Incremental
Magnetic Scales

ACCURACY TO ±5 µm/m

UP TO 150 m LENGTH

DISTANCE CODED REFERENCE MARK

The robust MS incremental magnetic scales consist of a stainless steel carrier and an elastomer-bonded ferrite. The elasto-ferrite layer is magnetised with 2 mm, 2.032 mm or 5 mm long alternating magnetic poles that form an incremental magnetic pattern.
For applications requiring higher accuracy, HMS solid magnetic scales are available. Their solid stainless steel construction provides improved mechanical stability, and the welded protective cover offers excellent resistance to harsh environments.



Features and benefits

- Accuracy class to ±5 µm/m
- Customer-selectable reference mark position
- Excellent resistance to dirt, dust and humidity
- Optional protective cover foil
- Flexible installation options
- Available in lengths up to 150 m

SMT PICK AND PLACE | PRINTING TECHNOLOGY | LINEAR MOTOR | INDUSTRIAL AUTOMATION | ASSEMBLY LINES

General information

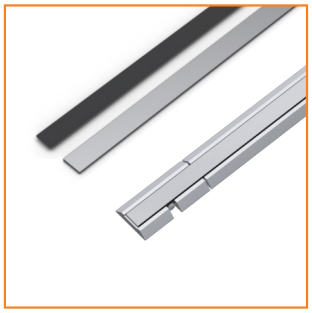
RLS incremental magnetic scales are designed for use in non-contact incremental encoder systems. The scales consist of a magnetised elastomer-bonded ferrite layer with alternating magnetic poles, forming an incremental magnetic pattern. Movement of the scale relative to the readhead is converted into electrical signals used to determine position, speed, and direction of movement.

Various incremental magnetic scale types are available to meet application-specific requirements. The main incremental magnetic scale families are MS flexible magnetic scales and HMS solid magnetic scales.

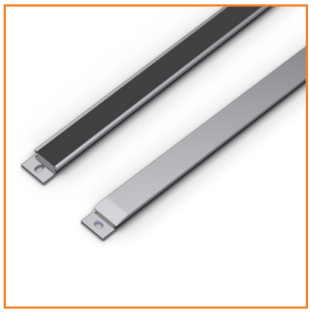
MS flexible incremental magnetic scales are available with different pole lengths, accuracy classes, and optional reference marks, depending on the scale type.

HMS solid incremental magnetic scales are designed for higher accuracy and improved thermal stability. The magnetic layer is bonded to a solid stainless steel substrate. HMS scales are available with higher accuracy classes and, for harsh industrial environments, with a welded stainless steel cover foil that protects the scale from contamination and mechanical damage.

Incremental scale variants



MS flexible magnetic scales (cover foil and TRS system depending on scale type)



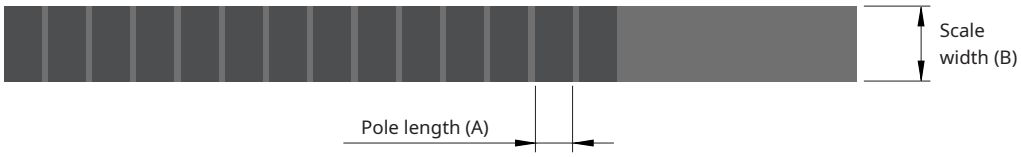
HMS solid magnetic scale (exposed or fully welded)

For detailed readheads documentation and 3D models, refer to:

- **HiLin**
- **LM10**
- **LM13**
- **LM15**
- **RLB**
- **RLC2IA**
- **RLC2IC**
- **RLC2HD**
- **RLM**

All documents are available in the **RLS Media Center**.

Selection guide



Scale	A [mm]	B [mm]	Accuracy [µm/m]	Compatibility with readheads					
				LM10/ LM13	LM15	RLB2/ RLC2HD	RLC2IA/ RLC2IC	RLM2	HL
MS05	2	5	±10 / ±20 / ±40	-	-	No Ri	Ri+DCRM	Ri+DCRM	-
MS07	2.032	5	±40	-	-	-	-	Ri*	-
MS10	2	10	±10 / ±20 / ±40	Ri+DCRM	-	-	-	-	-
MS12	2.032	10	±40	Ri*	-	-	-	-	-
MS15	5	10	±100	-	Ri+DCRM	-	-	-	-
MS19	2	15	±10	-	-	-	-	-	Ri
MS20	2.032	15	±10	-	-	-	-	-	Ri*
HMS1	2, 2.032	18	±5	-	-	-	-	-	Ri
HMS2	2, 2.032	18	±5	-	-	-	-	-	Ri*

* Compatible with DPI resolutions only.

Ri	-	Unique reference mark available
No Ri	-	No reference mark option, only incremental track available
Ri+DCRM	-	Unique and distance-coded reference mark available

Storage and handling

Storage temperature

MS05/07/10/12/15
–40 °C to +60 °C

MS19/20 and HMS
–40 °C to +75 °C

Operating temperature

MS05/07/10/12/15 (flat surface)
–40 °C to +100 °C

MS05/07/10/12/15 (curved surface)
–40 °C to +80°C

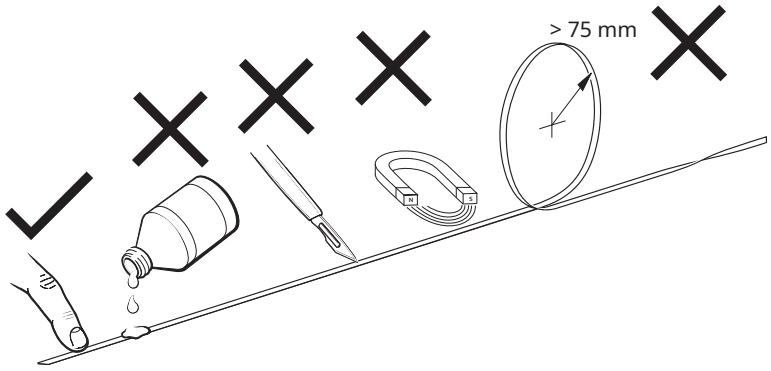
MS19/20 and HMS
–40 °C to +75°C

Humidity

All MS scales
85% non-condensing

HMS
IP67 with a cover foil

The storage temperature of the MS scale is lower than the specified operating temperature. This limitation has been defined because the scale may sustain damage within approximately two months if it remains rolled while exposed to elevated temperatures. Once the scale has been straightened and securely mounted, it may be safely exposed to the specified operating temperature range.



The minimum storage bending radius of incremental magnetic scale is 75 mm.

It is strongly recommended that the scale is factory cut at RLS otherwise the product warranty does not apply.

The magnetic scale should not be exposed to magnetic field densities higher than 25 mT on its surface, as this may damage the scale.

Chemical resistance

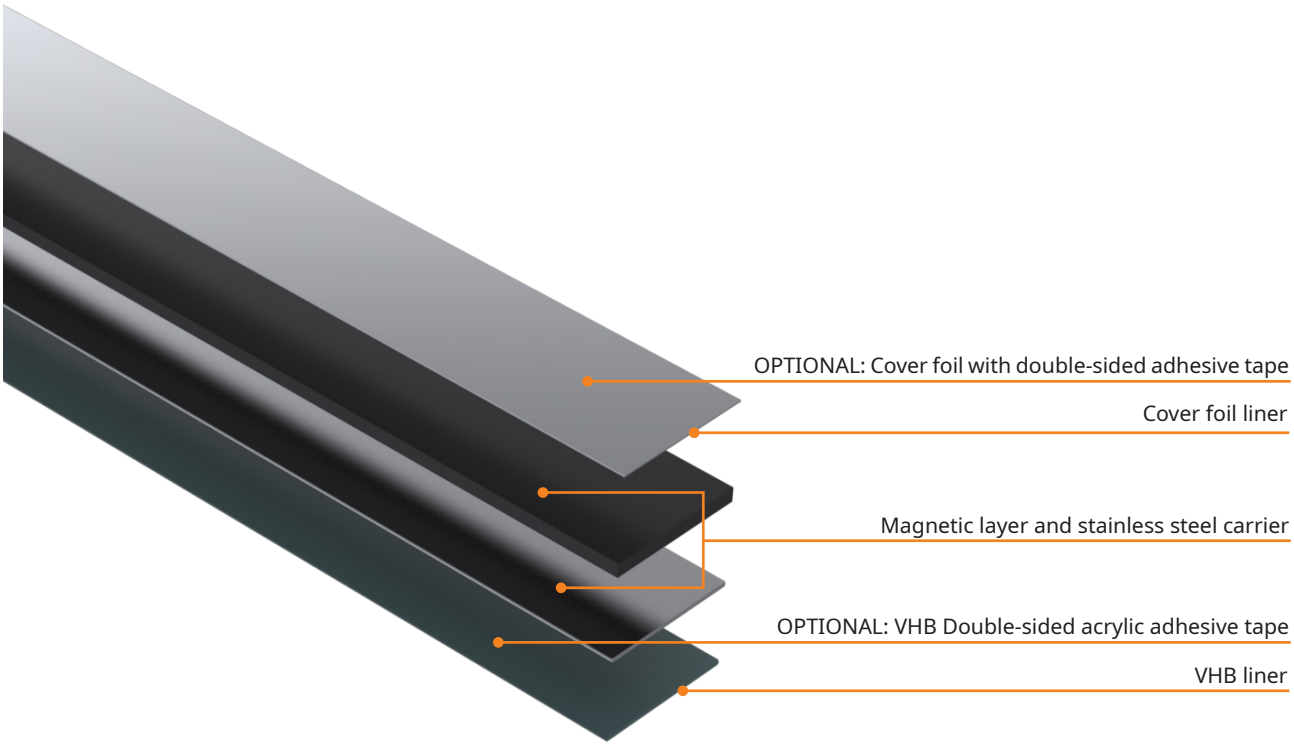
The use of alcohol for cleaning is considered safe, but the scale must not be immersed in alcohol. Furthermore, the scale surface print may disappear if the scale is not carefully cleaned.

HMS with a welded cover foil completely encapsulates the scale and protects it from aggressive industrial chemicals.

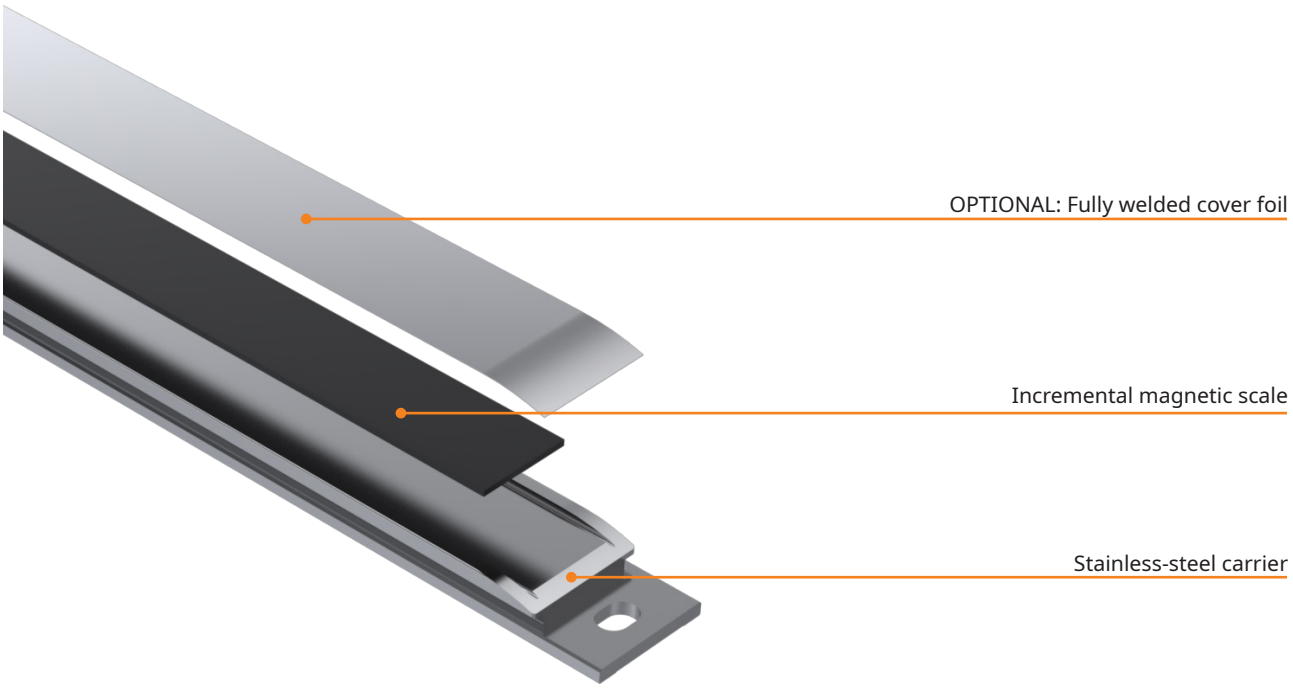
For more information on chemical resistance **contact RLS**.

