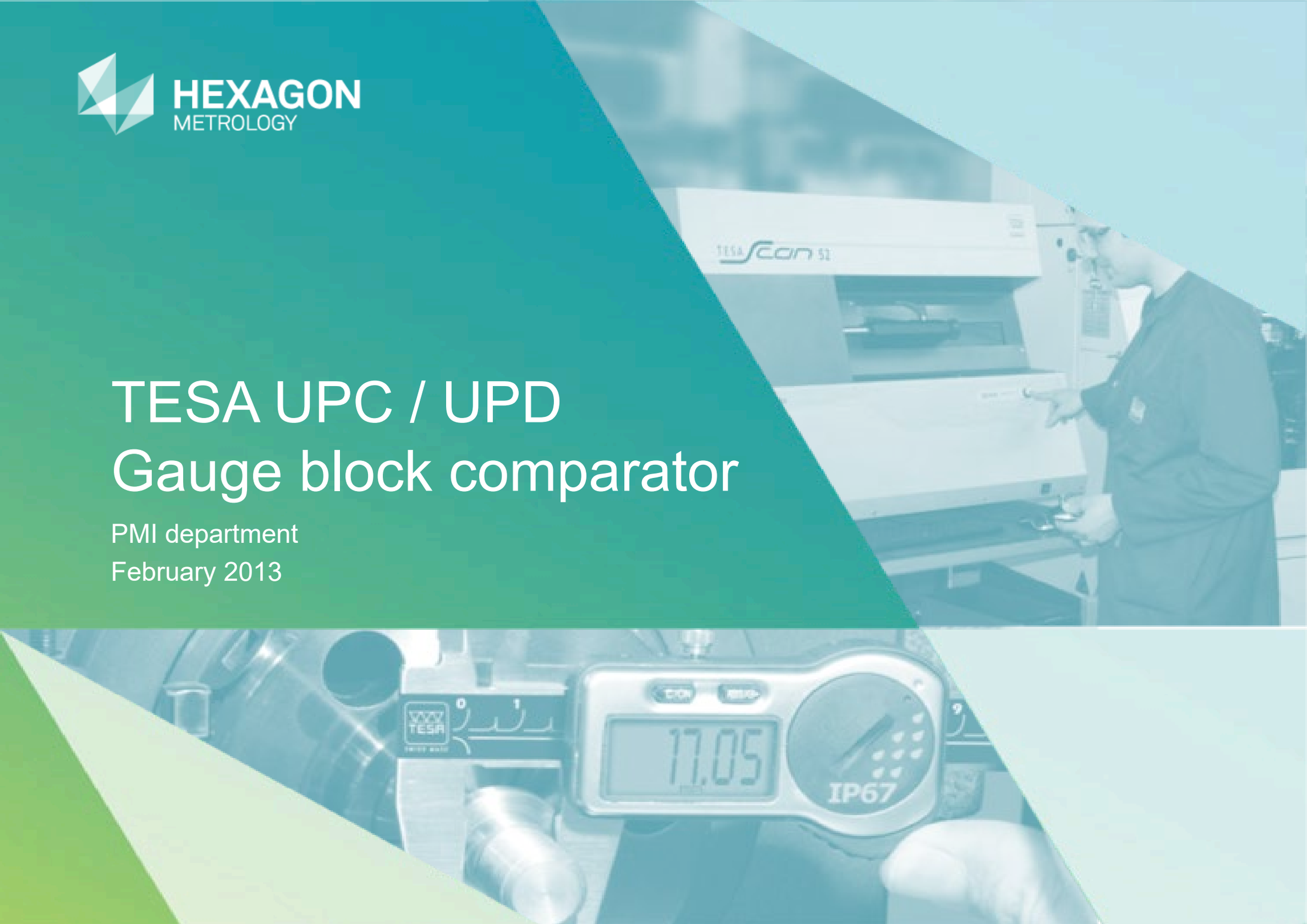
HEXAGON
METROLOGY

TESA UPC / UPD
Gauge block comparator

PMI department

February 2013



Summary

- Gauge Blocks — **Introduction**
- TESA UPC / UPD — **Configuration**
- TESA UPC — **Gauge Block Comparator**
  - For comparative measurements
- TESA UPD — **Gauge Block Comparator**
  - For comparative and direct measurements
- TESA UPT — **Temperature Device**
- TESA UP — **The Software Programme**
- TESA UPC / UPC — **System Components**
- Marketing — **Delivery Programme / Maintenance / Investments**

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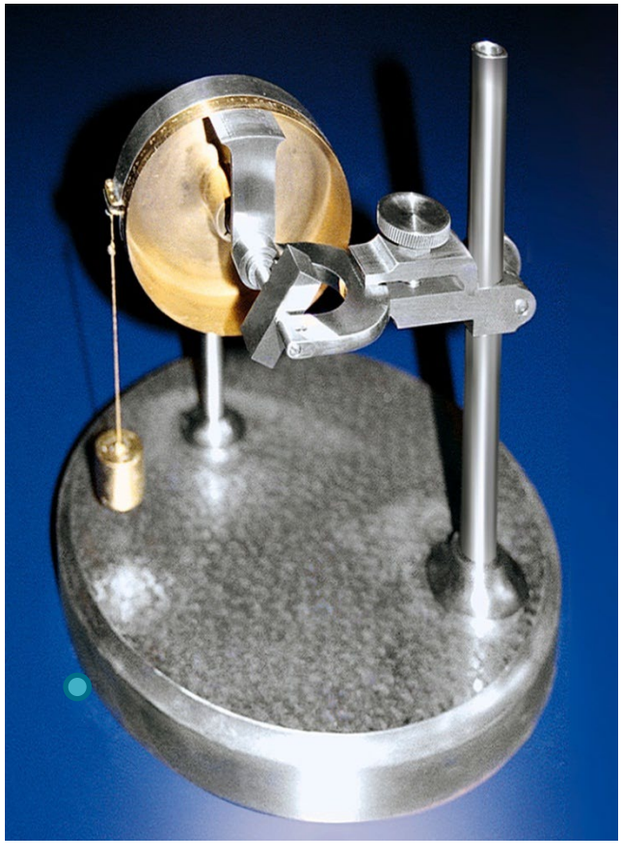
Gauge Blocks - Introduction

