

MARPOSS

# AMA

## ADVANCED MEASURING ARMSET



Displacement Sensors

**AMA™** is a line of mechanical measuring devices developed to satisfy the requirements of the market of measurement application providers. Based on their versatility and universal applicability, fixture makers, gauge makers and engineering sources will produce the right solution for their customers' applications.

# AMA TB TRANSMISSION BASIC DEVICE

Displacement  
Sensors



The AMA line of transmission units is characterized by 15 different designs, 8 mm and 3/8" clamping diameter, high precision and reliability, 12 mm thickness, variety of mounting options, wide range of contact offsets. AMA elements can be applied in combination with any pencil probe sensor type or indicators. Pneumatic actuation, available on some models, allows contact retraction to eliminate interference with the workpiece during manual and automatic part loading and unloading.

TB elements represent the basic version working by "fulcrum"

Bore  
Gauges



**TB10 and TB10C** have a working range of 1000  $\mu\text{m}$ .

The small size of these measuring armsets allows a reduced overall installation dimension.

TB10C requires a pencil probe shorter ( $\pm 0,5$  mm) than that for TB10 ( $\pm 1$  mm), due to the different position of the measuring gauge locking point.

Forks and  
Ring Gauges



Bench  
Gauges



**TB16 and TB16C** have a working range of 1600  $\mu\text{m}$ .

The small size of these measuring armsets allow a reduced overall installation dimension.

TB16C requires a pencil probe shorter ( $\pm 0,5$  mm) than that for TB16 ( $\pm 1$  mm), due to the different position of the measuring gauge locking point.

Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



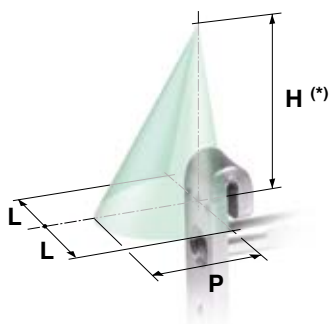
Software



## APPLICATION LIMITS

In case of vertical off-set, the Arm ratio (usually 1:1) changes as for below table:

Model	H (*)	L	P
	[mm]	[mm]	[mm]
TB10	30	14	20
TB10C	30	14	20
TB16	50	14	20
TB16C	50	14	20



(\*) With a vertical off-set the Arm Ratio changes:  
mod. TB10  $[30/(30 + h)]$  mod. TB16  $[50/(50 + h)]$  with  $h = 0$  to  $H$

# AMA TB TRANSMISSION BASIC DEVICE

NON ADJUSTABLE FEATURES		TB10		TB10C		TB16		TB16C	
		ø 8 mm	ø 3/8"	ø 8 mm	ø 3/8"	ø 8 mm	ø 3/8"	ø 8 mm	ø 3/8"
Contact thread		M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF
Working range	[µm]	1000 (0/+300)		1000 (0/+300)		1600 (0/+300)		1600 (0/+300)	
Suggested pretravel (•••)	[µm]	300		300		300		300	
Suggested overtravel (•••)	[µm]	700		700		1300		1300	
Measuring force at 300 µm from the front stop	[N]	F <sub>probe</sub> ± 0,3 (••)		F <sub>probe</sub> ± 0,3 (••)		F <sub>probe</sub> ± 0,3 (••)		F <sub>probe</sub> ± 0,3 (••)	
Stiffness K measured on the contact (only armset)	[N/mm]	0,9 ± 0,3		0,9 ± 0,3		0,4 ± 0,2		0,4 ± 0,2	
Mechanical repeatability error (2.77 σ) (assembled through the measuring gauge)	[µm]	≤ 0,15 (•)		≤ 0,15 (•)		≤ 0,15 (•)		≤ 0,15 (•)	
Mechanical repeatability error (2.77 σ) (assembled to one side)	[µm]	≤ 0,15 (•)		≤ 0,15 (•)		≤ 0,4 (•)		≤ 0,4 (•)	
Mechanical repeatability error (2.77 σ) (assembled to the base)	[µm]	≤ 0,4 (•)		≤ 0,4 (•)		≤ 0,4 (•)		≤ 0,4 (•)	
Maximum sensitivity error		± 1%		± 1%		± 1%		± 1%	
Linearity error on the working range	[µm]	≤ 2		≤ 2		≤ 2		≤ 2	
Thermal drift	[µm/°C]	≤ 0,2		≤ 0,2		≤ 0,2		≤ 0,2	
Operating and storage temperature	[°C]	-10 to 65		-10 to 65		-10 to 65		-10 to 65	
Weight	[g]	49		47		62		60	
Order code		B2927364005	B2927364035	B2927364006	B2927364036	B2927364003	B2927364033	B2927364004	B2927364034

