SYLVAC CALIBRATION STANDARD	ID Nr :	SYL 802
	Date :	07.04.2014 - E
DIAL GAUGES	By :	CMO
	Valid. by :	DSC

1. REFERENCE CONDITIONS

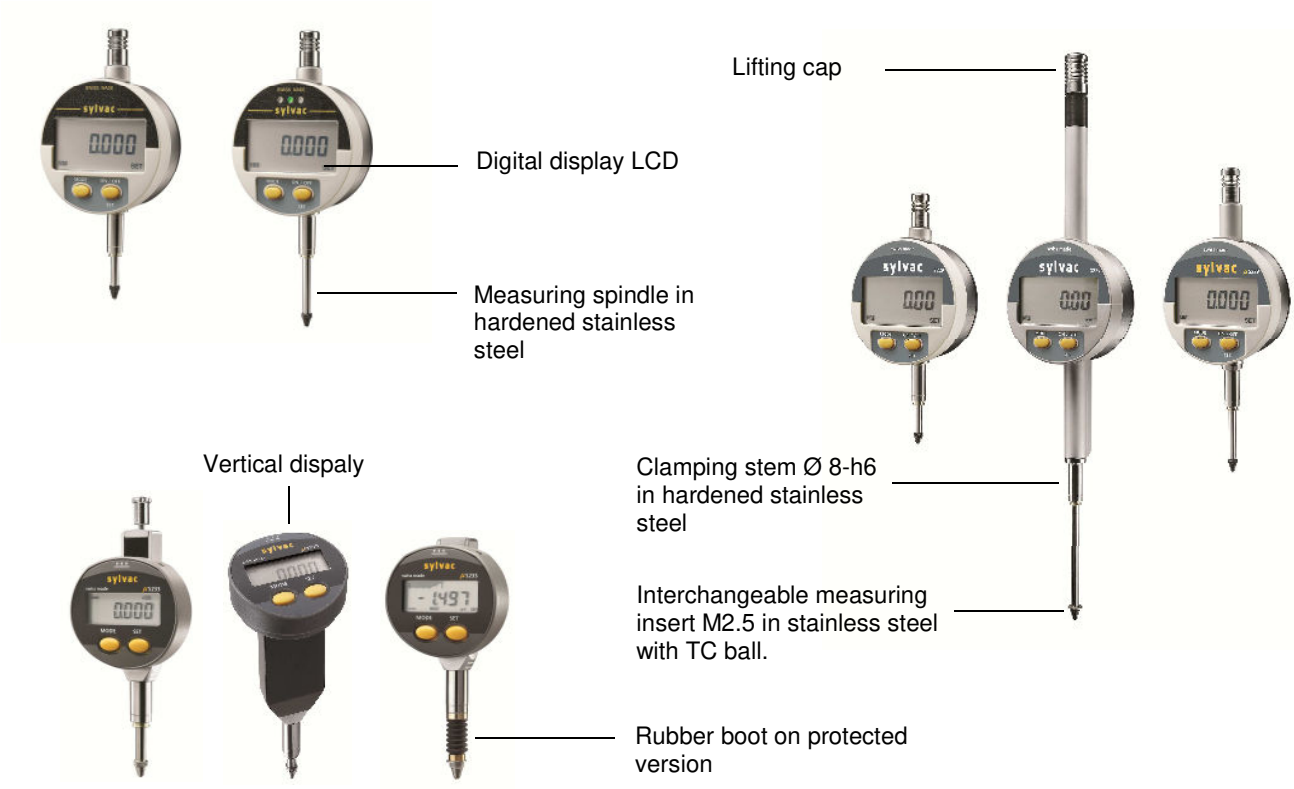
1.1. Measurement standards

- A high precision vertical testing stand (Sylvac M3).
- A computer set with calibration software (Sycopro).
- A set of gauge blocks.
- A vertical measuring stand with a granite or ceramic table.
- A force sensor (or a high accuracy balance).

1.2. Calibration ambient conditions

- The reference temperature is 20°C.
- The maximum variation of the room temperature (Δ max) is 1.5°C on a duration of 6 hours.

