall be of cylindrical form with a radius not exceeding one-half of their combined width (see figure 1).

#### 3.1.5 *Depth-measuring device*

The vernier calliper may be provided with a depth-measuring blade which is connected to the slider and allows the measurement of depths with reference to the end face of the beam (see figure 2).

#### 3.1.6 *Scales*

The beam shall be graduated in millimetres and the length of the scale shall be at least equal to the measuring range of the calliper plus the length of the vernier.

The length of the vernier scale may be 9, 19 or 39 mm (see figures 4, 5 and 6).

The scale lines of both the beam and the vernier shall be sharp, clear and perpendicular to the edge of the beam and their thickness shall be not less than 0,08 mm and not more than 0,2 mm.

The numbering on the beam and the vernier shall be such that the scale is easy to read.

\* For jaws with knife edges.

The distance between the graduated face of the beam and the edge of the graduated, bevelled face of the vernier shall not exceed 0,3 mm (see figure 3).

**4 ACCURACY**

**4.1 Measuring uncertainty**

The permissible measuring uncertainty in micrometres at  $\pm 2 s$ , as given in table 2, is calculated from the following formula :

$$\pm (50 + 0,1 L)$$

where  $L$  is any measured length, in millimetres, within the measuring range.

**4.2 Measuring faces**

With the slider clamped to the beam at any position within the measuring range of the calliper, the faces for external measurement shall be flat to within  $10 \mu\text{m}$  per 100 mm over their length. They shall be parallel to within  $20 \mu\text{m}$  per 100 mm over their length.

The faces for internal measurement shall be parallel to within  $10 \mu\text{m}$  over their length, and the permissible tolerance for their combined width (see 3.1.4) shall be :  $+ 30 \mu\text{m}$   
0

The measuring faces shall have a diamond pyramid hardness number of not less than

- 700 HV for plain carbon steel;
- 550 HV for stainless steel.

**4.3 Scale lines**

In any one instrument, the thickness of all scale lines on the main scale and vernier shall not differ by more than 0,03 mm.

**5 TABLES**

**5.1 Dimensions of vernier callipers**

TABLE 1

Dimensions in millimetres

External measuring range	Minimum projection of jaws $J_{\text{min}}$	Minimum length of faces for internal measurement $l_{\text{min}}$
0 to 135	35	6
0 to 160	40	6
0 to 200	50	8
0 to 250	50	10
0 to 300	60	10
0 to 500	80	15
0 to 750	80	15
0 to 1 000	100	20

**5.2 Measuring uncertainty**

TABLE 2

Measured length $L$	Measuring uncertainty at $\pm 2 s$ (95 %)
mm	$\mu\text{m}$
0	$\pm 50$
100	$\pm 60$
200	$\pm 70$
300	$\pm 80$
400	$\pm 90$
500	$\pm 100$
600	$\pm 110$
700	$\pm 120$
800	$\pm 130$
900	$\pm 140$
1 000	$\pm 150$