Welcome to the world of gauge block calibration

TESA Technology offers two instruments for two different ways of calibration

I was the first

Made by Brown & Sharpe for Mr. C.E. Johansson



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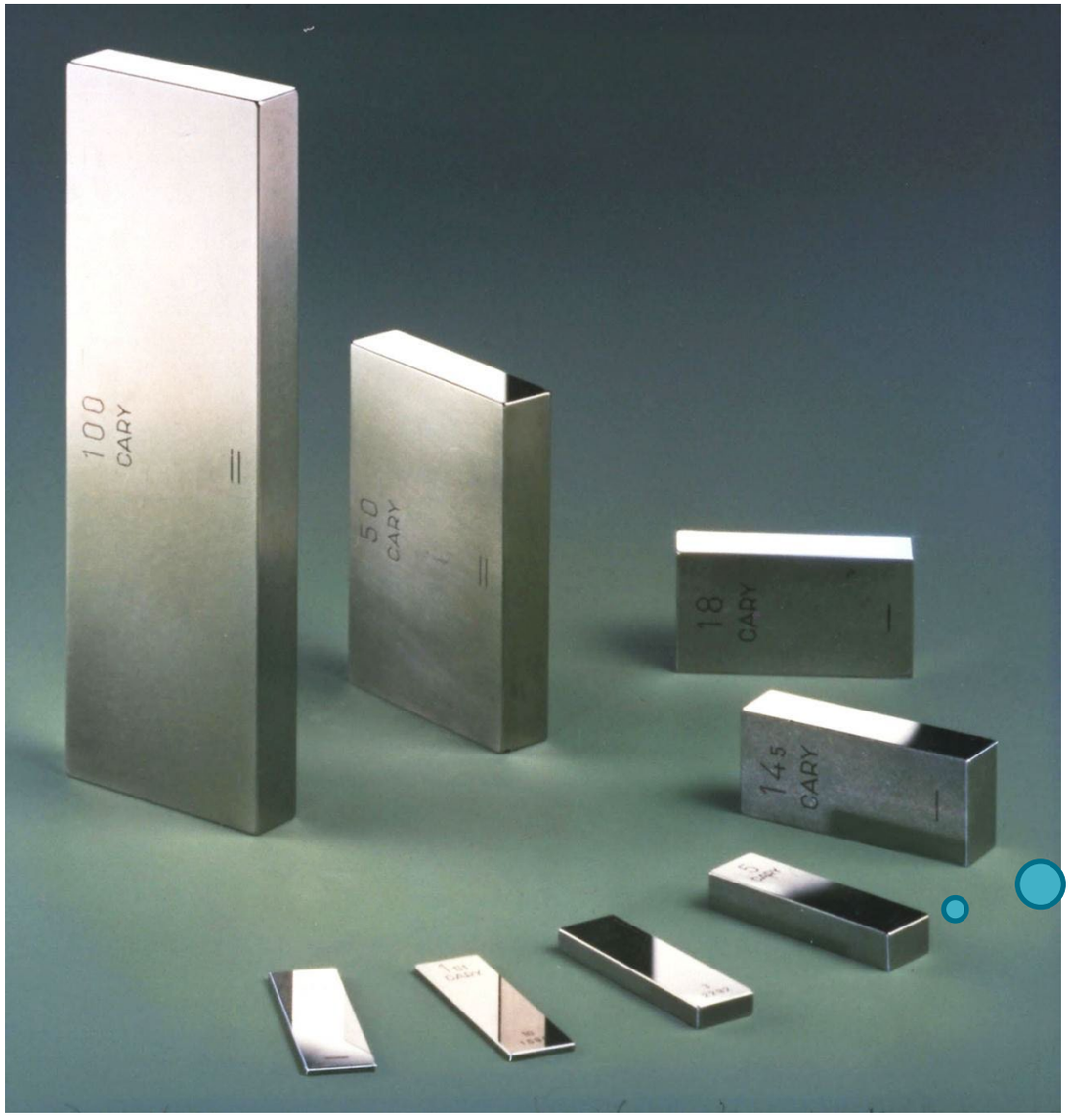
Gauge Blocks - Introduction



Gauge blocks:

The most significant material measures in dimensional metrology

Their periodic calibration ensures that they remain permanently reliable

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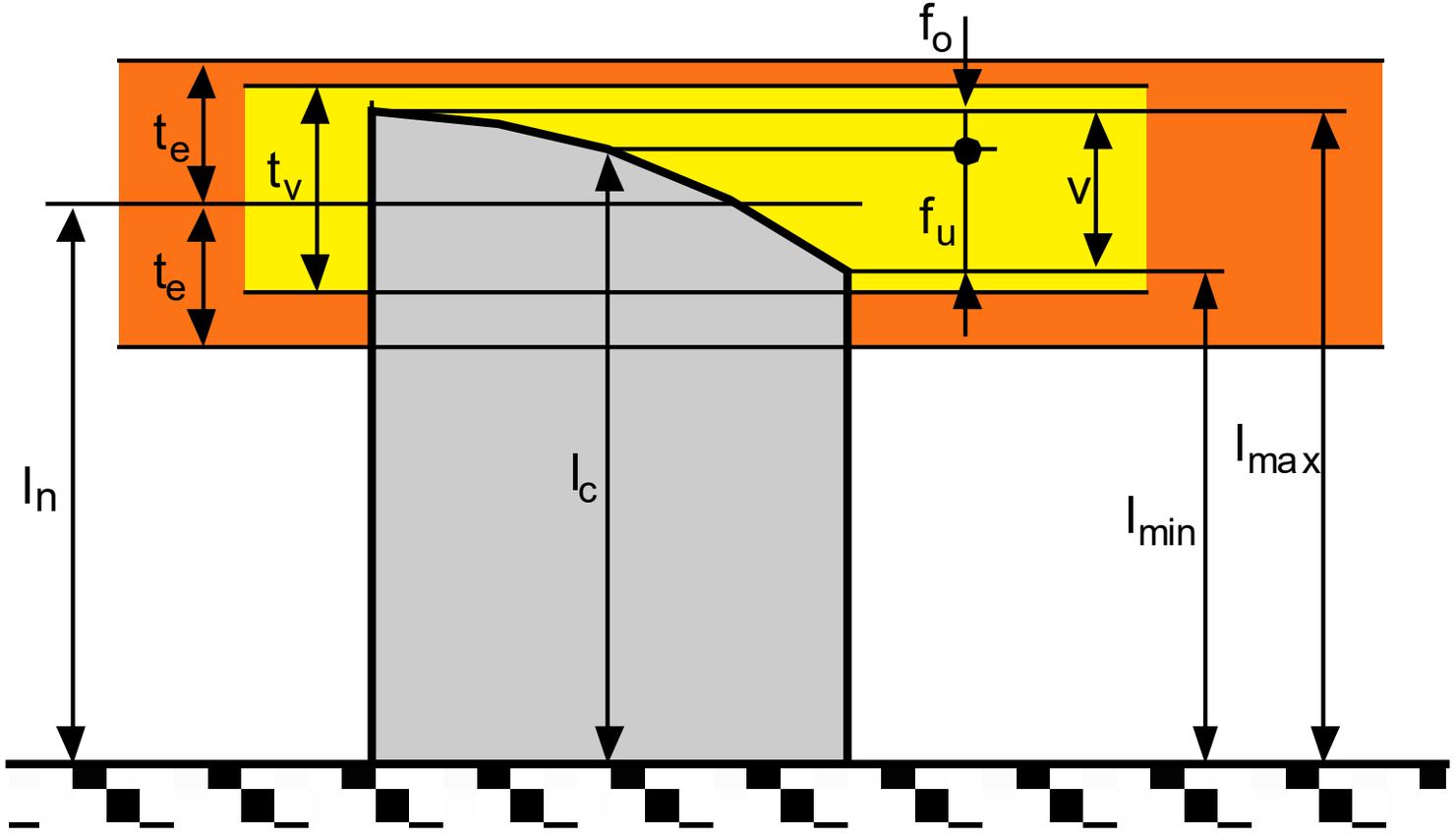
Gauge Blocks - Introduction

