

Use and Installation Manual

Photoelectrical modular linear encoder

Mod. L50PK-AV-12240-C-0-03/C12T

No.00031



SAFETY

The Manufacturer's products are designed and manufactured in full consideration of safety. Improper handling or installation may cause fires, electric shocks or serious harms. Improper installation may lead to inadequate performance of the machine. To prevent these occurrences, it is strongly recommended to read and carefully observe the instructions provided in this manual, before any installation, maintenance, inspection and repairing of the product.

Disposal of waste electrical and electronic equipment (WEEE)

European Council Directive 2002/96/EC



The use of the WEEE symbol indicates that this product may not be treated as household waste. If this product is disposed correctly, you will help to protect the environment. For more detailed information about the recycling of this product, please contact your local authority, your household waste disposal service provider or the retailer where you purchased the product.

PRECAUTIONS

General precautions

- Provide adequate safety measures to prevent damages due to product malfunctioning.
- Use outside the specifications and purposes indicated by the Manufacturer and modifications of the product will void any warranty and could modify product characteristics.
- When using the product in combination with other equipment, the functions and performance described in this manual may not be guaranteed, depending on environmental and operating conditions.

Installation precautions

- Separate signal and power supply lines.
- Maintain a minimum distance of 0.5 m between the product and any source of high voltage, high current or power relays.
- Make connections when power supply is switched off and batteries (when present) are excluded as well.
- The best system accuracy is attained by positioning the scale as close as possible to the machining area or to the object being measured.
- The scale should be mounted to be as accessible and protected and as close to the machine's slide guides as practically possible.
- Mount the scale with the sealing lips facing down or away from the machining area (see recommended mounting positions in paragraph 2.2.1).
- Spacer blocks or supporting arms should be adequately sized and made rigid to exclude any flexion or vibration that could compromise the scale's accuracy.
- The product should be used in a temperature range of 0 to 50 °C. Avoid exposing the optical scale to direct sunlight or to heat sources (e.g. motors, ovens, etc.).
- Do not place anything on the scale or step on it.

Warning:

Do not touch the contacts of the cable's connector in order to avoid electrostatic discharges (ESD) on the device.

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1 LIST OF COMPONENTS

- | | |
|---|---|
| 1) Reader head | 1 |
| 2) Cable..... | 1 |
| 3) Housing start | 1 |
| 4) Housing end..... | 1 |
| 5) Housing segments | L=1000, 1200, 1400, 1600, 1800 or 2000 mm
(for quantity see Table 1.1) |
| 6) Tape with grating | 1 |
| 7) Guiding tape | 1 |
| 8) Left end cap..... | 1 |
| 9) Right end cap..... | 1 |
| 10) Junction seal for end caps | 2 |
| 11) Junction seal | n° of housing segments + 1 |
| 12) Screw M5 x 90 (DIN912) | 1 (with washer and o-ring seal) |
| 13) Screw M4 x 80 (DIN912) | 1 (with washer and o-ring seal) |
| 14) Screw M4 x 18 (DIN912) | 4 (+ 4 washers) |
| 15) Screw M4 x 10 (DIN912) | 2 (+ 2 washers) |
| 16) Screw M2.5x16 (DIN7985A - +P) | 4 (+ 4 washers DIN433) |
| 17) Rubber bolt Ø18 | 2 |
| 18) Sealing lips | 2 x (ML+0.5 m) * |

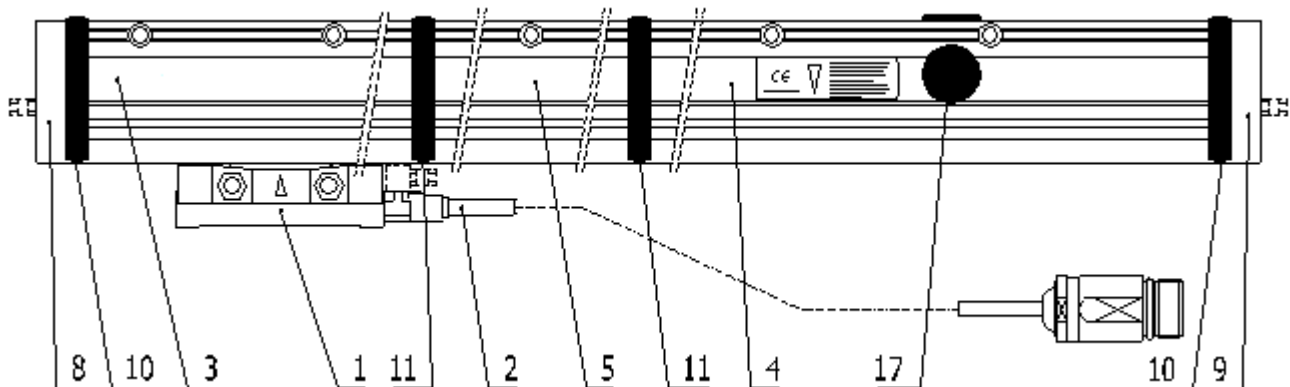


Figure 1.1

Components supplied for installation:

- Screw M5 x 50 DIN912..... $n=(ML-240)/200+4$ (e.g. ML=16840mm; n=87)
- Washer M5 DIN 433..... $n=(ML-240)/200+4$ (e.g. ML=16840mm; n=87)
- Screw M6 x 40 DIN912.....2 (For reader head mounting)
- Cable clamp (small).....4
- Screw M4 x 10 DIN 7985A (+P).....4 (For cable clamping)
- Installation manual.....1
- Air injection valve for scale housing.... 2
- Air injection valve for reader head..... (if specified in the order)