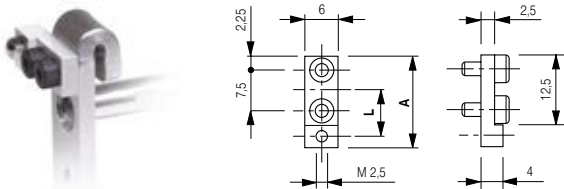
(•) With standard Marposs Red Crown F10 pencil probe. The performance is recorded at the suggested zero.

(••) F<sub>probe</sub> = Force of the measuring gauge. Ex.: with 0,8N measuring gauge, F = 0,8 ± 0,3 N

(•••) As the mechanical zero device is not available to identify any fixed positioning inside the measuring range, the "suggested zero position" (at 300µm from the front stop) is the one with minimum measuring errors.

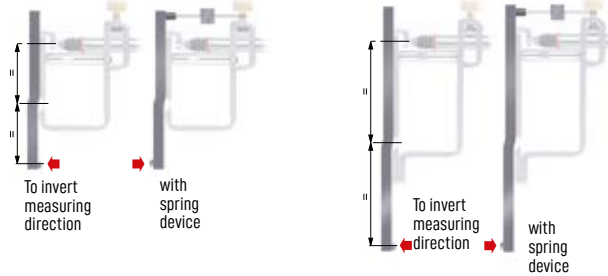
## ACCESSORIES

### OFF-SET ARMSET (arm ratio 1:1)



Model		A	OFF-SET L	Order Code
TB10	M 2,5	16,5 [mm]	8,5 [mm]	B2924017150
TB10C		18 [mm]	10 [mm]	B2924017151
TB16	4-48 UNF	16,5 [mm]	8,5 [mm]	B2924017152
TB16C		18 [mm]	10 [mm]	B2924017152

### STRAIGHT ARMSET (arm ratio 1:1)



Model		Order Code
TB10	8 [mm]	B3192736405
TB10C	3/8"	B3192736435
TB16	8 [mm]	B3192736403
TB16C	3/8"	B3192736433

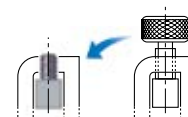
### SPRING DEVICE

Model	Order Code
TB10 - TB16	B2027364001
TB10C - TB16C	B2027364002



### ALTERNATIVE CLAMPING DEVICE (alternative to standard clamping)

Order Code  
B2027364000



#### Displacement Sensors



#### Bore Gauges



#### Forks and Ring Gauges



#### Bench Gauges



#### Indicators and Electronic Display Units



#### Interface Boxes for Data Acquisition



#### Software



# AMA TP TRANSMISSION PARALLELOGRAM DEVICE

Displacement Sensors



Bore Gauges



Forks and Ring Gauges



Bench Gauges



Indicators and Electronic Display Units



Interface Boxes for Data Acquisition



Software



TP elements represent the version working by "parallelogram". This design allows the devices to work with larger measuring ranges than the TB line. The TP elements work with an ARM ratio 1:1, not affected by the use of contact extension (within some design defined limits, see the Application Limits section). The available ranges are 1,2 mm and 6 mm.



**TP12E and TP12I** have a working range of 1200  $\mu\text{m}$ , therefore a pencil probe with  $\pm 1$  mm measuring range is suitable.

They are used in combination with SPRING push pencil probes and can be used for checking external or internal diameters.

On the top of the device an adjustable slide (accessory) can be assembled, that allows a fine adjustment of the contact position.



**TP12EP and TP12IP** have a working range of 1200  $\mu\text{m}$ , therefore a pencil probe with  $\pm 1$  mm measuring range is suitable.