as per ISO 3650:1998

$v = l_{max} - l_{min}$
$f_o = l_{max} - l_c$
$f_u = l_c - l_{min}$



L_n = nominal length

t_e = limit deviation at any point proceeding from the nominal length

lc = central length

fu & fo = variation v

t_v = tolerance of the variation v

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Gauge Blocks - Introduction

Calibration laboratory (examples)	Measurement procedure	Reference standard	Uncertainty of measurement *	Calibration certificate
National Physical Laboratory (NPL) Teddington UK *or* Swiss Federal Office of Metrology and Accreditation CH-3084 Wabern	Fundamental interferential measurement ISO 3650:1998 NPL TESA Interference comparator	**National standard** Wavelength lamps or wavelength stabilized laser	$0,02 + 0,2 \cdot 10^{-6} \cdot L$ µm L = Nominal length	NPL or METAS Calibration certificate
Calibration laboratories accredited, e.g. by UKAS, United Kingdom Accreditation Service *or* Swiss Calibration Service (SCS)		**Reference standard set** NPL or METAS Calibration certificate Calibration grade K	Level 1: $0,05 + 0,5 \cdot 10^{-6} \cdot L$ µm Level 2: $0,1 + 1,0 \cdot 10^{-6} \cdot L$ µm L = Nominal length	UKAS or SCS Calibration certificate
Central calibration laboratory in a company or institute	Comparative or direct measurement ISO 3650:1998 TESA UPD or UPC gauge block comparator	**Reference standard set** UKAS or SCS Calibration certificate Calibration grade K	Level 1: $0,05 + 0,5 \cdot 10^{-6} \cdot L$ µm Level 2: $0,1 + 1,0 \cdot 10^{-6} \cdot L$ µm Level x: see**	«In-house» Calibration certificate
Central calibration laboratory in local branches	«In-house» calibrations	**Company standard set** «In-house» Calibration certificate Grad 0 / **Company standard set** «In-house» Calibration certificate Grad 0	L = Nominal length	
Measuring rooms and other subordinate inspection centres		**Working standard set** «In-house» Calibration certificate Grade 0 or 1 / **Working standard set** «In-house» Calibration certificate Grade 0 or 1		
Inspection centres in the workshops		**Working standard set** Grade 1 or 2 / **Working standard set** Grade 1 or 2 / **Working standard set** Grade 1 or 2		

Tracing gauge blocks (material measures) to the unit of length (meter)

* Uncertainty of measurement for the deviation in central length from nominal length.
** The uncertainty is determined based on the ambient conditions specific to the measuring spot.

2001-04/KT

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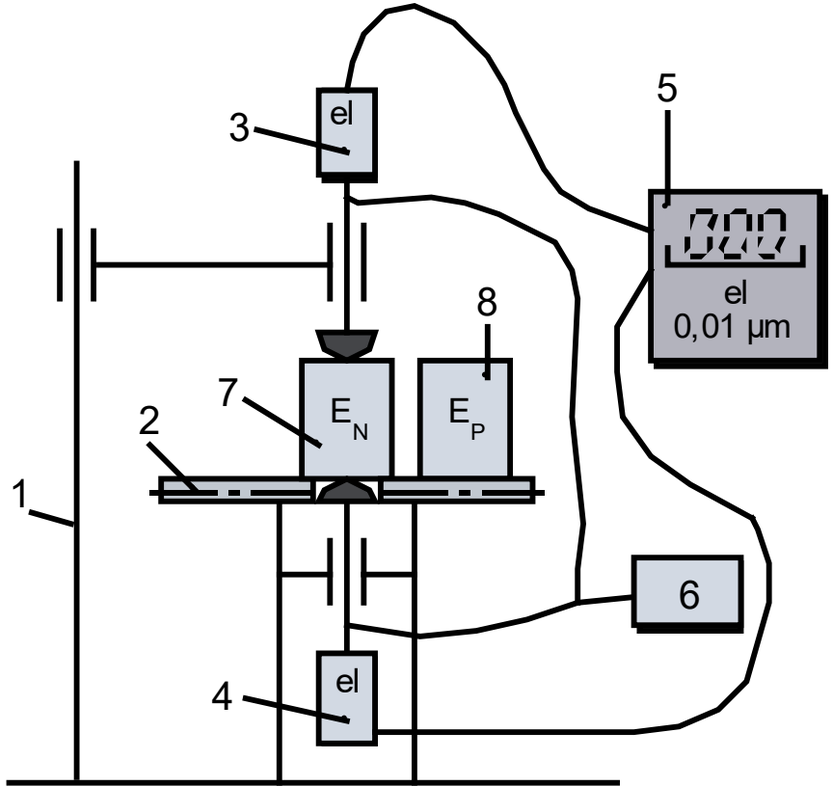
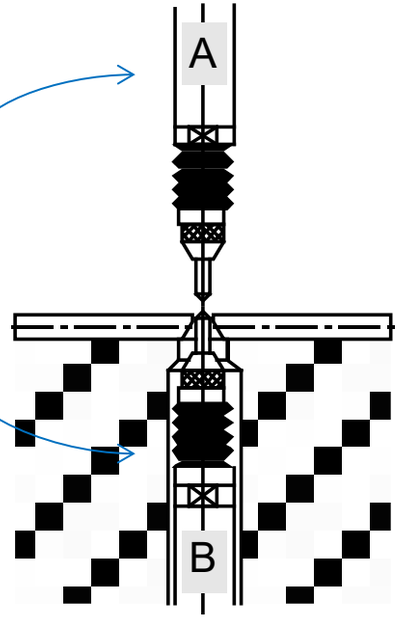
TESA UPC / UPD - Configuration

Acquisition of the gauge length with use of two probes.



Configuration layout

1) Measuring support
2) Measuring table
3) Upper probe
4) Lower probe
5) Electornique module
6) Pneumatic probe retraction (only for UPC)
7) Reference gauge block
8) Calibrated gauge block



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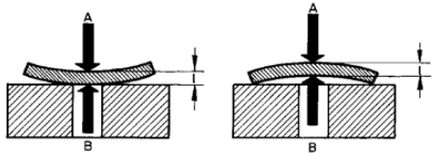
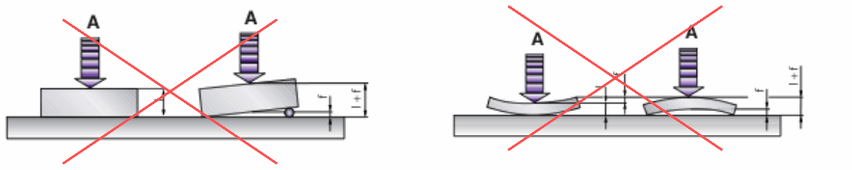
TESA UPC / UPD - Configuration

The economic and metrologic advantages of a dual probes measuring system:

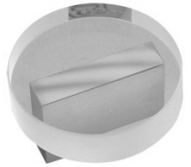
- The two probes in «sum measurement» mode ensure a correct measurement.