Magnetic scale design

Structure of MS incremental magnetic scale



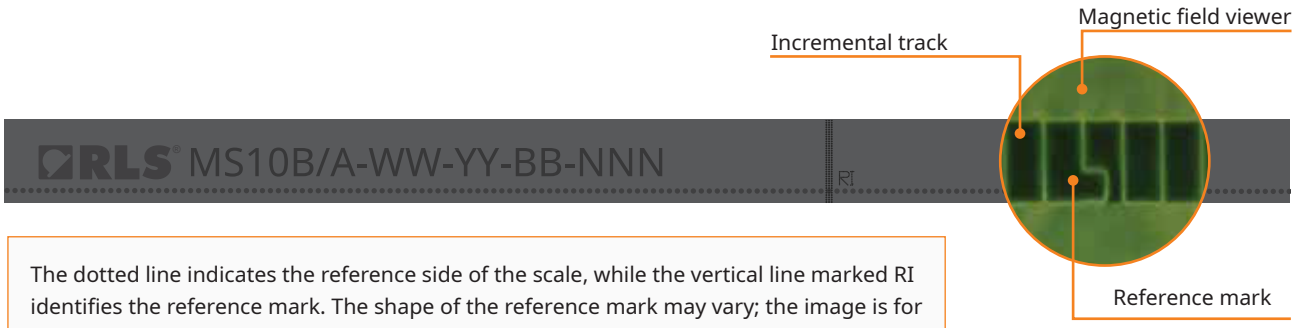
Structure of HMS incremental magnetic scale on a solid substrate



Scale markings

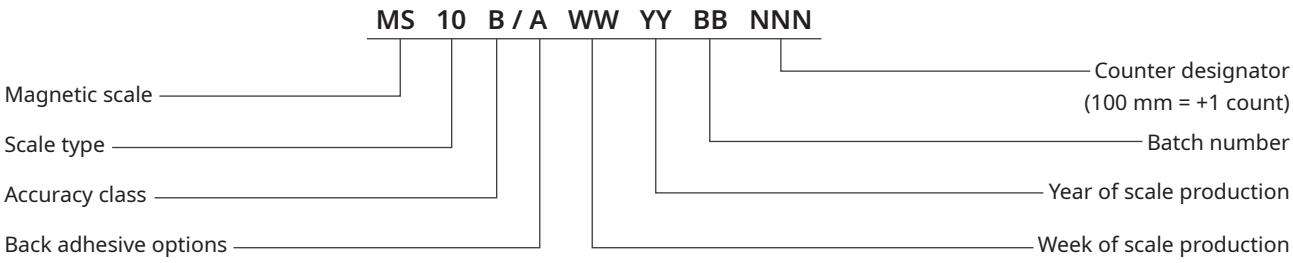
MS

The orientation of the magnetised reference mark and the incremental track is always the same, relative to the scale print as shown in the figure below.



The dotted line indicates the reference side of the scale, while the vertical line marked RI identifies the reference mark. The shape of the reference mark may vary; the image is for representation purposes only.

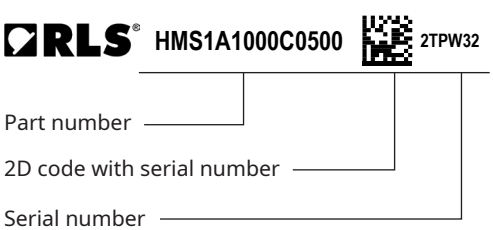
Scale surface print appears every 100 mm and contains the RLS logo and and the designator described below. If the scale is shorter than 100 mm it does not contain the print but just the dotted line with which the reference side of the scale can be determined.



HMS

The orientation of the magnetised reference mark and the incremental track is always the same, relative to the scale marking as shown in the figure below.



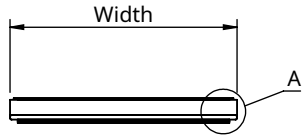


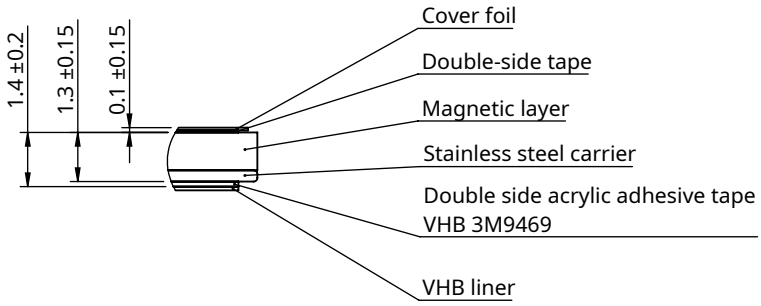
The print/engraving of the scale surface appears once per entire exposed/fully welded length of the scale. It includes the RLS logo, part number, serial number and QR code that contains serial number information.

Dimensions

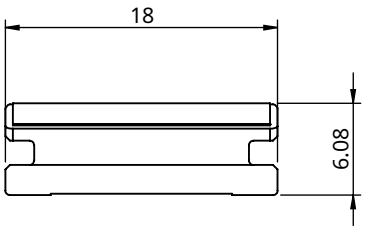
Dimensions and tolerances are in mm.

MS scale





HMS scale



Thickness

Dimensions are in mm.

Magnetic scale		MS05/07/10/12/15	MS19/20	HMS
Carrier		0.3	0.3	-
Double sided acrylic adhesive tape VHB 3M9469		0.13	0.13	-
VHB liner thicknes		0.1	0.1	-
Cover foil		0.076	0.076	-
Double-sided tape		0.05	0.05	-
Magnetic scale	With adhesive tape (without protective liner)	1.43 ±0.2	1.43 ±0.2	6.08 ±0.03
	Without adhesive tape	1.3 ±0.15	-	

Width

Dimensions are in mm.

Magnetic scale	MS05/07	MS10/12/15	MS19/20	HMS
Width	5 ±0.1	10 ±0.1	15 ±0.1	18 ±0.05
Cover foil width	4.8 (CF05)	7.6 (CF08) 9.5 (CF10)	14.5 (CF15)	-

Technical specifications

MS05/07/10/12/15

System data

Pole length	MS05/10: 2 mm MS07/12: 2.032 mm MS15: 5 mm
Reference mark	Unique / multiple / DCRM. Refer to **Part numbering** for more information.
Reference mark position tolerance (from edge of scale)	±0.5 mm ±accuracy class [µm/m] × 10^{-3} × reference mark position [m]
Scale accuracy*	Class A: ±20 µm/m Class B: ±40 µm/m Class C: ±100 µm/m Class D: ±10 µm/m
Maximum speed	Refer to **RLS Magnetic Scale Calculator**

* For more information about the accuracy please Refer to the MST01 technical article at **RLS Media center**.

Mechanical data

Material	Carrier	1.4310 stainless steel
	Magnetic scale	NBR elastoferrite
Mass		MS05/07: 31g/m MS10/12/15: 62 g/m
Maximum length		Class A, B, C: 50 m (up to 150 m upon request with longer lead time**) Class D: 20 m
Length tolerance		±0.5 mm ±acuracy class [µm/m] × 10-3 × scale length [m]
Expansion coefficient (carrier)		~17 × 10^{-6} m/mK
Minimum bending radius		75 mm

** Not applicable for MS05 and MS07.

Environmental data

Temperature	Operating	Flat surface: –40 °C to +100 °C	Curved surface:–40 °C to +80 °C
	Storage	–40 °C to +60 °C	

The storage temperature of the MS scale is lower than the specified operating temperature. This limitation has been defined because the scale may sustain damage within approximately two months if it remains rolled while exposed to elevated temperatures. Once the scale has been straightened and securely mounted, it may be safely exposed to the specified operating temperature range.

MS19/20

System data

Pole length	MS19: 2 mm MS20: 2.032 mm
Reference mark	Unique / periodic. Refer to **Part numbering**
Reference mark position tolerance (from edge of scale)	±0.5 mm ±accuracy class [µm/m] × 10^{-3} × reference mark position [m]
Scale accuracy*	±10 µm/m (at 20 °C)
Short length (30 mm) accuracy (at 20 °C)	±5 µm
Maximum speed	Refer to **RLS Magnetic Scale Calculator**

* For more information about the accuracy refer to the MST01 technical article at **RLS Media center**.

Mechanical data

Material	Carrier	1.4310 stainless steel
	Magnetic scale	NBR elastoferrite
Mass		64 g/m
Maximum length		20 m
Length tolerance		±0.5 mm ±acuracy class [µm/m] × 10^{-3} × scale length [m]
Expansion coefficient (carrier)		~17 × 10^{-6} m/mK
Minimum bending radius		75 mm

Environmental data

Operating and storage temperature	–40 °C to +75 °C

HMS

System data

Pole length	2 mm, 2.032 mm
Reference mark	Unique / periodic / DCRM. Refer to **Part numbering**
Reference mark position tolerance (from edge of scale)	±0.5 mm
Scale accuracy*	±5 µm/m (at 20°C)
Short length (30 mm) accuracy (at 20 °C)	±3 µm
Maximum speed	Refer to **Maximum speed table for HMS**

* For more information about the accuracy refer to the MST01 technical article at **RLS Media center**.

Mechanical data

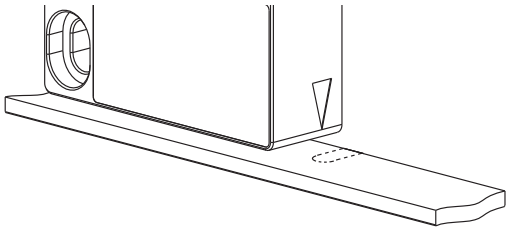
Material	Carrier	1.4016 stainless steel
	Magnetic scale	NBR elastoferrite
Mass		700 g/m
Maximum length		2.5 m
Length tolerance		30 mm < SL < 120 mm: ±0.3 mm 120 mm < SL < 400 mm: ±0.5 mm 400 mm < SL < 1000 mm: ±0.8 mm 1000 mm < SL < 2000 mm: ±1.2 mm 2000 mm < SL < 4000 mm: ±2 mm
Expansion coefficient (carrier)		10.4×10^{-6} m/mK

Environmental data

Operating and storage temperature	–40 °C to +75 °C

Reference mark options

The position of the magnetised reference mark is preset at the factory and cannot be changed.



Unique reference mark

The readhead must be ordered with reference mark option **A** (refer to corresponding readhead data sheet). The magnetic scale must be ordered with reference mark (refer to **Part numbering**). If required, the cover foil can be installed over the reference mark. Magnetised reference mark will have a visible marking.

Multiple reference marks

The readhead must be ordered with reference mark option **A** (refer to corresponding readhead data sheet). The magnetic scale must be ordered with reference mark option **P** (refer to **Part numbering**). Multiple reference marks are magnetised, factory predefined and spaced every 50, 100, or 200 mm on a 20 m long scale. For custom options please **contact RLS**.

Distance coded reference marks (DCRM)

The readhead must be ordered with reference mark option **A** (refer to corresponding readhead data sheet). The magnetic scale must be ordered with reference mark option **D** and a basic increment value (**K**). Refer to **Part numbering**.

The distance coded reference mark option provides multiple magnetised reference marks that are individually spaced according to a specific mathematical algorithm. The absolute position is calculated after traversing 2 succesive reference marks. Maximum length and minimum traverse depend on basic spacing between the reference marks (basic increment value K), as shown below.

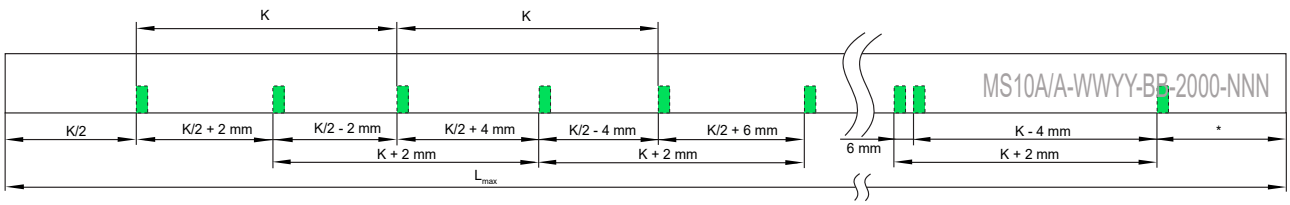
The basic increment K (in mm) is chosen at the point of order and must be divisible by 2 × P with no remainder.
Maximum codable length:

$$L_{max} = K\left(\frac{K}{2P} - 1\right) - 2P$$

L_{max} - Maximum codable length (in mm)
K - Basic increment (in mm)
P - Pole length (in mm)

The minimum distance that needs to be traversed to determine the absolute position equals **K - 2P.**

The distribution of the reference marks is shown in the figure below. DCRMs are produced by additional magnetisation of the magnetic scale.



* Depends on magnetic scale length.

How the absolute position is evaluated

The absolute position of the first traversed reference mark is calculated by the following formula:

$$RI1 = \left[\frac{1}{P} \times abs(2 \times \Delta RI - K) - sgn(2 \times \Delta RI - K) - 1\right] \times \frac{K}{2} + [sgn(2 \times \Delta RI - K) - sgn(D)] \times \frac{abs(\Delta RI)}{2}$$

The example of DCRM Calculation is below.

Variables

RI1 - Absolute position of first traversed reference mark (in mm)
ΔRI - Distance between two successively traversed reference marks (in mm)
K - Basic increment between two fixed reference marks (in mm)
D - Direction of movement (+1 or –1)

Operators

abs - Absolute value
sgn - Sign function (+1 or –1)

Timing of reference mark capturing

The minimum distance between 2 successive reference marks is eaqual to 3 × P. Subsequent electronics must be able to detect the position of 2 successive reference marks under the maximum speed condition. The minimum time for 2 successive reference marks to appear is given by the formula:

$$T_{Rimin} = \frac{3P}{V_{max}}$$

T_{Rimin} - Minimum time between 2 successive reference marks (in ms)
P - Pole length (in mm)
v_{max} - Maximum traverse speed (in m/s)

DCRM calculation example

P = 2 mm
K = 60 mm
Readhead is crossing 6th and 7th reference mark:

		Reference marks positions in mm:
1st	0	0
2nd	K/2 + 2	32
3rd	1 × K	60
4th	1.5 × K +4	94
5th	2 × K	120
6th	2.5 × K + 6	156
7th	3 × K	180

D = +1 ... positive direction of movement

ΔRI = 180 – 156 = 24

sgn (2 x dRI – K) = sgn (–12) = –1

RI1 = [1/2 × abs(2 × 24 – 60) – sgn(2 × 24 – 60) – 1] × 60/2 + [sgn(2 × 24 – 60) – 1] × abs(24)/2

RI1= [1/2 × abs(-12) – sgn(-12) – 1] × 60/2 + [sgn(-12) – 1] × abs(24)/2

RI1 = [1/2 × 12 – (–1) – 1] × 30+[– 1 – 1] × 12

RI1 = [1/2 × 12] × 30 – 2 × 12

RI1 = 6 × 30 – 24 = 156

In this case RI1 is the 6th reference mark.