2. FUNCTIONAL LAYOUT



3. CALIBRATION SPECIFICATIONS

3.1. Preparation

- General checking (display of the value, displacement of the measuring spindle, tightening of the measuring insert). If out of operation, it may be repaired or rejected, depending of damages found.
- External cleaning using a soft cloth. Solvents to be used: Soft detergent, isopropyl alcohol (except on the window), light benzine. When using the dial indicator intensively, lubricate the spindle with a drop of petrol.
- Keep the instrument and measurement standards under calibration conditions for at least 6 hours prior to the measurements.

3.2. Visual inspection

- Readability of the identification number and/or the serial number.
- Readability of the display.

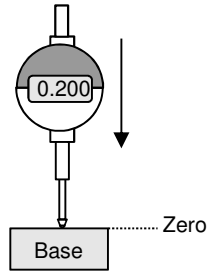
3.3. Functional checking

- Check the steady displacement of the measuring spindle over the entire measuring range (no hard point).
- Check the functionality of the keys (on/off, zero setting, mode).
- Check the stability of the digital display. Max. permitted error during 10 seconds: 1digit.
- Check the data output by connecting the instrument to a PC or to a Sylvac display unit.

3.4. Pretravel of the dial gauges before zero setting

The pretravel is the start position setting of the measuring spindle. Set the dial gauge on its stand, penetrate the spindle by bringing down the instrument to the base before zero setting of the display

Dial Gauge	Pretravel
Every types	0.2 mm



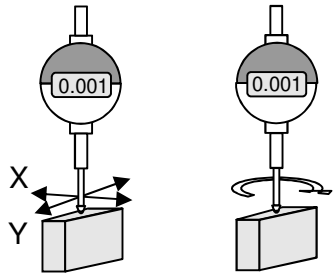
3.5. Checking of the radial and the rotation play

The play (gap) of the measuring spindle is a data of design it is not subject of verification during calibration. If necessary (when worn) the audit is performed as follows:

- Dial gauge fixed on a measuring stand.
- Checking of the spindle play (radial) : Contact point in pretravel position on a gauge block (see 3.4), slide the gauge block 1 mm in all 4 directions (±X; ±Y). Observe the variation on the display.
- Checking the rotation play : Contact point in pretravel position (see 3.4), perform a light rotation force on the spindle, with two fingers, without affecting the measuring force. Observe the variation on the display.

Chart 3.5.1

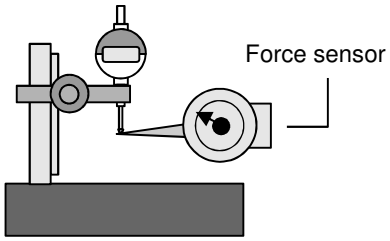
Dial Gauge	Max. variation of the display due to the play
0.01	0.01 mm
0.001	0.001 mm
NANO	0.0005 mm
S_Dial PRO	0.0003 mm



3.6. Measuring force

The the measuring force is a data of design it is not subject of verification during calibration. If necessary, the verification is performed as follows:

- The instrument is fixed in vertical position on a measuring stand
- Bring the spindle down to the force sensor.
- Check the force at the beginning and at the end of the range.
- Tolerances as per chart 3.9.



3.7. Measuring error

3.7.1. The measuring error consists mainly of a local error (sensor error) and a scale error. If necessary, the 2 errors can be checked separately as follows :

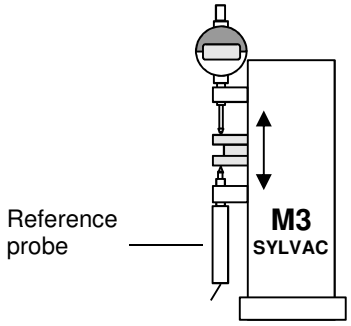
a) Checking of the local error: Check each 0.1mm over a distance of 1mm. Calculate the difference max. between the errors (Δ max).
b) Checking of the scale : Perform a certain number of measurements a multiple of the scale step spread out over the used measuring range (as per sensor generation, the step is 1.000, 1.016 or 1.524mm) Calculate the difference max. between the errors (Δ max).