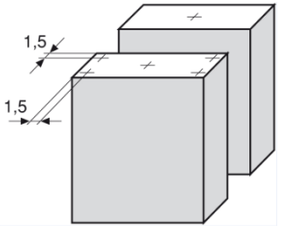
- No form and position errors influences. Especially for small thickness gauge blocks.



- No surface apposition makes the measuring cycles faster.



- Templates systems measuring *lc* point on the reference block and *lc* plus 4 other points on each corner of the block being measured



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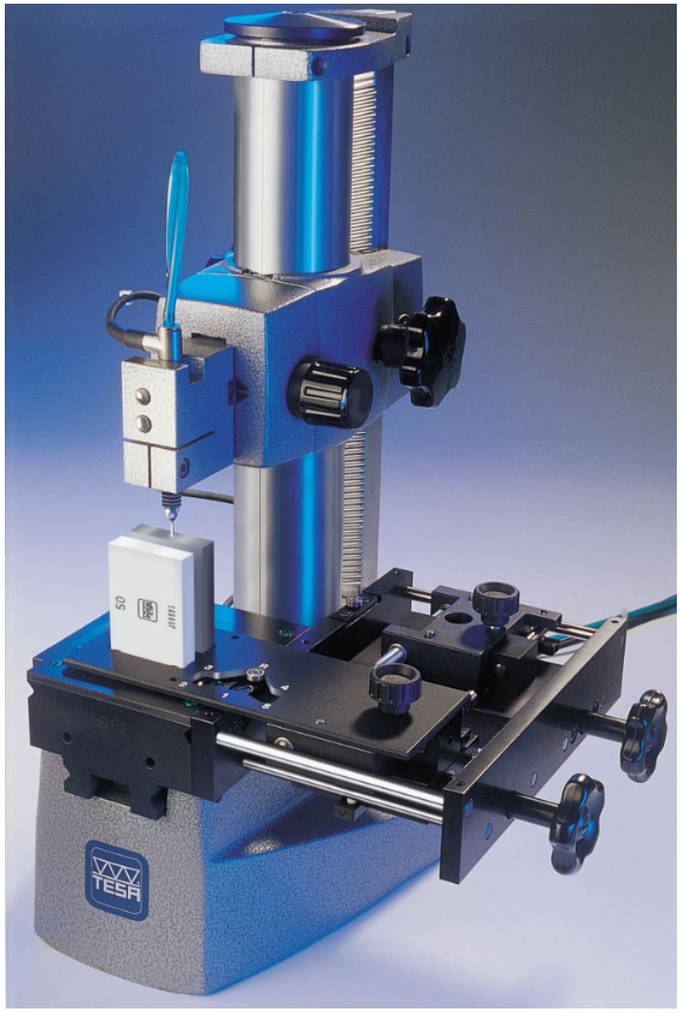
TESA UPC – Gauge Block Comparator

For **Comparative** Measurement



- Measuring gauge block of **same nominal length**.
- Application ranges from 0,5 up to 100 mm (up to 500 mm in specialty.)
- TESA high-precision inductive probes.
- Template system for gauge block positionning.
- Computer-aided data processing software available
- Ultra-precise temperature device can be integrated.
- Transfer on-line all length (and optionally the temperature).
- Performs calibrations by meeting ISO standards as well as EA guidelines.
- Greater accuracy execution available with a calibration certificate.

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TESA UPC – Gauge Block Comparator

TESA UPC execution ref. 05930014

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TESA UPC – Gauge Block Comparator

Errors of measurement

	Repeatability limit	Uncertainty of measurement
• Execution for greater accuracy	*1 **0,015 µm**	*2 *U = ± (0,05 + 0,5 x L) µm* (L in m)
• Standard execution	*1 **0,025 µm**	*2 *U = ± (0,10 + 1,0 x L) µm* (L in m)

*1 Without influence of the temperature

*2 Condition involves the use of reference standards whose uncertainty of measurement is:

U ≤ ± 0,015 µm
for the comparator calibration

U ≤ ± (0,02 + 0,2 x L) µm
for the gauge block calibration

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TESA UPD – Gauge Block Comparator

For **Direct** and **Comparative** Measurement with a 25mm span

The flexible concept that provides distinctive metrological features with substantial savings at the end of it all

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TESA UPD – Gauge Block Comparator

For **Direct** and **Comparative** Measurement with a 25mm span

- Measuring gauge block of **same or different nominal length**.
- Application ranges from 0,5 up to 100 mm (up to 500 mm in speciality.)
- TESA & HEIDENHAIN high-precision incrementale probes.
- Template systems for gauge block positionning.
- Computer-aided data software available.
- Ultra-precise temperature device can be integrated.
- Transfer on-line all lengths (and optionally the temperature).
- Performs calibrations by meeting ISO standards as well as EA guidelines.

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TESA UPD – Gauge Block Comparator

TESA UPC execution ref. S59300102

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TESA UPD – Gauge Block Comparator

The advantages that make it leader and unrivaled:

The Time:

- Number of probing points is thus reduced drastically.
- Measured value immediately displayed after the probe insert has come into contact.
- Number of calibrated gauge blocks increased with a single probed reference gauge

The Costs:

- Allows to calibrate over 90% of a 122-pieces gauge block set with the same reference standard.
- Consequently, it allows to reduce the reference set compared to the UPC.
- Reduce significantly the cost of purchase or maintenance on the references.
- No need to buy specific reference for an unusual nominal length (e.g. 17.6mm)