These models additionally feature a pneumatic piston, that allows the use of the elements with pneumatic retraction.

They are used in combination with SPRING push pencil probes and can be used for checking external or internal diameters.

On the top of the device an adjustable slides (accessory) can be assembled, that allows a fine adjustment of the contact position.



**TP12SE and TP12SI** are the self-centering versions of TP12E and TP12I. Self-centering measuring gauges for I.D. and O.D. can be designed by means of these models.

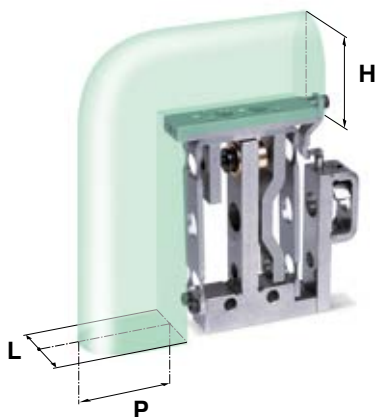
The most significant advantages are:

- Measurements can be carried out with two contact points and one indicator or pencil probe, with consequent costs reduction of the complete application.
- Only one repeatability error on one measuring transducer, instead of two repeatability errors on two measuring probes in case of measurement carried out with non self-centering elements.

## APPLICATION LIMITS

The area indicates where the contact can be positioned using an offset armset, whilst guaranteeing the correct arm set mechanical functioning.

H Max	L Max	P Max
[mm]	[mm]	[mm]
40	14	40



The A.R. remains 1:1 within the area, regardless of the offset, as the movement is of a parallelogram type and not of a fulcrum type. The maximum permitted values are highlighted in the table.

# AMA TP TRANSMISSION PARALLELOGRAM DEVICE



**TP60E and TP60I** have an extended measuring range up to 6 mm, and are suitable for checking external or internal diameters.

These elements work in combination with a  $\pm 5$  mm pencil probe.

Alternatively also indicators can be used to close the measuring application loop.



**TP60SE and TP60SI** are the self-centering versions of TP60E and TP60I. Self-centering measuring gauges for I.D. and O.D. can be designed by means of these models.

The most significant advantages are:

- Measurements can be carried out with two contact points and one indicator or pencil probe, with consequent costs reduction of the complete application.
- Only one repeatability error on one measuring transducer, instead of two repeatability errors on two measuring probes in case of measurement carried out with non self-centering elements.

Displacement Sensors



Bore Gauges



Forks and Ring Gauges



Bench Gauges



Indicators and Electronic Display Units



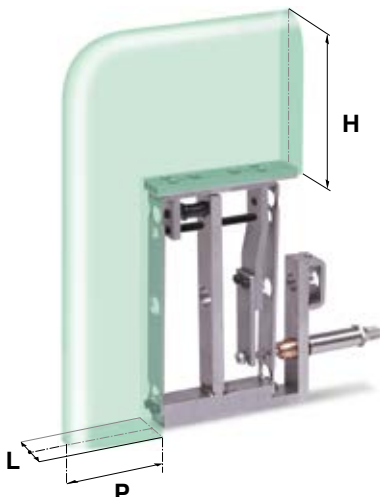
Interface Boxes for Data Acquisition



Software



## APPLICATION LIMITS



The area indicates where the contact can be positioned, using an offset armset, whilst guaranteeing the correct armset mechanical functioning.

H Max	L Max	P Max
[mm]	[mm]	[mm]
90	14	50



The A.R. remains 1:1 within the area, regardless of the offset, as the movement is of a parallelogram type and not of a fulcrum type. The maximum permitted values are highlighted in the table.