DCRM for MS scales

For MS scales, DCRM availability and parameters depend on the scale type and pole length. The maximum codable length is determined by the basic increment (K) and the magnetic pole length (P).

K (mm)	Maximum codable length (mm)	
	P = 2 mm	P = 5 mm
20	76	-
40	356	-
60	836	-
80	1,516	-
100	2,396	890
200	9,796	3,790
300	22,196	8,690
400	39,596	15,590
500	61,996	24,490
600	89,396	35,390
700	-	48,290
800	-	63,190
900	-	80,090
1,000	-	98,990

There must be at least 3 reference marks on the scale.

Basic increment (K in mm) - Represents the distance in mm between odd reference marks; it determines the maximum codable length over which the absolute position can be defined. It also determines the minimum distance which needs to be traversed to capture 2 adjacent reference marks. The basic distance should be divisible by the length of 2 poles (in mm). K is customer selectable.

Maximum codable length (L_{max} in mm) - Is the maximum length of the magnetic scale over which the DCRM feature can be applied and still provide a unique absolute position. Lengths shorter than the maximum length may be used (refer to Table 1).

Pole length (P in mm) - Is the length of a magnetised pole (S or N). We currently offer magnetic scales with pole lengths of 2 mm (MS10) and 5 mm (MS15).

DCRM availability and maximum codable length for MS scales depend on the chosen scale type and pole length. Not all combinations are available.

DCRM for HMS scales

For HMS scales, DCRM parameters are predefined and depend on the scale length. HMS scales must be ordered with reference mark option D and a specified basic increment (K).

Table of available basic increment values for HMS specific scale lengths.

Scale length (L) (mm)	Measuring length (mm)	K
160	100	24
210	150	28
260	200	32
310	250	36
360	300	40
460	400	44
560	500	48
660	600	52
760	700	56
860	800	60
960	900	64

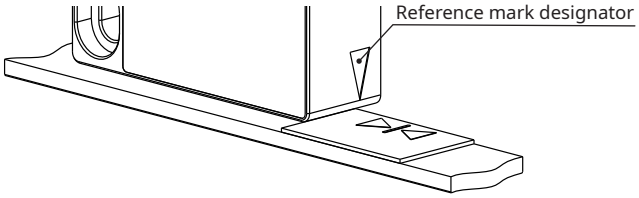
Scale length (L) (mm)	Measuring length (mm)	K
1060	1000	68
1160	1100	72
1260	1200	72
1360	1300	76
1500	NA	84
2000	NA	94
2400	NA	104

Periodic reference mark

The readhead must be ordered with reference mark option **C** (refer to corresponding readhead data sheet). The magnetic scale must be ordered without reference mark option (refer to **Part numbering**). The position information is output in incremental quadrature format with periodic reference pulses. The periodic reference pulses correspond to the magnetic pole length.

Stick-on reference mark

The readhead must be ordered with reference mark option **A** (refer to corresponding readhead data sheet). The magnetic scale must be ordered without reference mark option (refer to **Part numbering**). After the scale is installed, a reference mark sticker can be applied to the desired position on top of the scale using the reference mark applicator tool. Make sure that the reference mark sticker is aligned with the corresponding side of the readhead where the reference mark designator is located. It is recommended that the stick-on reference mark is applied for prototyping purposes only. As soon as the applications go to serial production, it is recommended to use a predefined magnetised reference mark. For the part number of the reference mark and applicator tool, refer to Accessories on **page 41**.

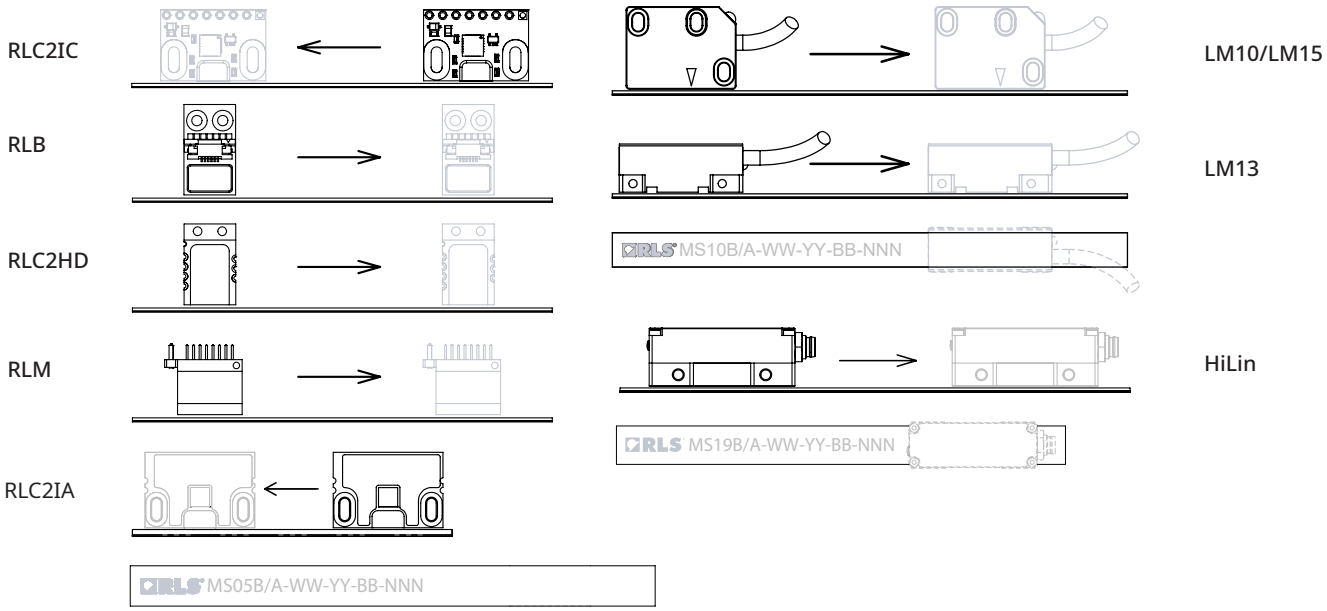


Stick-on reference mark is only available for MS10 scale.

Positive direction

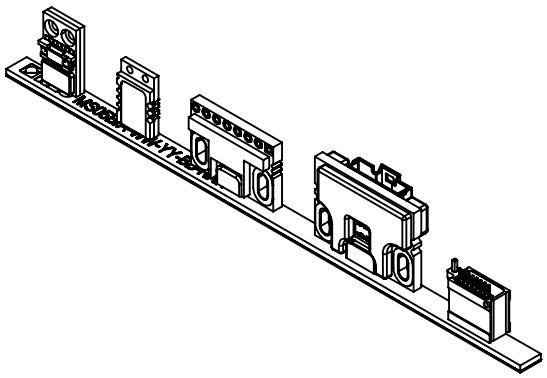
Digital output signals – A leads B (magnetic scale is stationary)

Analogue output signals (1 V_{pp}) – V_1 leads V_2



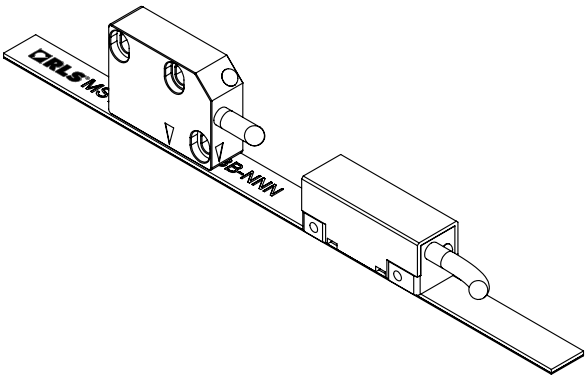
Readhead orientation

RLB/RLC2HD/RLC2IC*/ RLC2IA/RLM with MS05/07

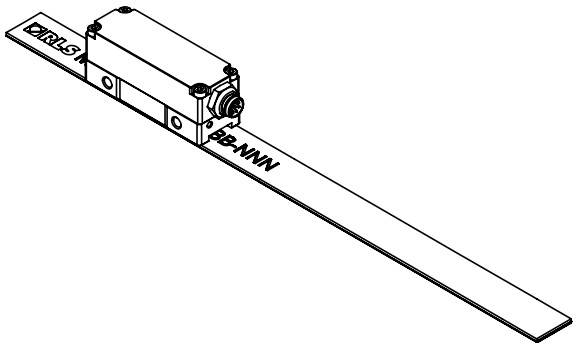


*Valid for all RLC2IC connector variants

LM10/LM15/LM13 with MS10/12



HiLin with MS19/20



HiLin with HMS scale

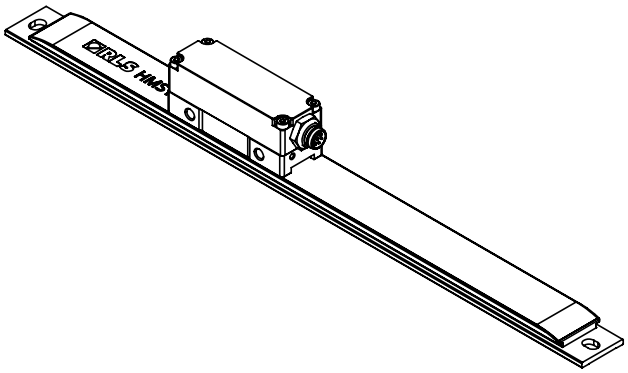


Illustration shows the orientation of the readhead in relation to the magnetic scale.

Installation instructions

Dimensions and tolerances are in mm. Dimensions without tolerance values are in accordance with ISO 2768-m.

Installation with adhesive tape

Applicable for MS05, MS07, MS10, MS12, MS15, MS19, MS20

Surface preparation

MS scales can be equipped with VHB backside adhesive tape. Most substrates are best prepared by cleaning with a 50:50 mixture of isopropyl alcohol and water before applying the magnetic scale. Exceptions to the general procedure that may require additional surface preparation include:

- Heavy oil/grease: To remove heavy oil or grease from a surface, a degreaser or solvent-based cleaning agent may be required, followed by cleaning with IPA/water.
- Abrasion: Sanding a surface and then cleaning with IPA/water can remove heavy dirt or oxidation and improve adhesion.
- Adhesion promoters: Priming a surface can significantly improve initial and ultimate adhesion to many materials such as plastics and paints.
- Porous surfaces: Most porous and fibrous materials such as wood, chipboard, concrete, etc. must be sealed to provide a unified surface.
- Unique materials: Special surface preparation may be required for glass and glass-like materials, copper and copper-containing metals, plastics or rubber containing migrating components (e.g. plasticisers).

Further information can be found online under "**Surface Preparation for 3M™ VHB™ Tape Applications**".

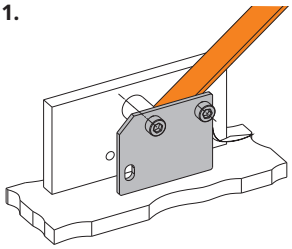
Good surface contact can be achieved by applying a pressure of about 100 kPa. At room temperature, approximately 50 % of the final bond strength is achieved after 20 minutes, 90 % after 24 hours and 100 % after 72 hours. Dynamic overlap shear (peak force to separate is measured after 72 hours dwell time): 830 kPa.

Scale installation with applicator tool

To simplify the scale installation use LM10ASC00 applicator tool with LM10/LM15 readhead, LM13ASC00 applicator tool with LM13 readhead or ACC047 applicator tool with HiLin readhead. For more information efer to chapter **Readhead installation with applicator tool**.

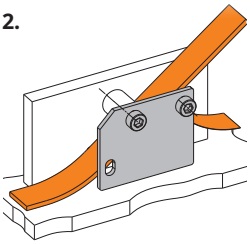
Explainer video: Installation process using applicator tool for LM10/LM15

1.



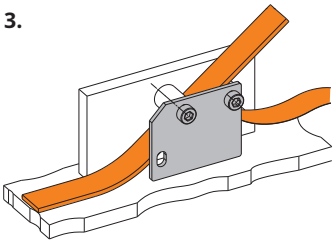
Load the scale into the applicator tool.
Separate the backing paper from the first 40 mm of scale and feed the scale into the applicator tool.

2.



Apply the scale.
Carefully push the scale through to the end scale mark without allowing premature adhesion. Once in position, attach the end of the scale with light finger pressure. Move the axis slowly through its full range of motion while applying light finger pressure behind the applicator tool and gently pulling away the backing paper.

3.



Ensure complete adhesion.
Apply firm finger pressure along the full length of the scale from the centre outwards to each end.

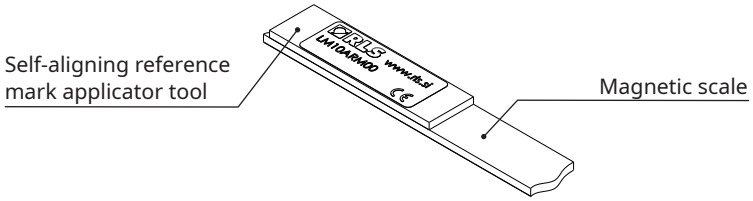
To prevent premature sticking, reapply ~20 mm of liner to the end of the scale before inserting it into the applicator tool.