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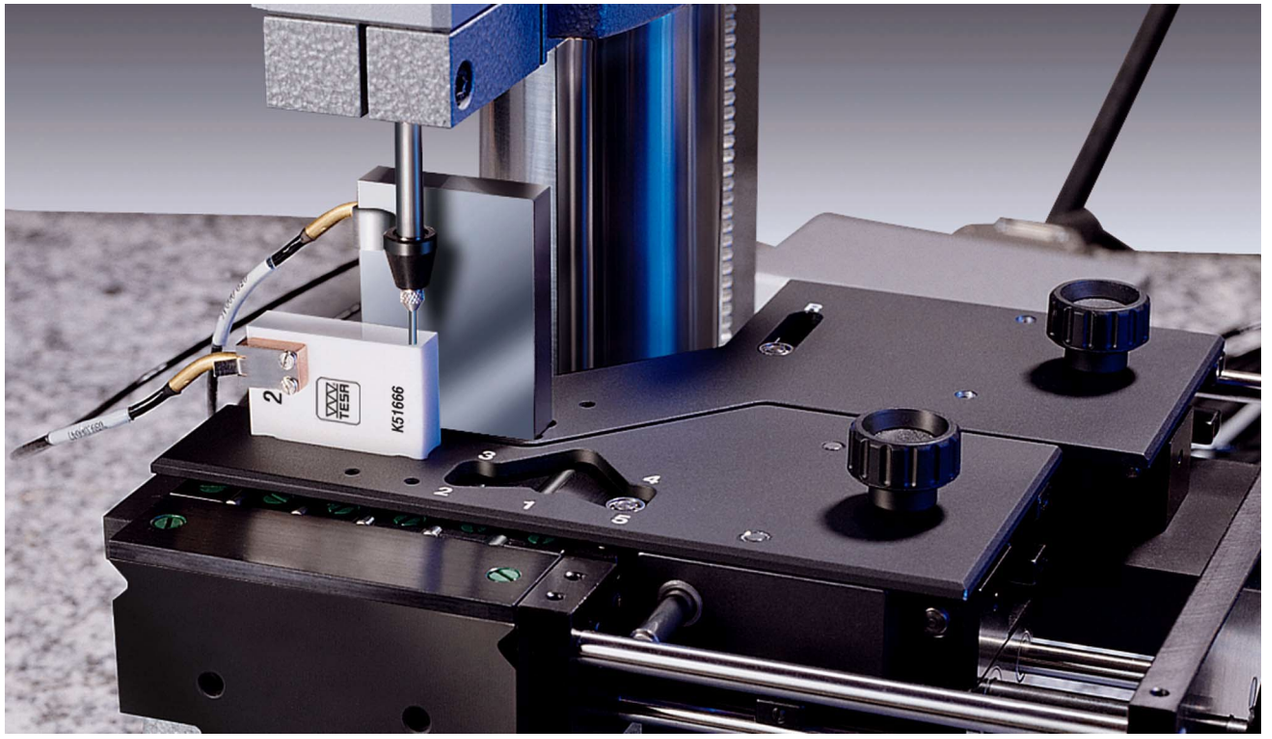
TESA UPD – Gauge Block Comparator

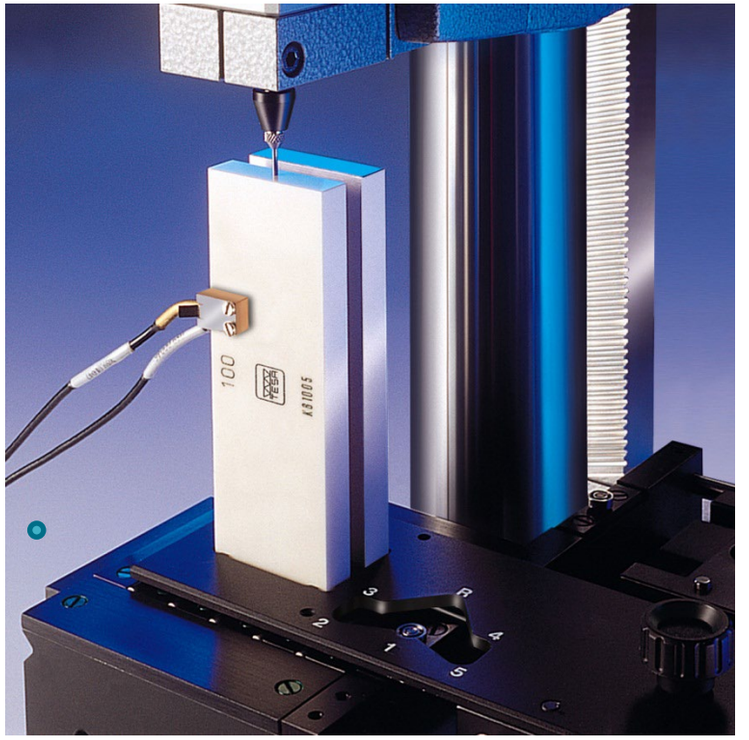


Direct measurement

- *Comparison with a variation in nominal length of 25mm*

Comparative measurement

- *Comparison of gauge blocks when same nominal length*



for smaller systematic errors

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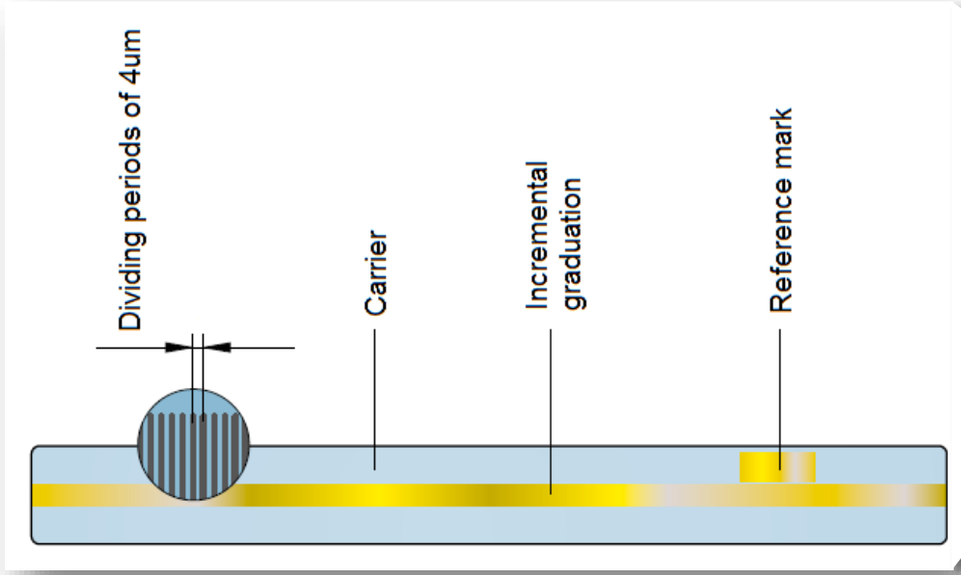
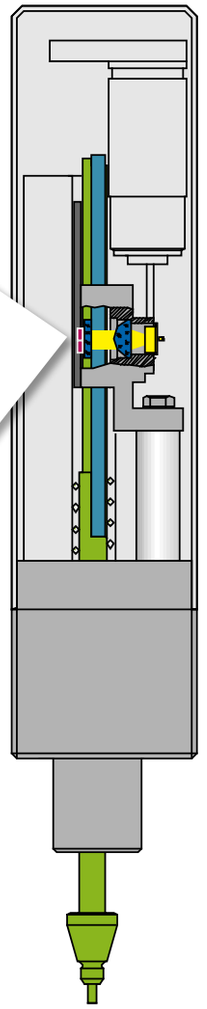
TESA UPD – Gauge Block Comparator

Upper HEIDENHAIN high-precision axial probes

- 25mm measuring span
- Opto-electronic measuring system
- ZERODUR glass ceramic scale with incremental divission
- ABBE's principle fully respected
- Accuracy ≤ 5 nm
- Motorised measuring bolt activation
- 0.000005 mm (5 nm) numerical interval





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TESA UPD – Gauge Block Comparator

Errors of measurement

Repeatability limit	Uncertainty of measurement
*[1] **0,015 µm**	*[2] *U = ± (0,05 + 0,5 x L) µm* (L in m)

*[1] Without influence of the temperature

*[2] Condition involves the use of reference standards whose uncertainty of measurement is:

U ≤ ± 0,015 µm
for the comparator calibration

U ≤ ± (0,02 + 0,2 x L) µm
for the gauge block calibration

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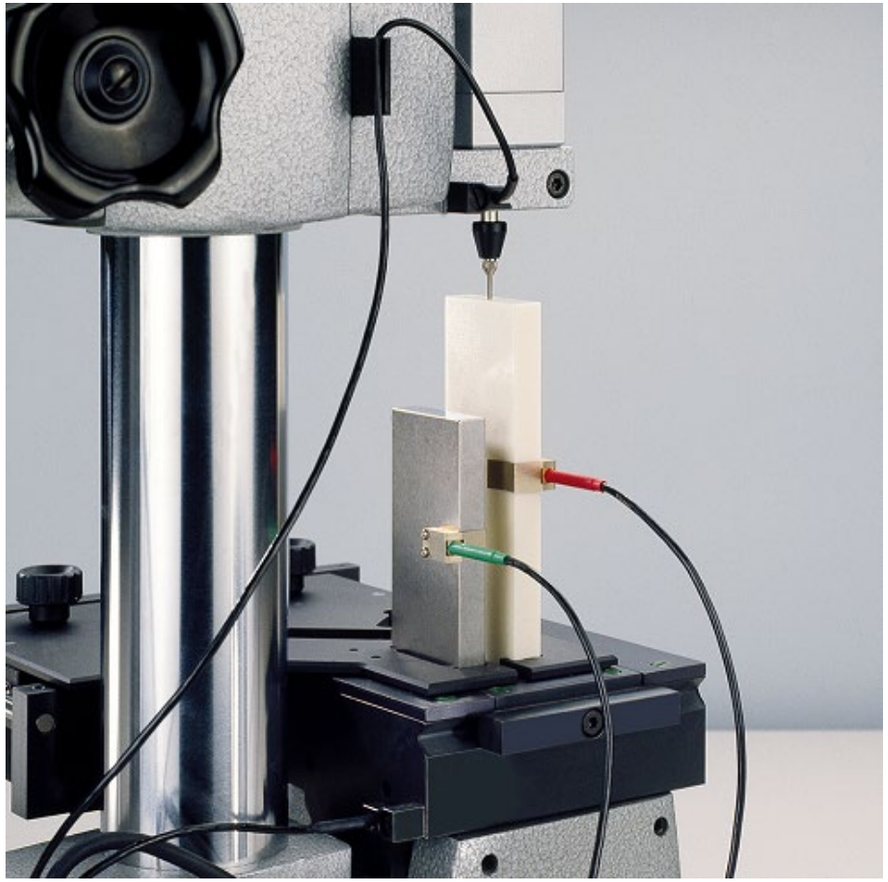
TESA UPT – Temperature Device

For TESA gauge block comparators UPC and UPD



- 4 temperature sensors PT100 (4-wires type).
- 2 of them with clamps for the gauge blocks
- Numerical interval: 0.001°C
- Calibrated for the measuring range from 19°C up to 24°C
- Uncertainty of measurement: U = +/- 0.03°C
- Delivered with SCS calibraiton certificate

… also used on measuring equipments such as horizontal measuring benches or height gauges.

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TESA UP – Software Programme

For TESA gauge block comparators UPC and UPD

- On-line processing of length and temperature values.
- Automatic execution of all relevant corrections.
- Large possibilities for a self-creation of certificates and calibration modes.
- Result outputs according to ISO 3650:1998, to 6 other standards and to a personnalized one.
- Available in 11 languages.
- Compatible with Win 7 (32 bits) and lower.
- Compatible for comparators from competitors.
- Delivered with protective dongle (hard-key) in USB

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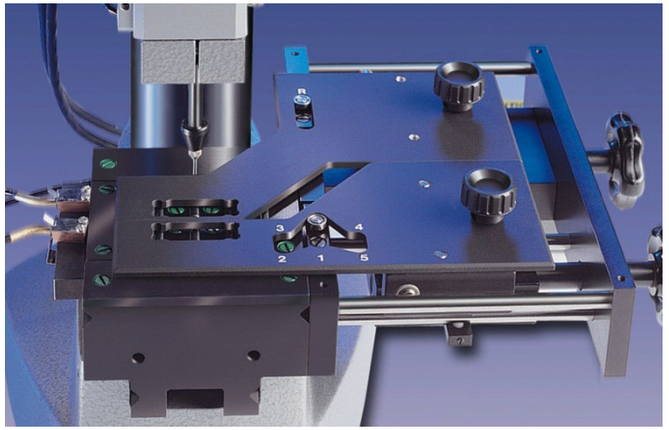
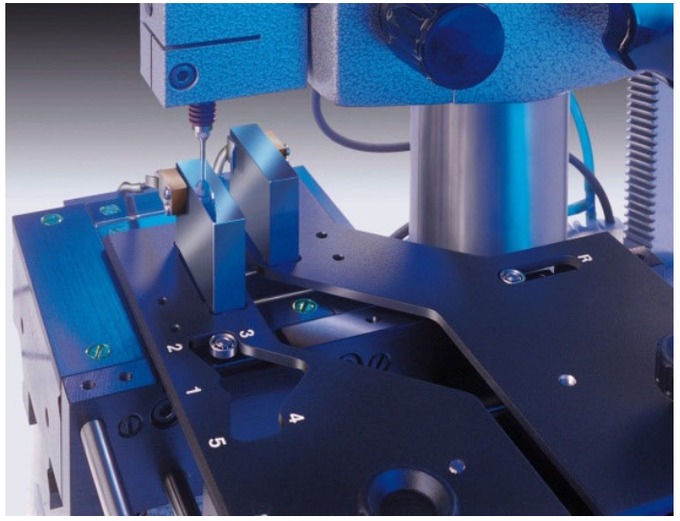
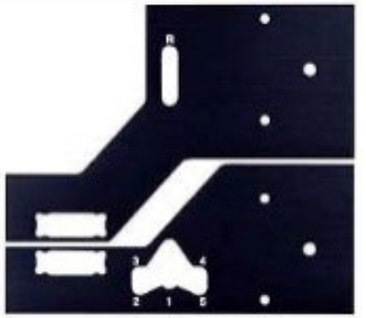
TESA UPC / UPD – System Components

Dual Template: a patented pending system for TESA UPD and optionnaly for UPC





Main target: to protect the expensive reference gauge blocks.



How: by reducing the travel of the reference gauge blocks of about 70%.

This contribute to lower the risks of damaging and wearing the the measuring faces.
This double protection blocks leads to significant cost savings by reducing needs for:

- Recalibration
- Restoring measuring faces, replacing worn or damaged referenced gauges
- Life extension of the full reference sets.
- Longer life of the pins of the table of the UPC or UPD.