# AMA TP TRANSMISSION PARALLELOGRAM DEVICE

Displacement  
Sensors



		TP12E		TP12I		TP12EP		TP12IP		TP12SE		TP12SI	
		ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"
<b>NON ADJUSTABLE FEATURES</b>													
Contact thread		M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF
Working range	[µm]	1200 (0/+300)		1200 (0/+300)		1200 (0/+300)		1200 (0/+300)		1200 (0/+300)		1200 (0/+300)	
Retraction field	[µm]	0		0		900 (0/+100)		900 (0/+100)		0		0	
Pretravel	[µm]	350 ± 50		350 ± 50		350 ± 50		350 ± 50		350 ± 50		350 ± 50	
Overtravel	[µm]	800 min		800 min		800 min		800 min		800 min		800 min	
Stiffness K measured on the contact	[N/mm]	0,75 ± 0,2		0,95 ± 0,2		0,75 ± 0,2		0,95 ± 0,2		1,2 ± 0,2		0,8 ± 0,2	
Mechanical repeatability error (2.77 σ)	[µm]	≤ 0,2 (•)		≤ 0,2 (•)		≤ 0,2 (•)		≤ 0,2 (•)		≤ 0,6 each pair (•)		≤ 0,6 each pair (•)	
Maximum sensitivity error		± 1,5%		± 1,5%		± 1,5%		± 1,5%		± 1,5%		± 1,5%	
Linearity error on the working range	[µm]	≤ 2		≤ 2		≤ 2		≤ 2		≤ 2		≤ 2	
Thermal drift	[µm/°C]	≤ 0,2		≤ 0,2		≤ 0,2		≤ 0,2		≤ 0,2		≤ 0,2	
Operating and storage temperature	[°C]	-10 to 65		-10 to 65		-10 to 65		-10 to 65		-10 to 65		-10 to 65	
Operative pressure	[MPa]	-		-		0,3 to 0,7		0,3 to 0,7		-		-	
Weight	[g]	147		147		154		154		132		132	

Bore  
Gauges



Forks and  
Ring Gauges



Bench  
Gauges

		TP60E		TP60I		TP60SE		TP60SI	
		ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"
<b>ADJUSTABLE FEATURES</b>									
Measuring force at 350 µm from the front stop	(N) ± 0,15	$F_{min} = F_{probe} - 0,25 (••)$		$F_{min} = 1,2 - F_{probe} (••)$		$F_{min} = F_{probe} - 0,25 (••)$		$F_{min} = 1,2 - F_{probe} (••)$	
Maximum measuring force	[µm]	$F_{MAX} \geq F_{probe} + 0,05 (••)$		$F_{MAX} \geq 1,5 - F_{probe} (••)$		$F_{MAX} \geq F_{probe} + 0,05 (••)$		$F_{MAX} \geq 1,5 - F_{probe} (••)$	
Order code		B2924051200	B2924051202	B2924051201	B2924051203	B3024051204	B3024051206	B3024051205	B3024051207
								B2924051208	B2924051209
								B2924051228	B2924051229

(•) With standard Marposs Red Crown F10 pencil probe.  
(••) F probe = Force of the measuring gauge.  
The armset is provided at F min minimum measuring force.

Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



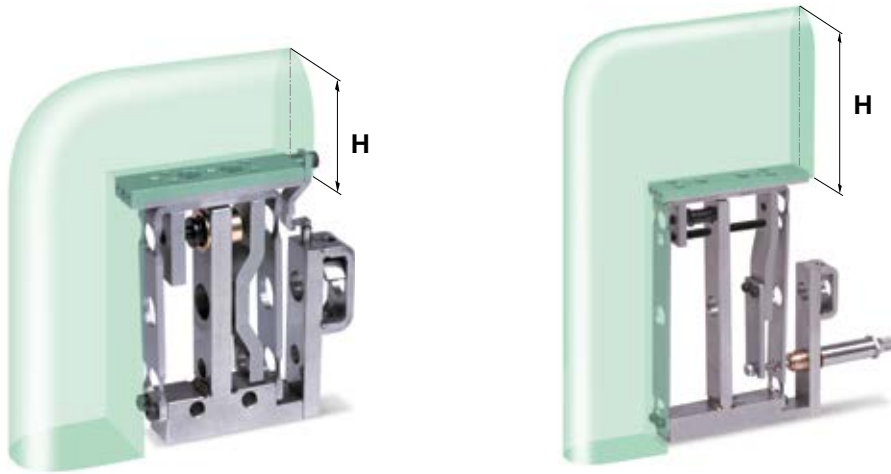
Software



		TP60E		TP60I		TP60SE		TP60SI	
		ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"	ø 8 mm	3/8"
<b>NON ADJUSTABLE FEATURES</b>									
Contact thread		M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF	M2,5	4-48 UNF
Maximum working range	[µm]	6000 (0/+300)		6000 (0/+300)		6000 (0/+300)		6000 (0/+300)	
Stiffness K measured on the contact	[N/mm]	0,15 ± 0,1		0,25 ± 0,1		0,25 ± 0,1		0,15 ± 0,1	
Mechanical repeatability error (2.77 σ)	[µm]	≤ 0,3 (•)		≤ 0,3 (•)		≤ 0,6 each pair (•)		≤ 0,6 each pair (•)	
Maximum sensitivity error		± 1,5%		± 1,5%		± 1,5%		± 1,5%	
Linearity error on the working range	[µm]	≤ 6		≤ 6		≤ 6		≤ 6	
Thermal drift	[µm/°C]	≤ 0,2		≤ 0,2		≤ 0,2		≤ 0,2	
Operating and storage temperature	[°C]	-10 to 65		-10 to 65		-10 to 65		-10 to 65	
Operating pressure	[MPa]	0,3 to 0,6		0,3 to 0,6		0,3 to 0,6		0,3 to 0,6	
Weight	[g]	292		294		267		269	
<b>ADJUSTABLE FEATURES</b>									
Adjusted working range	[µm]	5700 ± 100		5700 ± 100		5700 ± 100		5700 ± 100	
Retraction range	[µm]	5500 ± 100		5500 ± 100		5500 ± 100		5500 ± 100	
Measuring force at zero (ref. of the travel centre + 2750 µm)	(N) ± 0,15	$F_{min} = F_{probe} + 0,2 (••)$		$F_{min} = 2,6 - F_{probe} (••)$		$F_{min} = 2,6 - F_{probe} (••)$		$F_{min} = F_{probe} + 0,2 (••)$	
Maximum measuring force	(N)	$F_{MAX} \geq F_{probe} + 0,5 (••)$		$F_{MAX} \geq 3,0 - F_{probe} (••)$		$F_{MAX} \geq 3,0 - F_{probe} (••)$		$F_{MAX} \geq F_{probe} + 0,5 (••)$	
Order code		B2924051400	B2924051430	B2924051401	B2924051431	B2924051409	B2924051407	B2924051406	B2924051408

(•) With standard Marposs Red Crown FR11 pencil probe. The performance is recorded at the travel centre.  
(••) F probe = Force of the measuring gauge.  
The armset is provided at F min minimum measuring force.

# AMA TP TRANSMISSION PARALLELOGRAM DEVICE



Displacement  
Sensors






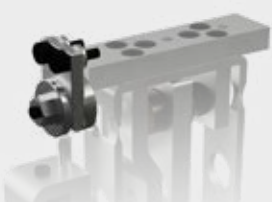
Bore  
Gauges



Forks and  
Ring Gauges



## ACCESSORIES

Model	Model	H <sup>(*)</sup> MAX (mm)	S	Order code		
<b>Slide</b>	TP12	M 2,5	20	4	B2924051211	Retooling range 0 ÷ 15 mm 
			40	6	B2924051219	
		4-48 UNF	20	4	B2924051212	
			40	6	B2924051220	
	TP60	M 2,5	90	6	B2924051405	
		4-48 UNF	90	6	B2924051435	
<b>Armset</b>	TP12	M 2,5	(A = 30 mm)		B3192405120	Armset 
		4-48 UNF			B3192405123	
	TP60	M 2,5	(A = 60 mm)		B3192405140	
		4-48 UNF			B3192405143	
<b>Off-set Armset</b>	M 2,5	8,5 mm		B2924017150	Off-set Armset 	
		10 mm		B2924017151		
	4-48 UNF	8,5 mm		B2924017152		
		10 mm		B2924017153		
<b>Pretravel/Overtravel limiter</b>	TP12 (any model)			B2924051260		

(\*) The Arm Ratio is 1:1 for any contact position.

Note: the pretravel/overtravel limiter must always be used when TP12 is equipped with Red Crown F05/H05 probes having a measuring range of ± 0,5 mm.