4. **Apply cover foil (if used).**
   Degrease the scale surface with alcohol and install as per scale installation instructions in step 3 onwards.

5. **Remove the applicator tool.**
   When the scale has been applied unbolt the applicator tool from the readhead mounting bracket.

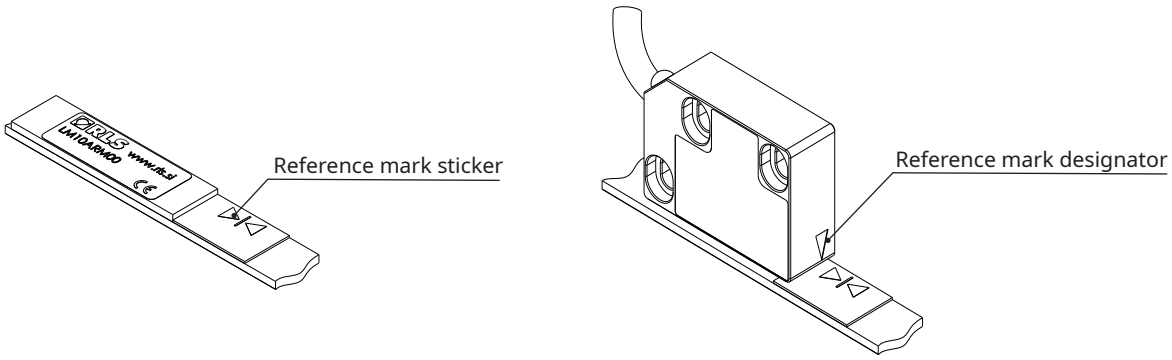
Reference mark installation (MS10 only)

6. **Apply the stick-on reference mark (if used).**
   Place the LM10ARM00 reference mark applicator tool on scale in the correct orientation/required position along the length.

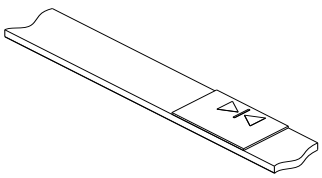


7. **Stick the reference mark on the scale.**
   Remove the backing paper from the reference mark sticker and carefully attach it to the surface of the scale by placing it next to the applicator tool.

> Correct orientation of the reference mark is crucial. The mark on the sticker should be on the same side as the reference mark designators.



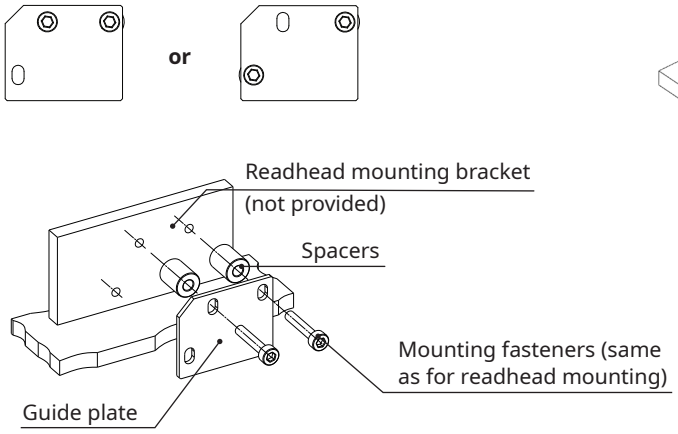
8. **Remove the stick-on reference mark applicator tool.**
   Remove the applicator tool leaving the reference mark sticker in the desired position.



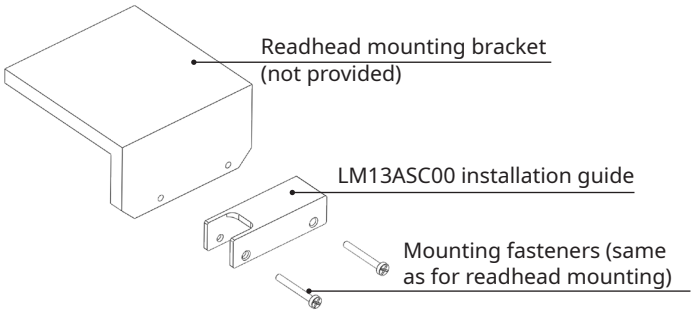
> Do not remove the scale for refitting or use elsewhere once it has been applied to the mounting surface. The scale can be applied only once.

Readhead installation with applicator tool

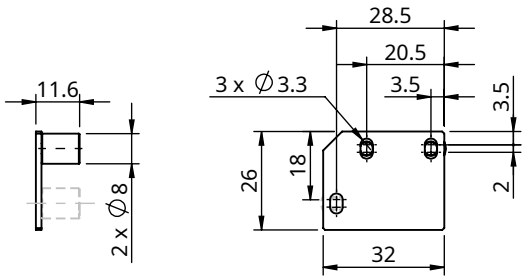
LM10 readhead with LM10ASC00 applicator tool



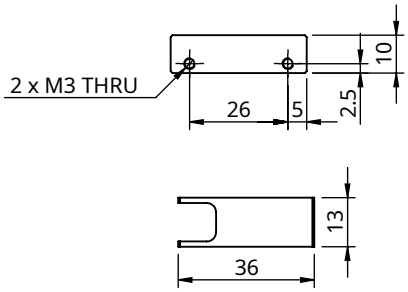
LM13 readhead with LM13ASC00 applicator tool



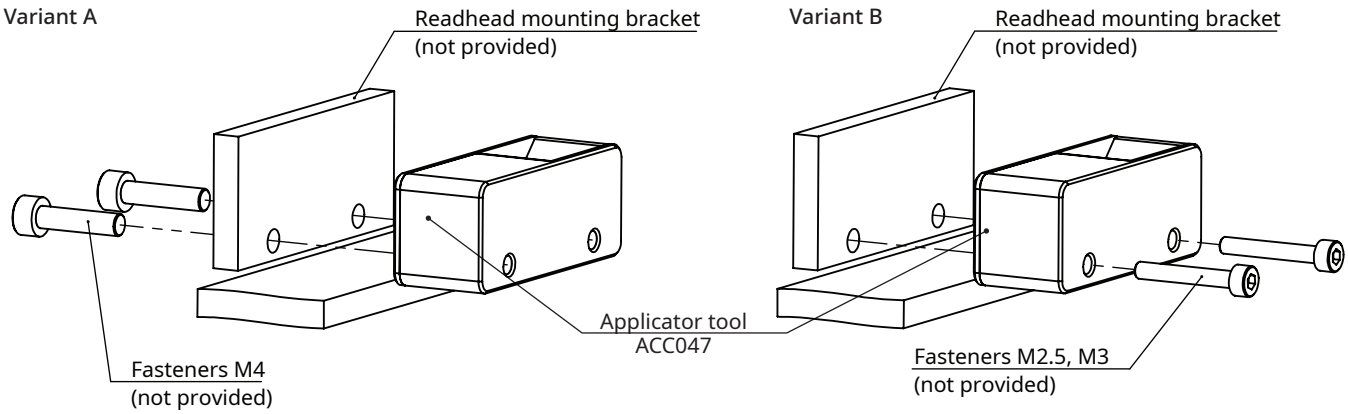
LM10/LM15 applicator assembly



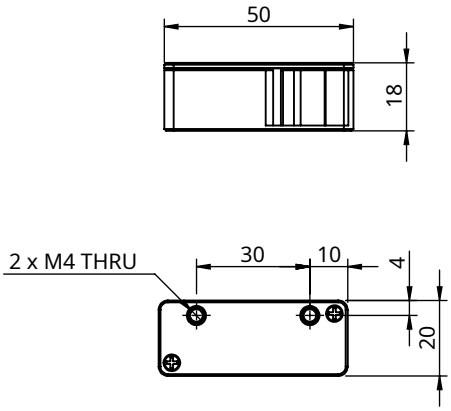
LM13 applicator assembly



HiLin readhead with ACC047 applicator tool



HiLin applicator assembly



Partial arc installation

Applicable for MS05, MS07, MS10, MS12 and MS15

The minimum bending radius of the magnetic scale is 75 mm. It is advised using the end-clamps on both ends to prevent the scale from peeling off the surface.

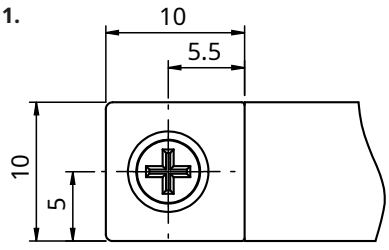
> Installing the scale around the circular part will reduce the system total accuracy.

Installation with end clamps

Applicable for MS10, MS12 and MS15

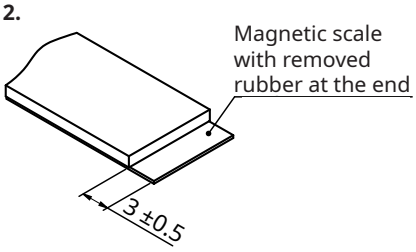
End clamp kit is designed to secure the ends of the MS scale. Ensure the installation surface is clean and free of debris. The kit includes two end clamps and two fasteners M2.5 × 6 DIN 965.

1.



Prepare the mounting surface.
Drill the holes to the mounting surface as shown above. Refer to the table below for the minimum distance of the reference mark from the edge.

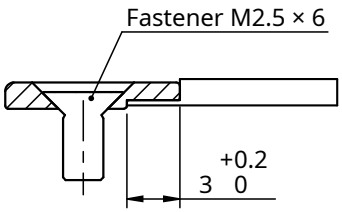
2.



Prepare the magnetic scale.
If the scale was not ordered pre-prepared for installation with end clamps, please make sure that:

- the hole to hole distance is correct (Scale length + 6 mm),
- the rubber surface at the ends of the scale was cut and removed as shown in the figure above.

3.



Install the scale to the surface.
Make sure that the scale has been cut to the correct length and the mounting surface has been cleaned. Install the self-adhesive scale using the scale applicator tool.

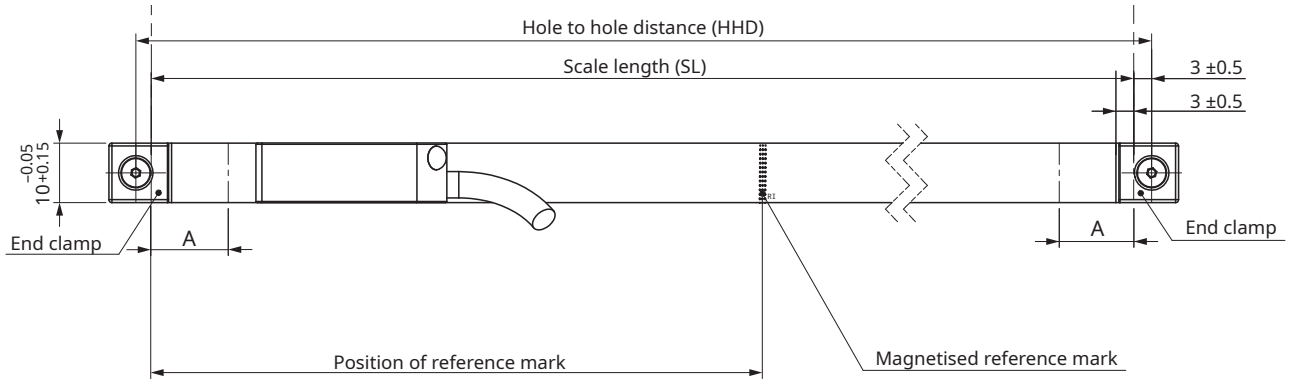
Install the end clamp.
Use the supplied fasteners and attach the end clamps so that the magnetic scale is held under the clamp.

Ensure that the readhead does not collide with the end clamp. Adjust the ride height accordingly.

Magnetic scales can be mounted using only end clamps, without VHB adhesive tape. However, the mounting surface must be properly prepared. To prevent lateral movement of the magnetic scale, mill a groove 10 mm wide and at least 0.3 mm deep in the mounting surface.

If end clamps are used without VHB adhesive tape, the recommended maximum scale length is 100 mm. End clamps secure the ends of the scale; however, for optimal stability, it is strongly recommended to use both end clamps and VHB adhesive tape together.

Installation of MS scale with end clamps



HHD = SL + (6 mm ±1 mm)
Measuring length with end clamps = SL - 26 mm
A - The minimum distance of the reference mark from the edge

Installation with TRS

Applicable for MS10, MS15, MS19 and MS20

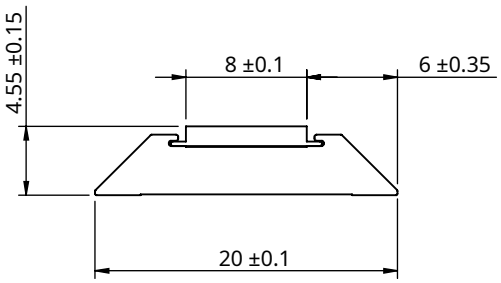
TRS system is designed for applications that require an easily removable scale. The track system consists of aluminium guide rails, available in 1 m and 2 m sections, and a scale clamp element. It holds the magnetic scale securely while allowing it to expand and contract freely. The scale clamp provides a fixed point from which the magnetic scale can expand.

If damaged, the scale can be pulled out of the guide rails and replaced even if access is limited, reducing machine downtime. This feature also makes the system ideal for large machines that need to be disassembled for transport.