* ML = Measuring Length

Measuring length [mm]	Housing			Measuring length [mm]	Housing			Measuring length [mm]	Housing		
	Start	Interm.	End		Start	Interm.	End		Start	Interm.	End
3240	1	2	1	12240	1	6	1	21240	1	11	1
3440	1	2	1	12440	1	7	1	21440	1	11	1
3640	1	2	1	12640	1	7	1	21640	1	11	1
3840	1	2	1	12840	1	7	1	21840	1	11	1
4040	1	2	1	13040	1	7	1	22040	1	11	1
4240	1	2	1	13240	1	7	1	22240	1	11	1
4440	1	3	1	13440	1	7	1	22440	1	12	1
4640	1	3	1	13640	1	7	1	22640	1	12	1
4840	1	3	1	13840	1	7	1	22840	1	12	1
5040	1	3	1	14040	1	7	1	23040	1	12	1
5240	1	3	1	14240	1	7	1	23240	1	12	1
5440	1	3	1	14440	1	8	1	23440	1	12	1
5640	1	3	1	14640	1	8	1	23640	1	12	1
5840	1	3	1	14840	1	8	1	23840	1	12	1
6040	1	3	1	15040	1	8	1	24040	1	12	1
6240	1	3	1	15240	1	8	1	24240	1	12	1
6440	1	4	1	15440	1	8	1	24440	1	13	1
6640	1	4	1	15640	1	8	1	24640	1	13	1
6840	1	4	1	15840	1	8	1	24840	1	13	1
7040	1	4	1	16040	1	8	1	25040	1	13	1
7240	1	4	1	16240	1	8	1	25240	1	13	1
7440	1	4	1	16440	1	9	1	25440	1	13	1
7640	1	4	1	16640	1	9	1	25640	1	13	1
7840	1	4	1	16840	1	9	1	25840	1	13	1
8040	1	4	1	17040	1	9	1	26040	1	13	1
8240	1	4	1	17240	1	9	1	26240	1	13	1
8440	1	5	1	17440	1	9	1	26440	1	14	1
8640	1	5	1	17640	1	9	1	26640	1	14	1
8840	1	5	1	17840	1	9	1	26840	1	14	1
9040	1	5	1	18040	1	9	1	27040	1	14	1
9240	1	5	1	18240	1	9	1	27240	1	14	1
9440	1	5	1	18440	1	10	1	27440	1	14	1
9640	1	5	1	18640	1	10	1	27640	1	14	1
9840	1	5	1	18840	1	10	1	27840	1	14	1
10040	1	5	1	19040	1	10	1	28040	1	14	1
10240	1	5	1	19240	1	10	1	28240	1	14	1
10440	1	6	1	19440	1	10	1	28440	1	15	1
10640	1	6	1	19640	1	10	1	28640	1	15	1
10840	1	6	1	19840	1	10	1	28840	1	15	1
11040	1	6	1	20040	1	10	1	29040	1	15	1
11240	1	6	1	20240	1	10	1	29240	1	15	1
11440	1	6	1	20440	1	11	1	29440	1	15	1
11640	1	6	1	20640	1	11	1	29640	1	15	1
11840	1	6	1	20840	1	11	1	29840	1	15	1
12040	1	6	1	21040	1	11	1	30040	1	15	1

Table 1.1

2.1 Dimensions



2.2 Precautions

2.2.1 Recommended mounting positions

Install L50 scale as suggested in Figure 2.2, to prevent contamination from dust and liquids.

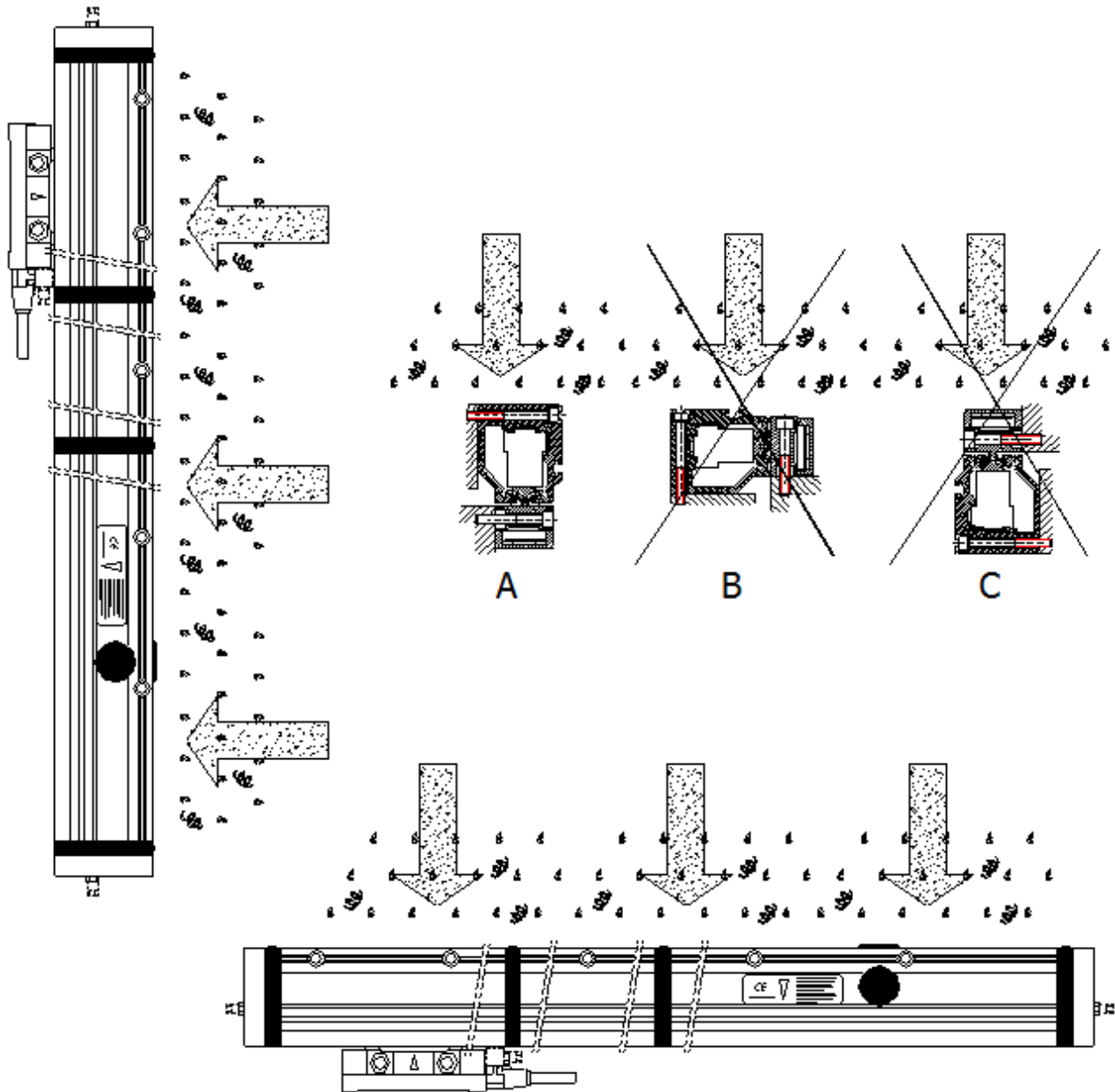


Figure 2.2

The use of a sheet metal cover (especially for particularly exposed axes) is recommended to prevent any damage from falling tools or material and from infiltration of oils or fluids.

2.2.2 Preventing overrun

The use of safety devices (e.g. stoppers) is recommended whenever the reader head risks hitting the optical scale's ends, while moving along the entire measuring length.