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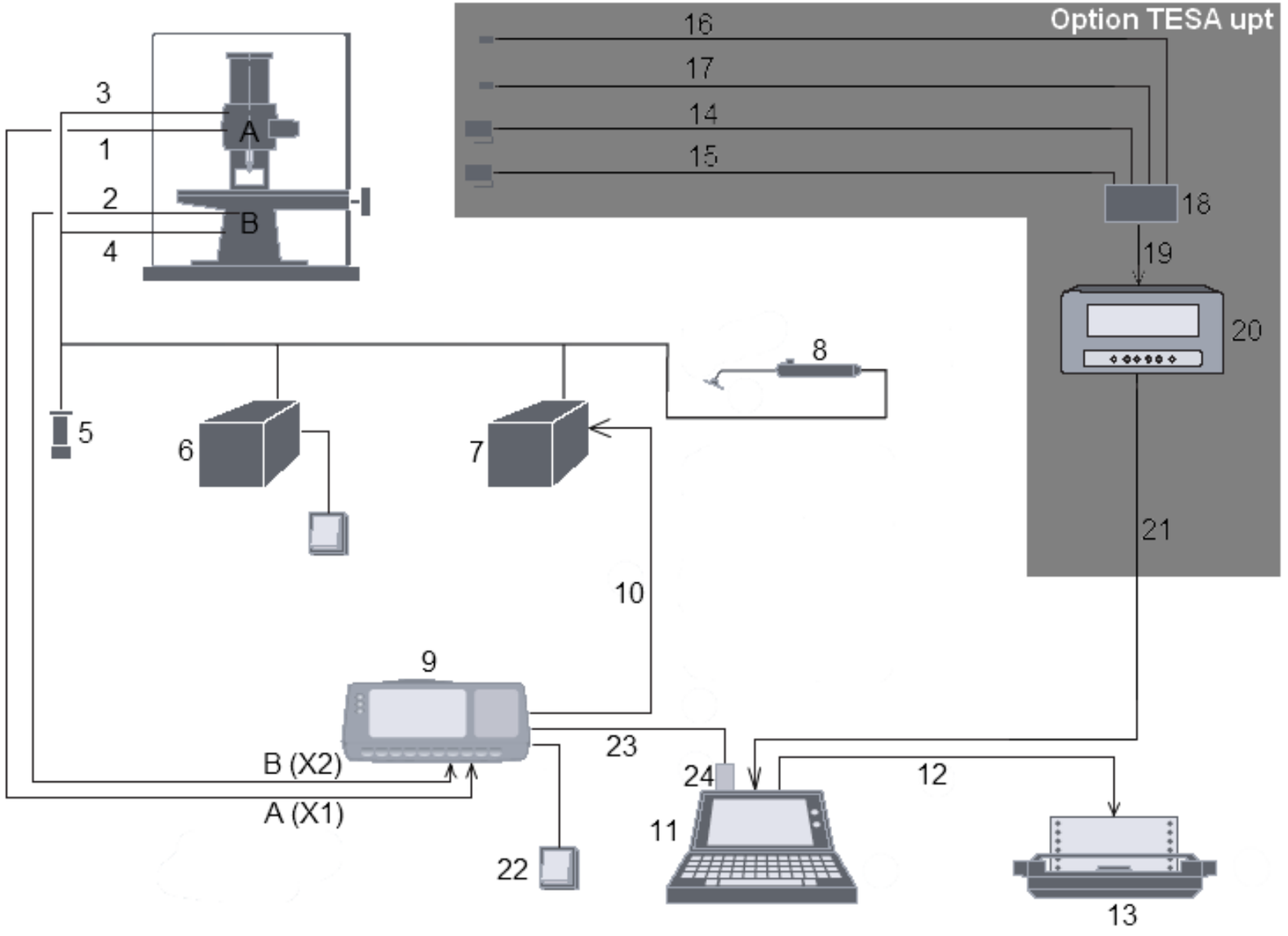
TESA **UPC** – System Components



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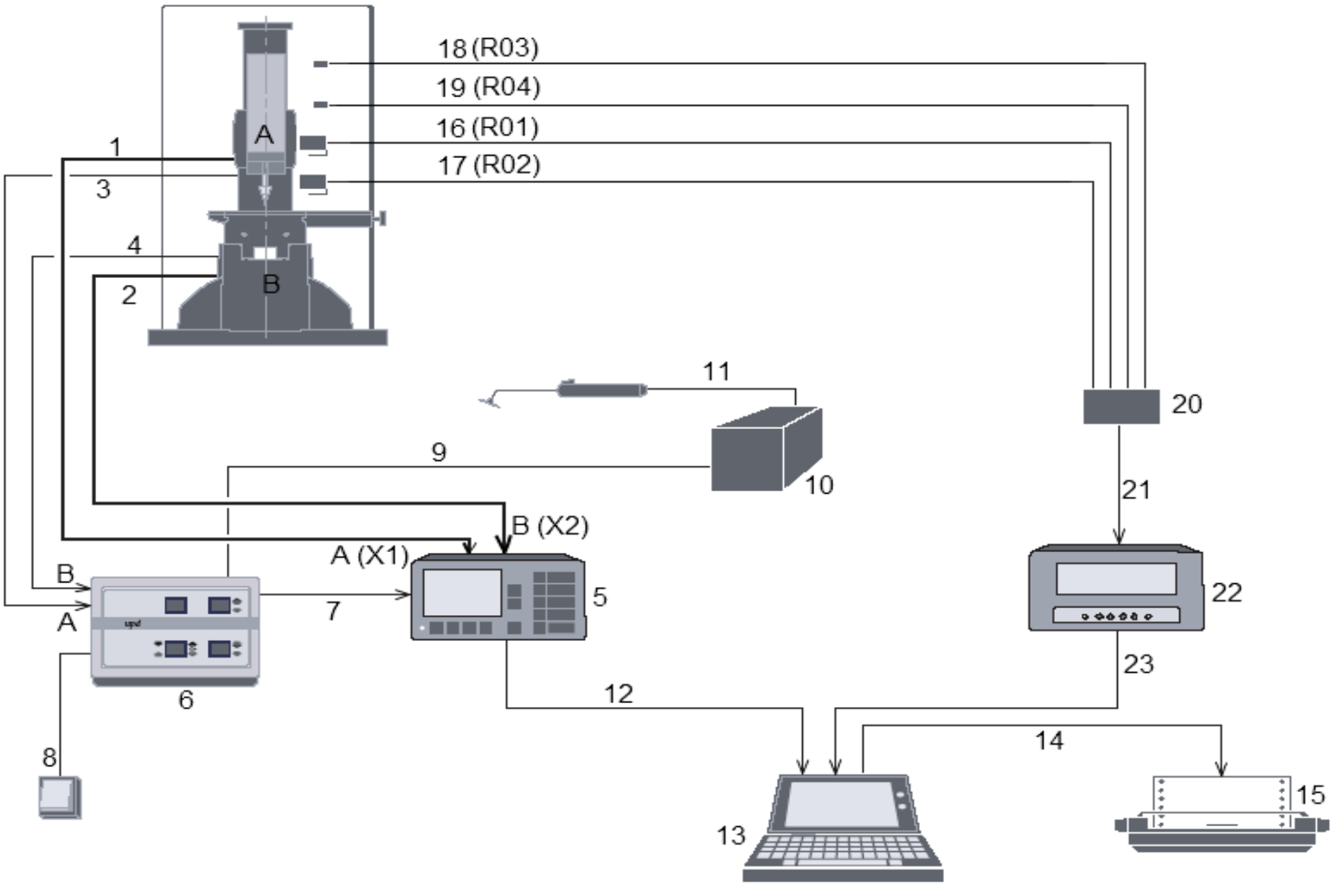
TESA **UPD** – System Components



