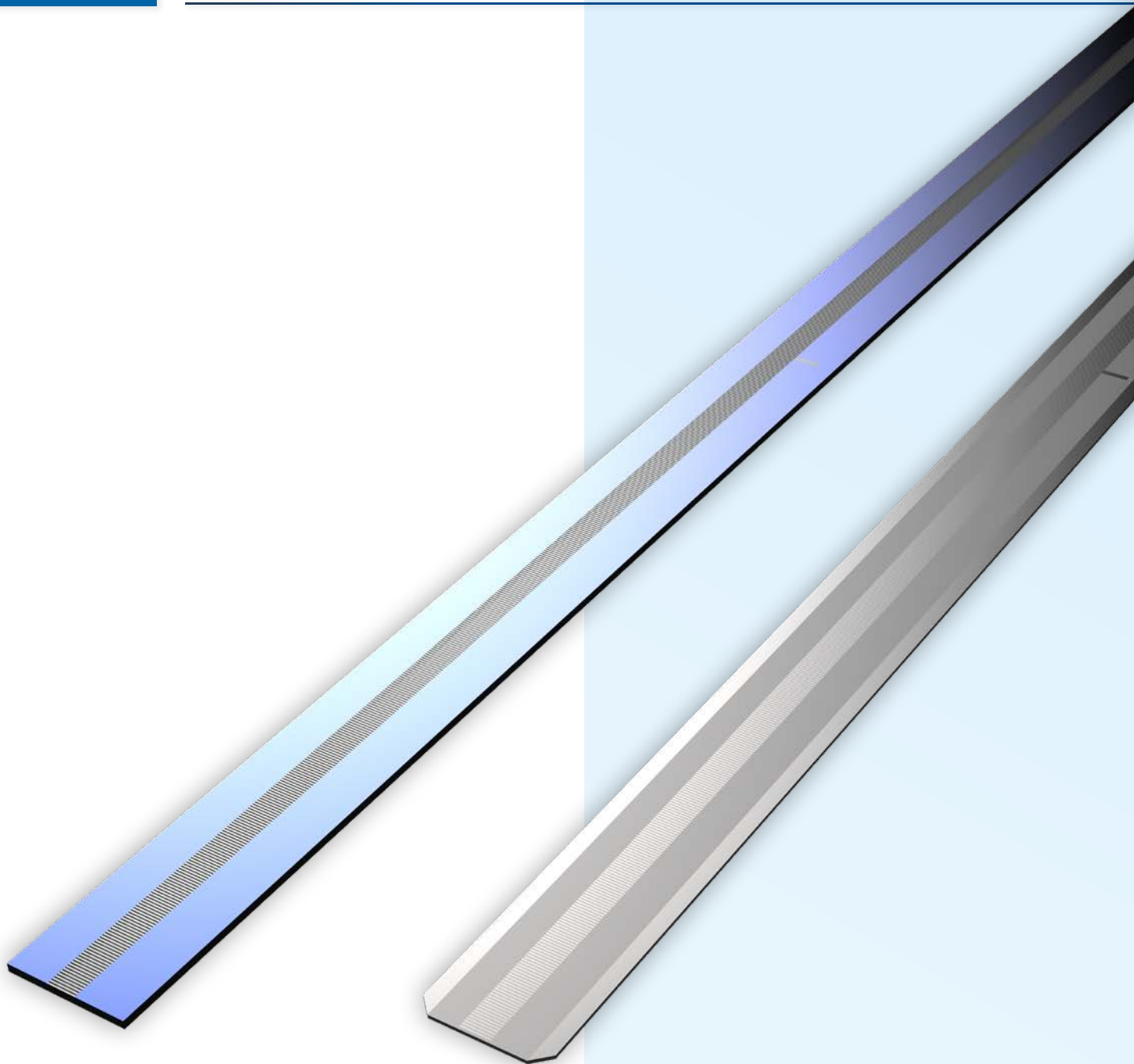


NUMERIK
JENA



 **MI** Scale Tape

Linear incremental Scale Tape for LIKgo & LIKselect



Original Operating Instructions

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1. Overview

The scale tape MI for the measuring systems LIKgo and LIKselect from NUMERIK JENA has regular structures for a 20 µm grating period.

As a standard, stainless steel or float glass is offered as the carrier material for this graduation. For long measuring lengths, a stainless steel strip serves as the base.