Bench  
Gauges



Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



Software





# AMA TP TRANSMISSION PARALLELOGRAM DEVICE

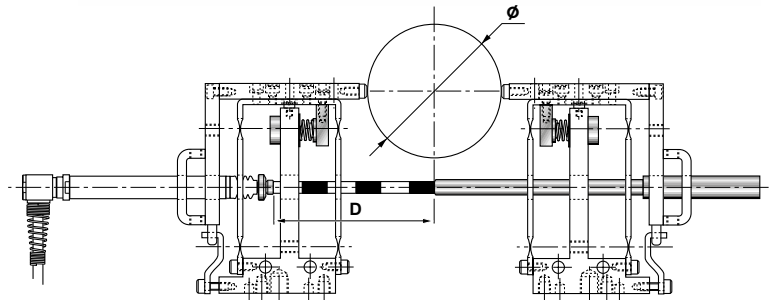
## SELF-CENTERING KIT

Model	Ø	Order Code
TP12	8 mm	B2924051210
	3/8"	B2924051213
TP60	8 mm	B2924051410
	3/8"	B2924051413



## Extensions (D)

D	Order Code
10 mm	B1024017105
15 mm	B1024017106
20 mm	B1024017107
25 mm	B1024017108
30 mm	B1024017109
70 mm	B1019750093
80 mm	B1019750122



Model													
TP12	Ø [mm]	0-3	3-8	8-13	13-18	18-23	23-28	28-33	33-38	38-43	43-48	48-53	53-58
	D [mm]	10	15	20	25	30	35	40	45	50	55	60	65
TP60	Ø [mm]	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	-	-
	D [mm]	-	10	20	30	40	50	60	70	80	90	-	-

D should be obtained with the lowest number of extensions.



Self-centering group for external  
Ø 20 mm obtained with:

- TP12SE (Q.ty 2)
- Slide (Q.ty 2)
- Self-centering kit (Q.ty 1)
- 30 mm extension (Q.ty 1)



Self-centering group for external  
Ø 75 mm obtained with:

- TP60SE (Q.ty 2)
- Slide (Q.ty 2)
- Self-centering kit (Q.ty 1)
- 70 mm extension (Q.ty 1)

Displacement  
Sensors



Bore  
Gauges



Forks and  
Ring Gauges



Bench  
Gauges



Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



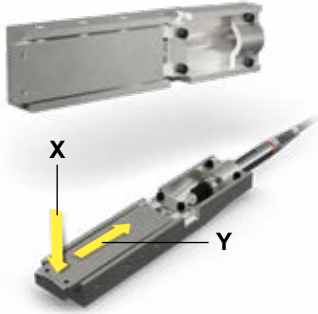
Software





# AMA TS TRANSMISSION SHOULDER DEVICE

The TS element is used for the measurement of shoulders. Its geometry allows it to be applied even when space is limited.



**TS12** and **TS21** are the mechanical versions for use in combination with Spring Push pencil probes, dial and digital indicators.

**TS12** has a working range of 1200  $\mu\text{m}$ , **TS21** has a range of 1800 to 2100  $\mu\text{m}$ , therefore a pencil probe with  $\pm 1$  mm measuring range is suitable for both versions.

The TS transmits a dimensional variation along the axis "X", which is transformed into a variation of the same entity at 90° along the axis of measurement "Y".



**TS12E** is the version with built-in transducer that offers better repeatability and accuracy.

It is available with LVDT and HBT transducer, also compatible with Tesa electronics.