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TESA UPC / UPD – Delivery Programmes

TESA UPC: 8 Ordering variations

TESA UPC gauge block comparator equipped with single template system											
	05930000	Standard execution, without computer application									●
	05930001	Execution for greater accuracy, without computer application								●	
	05930002	Standard execution, with computer application							●		
	05930003	Execution for greater accuracy, with computer application						●			
TESA UPC gauge block comparator equipped with single and dual template system											
	05930012	Standard execution, without computer application					●				
	05930013	Execution for greater accuracy, without computer application				●					
	05930014	Standard execution, with computer application			●						
	05930015	Execution for greater accuracy, with computer application	●								
Each version consists of:											
1	01610401	1 TESA UPC mechanical part Equipped with the single template system						●	●	●	●
1a	05960030	1 TESA UPC mechanical part Equipped with the single and dual template system	●	●	●	●					
2	03260401	1 Pneumatic retraction of the measuring bolt, manually operated				●					●
3	03260432	1 Electric vacuum pump with foot switch			●					●	
4	03260433	1 Electric vacuum pump with external control	●	●				●	●		
5	01660011	1 Pneumatic suction loader	●	●	●			●	●	●	
6	04430012	1 TESATRONIC electronic unit TT90	●	●	●	●		●	●	●	●
	05960039	1 Set of TESA UPC accessories, including the components listed under 7,8,9									
7	04761049	1 Opto-RS cable, bidirectional	●	●				●	●		
8	04760087	1 Opto-RS interface	●	●				●	●		
9	04761070	1 Connecting cable TESATRONIC TT90 to vacuum pump	●	●				●	●		
10	04768000	1 Hand switch	●	●				●	●		
11	01690021	1 Option for greater accuracy with calibration certificate	●		●			●		●	

TESA UPD: 3 Ordering variations

	05930005	TESA UPD gauge block comparator with temperature device*			●
	05930004	TESA UPD gauge block comparator without temperature device*		●	
	S59300102	TESA UPD gauge block comparator, complete* with temperature device, TESA UP software programme for value processing, PC (standard), printer	●		
		Key components			
1	05930008	1 TESA UPD mechanical part	●	●	●
2	05960016	1 HEIDENHAIN computing counter ND 287 featuring 2 probe inputs	●	●	●
3	05960013	1 Control panel	●	●	●
4	05960014	1 Connecting cable for control panel to ND 287 computing counter	●	●	●
5	04768001	1 Foot switch	●	●	●
6	01660011	1 Suction loader	●		●
7	03260433	1 Electrical vacuum pump with external control, 230 Vac, 50 Hz	●		●
8	05960028	1 Connecting cable for electric vacuum pump to control panel	●		●
9	05930011	1 TESA UPT temperature device, complete	●		●
14	05960025	1 TESA UP software programme for value processing	●		
15	S59070014	1 Computer. For minimum requirements, refer to page L-14	●		
16	03969007	1 Connecting cable for ND 287 counter to host computer	●		
17	05960026	1 Connecting cable for temperature device to host computer	●		
18	S59070012	1 Laser printer, colour	●		
19	S59070013	1 Connecting cable for host computer to printer	●		

* Special execution for 110 Vac, 60 Hz also available on request.

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TESA UPC / UPD – Delivery Programmes

Options (depending the delivery programme) and Accessories:

№	=	
05960025	**TESA UP software programme for gauge block calibration** Running under WINDOWS 98, 2000, NT, XP *Software package including:* 1 CD-ROM plus 1 USB protective Hard-key	

05930011	**TESA UPT temperature device for TESA Gauge Block Comparators** Fully calibrated for the measuring ranges from 19°C up to 24°C with a numerical interval to 0,001 °C. Supplied with a calibration certificate issued by the Swiss Calibration Service (SCS). Uncertainty of measurement achieved during calibration U = ± 0,03°C. *Consisting of:*	
05960018	1 Set of 4 temperature sensors PT100 platinum resistances giving exceptional long-term stability while drifts are kept to a minimum over years of use. This set includes the following sensors: 1 Temperature sensor with clamp R for reference gauge blocks having nominal lengths from about 14 mm, No. 05960009. 1 Temperature sensor with clamp P for gauge blocks to be calibrated having nominal lengths from about 14 mm, No. 05960008 2 Temperature sensors mounted on the measuring stand or the table. PT 100 sensors. 3 g8 in diameter, 10 mm long. Order number for a single item: 05960010.	
05960038	1 FLUKE 1529 measuring unit for temperature Precision thermometer including a switch for the measuring points. With use of the PT 100 platinum resistances, provides 4 measuring channels with a 0,001 °C numerical interval.RS 232 or IEEE 488 data output. 115 or 230 Vac for 50 or 60 Hz.	
05960012	1 Adapter. Allows up to 4 temperature sensors to be connected.	
05960011	1 Connecting cable For adapter No 05960012 to measuring unit No 05960038.	
05960026	**Connecting cable** For serial data transfer from temperature device to computer, 9-pin/m and 9-pin/f connector.	

№	=	µm
	Set of 11 gauge blocks for calibrating each comparator *Set composition as listed in the chart opposite. Supplied with:*	
S59110152	Calibration certificate issued by the Physikalisch Technische Bundesanstalt (PTB)	± 0,015
S59110489	Calibration certificate issued by a laboratory accredited by the German calibration service (DKD)	± 0,030
Full tungsten carbide set also available on request		

№	Pairs N°	Nominal length A mm	B mm
	1	0,5	0,5
	2	1,0	1,005
	3	1,0	1,01
	4	4,0	4,0
	5	100,0	100,0
	6	6,0	6,0*

* Special bridge-shaped gauge blocks (see drawing) used for establishing the measuring deviations of lower probe B.

№	=	µm
	9-piece gauge set for the calibration of TESA UPD *Set composition as listed in table opposite. Supplied with:*	
S59300103 **S59300107**	Calibration certificate issued by the laboratory of a national institute of metrology Metas (Switzerland) PTB (Germany)	±(0,02+0,2·L) µm L in m Measuring method: direct inteferometry
S59300104	Calibration certificate issued by a laboratory officially accredited SCS	±(0,05+0,5·L) µm L in m Measuring method: by comparison

Set Composition (mm)
1 5 10 15 20 25 50 75 100

Steel

Accuracy grade K

Other set compositions or carbide gauge blocks also available on request.

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TESA UPC / UPD - Conclusion

– TESA offer the **widest range** of measuring equipments for gauge block calibration **Worldwide**.

- TESA **UPD** Gauge Block Comparator is the only one of its class that has no competitor.

Precision – our identity

You have more questions. A team of Enginneers is at your dispositon at:

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