The position information is obtained by optical detection of the individual increments. Since a reference is required to determine positions, the scale tape has an additional track with a reference mark.

The following materials are offered as standard:

- Stainless steel
- Float glass

As constructive versions there is a choice between:

- a measuring standard with nameplate
- a measuring standard without nameplate

Further criteria for the selection of the suitable measuring scale are:

- the fastening type
- the position of the reference mark
- the available standard lengths

2. Material Properties

In addition to the standard variants of stainless steel and float glass of the measuring standard MI from NUMERIK JENA, other materials are available. If you are planning projects with special material requirements - please contact us.

2.1 Stainless steel

The SINGLEFLEX measuring standard is a single stainless steel tape on which the increments and one or more reference marks are applied. This stainless steel tape is provided with a double-sided adhesive tape and can simply be stuck onto the machine bed. It is also available without adhesive tape.

The properties are listed below:

Features - Stainless steel band (straightened and polished)		
Description	Sandvik 7C27Mo2	EN 1.4034
Mechanical Properties	Density ρ (at 25 °C)	7.7 g/cm ³
	Zugfestigkeit	1730 N/mm ²
Thermal Properties	Coefficient of Mean Linear Thermal Expansion α	$10.6 \times 10^{-6} \text{ K}^{-1}$
	Specific Heat Capacity c_p (20 - 100 °C)	$460 \text{ J} \times (\text{kg} \times \text{K})^{-1}$
	Specific Thermal Conductivity λ (20 °C)	$24 \text{ W} \times (\text{m} \times \text{K})^{-1}$
Geometric Properties	Roughness	10 nm
	Width	8.0 (± 0.03) mm
	Thickness	0.254 (± 0.004) mm
	Flatness	< 0.3 % of belt width
	Straightness	limited to 1.0 mm/m
	Ring Curvature	< 10 mm / 300 mm

Chart 1

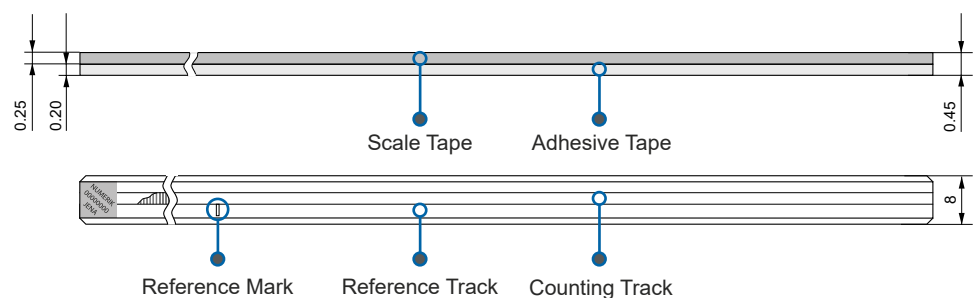


Image 1

2.2 Float glass

The standard glass scales from NUMERIK JENA are made of float glass.

See the properties listed below:

Properties - Float glass		
Mechanical Properties	Density ρ (at 25 °C)	2.477 g/cm ³
	Young's Modulus E	74 kN/mm ²
	Poisson's Ratio μ	0.215
Thermal Properties	Coefficient of Mean Linear Thermal Expansion α (20 °C; 300 °C)	$8.8 \times 10^{-6} \text{ K}^{-1}$
	Specific Heat Capacity c_p (20 °C; 100 °C)	0.84 KJ x (kg x K) ⁻¹
	Transformation Point	615 °C (± 10 °C)
Optical Properties	Refractive Index n_d (588 nm)	1.508
Chemical Properties	Main Constituents	SiO ₂ (69 - 74%), CaO (5 - 12%), NaO (12 - 16%), MgO (0 - 6%), AlO (0 - 3%)