3.7.2. Checking of the max. error (fe) on a testing stand M3 Sylvac or an other vertical calibration stand. By measuring distances outside of the scale step, we check the total error :

- Set the dial indicator and adjust the pretravel before setting at zero (see 3.4).
- To measure «race up» only (according to chart 3.7.2.1).
- Calculate the difference max. between the errors (Δ max).
- Tolerances as per chart 3.9.

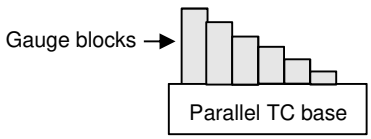
Chart 3.7.2.1

Range	Measuring steps
5 mm	0 à 5.04 mm, each 0.56 mm
12.5 mm	0 à 12.7 mm, each 1.27 mm
25 mm	0 à 25.4 mm, each 2.54 mm
30 mm	0 à 30.5 mm, each 3.05 mm
50 mm	0 à 50.5 mm, each 5.05 mm
100 mm	0 à 101 mm, each 10.1 mm
150 mm	0 à 151 mm, each 15.1 mm



3.7.3. Checking of the max. error (fe) using a set of gauge blocks. If there is no vertical testing stand available, the checking will be made on gauge blocks :

- The dial indicator fixed vertically on a measuring stand with granite or ceramic table.
- If possible, the gauge blocks will be slight on a parallel base made of tungsten carbide. Manipulations of the gauge blocks increase the measurement uncertainty.
- Adjust the pretravel before setting at zero (see 3.4).
- Care about dust and other deposits.
- Calculate the difference max. between the errors (Δ max).
- Tolerances as per chart 3.9.



3.8 Repeatability:

The repeatability is a data of design it is not subject of verification during calibration. If necessary, the verification is performed as follows:

- Perform 10 successive measurements on a gauge block (see 3.7.3.).
- Calculate the max. deviation (delta).
- Tolerances as per chart 3.9.

Chart 3.9

Dial Gauge	Measuring force[1] (over whole range)	Max. error (fe)[2] by type			Max. local error[3]	Repeta-bility[4]
		0.01	0.001	0.0001		
S233 - 5mm with rubber boot (P)	0.50-0.65 N ± 20% (Hysteresis : 0.1N) 0.60-1.20 N ± 20% (Hysteresis : 0.2N)	10 µm	**5 µm** ANALOG **4 µm**	---	0.01 : 8 µm 0.001 : 4 µm ANALOG 3.4 µm	0.01 : 5 µm 0.001: 2 µm
S233 - 12.5mm with rubber boot (P)	Standard : 0.50-0.90 N ± 20% (Hysteresis : 0.2N) Low : 0.35-0.50 N ± 20% High : 1.80-2.30 N ± 20% 0.60-1.30 N ± 20% (Hysteresis : 0.2N)	10 µm	**5 µm**	---	0.01 : 8 µm 0.001 : 4 µm	0.01 : 5 µm 0.001: 2 µm
S233 - 30 mm	0.55-1.35 N ± 20% (Hysteresis : 0.2N)	10 µm	**7 µm**	---	0.01 : 8 µm 0.001 : 4 µm	0.01 : 5 µm 0.001: 2 µm
S229 / S213 12.5mm with rubber boot (P)	Standard : 0.65-0.90 N ± 20% (Hysteresis : 0.02N) Low : 0.40-0.55 N ± 20% High : 1.00-1.60 N ± 20% Standard : 0.65-1.40 N ± 20% (Hysteresis : 0.1N)	10 µm	**5 µm**	---	0.01 : 8 µm 0.001 : 3.4 µm	0.01 : 5 µm 0.001: 2 µm
S229 / S213 25mm with rubber boot (P)	Standard : 0.65-1.15 N ± 20% (Hysteresis : 0.02N) Low : 0.45-0.90 N ± 20% High : 0.90-1.80 N ± 20% Standard : 0.65-1.80 N ± 20% (Hysteresis : 0.1N)	10 µm	**5 µm**	---	0.01 : 8 µm 0.001 : 3.4 µm	0.01 : 5 µm 0.001: 2 µm
S229 / S213 50mm	2.50-4.00 N ± 20% (Hysteresis : 0.6N)	20 µm	**7 µm**	---	0.01 : 8 µm 0.001 : 3.4 µm	0.01 : 5 µm 0.001: 2 µm
S229 / S213 100mm	1.60-3.50 N ± 20% (Hysteresis : 0.8N)	20 µm	**8 µm**	---	0.01 : 8 µm 0.001 : 3.7 µm	0.01 : 5 µm 0.001: 2 µm
S229 / S213 150mm	2.20-5.70 N ± 20% (Hysteresis : 1.5N)	20 µm	**9 µm**	---	0.01 : 8 µm 0.001 : 4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial ONE 12.5mm	0.60-0.90 N ± 20% (Hysteresis : 0.02N)	20 µm	**5.4 µm**	---	0.01 : 9 µm 0.001 : 4.4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial ONE 25mm	0.60-1.20 N ± 20% (Hysteresis : 0.02N)	20 µm	**6.4 µm**	---	0.01 : 9 µm 0.001 : 4.4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial ONE 50mm	0.70-1.40 N ± 20% (Hysteresis : 0.02N)	20 µm	**8 µm**	---	0.01 : 9 µm 0.001 : 4.4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial WORK 12.5mm with rubber boot (P)	Standard : 0.65-0.90 N ± 20% (Hysteresis : 0.02N) Faible : 0.40-0.55 N ± 20% Forte : 1.00-1.60 N ± 20% Standard : 0.65-1.40 N ± 20% (Hysteresis : 0.1N)	10 µm	**3 µm** BASIC **4 µm**	NANO **1.8 µm**	0.01 : 8 µm 0.001 : 3.4 µm NANO : 1.0 µm	0.01 : 5 µm 0.001: 2 µm NANO 0.5 µm
S_Dial WORK 25mm avec soufflet (P)	Standard : 0.65-1.15 N ± 20% (Hysteresis : 0.02N) Low : 0.45-0.90 N ± 20% High : 0.90-1.80 N ± 20% Standard : 0.65-1.80 N ± 20% (Hysteresis : 0.1N)	10 µm	**4 µm** BASIC **5 µm**	NANO **2.2 µm**	0.01 : 8 µm 0.001 : 3.4 µm NANO : 1.0 µm	0.01 : 5 µm 0.001: 2 µm NANO 0.5 µm