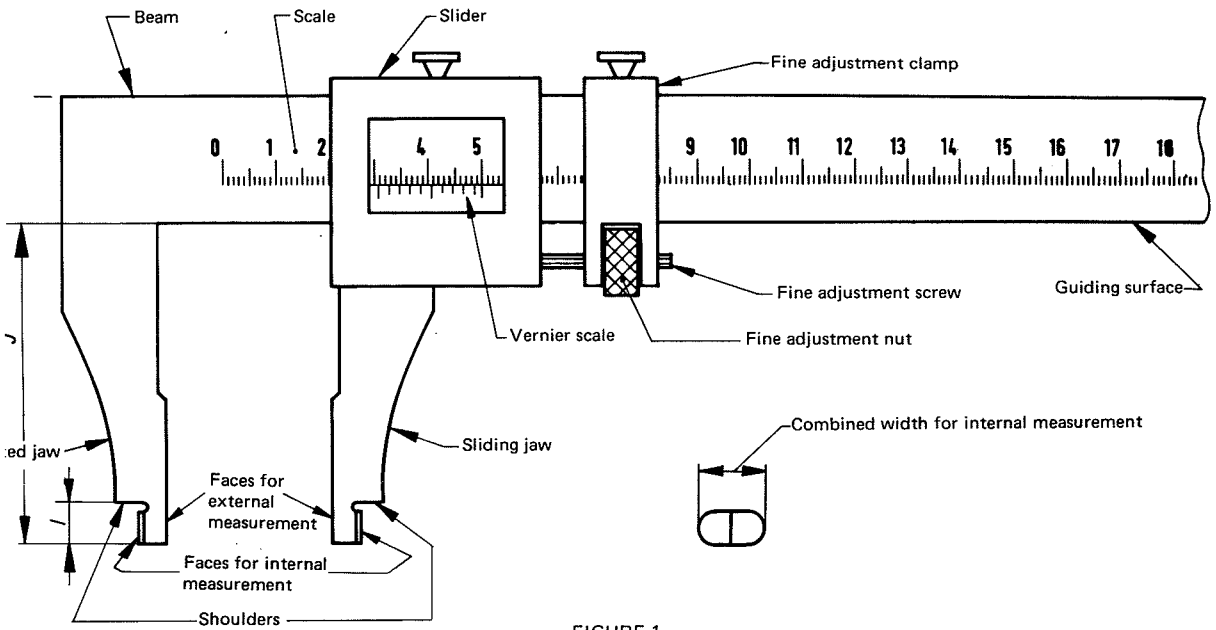


FIGURE 1

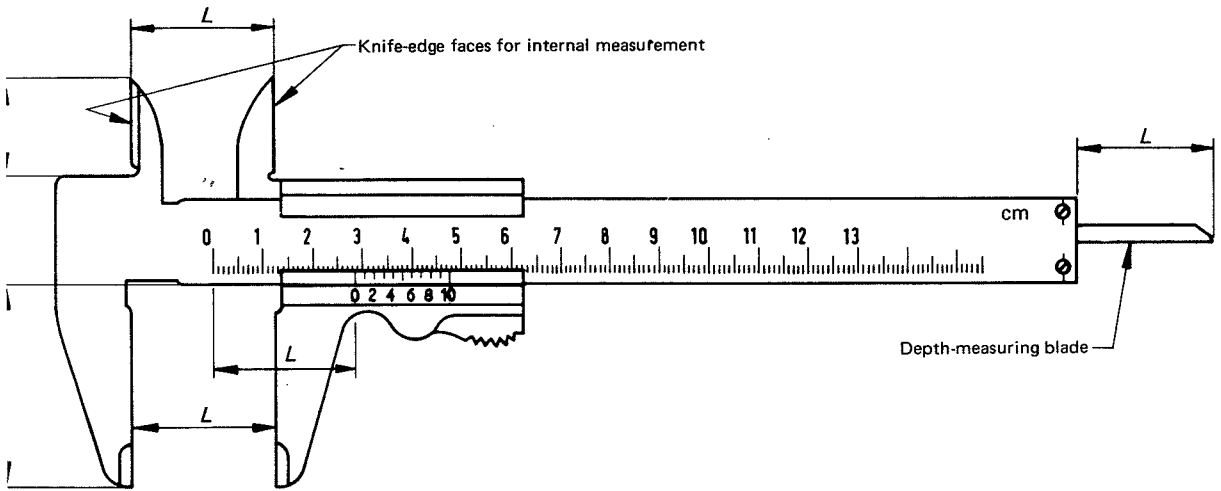


FIGURE 2

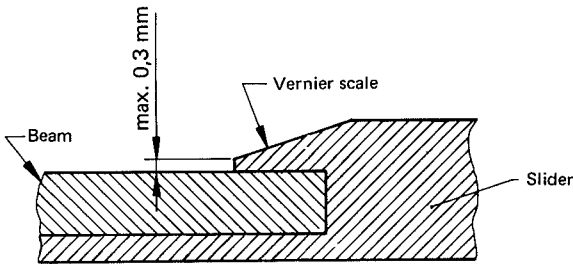


FIGURE 3

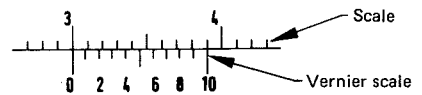


FIGURE 4 — 0,1 vernier of length 9 mm

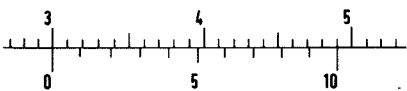


FIGURE 5 — 0,1 vernier of length 19 mm

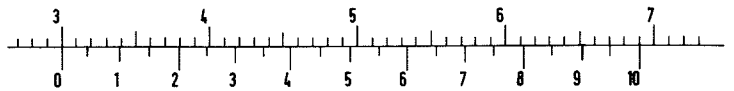


FIGURE 6 — 0,05 vernier of length 39 mm

NOTE — The illustrations are diagrammatic only and are not intended to show details of design.

ANNEX  
METHODS OF TEST

**A.1 MEASURING UNCERTAINTY**

The inherent errors of measurement of a vernier calliper may be checked with gauge block combinations of known size, chosen to cover a number of points both over range of the instrument and that of the vernier.

The measuring faces of the gauge blocks shall be placed between the jaws, and the outside measuring faces of the calliper shall be checked at three points.

**A.2 MEASURING FACES**

**A.2.1 Flatness**

The flatness of the faces for external measurement may be checked by applying a "knife edge" straightedge, or by another appropriate method.

**A.2.2 Parallelism**

The parallelism of the faces for external measurement may be checked by inserting gauge blocks between them at different points of the jaws and at different measured lengths by varying the sizes of the gauge blocks.

The parallelism of the faces for external measurement shall not be affected by clamping the slider. This may be checked by leaving a narrow gap between the measuring faces and observing this gap when clamping the slider.

The parallelism of the faces for internal measurement may be checked by means of a micrometer. To ensure that the radius is not too large, the combined jaws may be checked with a plain ring gauge of 5, 10 or 20 mm diameter, as applicable.

**A.2.3 Scale lines**

The thickness of the scale lines may be checked by direct measurement with a microscope fitted with a micrometric device.