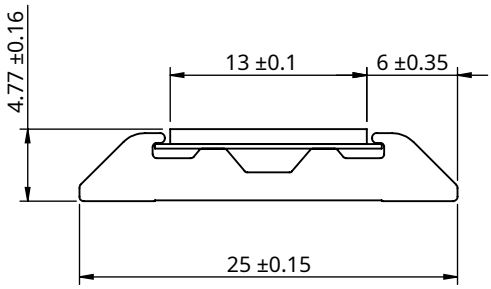
The design of the track section allows installation next to most standard guide rails or freely on any surface. This makes it suitable for many applications, such as automated assembly lines, packaging equipment, printing and other machines where the scale must be installed/removed for transport, or simply for all applications where the thermal expansion of the scale must be independent of the machine structure.

Technical specifications	TRS for MS10/MS15	TRS for MS19/MS20
Part numbers	TRS100A00, TRS200A00 TRE004A00, TRE004A01	TRS100B00, TRS200B00 TRE004B00
Material	Aluminium, EN AW-6060	Aluminium, EN AW-6060
Mass	157 g/m	200 g/m
Thermal expansion	~25 µm/m/°C	~25 µm/m/°C
Dimensions - cross section	20 mm × 4 mm	25 mm × 4.5 mm
Available section lengths	1 m, 2 m	1 m, 2 m

From MS10 to MS15 with TRS system



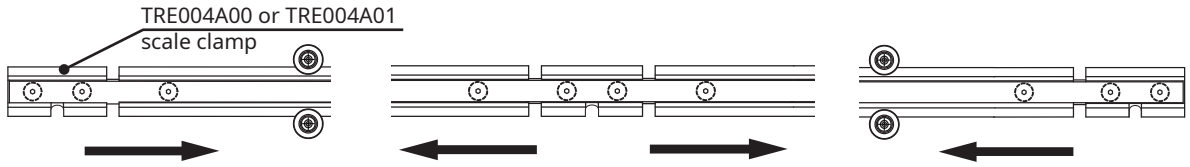
MS19/MS20 with TRS system



Installation tips

Thermal expansion control

The scale can be fixed either at the left/right end or at the center depending on the thermal expansion scheme.

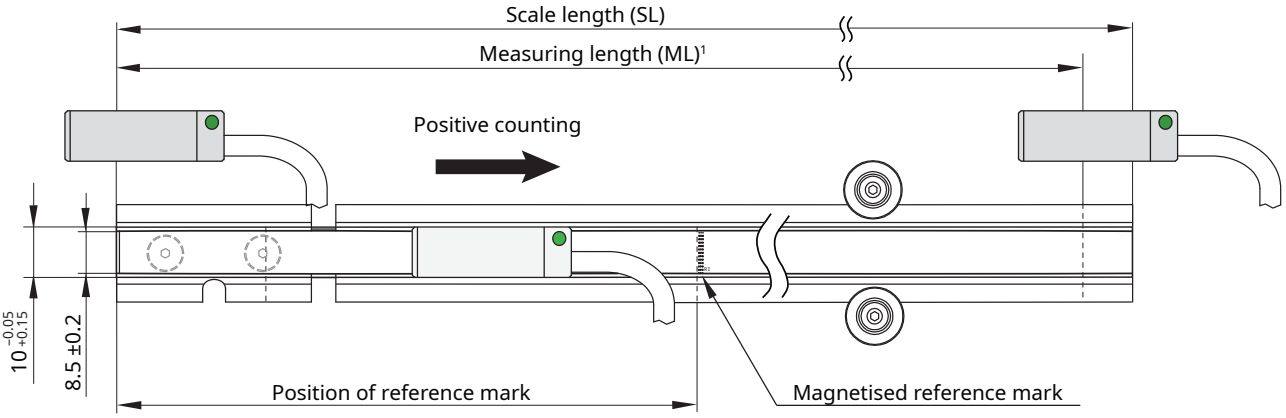


The scale expands to the **right**.

The scale expands in **both directions**.

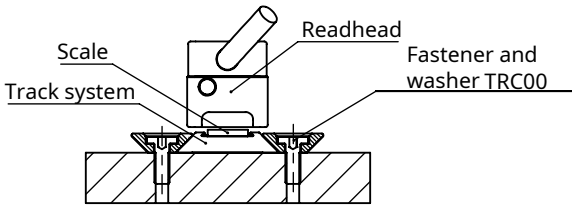
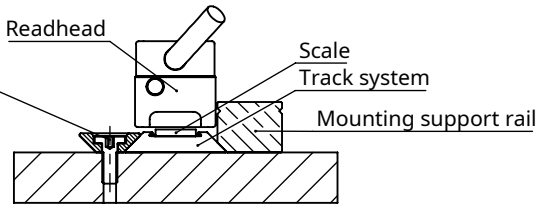
The scale expands to the **left**.

Example: LM10 on MS10 scale with track system



[1] ML = SL - 10 mm

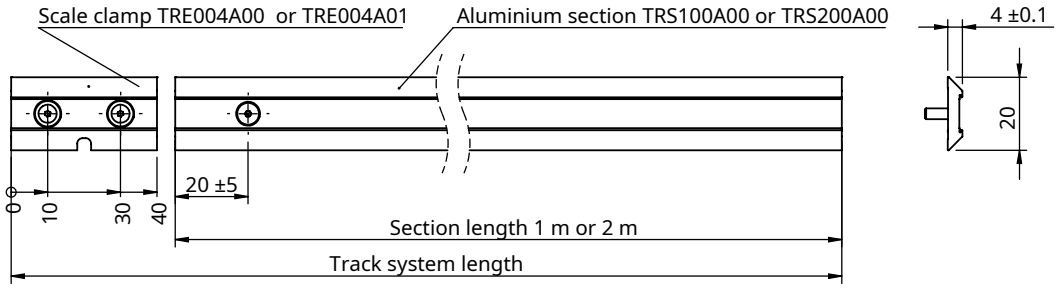
Installation methods

Installation method 1	Installation method 2
	
No mounting support rail available	Mounting support rail available for alignment of track section

	Number of TRC00 (fasteners and washers) required	
Track section	**Installation method 1**	**Installation method 2**
TRS100A00 or TRS100B00	8	4
TRS200A00 or TRS200B00	16	8

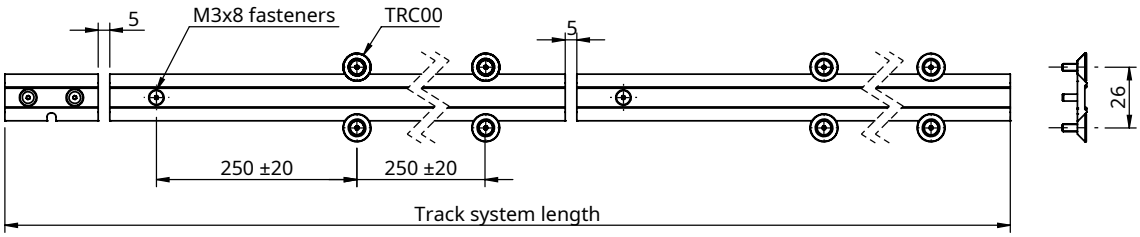
Combining the method 1 and method 2 is not recommended. The temperature can affect the expansion and contraction of the aluminium profiles and scales and therefore cause deformations.

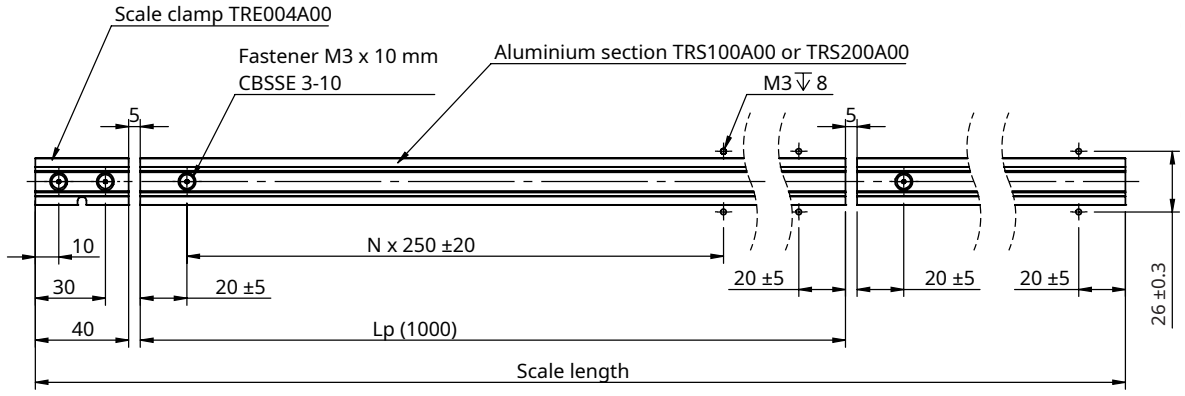
For MS10/12/15 installation: TRS100A00 or TRS200A00



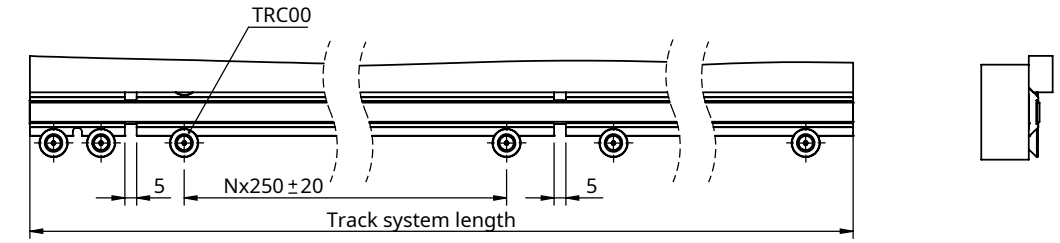
Installation method 1

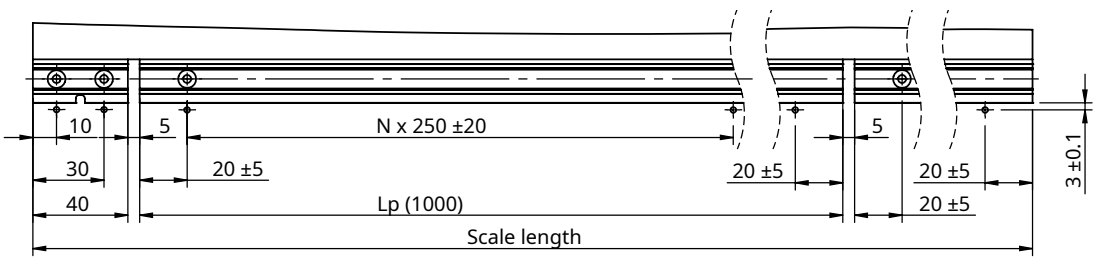
Valid for TRS supporting MS10 scale. Recommended use of M3x 8 (CBSM3-8 Misumi). For more information refer to the **Table of recommended fastener tightening torques** at **RLS Media center.**



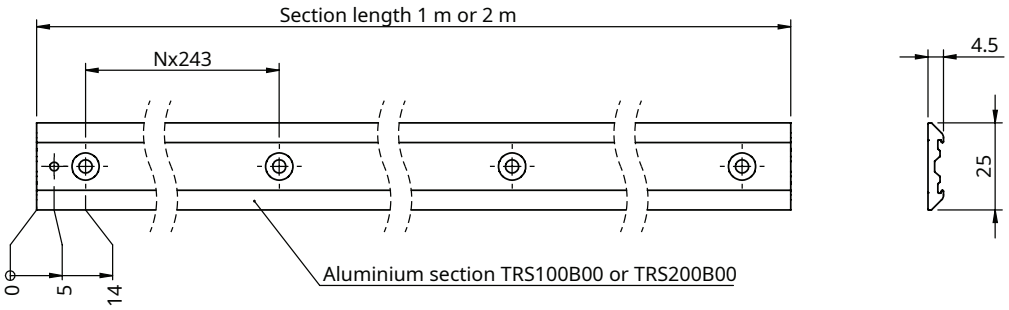


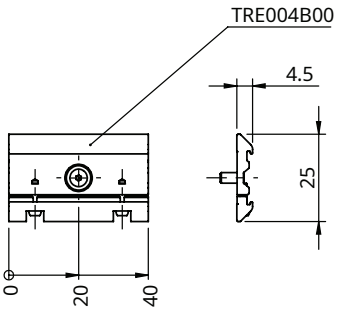
Installation method 2





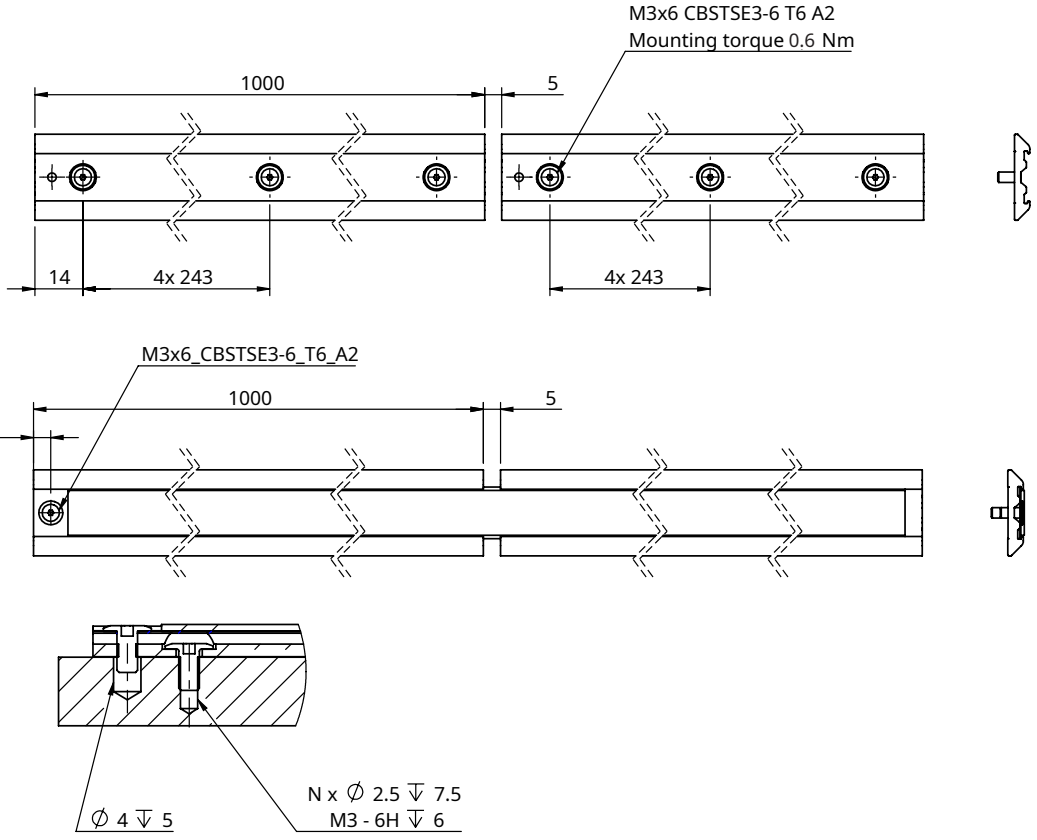
For MS19/20 installation: TRS100B00 or TRS200B00