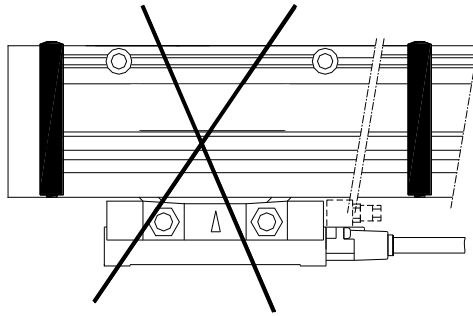


Figure 2.3

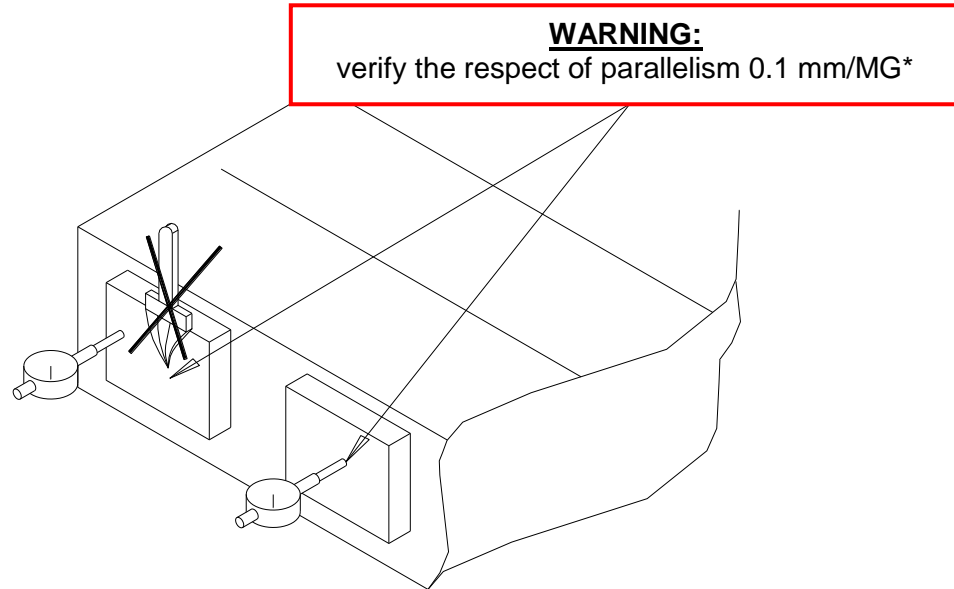
2.3 Tools required for installation

- Distance plate 4 mm; for segment positioning (see Figure 2.7)
- Marking pin Ø 6; to mark the position of M5 threaded holes on the machine (see Figure 2.7)
- Bracket for reader head mounting
- Hexagon wrench for M2.5 (2 mm) 1
- Hexagon wrench for M5 (4 mm) 1
- Hexagon wrench for M6 (5 mm) 1
- Screwdriver no. 2 (+) 1
- Tap drill M5 1
- Tap drill M6 1
- Drill Ø 4.2 1
- Drill Ø 5 1

2.4 Mounting procedure

2.4.1 Preliminary operations

1. The mounting surface must be clean and free of paint



* MG = Machine Guide

Figure 2.4

2. Mounting tolerances

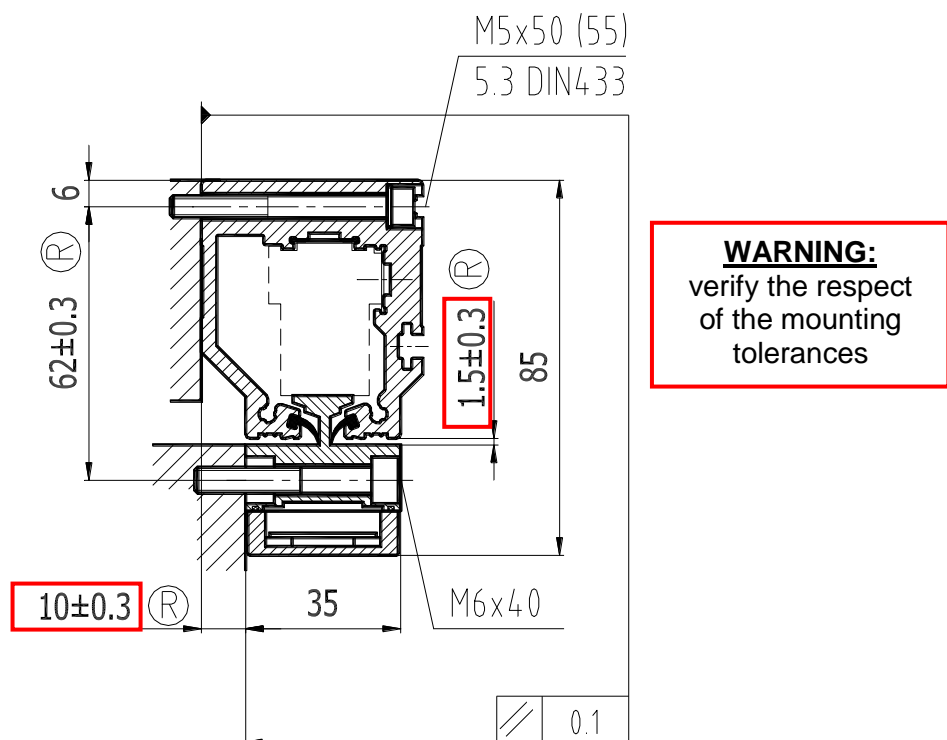


Figure 2.5(a)

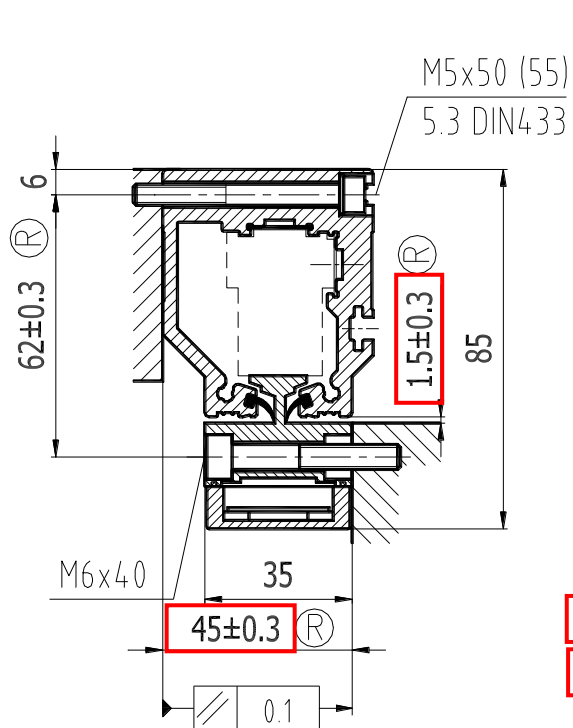


Figure 2.5(b)

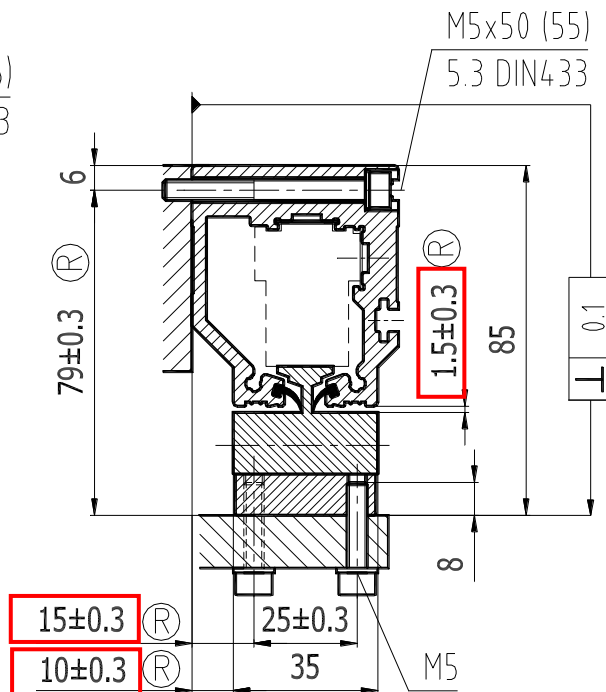


Figure 2.5(c)