Chart 2

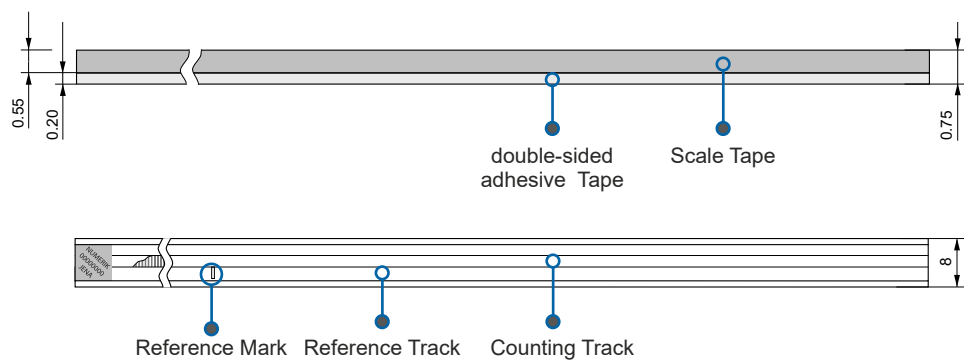


Image 2

2.3 Adhesive Tape

The application of the measuring standard to the substrate is usually done by gluing. The thickness of the adhesive tape must be taken into account. For product versions that are used for vacuum applications, the double-sided adhesive tape is not applied.

Properties - temperature-resistant double-sided adhesive tape		
Base material	PET Film	
Color	transparent	
Thickness	0.2 mm	
Adhesive mass	Modified acrylate	
Tensile strength	20 N/cm	
Temperature resistance	short term	200 °C
	long term	100 °C
Adhesion to	Stainless steel	14 N/cm
	Aluminum	12.6 N/cm
	PVC	12.8 N/cm

Chart 3



The procedure for applying the scale tape with double-sided adhesive tape is explained in detail in the product data sheet.

3. Technical Properties

The accuracy of the measuring standard influences the encoder-specific position deviations. The influencing variables here are:

- the homogeneity and period definition of the graduation,
- the alignment of the graduation on its carrier

The accuracy of the measuring standard is indicated by the uncompensated maximum value of the baseline error. This accuracy is ascertained under ideal conditions via measurement of the position errors with a serially produced scanning head. The distance between the measuring points is equivalent to the integer multiple of the signal period. As a result, interpolation errors have no effect.

Properties	Baseline Error		Measuring length (ML)	Grating period
	Accuracy grade	for interval		
MI5 Stainless Steel	3 $\mu\text{m}/\text{m}$	$\pm 750 \text{ nm}$ (50 mm)	max. 2490 mm (ML > 2490 mm on request)	20 μm
	5 $\mu\text{m}/\text{m}$			
MI6 Float glass	1 $\mu\text{m}/\text{m}$	$\pm 275 \text{ nm}$ (10 mm)	maximal 90 mm (ML > 90 mm on request)	20 μm

Chart 4

The accuracy grade a defines the upper limit of the baseline error within any section of up to one meter in length. For special encoders, an additional baseline error is stated for defined intervals of the measuring standard.

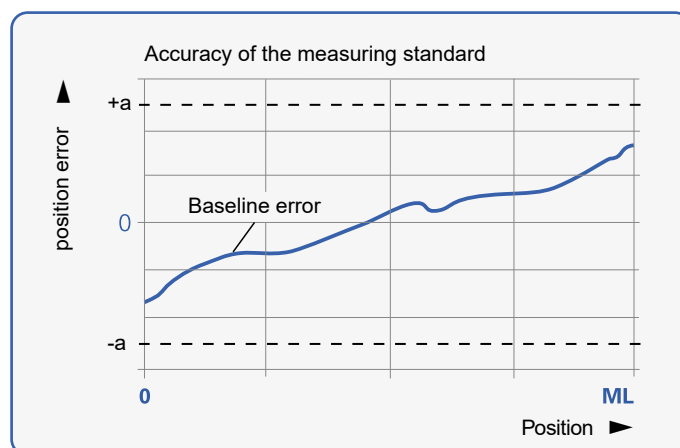


Image 3

4. Design Versions/Variants

The measuring standards are available in different constructive designs, in particular with regard to the total length. A nameplate is applied to standard lengths. For applications with very limited dimensions, the version with minimized total length can be selected - the nameplate is then eliminated. The measuring length (ML) corresponds to the total length of the measuring scale without considering the nameplate.