Dial Gauge	Measuring force[1] (over whole range)	Max. error (fe)[2] by type			Max. local error[3]	Repeta-bility[4]
		0.01	0.001	0.0001		
S_Dial WORK 50mm	2.50-4.00 N ± 20% (Hysteresis : 0.6N)	20 µm	**5 µm** BASIC **7 µm**	---	0.01 : 8 µm 0.001 : 3.4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial WORK 100mm	1.60-3.50 N ± 20% (Hysteresis : 0.8N)	20 µm	**6 µm**	---	0.01 : 8 µm 0.001 : 3.7 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial WORK 150mm	2.20-5.70 N ± 20% (Hysteresis : 1.5N)	20 µm	**10 µm**	---	0.01 : 8 µm 0.001 : 4 µm	0.01 : 5 µm 0.001: 2 µm
S_Dial PRO BASIC 50mm	2.50-4.00 N ± 20% (Hysteresis : 0.6N)	---	---	**1.5 µm**	0.8 µm	0.2 µm

[1] Dial gauge in vertical position, measuring spindle going out to the bottom.

[2] The max. error (fe) is the maximum difference between the lowest and the highest point of the curve of errors (Δmax.errors). For indication, the rounding error can add up to 0.5 digit (respectively 5 µm, 0.5 µm et 0.05µm) to the uncertainty of each measure.

[3] The max. local error corresponds to the measuring sensor error (checked each 0.1mm over 1 step of the scale). The rounding error can add up to 0.5 digit.

[4] The rounding error can add up to 0.5 digit.

4. RESULT AND DECISION

- Print a calibration certificate (using the Sycopro calibration software).
- If the measurement results are not conform, the instrument must be either repaired and calibrated again, or downgraded or recycled.
- Note that for an instrument with resolution to 1/100, the rounding error may, in the worst case, add 9 µm to the max. error (fe) specified in chart 3.9.