2.4.2 Mounting the scale body

1. Mounting the housing segments:
 - a. Mounting of the housing start:

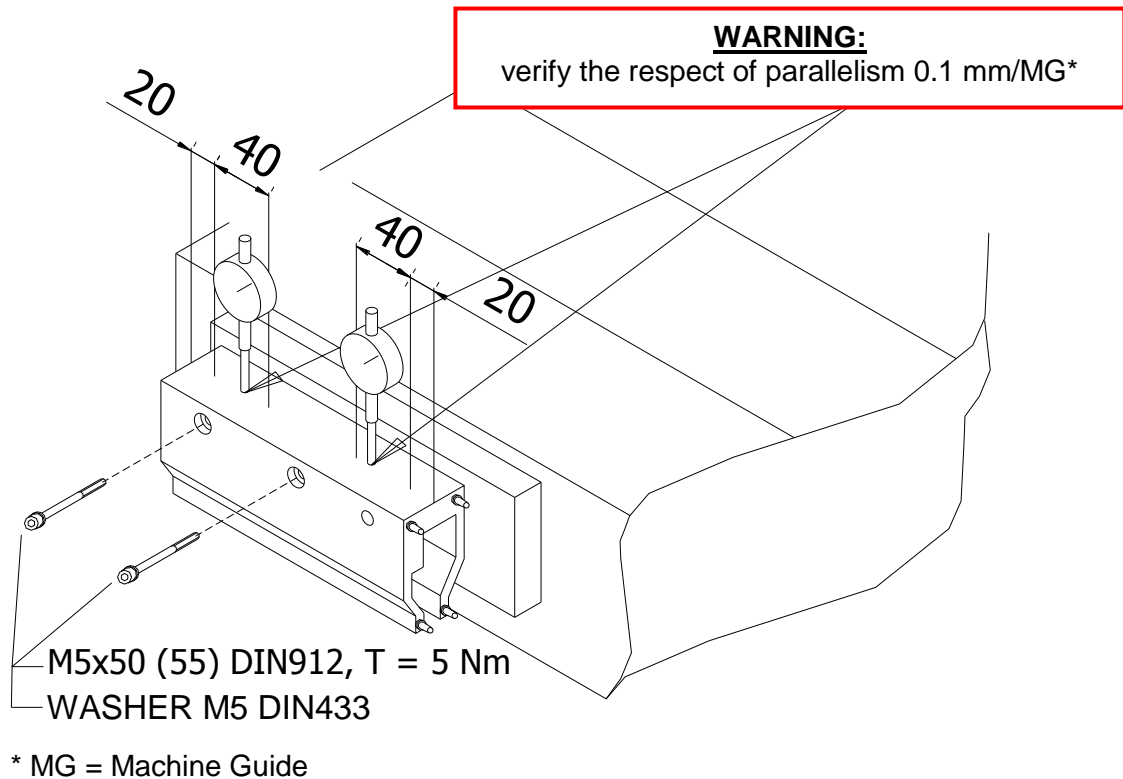
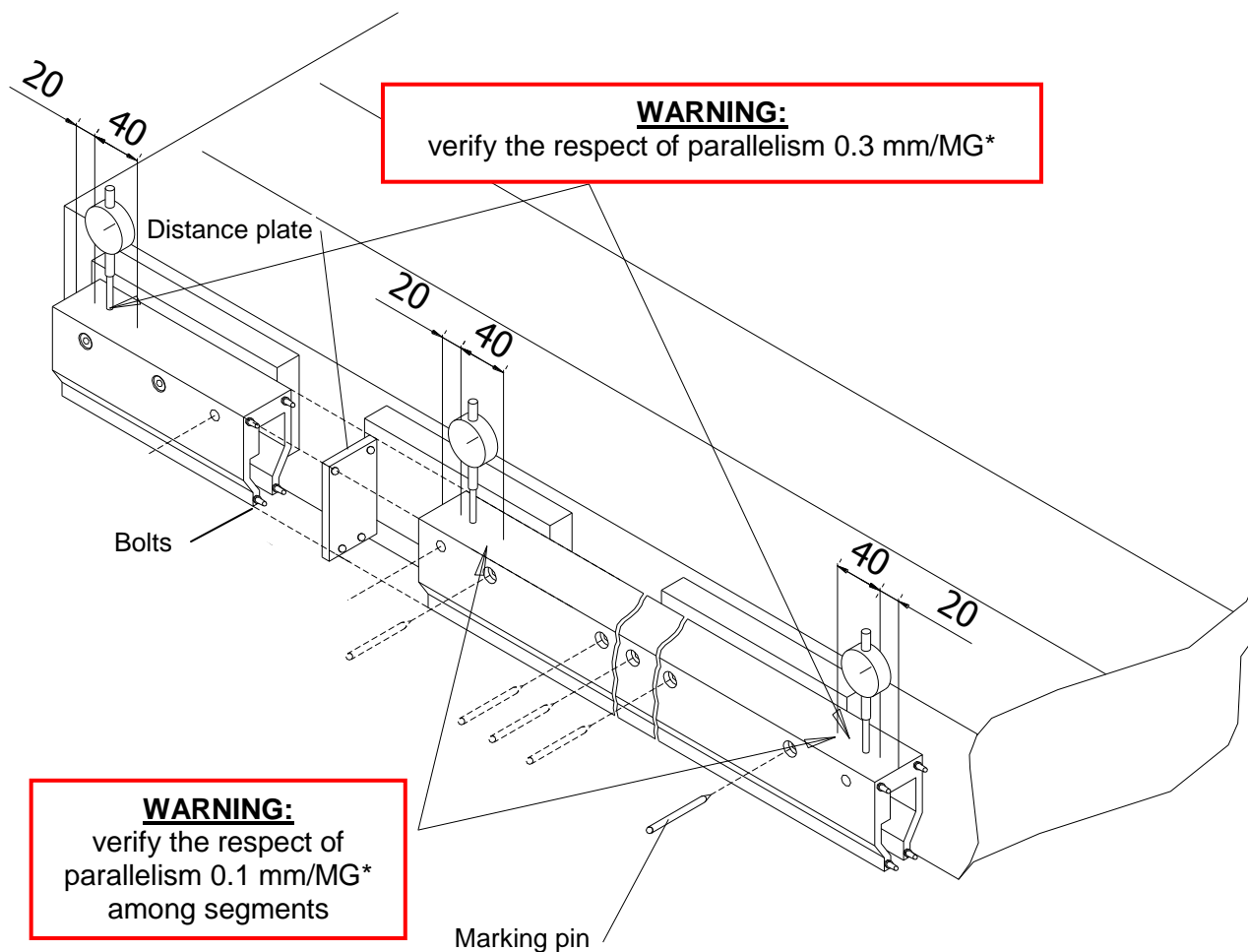


Figure 2.6

Note: During installation, make sure that no contamination enters the scale.

b. Mounting of the intermediate segments:

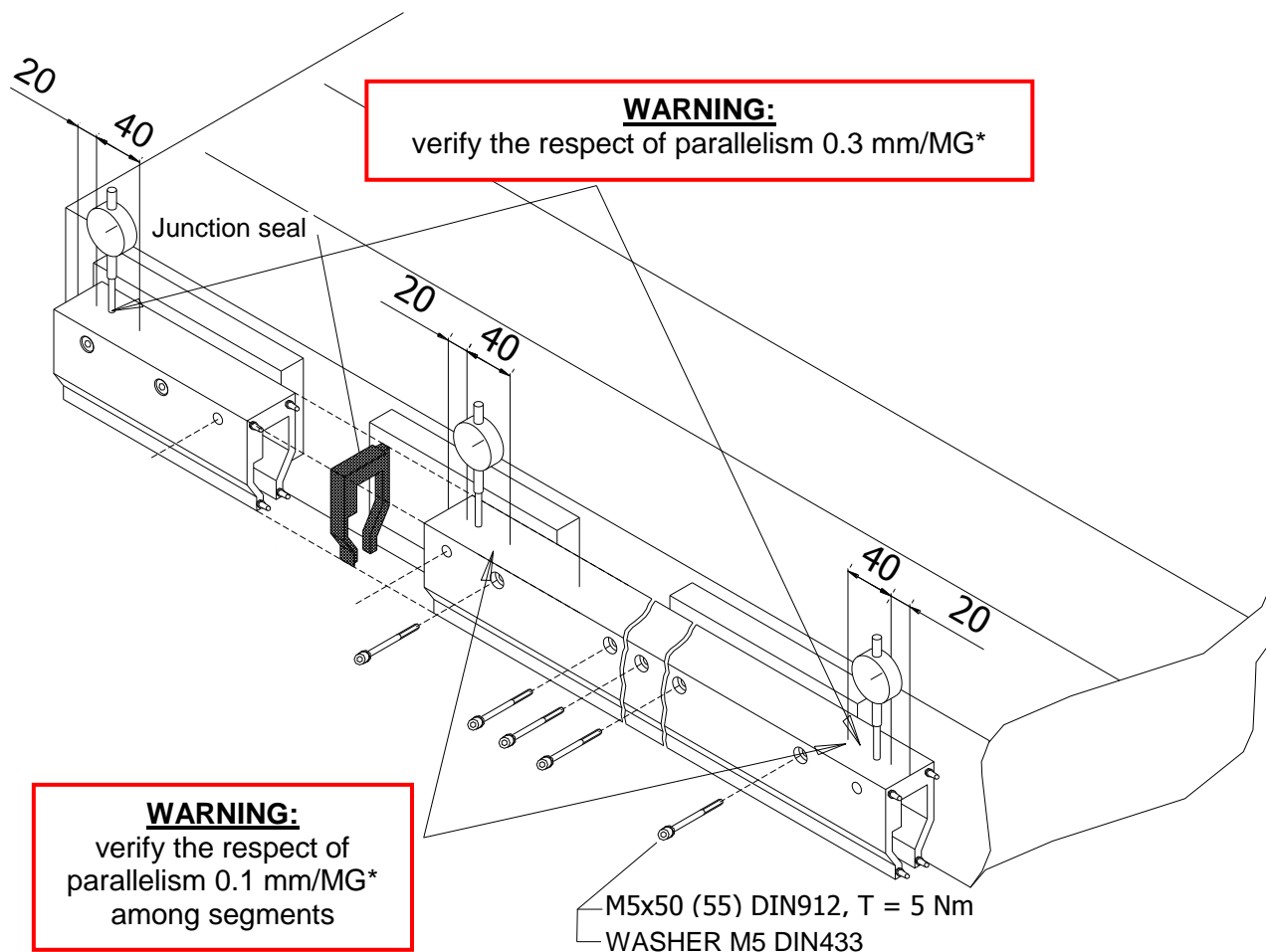
- Insert the 4 mm distance plate on the 4 bolts of the housing start.
- Place the intermediate segment in contact with the distance plate.
- Align each intermediate module to the parallelism value of 0.1 mm/MG*.
- Mark the position of the M5 threaded holes.
- Remove the segment and drill the M5 threaded holes.



* MG = Machine Guide

Figure 2.7

- Remove the distance plate and insert the junction seal on the 4 bolts.
- Fix the intermediate segment on the starting one (or other intermediate), without tightening completely the screws.
- Verify that the junction seal adheres properly to the segments (see Figure 2.9).
- Align the intermediate module to the parallelism value of 0.1 mm/MG*.
- Tighten the M5x50 (55) screws with a torque of 5 Nm.



* MG = Machine Guide

Figure 2.8

Note: All the intermediate segments must be aligned so that the entire scale will have a parallelism tolerance within 0.3 mm/MG*.

Note: The junction seal protects the optical scale from dust and liquids. The best performance is obtained with a distance of 4 ± 0.15 mm between segments, as indicated in Figure 2.9.