4.1 Measuring Standard, Standard Length

(ML + 15 mm)

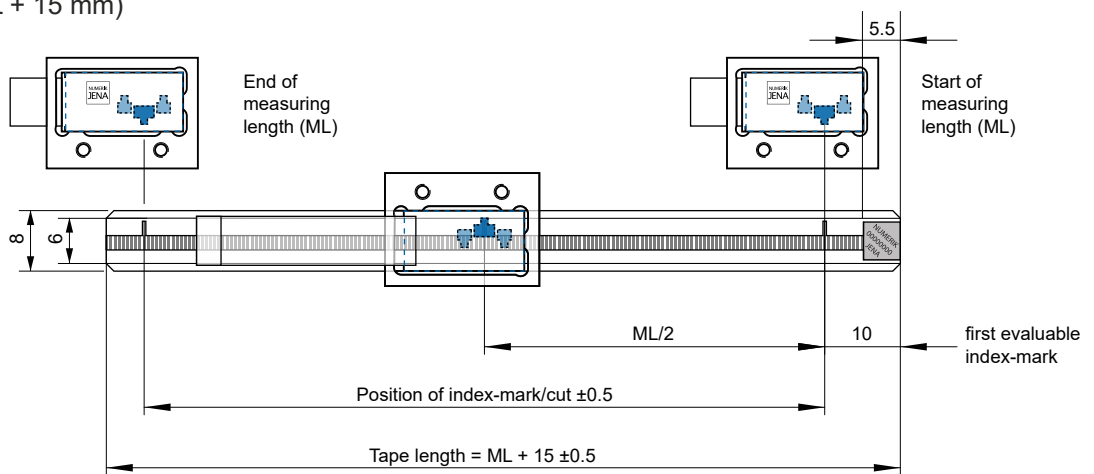


Image 4

4.2 Measuring Standard, Minimized Total Length

(ML + 10 mm), without nameplate

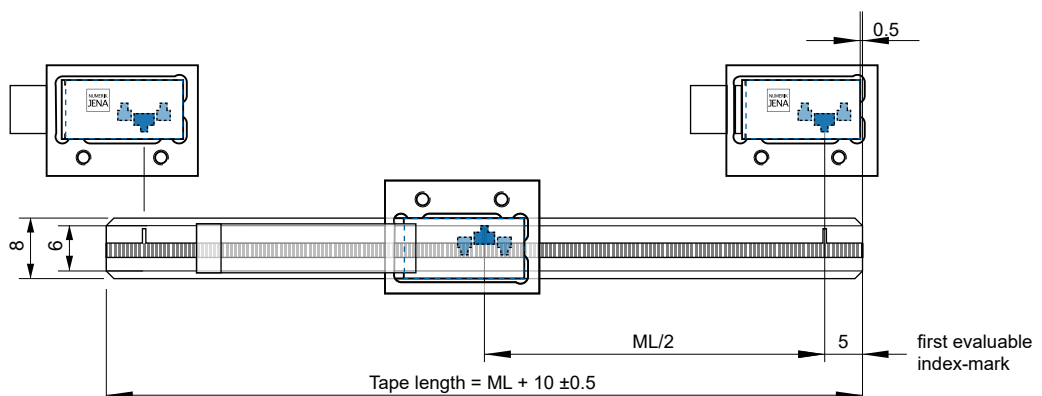


Image 5



For more information on our linear measuring systems, please refer to the respective data sheets and our website at www.numerikjena.de.

4.3 *Position of the reference mark*

NUMERIK JENA offers different variants for the position of the reference mark on the measuring scale. As standard, the reference mark is located in the middle of the measuring length. Depending on the application, versions without a reference mark or measuring standards with a customer-specific position can also be realized. Please contact us if you have special requirements.

Depending on the chosen design, all standard lengths are available. For steel scale tapes, measuring lengths up to 2480 mm can be produced with a central reference mark. For customer-specific reference marks or scale tapes without reference marks, the maximum standard measuring length that can be supplied depends on the selection of the constructive design. Scale tapes up to 1240 mm with no or a customer-specific reference mark count as standard measuring lengths - higher dimensions can be provided on request. For glass scales, the maximum measuring length for versions without a nameplate is 45 mm, for the selection with a nameplate up to 40 mm within the standard.

4.4 *Standard Measuring Lengths*

The MI measuring standards are offered in standard lengths and widths. If a different length is required for a special application, NUMERIK JENA will shorten the next higher standard length to the required dimension (please note additional information on measuring lengths under 4.3). If other dimensions are required, please contact us.