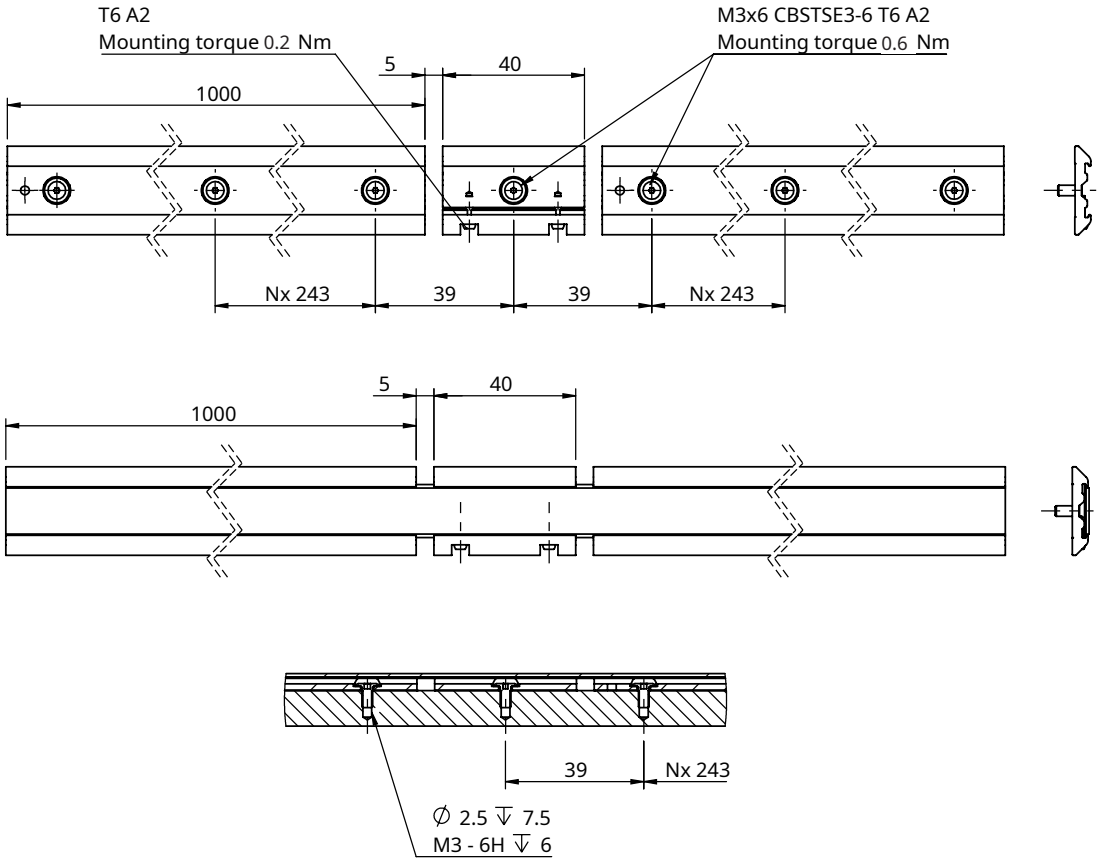
Installation method 1

Using fastener to fixate the end of the scale. The scale must be ordered with the holes at both ends.



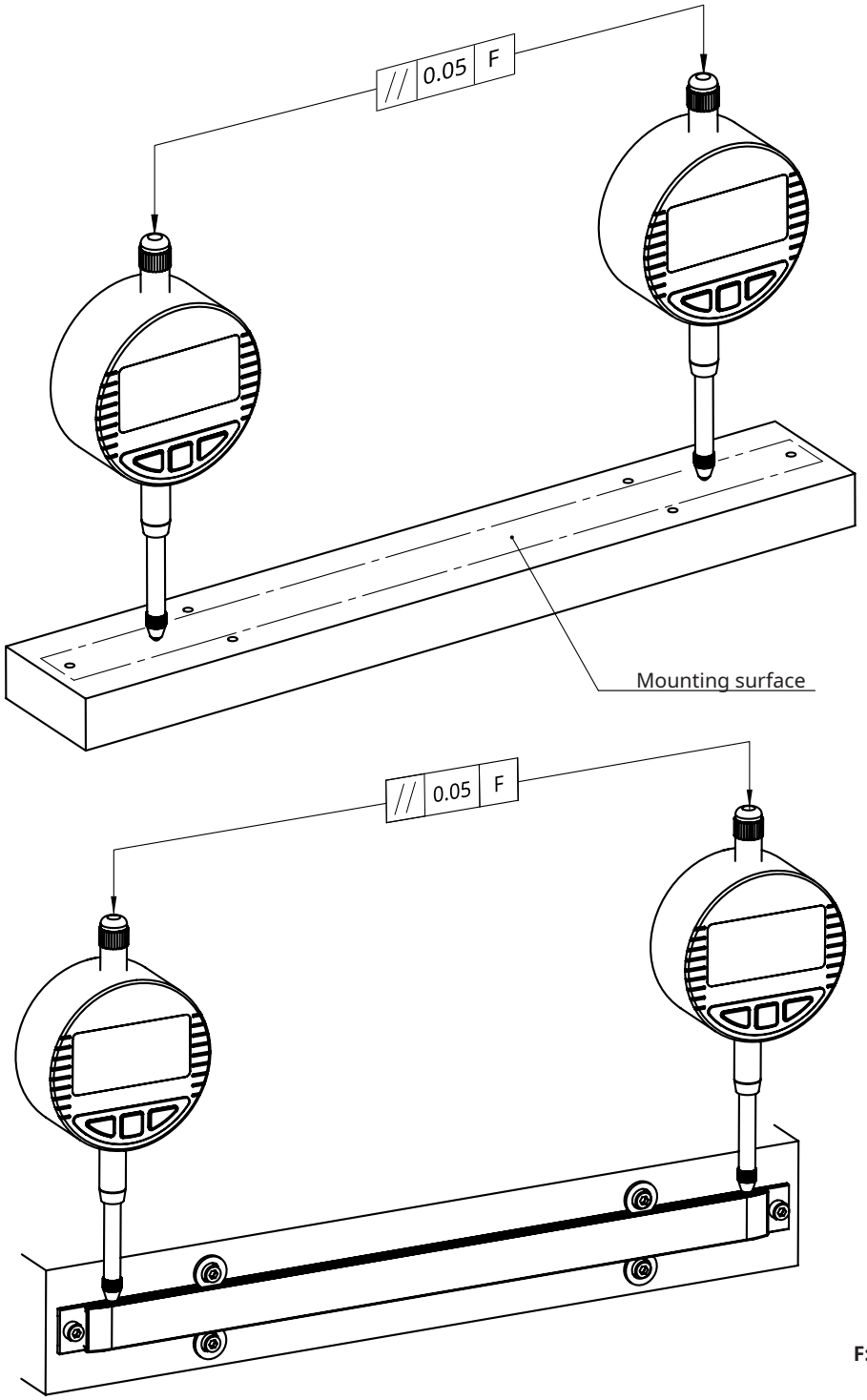
Installation method 2

With scale clamp fixing element. The fixing element can be placed at the beginning, middle or at the end of the scale.



Installation of solid magnetic scale (HMS)

Mounting on steel substrate with similar coefficient of thermal expansion (CTE) – recommended. Make sure that the mounting surface of the magnetic scale has been cleaned and degreased before you proceed.



F: Machine guideway

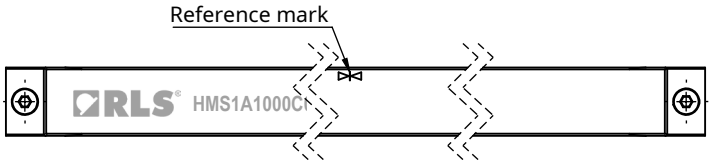
To achieve specified performance, maintain the mounting surface and the readhead guideway inside 0.05 mm parallelism according to the machine guideway.

Mounting dimensions and fastener layout

Two installation methods are available for SAS scales. Installation method 1 is intended for standard installations, while Installation method 2 is intended for applications requiring a lower-profile mounting arrangement. Both methods follow the same mounting procedure described below.

For scales up to 150 mm long

Mount the left-most and right-most fasteners. No additional washers required along the scale. Refer to the table of recommended fasteners and washers on **page 30**.

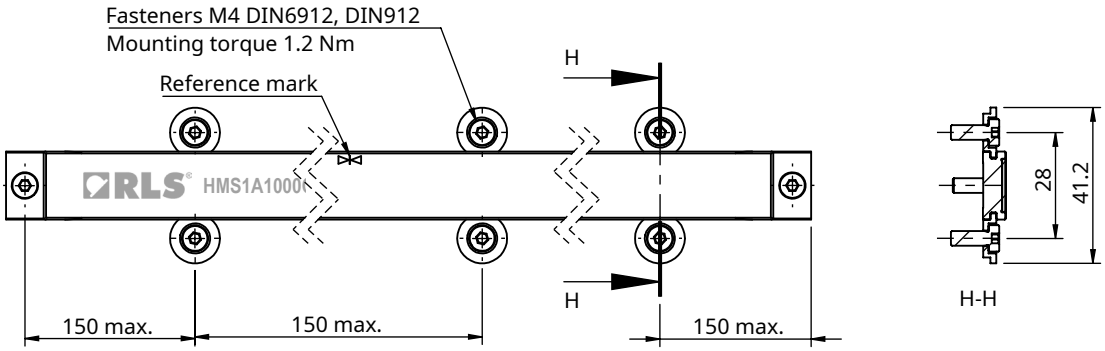


For scales longer than 150 mm

Use washers every 150 mm along the scale to prevent bending.

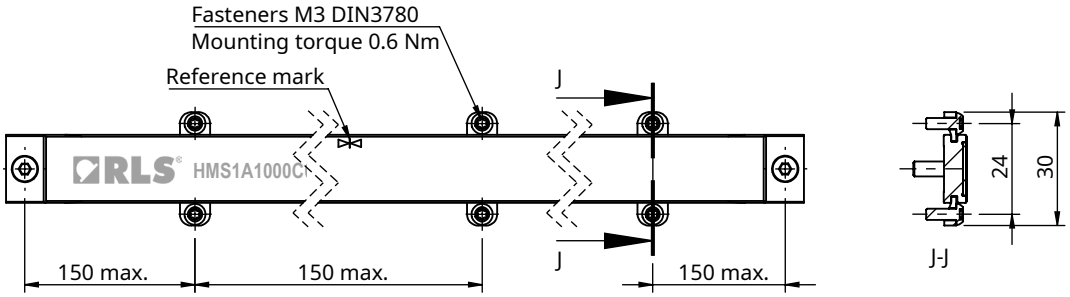
Installation method 1 (M4 fasteners)

Installation method 1 uses M4 DIN6912/DIN912 fasteners. The mounting arrangement and cross-section are shown below.The required number of fasteners and washers is supplied with the scale. Refer to the table of recommended fasteners and washers on **page 30**.

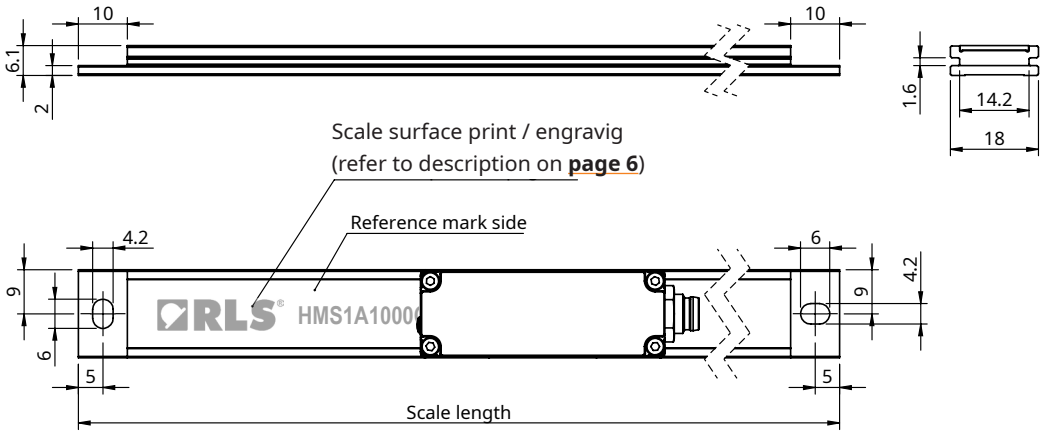


Installation method 2 (M3 fasteners)

Installation method 2 uses M3 DIN3780 fasteners. The mounting arrangement and cross-section are shown below. The required number of fasteners and washers is **not supplied with the scale and must be ordered separately** (TRC01). Refer to the table of recommended fasteners and washers on **page 30**.