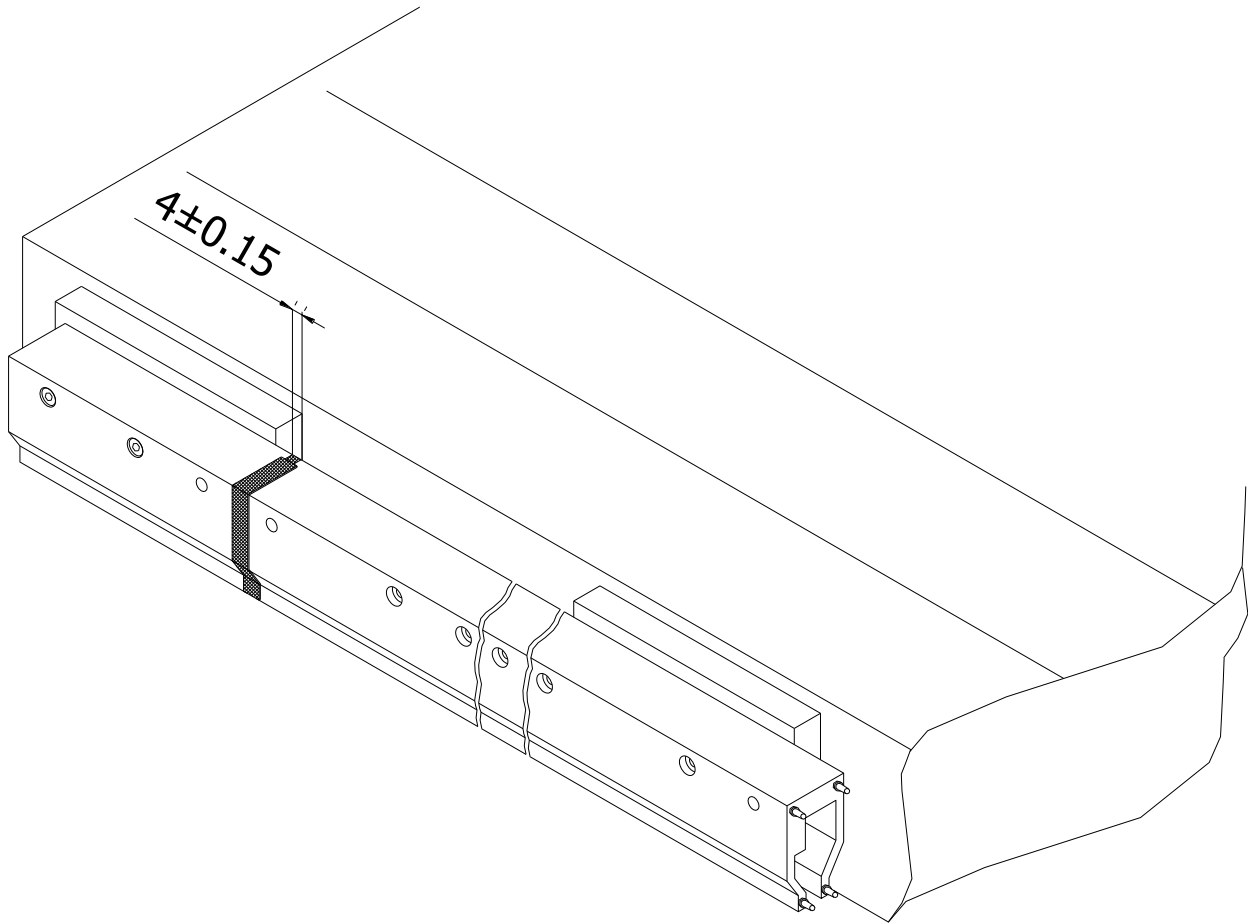


Figure 2.9

Repeat the operations described at point **b** until all the housing segments are mounted.

2. Inserting the guiding tape:

Insert the guiding tape, starting from the side with the identification label, placed on the housing start.

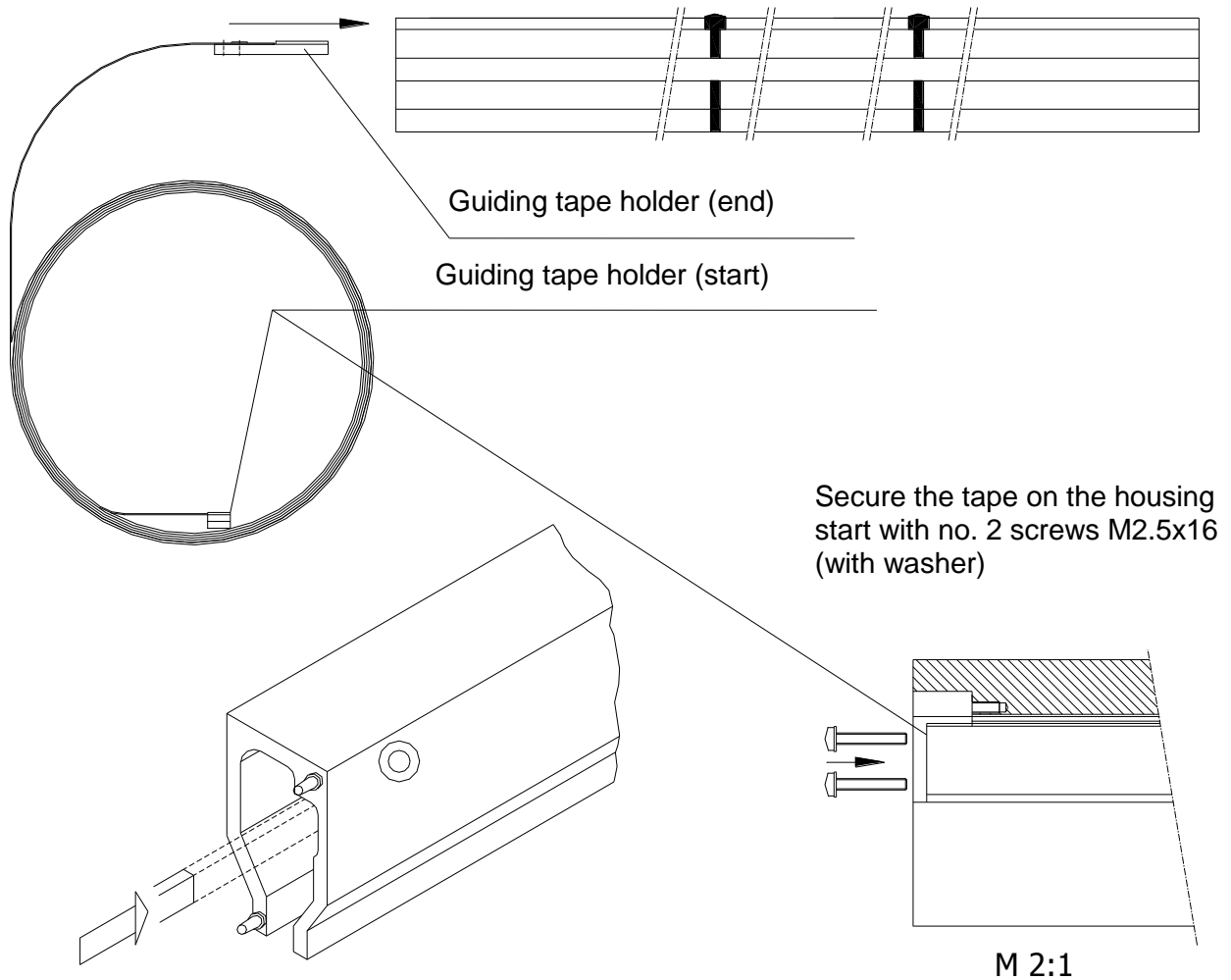


Figure 2.10

Note: Avoid any deposit of dirt on the guiding tape. For this purpose, clean the tape with a soft cloth and alcohol during insertion.
Do not bend the tape before or during its insertion on the segments.