5. Cleaning

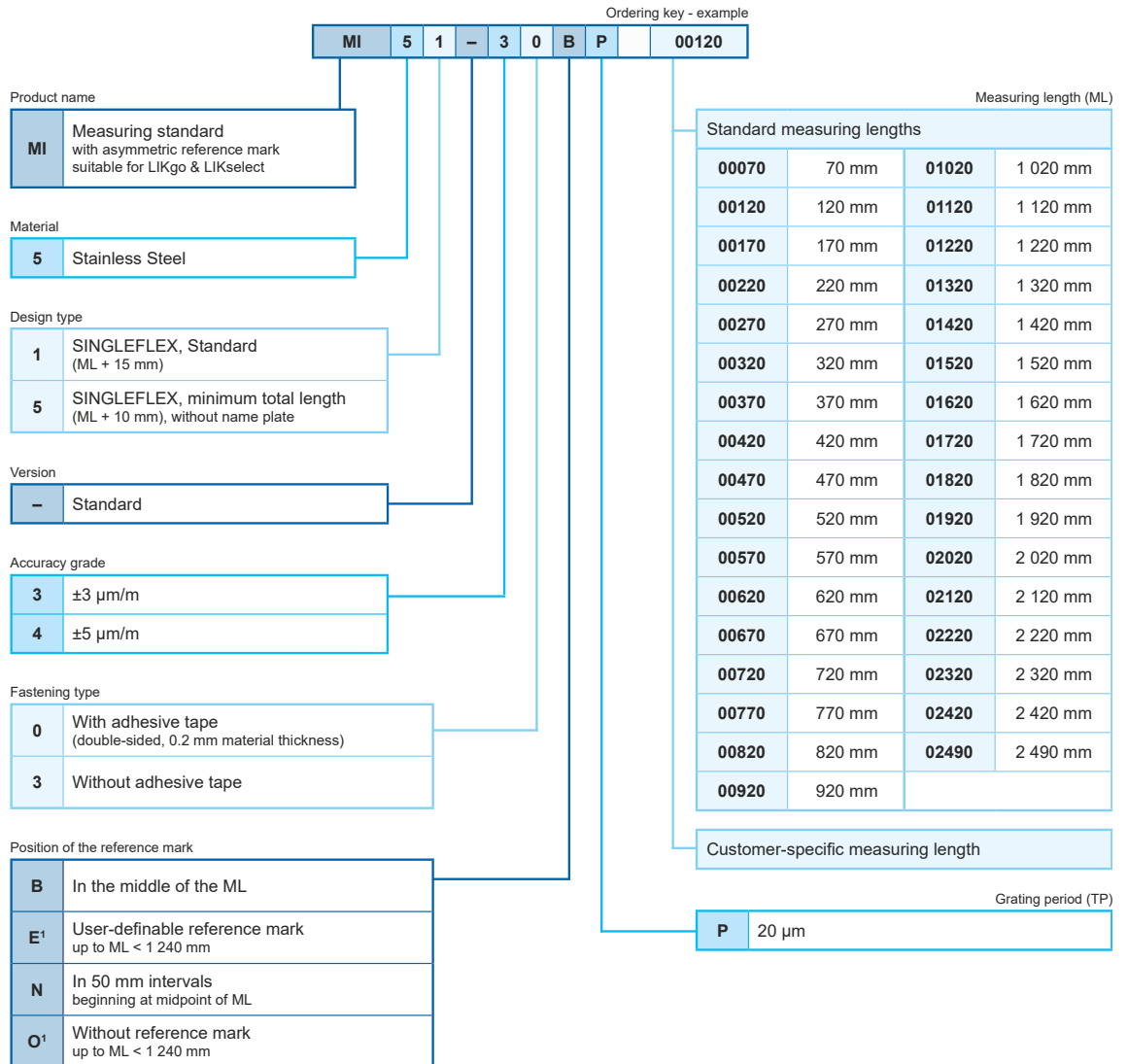
- Depending on the installation position and the ambient conditions, occasional cleaning of the scale surface and the sensor surface of the measuring head (scanning window for counting and reference track) may be necessary.
- When cleaning the components, make sure that deposited particles do not scratch the scanning sensors and the measuring standard!
- Remove rough contamination preferably with a soft brush or with oil-free compressed air.
- Clean with absorbent cloth or a soft, lint-free cloth, if necessary with the help of a solvent (e.g. acetone or alcohol).
- Avoid contact between solvents and the adhesive tape! This can cause the adhesive layer to dissolve and thus reduce the adhesive strength or cause the tape to detach completely.