	TS12		TS21				TS12E LVDT		TS12E HBT		TS12E HBT TESA	
	$\varnothing 8$ mm	3/8"	$\varnothing 8$ mm		$\varnothing 3/8$ "							
<b>NON ADJUSTABLE FEATURES</b>												
Arm ratio (min and max value)	1		1,50	1,75	1,50	1,75	1		1		1	
Suggested pretravel (***)	[ $\mu\text{m}$ ]	300	450	525	450	525	550	600	550	600	550	600
Suggested overtravel (***)	[ $\mu\text{m}$ ]	900	1350	1575	1350	1575	700	800	700	800	700	800
Contact thread		M2	M2		M2		M2		M2		M2	
Measuring force at suggested zero	[N]	$F_{\text{probe}} + 0,8 \pm 0,2$ (**)	$F_{\text{probe}} + 0,4 \pm 0,2$ (**)	$F_{\text{probe}} + 0,25 \pm 0,2$ (**)	$F_{\text{probe}} + 0,4 \pm 0,2$ (**)	$F_{\text{probe}} + 0,25 \pm 0,2$ (**)	$0,8 \pm 0,2$		$0,8 \pm 0,2$		$0,8 \pm 0,2$	
Mechanical repeatability error (2.77 $\sigma$ )	[ $\mu\text{m}$ ]	$\leq 0,5$ (*)	$\leq 0,5$ (*)		$\leq 0,5$ (*)		$\leq 0,3$		$\leq 0,3$		$\leq 0,3$	
Maximum sensitivity error		$\pm 2\%$	$\pm 2\%$		$\pm 2\%$		$\pm 0,5\%$		$\pm 0,5\%$		$\pm 0,5\%$	
Linearity error	[ $\mu\text{m}$ ]	$\leq 5$ (in 1000 $\mu\text{m}$ )	$\leq 10$		$\leq 10$		$\leq 3$		$\leq 3$		$\leq 3$	
Thermal drift	[ $\mu\text{m}/^{\circ}\text{C}$ ]	$\leq 0,2$	$\leq 0,2$		$\leq 0,2$		$\leq 0,25$		$\leq 0,25$		$\leq 0,25$	
Protection degree		-	-		-		IP65		IP65		IP65	
Operating and storage temperature	[ $^{\circ}\text{C}$ ]	-10 to 65	-10 to 65		-10 to 65		-10 to 65		-10 to 65		-10 to 65	
Weight	[g]	80   82	80		82		80		80		80	
Sensitivity	[mV/V/mm]	-	-		-		$230 \pm 0,5\%$		$73,75 \pm 0,5\%$		$73,75 \pm 0,5\%$	
Calibration spec.	LVDT	-	-		-		3,5355 Vrms @ 7,5 kHz with load 1 M $\Omega$ /360 pF		10 Vpp @ 7,5 kHz with load 2 k $\Omega$ $\pm 0,1\%$		3 Vrms @ 13 kHz with load 2 k $\Omega$ $\pm 0,1\%$	
<b>ADJUSTABLE FEATURES</b>												
Working range	[ $\mu\text{m}$ ]	1200 (0/+200) to 900	1800 (0/+200) to 1350	1800 (0/+200) to 1575	1800 (0/+200) to 1350	2100 (0/+200) to 1575	1000		1000		1000	
Order code		B2927364100   B2927364130	B2927364101		B2927364131		B3427364150		B3427364005		B3427364100	

(\*) With standard Marposs Red Crown F10 pencil probe. The performance is recorded at the suggested zero.

(\*\*) F probe = Force of the measuring gauge.

(\*\*\*) As the mechanical zero device is not available to identify any fixed positioning inside the measuring range, the "suggested zero position" (at 450  $\mu\text{m}$  from the front stop with arm ratio 1,5) is the one with minimum measuring errors.

Displacement Sensors



Bore Gauges



Forks and Ring Gauges



Bench Gauges



Indicators and Electronic Display Units



Interface Boxes for Data Acquisition



Software



# AMA TS TRANSMISSION SHOULDER DEVICE

## ACCESSORIES

Contact for **TS12** (ar 1:1)



**Order Code**  
B3292736401

Contact for **TS12** (ar 1:1)



R	Order Code
5	B3292736405
20	B3292736410

Contact for **TS12E** (ar 1:1)



**Order Code**  
B3292736430

Armset for grooves for **TS21** (ar 1:1.75)