3. Inserting the tape with grating:

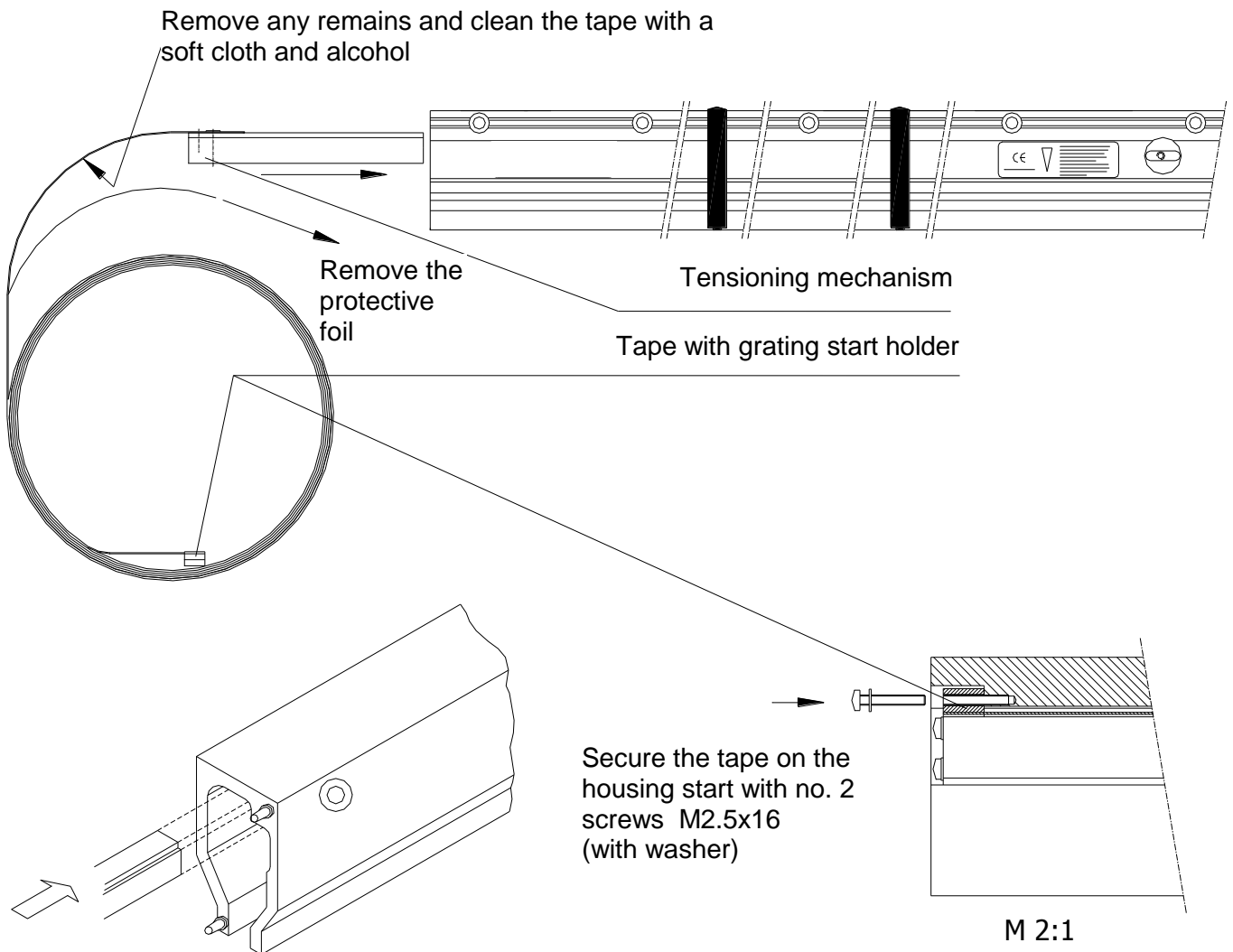


Figure 2.11

Note: Avoid any deposit of dirt on the tape. For this purpose, clean the tape with a soft cloth and alcohol during insertion.
Do not bend the tape before or during its insertion on the segments.
Do not touch the graduated area of the tape.

4. Inserting the sealing lips:

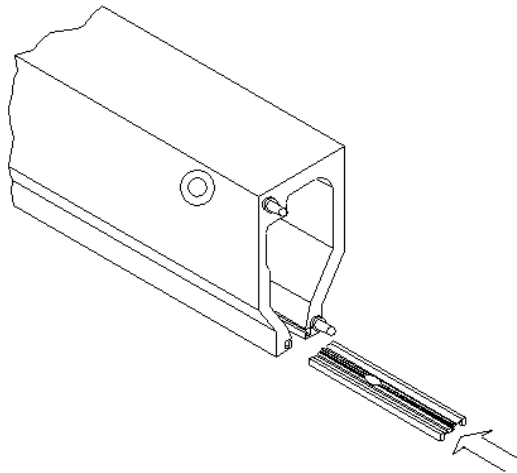


Figure 2.12

- a. Insert the sealing lips and slide them along the segments, one at a time.
- b. Cut the sealing lips with a cutter, so that they stick out of the housing end by around 16 mm (see Figure 2.13).

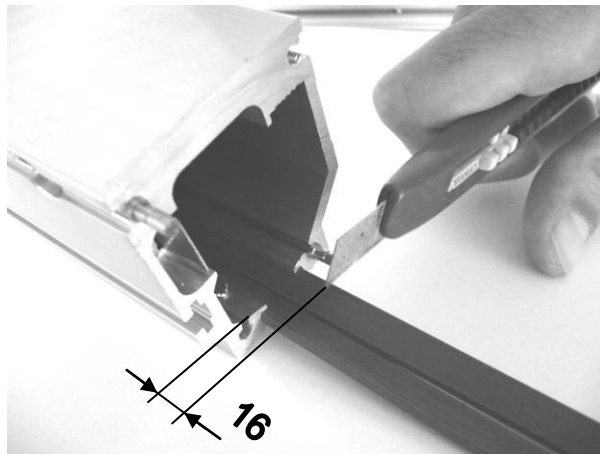


Figure 2.13

- c. Make a 6 mm incision in the final part of both sealing lips, so that they appear as shown in Figure 2.14. This incision will allow the installer to tighten screw A in the end cap (see Figure 2.16).

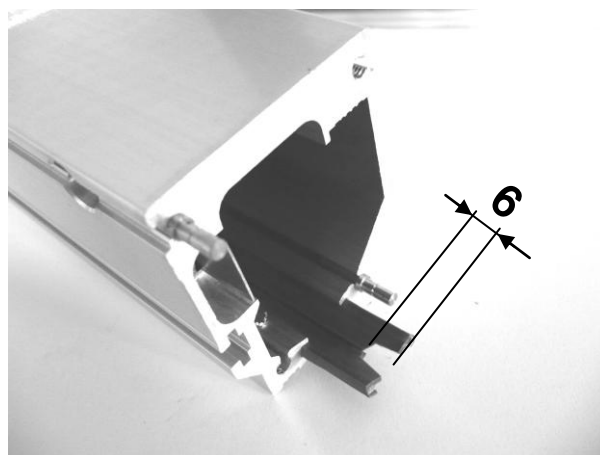


Figure 2.14

5. Fixing the final end cap and tensioning the tape and guiding tape:
- After having inserted and cut the sealing lips as indicated in the previous paragraph, mount the junction seal for the end cap (see Figure 2.15).
 - Mount the final end cap.
 - Secure the end cap with screws M4x18 DIN912 with washers.