ATTENTION: Acetone and alcohol are flammable liquids!

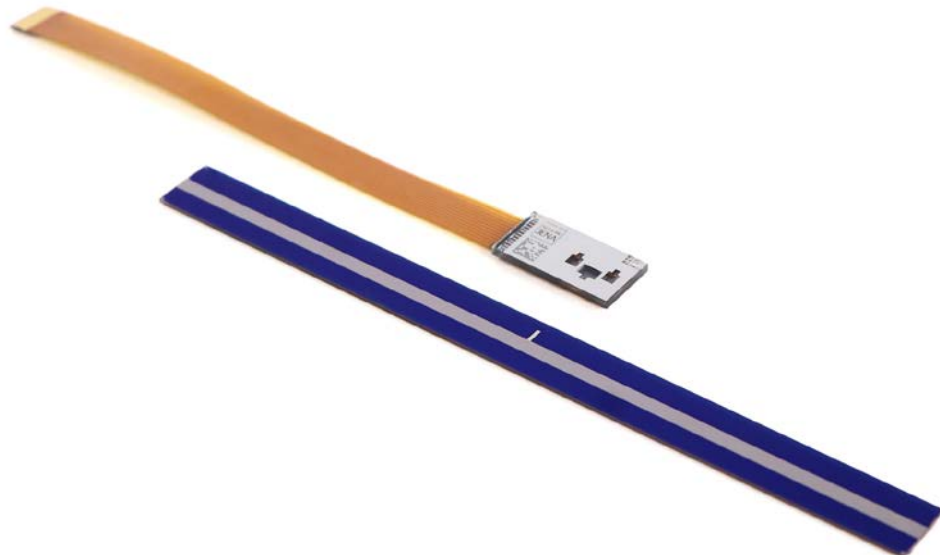
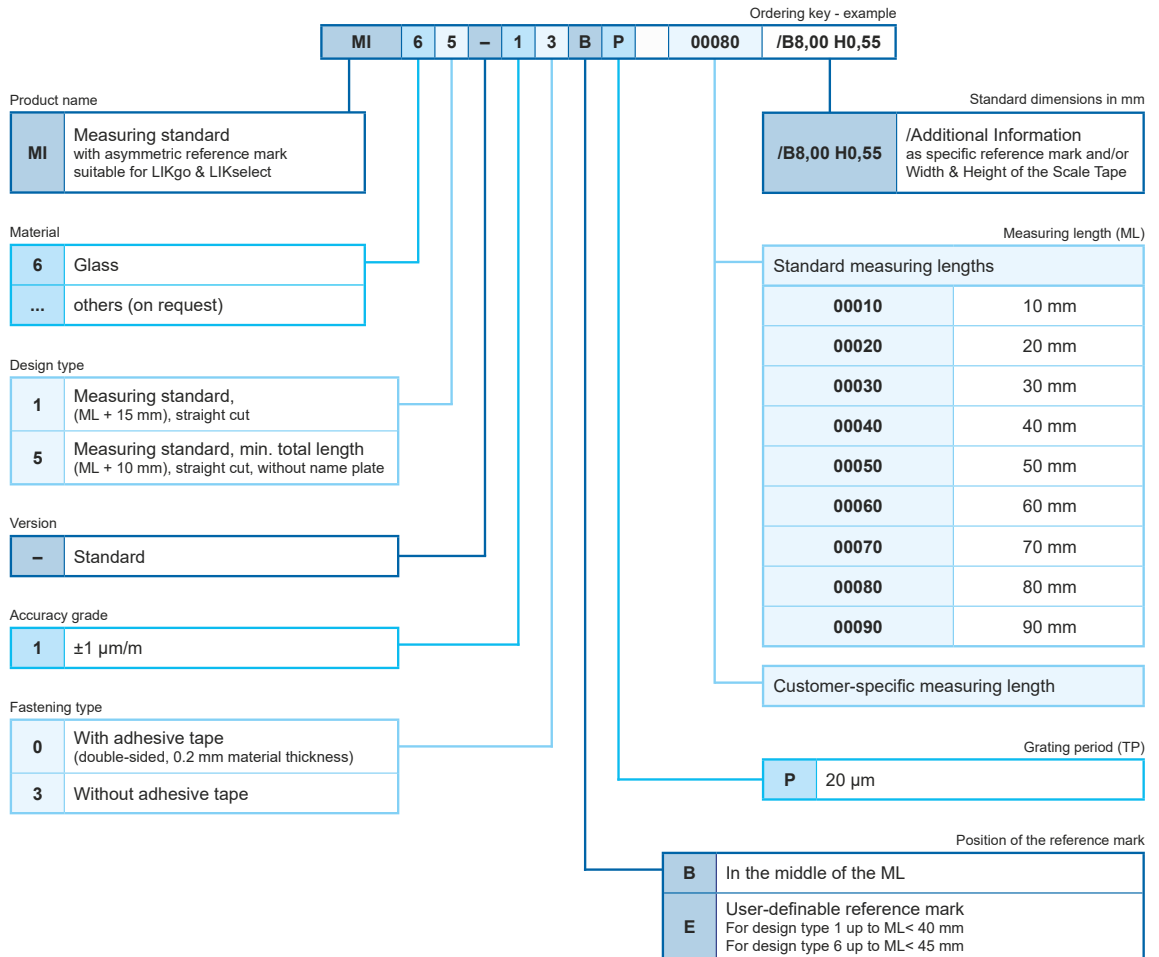
6. Ordering Key