For recommended fastener tightening torques, refer to document Table of recommended fastener tightening torques (TTD01) available at **RLS Media center**.



Scale length [mm]	Measuring length [mm]	Nr. of MN01509 washers / TRC01 kits**	Nr. of fasteners (M4 x 10 IMBUS ISO 7380)*
110	50	2	4
160	100	2	4
210	150	2	4
260	200	4	6
310	250	4	6
360	300	4	6
460	400	4	6
560	500	6	8
660	600	8	8
760	700	10	12
860	800	12	14
960	900	12	14
1060	1000	14	16
1160	1100	14	16
1260	1200	16	18
1360	1300	16	18
1560	1481	20	22
2060	1981	26	28
2460	2381	32	34

* Two additional M4 fasteners are required to attach the scale at both ends. Two M4 DIN 125 stainless-steel washers are included.
** TRC01 must be ordered separately.

Installation of MS19/20 magnetic scale with adhesive and fasteners at both ends

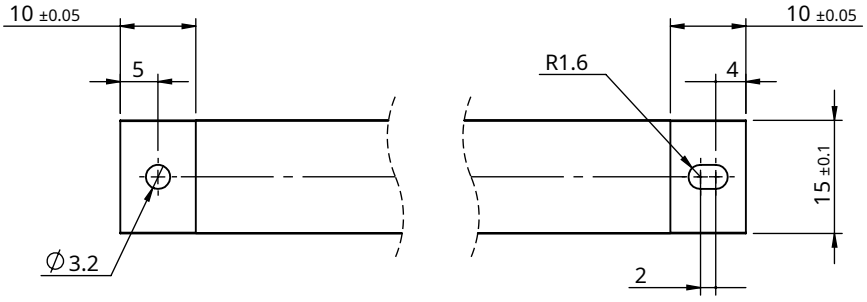
The MS19/20 scale can be installed in two different ways:

- With adhesive tape.
- With adhesive tape and fasteners at both ends.

The fasteners (M3x6 CBSTSE3-6 T6 A2) at both ends prevent the magnetic scale from lifting from the mounting surface when installed on a curved surface, such as rotating shaft. The scale must not be secured solely by the end fasteners without the adhesive tape. Fasteners alone may not provide sufficient retention, allowing the scale to bow between the mounting points and come into contact with the readhead, which may result in malfunction.

The left side of the MS19/20 scale has a ∅ 3.2 mm hole and a slot hole on the right side. The slot hole is used to compensate for the length tolerance of the scale and possibly also the tolerance between the holes on the shaft.

Before final installation, place the scale on the shaft and verify that the mounting holes at both ends align with the corresponding holes on the shaft.

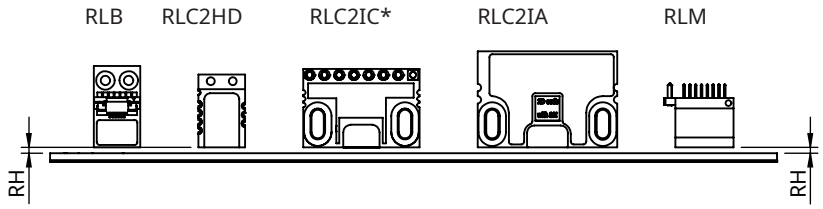


Installation tolerances

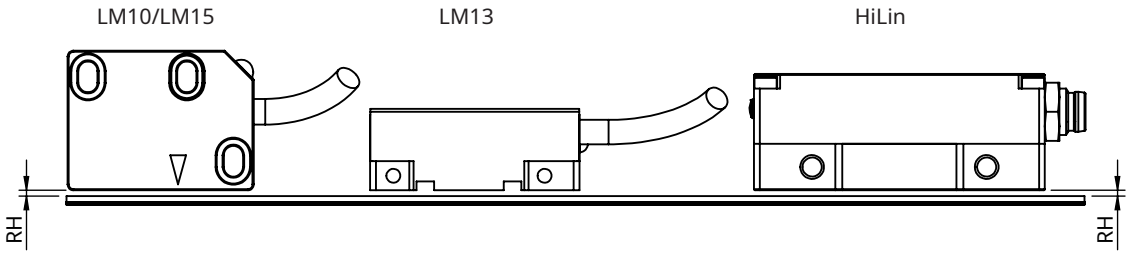
Ride height (RH)

		LM10/LM13	LM15	RLB/RLC2IA/ RLC2IC/RLM	HiLin	
					MS19/20	HMS
No cover foil	**No Ri**	$0.3^{+1.2}_{-0.2}$	$0.5^{+3.5}_{-0.4}$	$0.3^{+0.5}_{-0.2}$	0.1 to 0.4	0.1 to 0.3
	Magnetised Ri	$0.3^{+0.7}_{-0.2}$	$0.5^{+2.5}_{-0.4}$			
	Stick-on Ri	$0.6^{+0.4}_{0}$	–	–	–	–
With cover foil	**No Ri**	$0.3^{+1.1}_{-0.2}$	$0.5^{+3.4}_{-0.4}$	$0.3^{+0.4}_{-0.2}$	0.1 to 0.3	0.1 to 0.3
	Magnetised Ri	$0.3^{+0.6}_{-0.2}$	$0.5^{+2.4}_{-0.4}$			

Values in mm, marked RH.



* Values apply for all RLC2IC encoder variants.

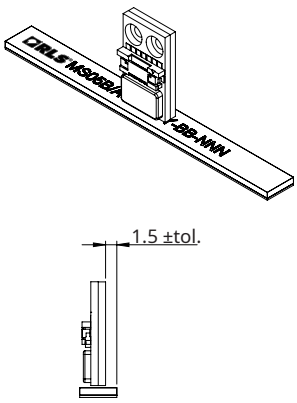


Lateral offset

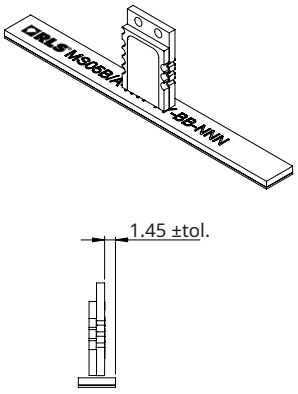
	LM10/LM13	LM15	RLB/RLC2IA/ RLC2IC/RLM	HiLin	
				MS19/20	HMS
No Ri	±1	±1	±0.5	±0.2	±0.2
Magnetised Ri	±0.7	±0.7			
Stick-on Ri		-	-	-	-

Values in mm.

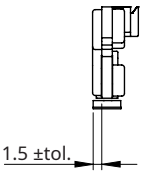
RLB



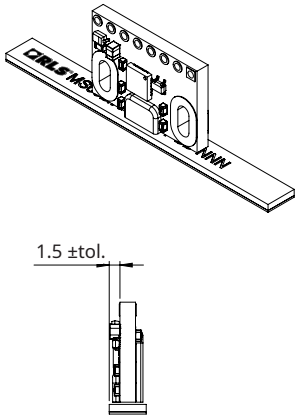
RLC2HD



RLC2IA

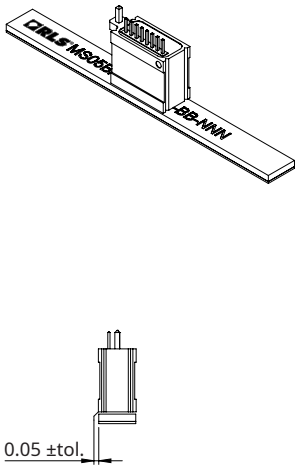


RLC2IC*

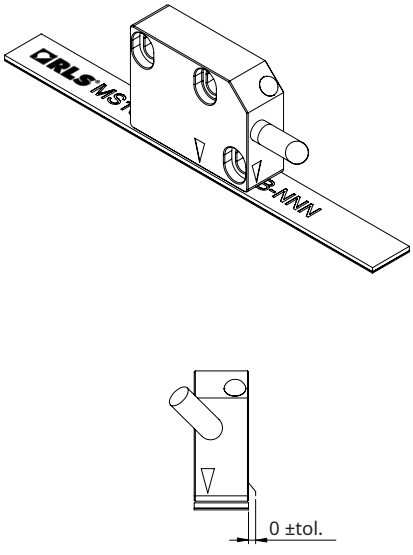


* Values apply for all RLC2IC encoder variants.

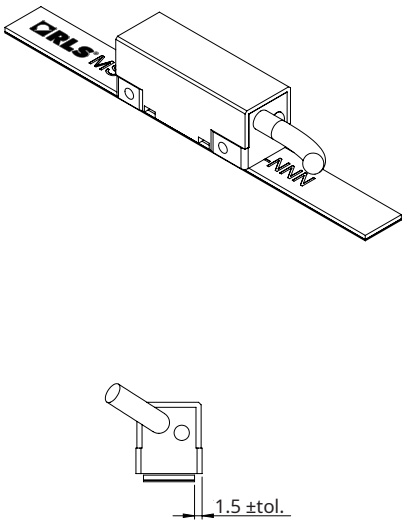
RLM



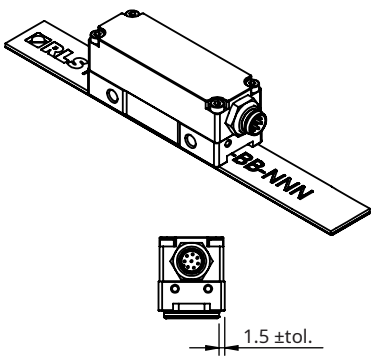
LM10/LM15



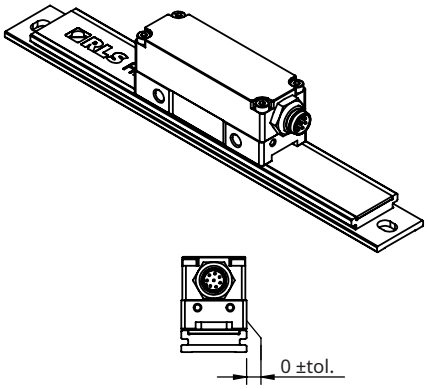
LM13



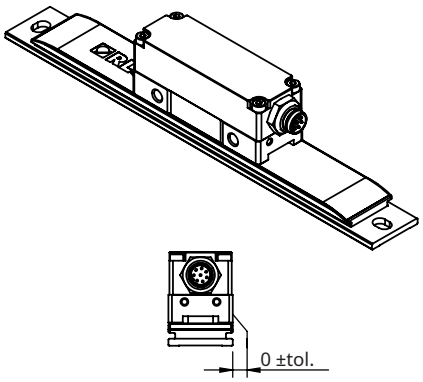
HiLin with MS19/20



HiLin with HMS exposed solid magnetic scale

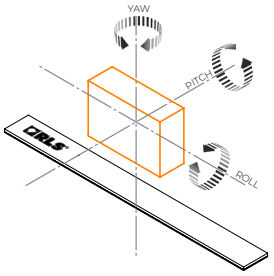


HiLin with HMS fully welded solid magnetic scale



Roll, pitch and yaw

	LM10/LM13/ LM15	RLB/ RLC2HD	RLC2IA/ RLC2IC*/RLM	HiLin	
				MS19/20	HMS
Roll	±3	±2	±1	±1	±1
Pitch	±3	±2	±1	±0.5	±0.5
Yaw	±3	±2	±1	±0.5	±0.5

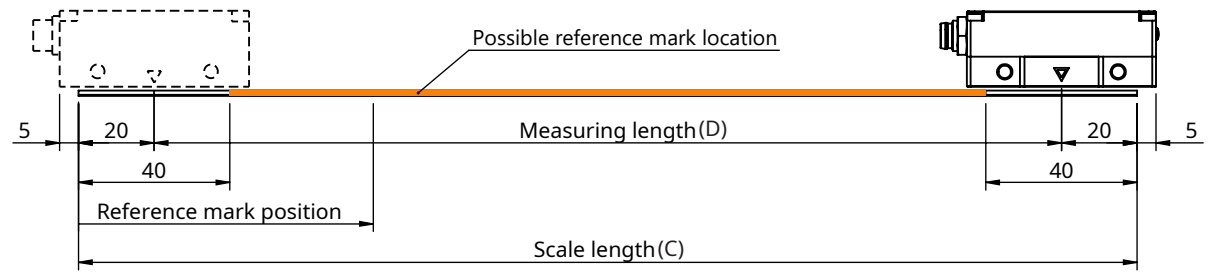


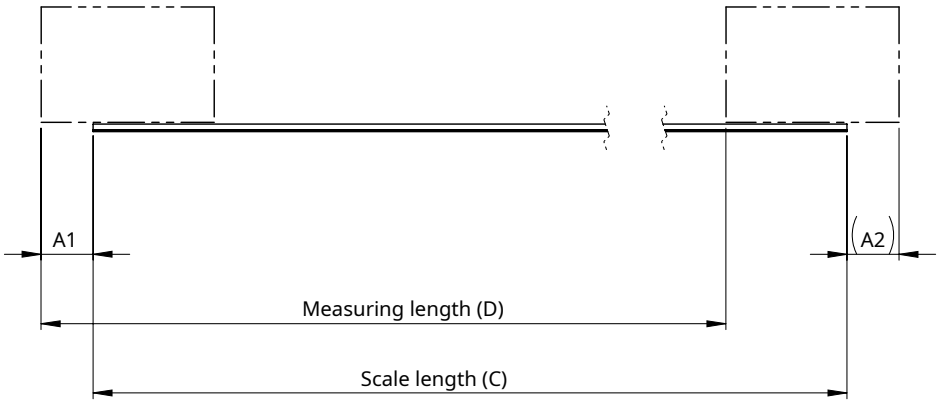
Values in °. Illustration is intended for representation purpose only. The readhead is symbolic.