**Order Code**  
B3292736415

Interface block for Quick set support bracket



**Order Code**  
B2927364150

Side cover



**Order Code**  
B1027364145

Displacement  
Sensors



Bore  
Gauges



Forks and  
Ring Gauges



Bench  
Gauges



Indicators and  
Electronic  
Display Units



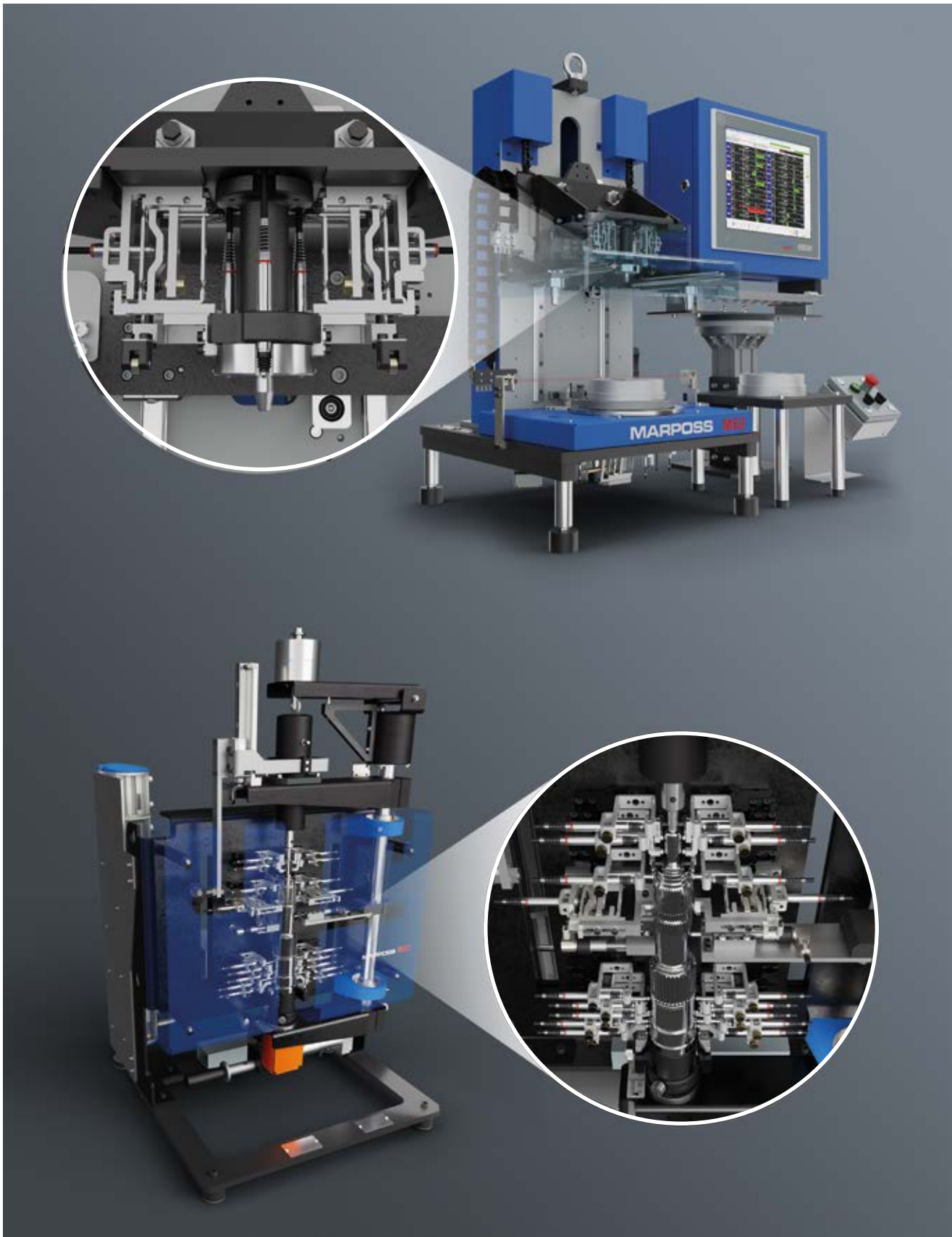
Interface  
Boxes for Data  
Acquisition



Software



**Application** examples



Displacement  
Sensors



Bore  
Gauges



Forks and  
Ring Gauges



Bench  
Gauges



Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



Software



# THE PRODUCT LINE

## HOW TO DESIGN YOUR OWN APPLICATION

Displacement  
Sensors



Bore  
Gauges



Forks and  
Ring Gauges



Bench  
Gauges



Indicators and  
Electronic  
Display Units



Interface  
Boxes for Data  
Acquisition



Software