6.2 Ordering Key - MI Scale Tape (Stainless Steel)

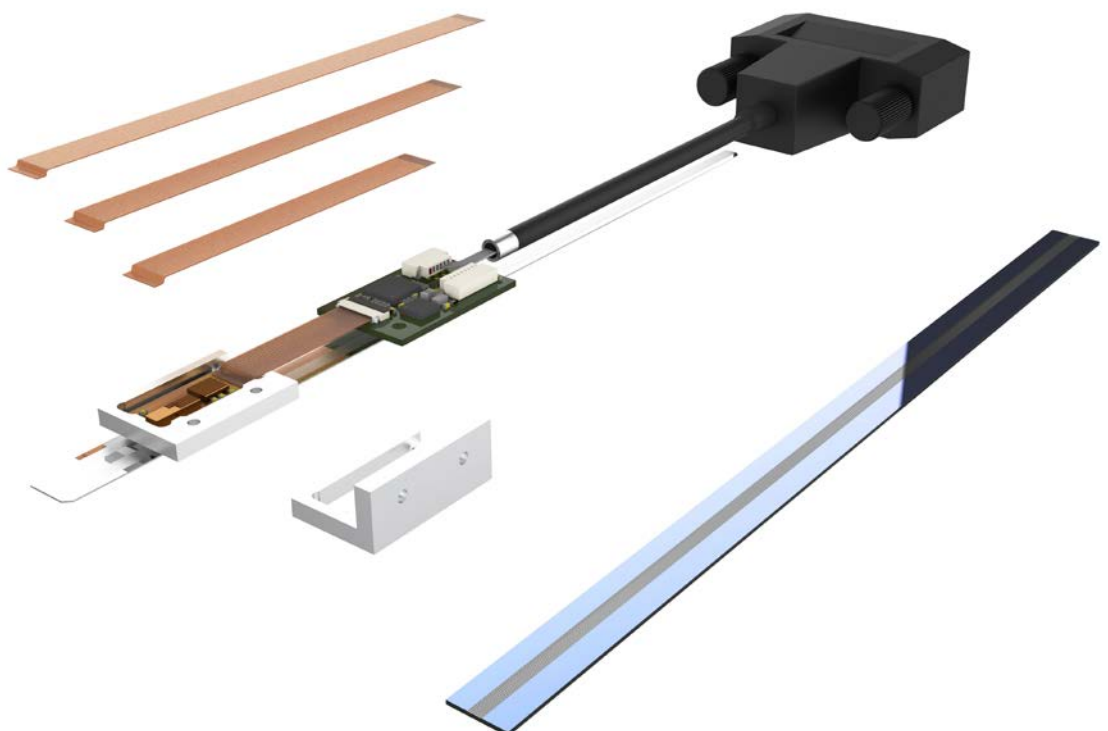


¹ For measuring lengths > 1 240 mm on request

6.2 Ordering Key - MI Glass Scale (Float glass)



Operating Instructions MI





SIMPLY PRECISE

NUMERIK JENA GmbH

Im Semmicht 4
07751 Jena
Germany

Tel.: +49 3641 4728-0
E-Mail: info@numerikjena.de
www.numerikjena.de

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