* Values apply for all RLC2IC encoder variants.

How to define scale length

From MS05 to MS20

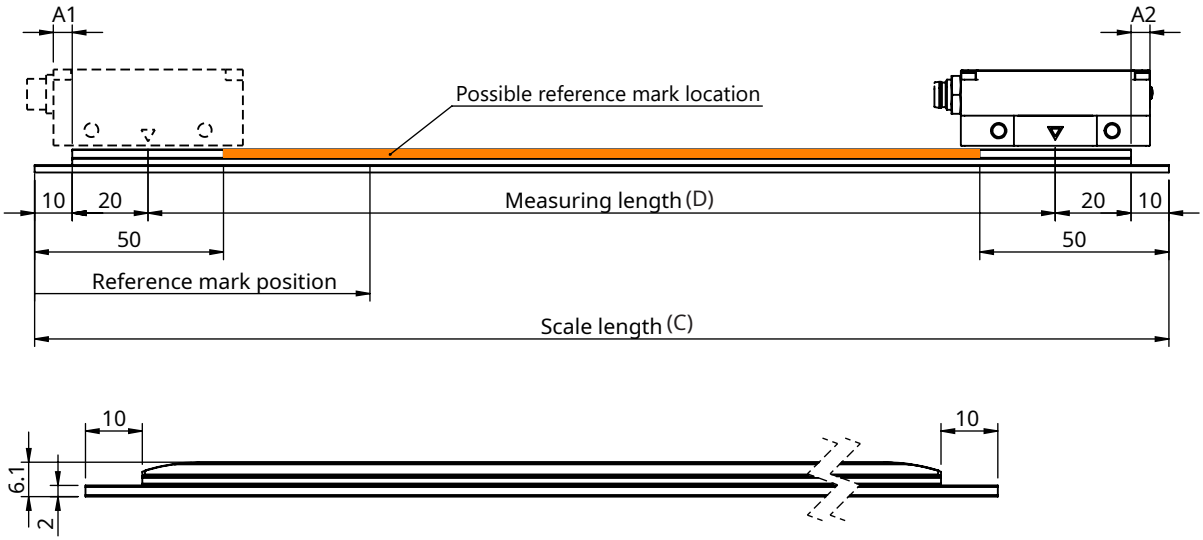






Readhead	A1	A2	B	C
LM10	13 mm	7 mm	Min. 10 mm	D + 20 mm
LM13	11 mm	13 mm	Min. 10 mm	D + 20 mm
LM15	6.5 mm	0.5 mm	Min. 10 mm	D + 20 mm
RLB	–2 mm	–2 mm	-	D + 10 mm
RLC2HD	–2 mm	–2 mm	-	D + 10 mm
RLC2IA	6 mm	6 mm	Min. 8 mm	D + 16 mm
RLC2IC	4 mm	4 mm	Min. 8 mm	D + 16 mm
RLM	–1 mm	–1 mm	Min. 8 mm	D + 10 mm
HiLin with MS	5 mm	5 mm	20 mm	D + 60 mm

HMS



Readhead	A1	A2	B	C
HiLin with welded/non-welded HMS	5 mm	5 mm	20 mm	D + 60 mm

Part numbering

From MS05 to MS15

MS 10 B 1000 B 0032

Scale type

05 - 2 mm pole length, 5 mm width
07 - 2.032 mm pole length, 5 mm width
10 - 2 mm pole length, 10 mm width
12 - 2.032 mm pole length, 10 mm width
15 - 5 mm pole length, 10 mm width

Accuracy class

A - ±20 µm/m
B - ±40 µm/m
C - ±100 µm/m
D - ±10 µm/m

Scale length

xxxx - xxxx equals scale length in cm
Mxxx - xxx equals scale length in mm (for scale lengths below 1 m)

Refer to **Page 27** for scale length definition.

Options

A - VHB back adhesive tape (standard)
B - VHB back adhesive tape; with cover foil *
C - VHB back adhesive tape; ends prepared for end clamping (MS10 option only)
G - No VHB back adhesive tape; sides prepared for insertion into track section
H - No VHB back adhesive tape, sides prepared for insertion into track section; with cover foil *
I - No back adhesive tape
N - No back adhesive tape; with cover foil *
P - No back adhesive tape; ends prepared for end clamping (MS10 option only) **

* Cover foil is not factory mounted on the scale and must be ordered separately, refer to **Cover foil part number.**
** It can only be used when the magnetic scale is installed in the groove to prevent lateral sliding. The groove dimension must correspond to the scale width.

Reference mark

0000 - No reference mark
xxxx - Reference mark; xxxx equals position of reference mark in cm (For reference mark tolerance, refer to **the Technical specification**)
Dxxx - Distance coded reference mark; xxx equals basic increment K
Mxxx - Reference mark; xxxx equals position of reference mark in mm (For reference mark tolerance, refer to **the Technical specification**)
Pxxx - Multiple reference marks in mm; xxx equals distance between magnetised reference marks in mm, factory predefined to 50 mm, 100 mm and 200 mm. (For reference mark tolerance, refer to **the Technical specification**)

Not all part number combinations are valid. Refer to the table of available combinations on the next page.

Table of available combinations

Series	Scale type	Accuracy class	Scale length	Options	Reference mark
MS	05	A / B / D	xxxx / Mxxx	A / B / I / N	0000 / xxxx / Mxxx / Dxxx
	07	B	xxxx / Mxxx		0000 / xxxx / Mxxx
	10	A / B / D	xxxx / Mxxx	A / B / C / G / H / I / N / P	0000 / xxxx / Mxxx / Dxxx
			2000		P050 / P100 / P200
	12	B	xxxx / Mxxx	A / B / G / H / I / N	0000 / xxxx / Mxxx
	15	C			0000 / xxxx / Mxxx / Dxxx

More information about the max speed of readheads at **RLS Magnetic Scale Calculator.**

MS19/20

MS 19 B 1000 A B 0032

Scale type

19 - 2 mm pole length
20 - 2.032 mm pole length, DPI

Accuracy class

D - ±10 µm/m

Scale length

xxxx - xxxx equals scale length in cm

Refer to **Page 27** for scale length definition.

Mechanical options

A - N/A
L - With slot holes at both ends of the scale (fasteners included)
G - No back-adhesion tape, prepared for track section
H - No back-adhesion tape, prepared for track section, with slot holes at both ends of the scale (fasteners included)

Options

A - VHB back adhesive tape (standard)

* Cover foil is not factory mounted on the scale and must be ordered separately (cover foil is up to 50 mm longer than specified with the part number).
** It can only be used when the magnetic scale is installed in the groove to prevent lateral sliding. The groove dimension must correspond to the scale width.

Reference mark

0000 - No reference mark
xxxx - Reference mark; xxxx equals position of reference mark in cm
(For reference mark tolerance, refer to **the Technical specification**)

Not all part number combinations are valid. Refer to the table of available combinations below.

Table of available combinations

Series	Scale type	Accuracy class	Scale length	Options	Mechanical options	Reference mark
MS	19	D	xxxx	A	A / L / G / H	0000 / xxxx
	20					0000

HMS

HMS 1 A 1100 A 0020

Pole length

1 - 2 mm
2 - 2.032 mm (DPI)

Special requirement

A - N/A (no special requirement)

Measuring scale length (max. 2500 mm)

0050 - 50 mm	**0300** - 300 mm	**0800** - 800 mm	**1300** - 1300 mm
0100 - 100 mm	**0400** - 400 mm	**0900** - 900 mm	**1500** - 1500 mm
0150 - 150 mm	**0500** - 500 mm	**1000** - 1000 mm	**2000** - 2000 mm
0200 - 200 mm	**0600** - 600 mm	**1100** - 1100 mm	**2500** - 2500 mm
0250 - 250 mm	**0700** - 700 mm	**1200** - 1200 mm	

Options

A - No cover foil
C - Welded cover foil

Reference mark

0000 - No reference mark
Dxxx - Distance coded reference mark; where xxx equals basic increment K in mm
xxxx - Reference mark; xxxx equals position of reference mark in cm
(For reference mark tolerance, refer to **the Technical specification**. xxxx has to be an even number.)
Mxxx - Reference mark; xxx equals position of reference mark in mm
(For reference mark tolerance, refer to **the Technical specification**. xxxx has to be an even number.)

Not all part number combinations are valid. Refer to the table of available combinations below.

Table of available combinations

Series	Pole length	Special requirement	Measuring scale length	Options	Reference mark
HMS	1	A	xxxx	A / C	0000 / Dxxx / xxxx / Mxxx
	2				

Track section system

TR S 100 A 00

Track section system
TR - Track section system

Integral part
S - Aluminium profile for scale insertion
E - Link for fixing the scale

Length of the TRS
100 - 1.0 m long TRS profile
200 - 2.0 m long TRS profile

Compatibility with scales
A - Compatible with scales from MS05 to MS15
B - Compatible with MS19/MS20

Special requirements
00 - No special requirements

Cover foil

CF 10 1000

Cover foil width
05 - 5 mm
08 - 8 mm (for track system option only)
10 - 10 mm
15 - 15 mm

Cover foil length
xxxx - xxxx equals foil length in cm*

* Cover foil is up to 50 mm longer than specified with the part number.

Accessories



Magnet viewer
MM0001

For HMS



M4 washer for HMS profile
MN01509

Included when ordering a SAS10/19 scale.



M3 fastener and washer for HMS profile
TRC01

Not included with a HMS scale and must be ordered separately.

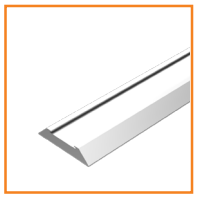
From MS05 to MS15



Applicator tool for magnetic scale and cover foil
LM13ASC00



Applicator tool for magnetic scale and cover foil
LM10ASC00



Track section
TRS100A00 (1.00 m)
TRS200A00 (2.00 m)

(1x fastener M3x10 included)



End clamp kit
LM10ECL00

(2 clamps + 2 fasteners)



Fastener and washer
TRC00



Scale end clamp with fasteners, 0.04 m
TRE004A00

(2x fastener M3x10 and 1x fastener M2x4 included)



Scale joining clamp with fasteners, 0.04 m
TRE004A01

(2x fastener M3x10 and 2x fastener M2x4 included)



Stick-on reference mark
LM10SRM00



Applicator tool for stick-on reference mark
LM10ARM00

For MS19/20



Scale applicator tool
ACC047

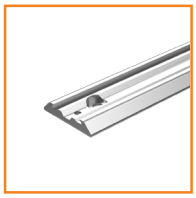


Fastener and washer for TRS profile
TRC00



Scale clamp with fasteners, 0.04 m
TRE004B

(2x fastener M2x8 and 1x fastener M3x6 included)



Track section
TRS100B00 (1.00 m)

(5x fastener M3x6 included)

TRS200B00 (2.00 m)
(9x fastener M3x6 included)

Packaging

When option **B**, **H** or **N** is selected for the MS05/07/10/12/15 scales, the protective cover foil is supplied with the scale (cover foil is up to 50 mm longer than specified with the part number). The cover foil is not pre-installed on the scale.

Accuracy class D scales
Special packaging is used to prevent demagnetization by maintaining distance between scale rolls. MS10 scales shorter than 1000 mm (and MS05 scales shorter than 950 mm) are packed individually in a plastic tube, while spiral packaging is used for longer lengths.

All magnetic scales have 12 months shelf life and should be installed within this period.

Product	Quantity	Length (mm)	Packaging
MS05/07/10/12/15	More than 20 pcs	≤ 300	Plastic tube
		> 300	Rolled in cardboard box
	Up to 20 pcs	≤ 600	Plastic tube
		> 600	Rolled in cardboard box
MS19/20	-	≤ 300	Plastic tube
		> 300	Spiral
HMS	-	-	Wooden box*
TRS	-	-	Cardboard tube

* Fasteners and washers are packed separately.

Head office

RLS Merilna tehnika d.o.o.

Poslovna cona Žeje pri Komendi
Pod vrbami 2
SI-1218 Komenda
Slovenia

T +386 1 5272100
E mail@rls.si

www.rls.si

Global support

Visit our **website** to contact your nearest sales representative.

Document issues

Issue	Date	Page	Description
8	5. 2. 2025	3	Packaging options amended
9	21. 7. 2025	10	Installation tool amended
10	4. 11. 2025	22	Cover foil comment added
11	30. 6. 2026	1, 3-6, 9-10, 13, 14, 15, 19, 22, 25-35, 38-39, 41-43	HMS solid magnetic scales added
		2	Incremental scale variants chapter added
		3, 14, 15, 31-34	RLC2IA added
		7	Dimenions chapter added
		18	Dimensions of applicator tool added
		23-24	TRS installation drawings amended
		40	TRS part numbering added
12	29. 7. 2026	29, 30, 42	HMS mounting and TRC01 added
13	7. 10. 2026	37, 39, 40	Part numbering amended

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