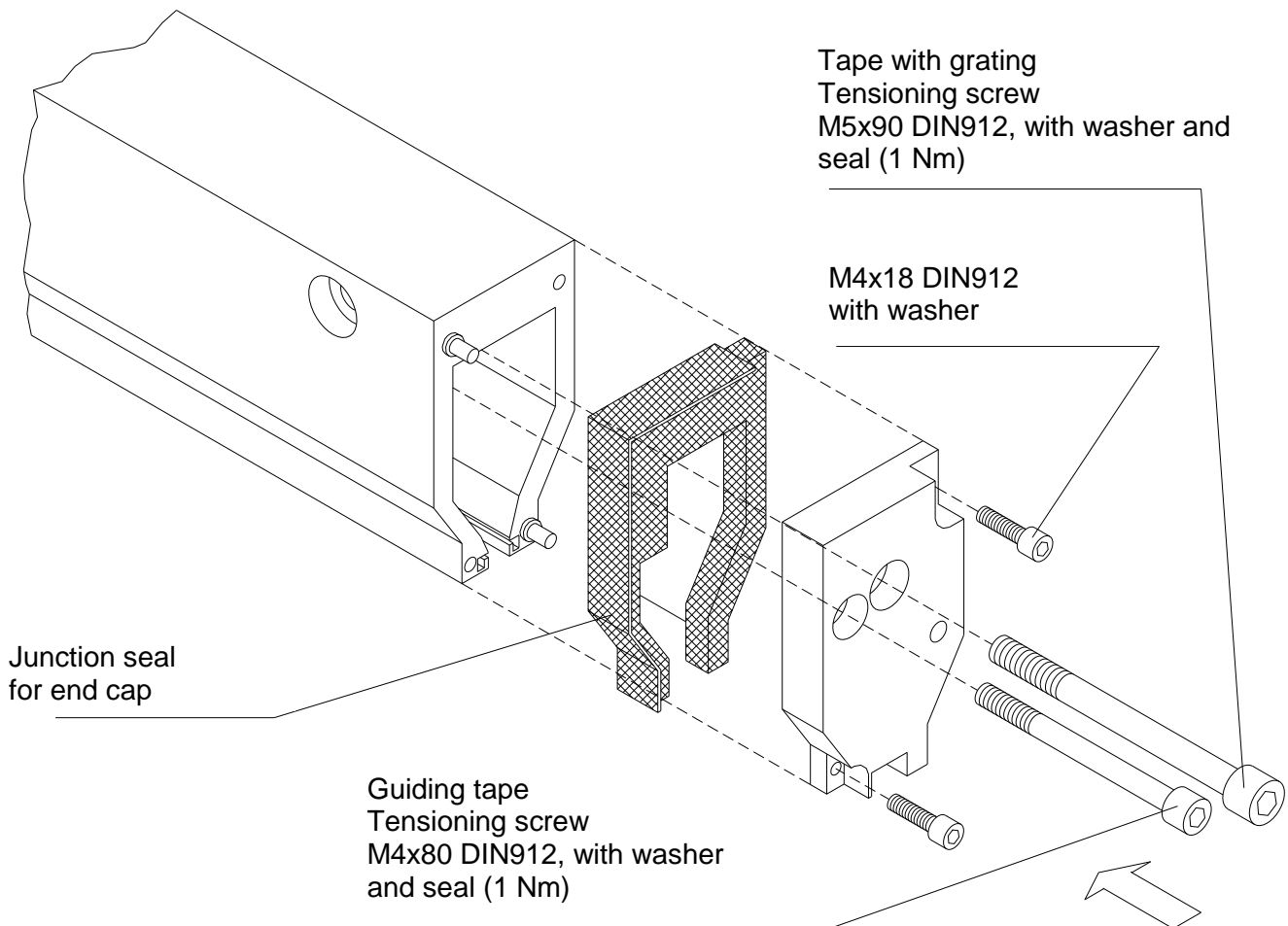


Figure 2.15

- Secure the sealing lips with screw A in plaque B, oriented as shown in Figure 2.16.

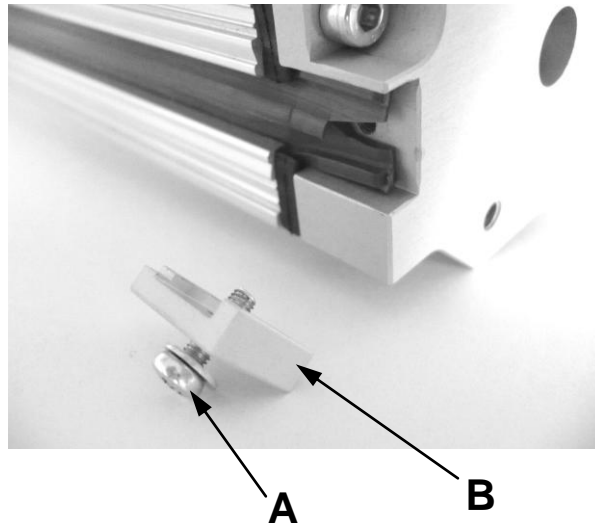


Figure 2.16

- e. Tense the guiding tape with the tensioning screw M4x80 DIN912 with washer and seal (torque 1 Nm).
- f. Tense the tape with grating with the tensioning screw M5x90 DIN912 with washer and seal (torque 1 Nm).

2.4.3 Mounting the reader head

1. Select the cable orientation:

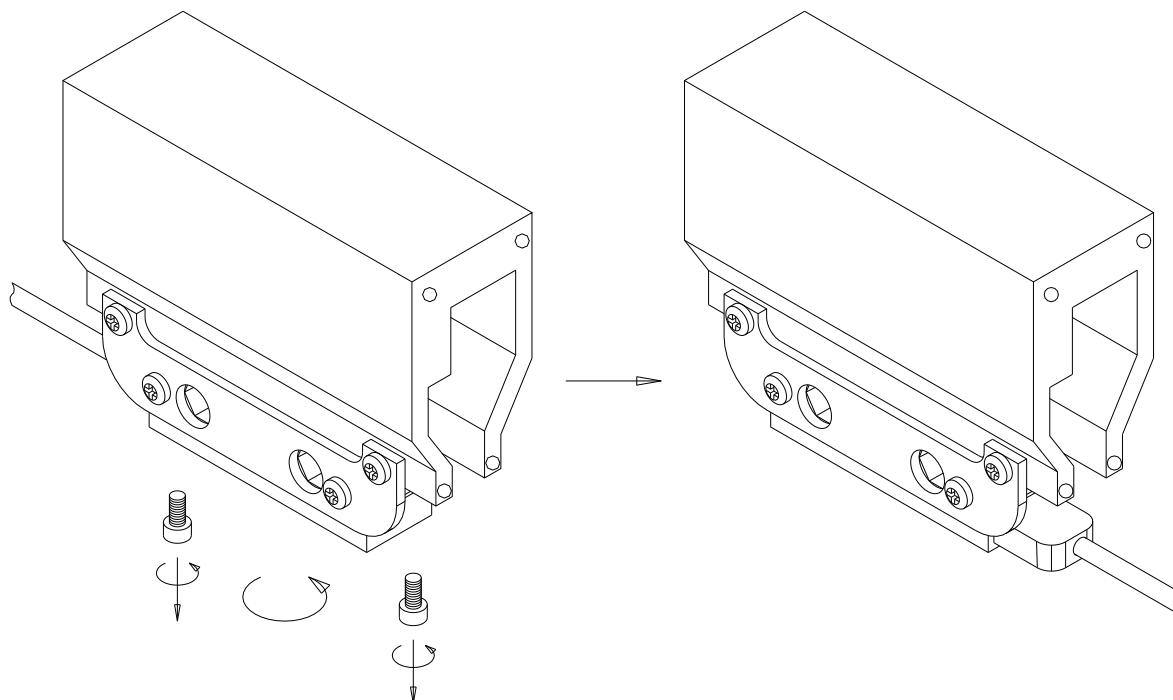


Figure 2.17

2. Insert the reader head:

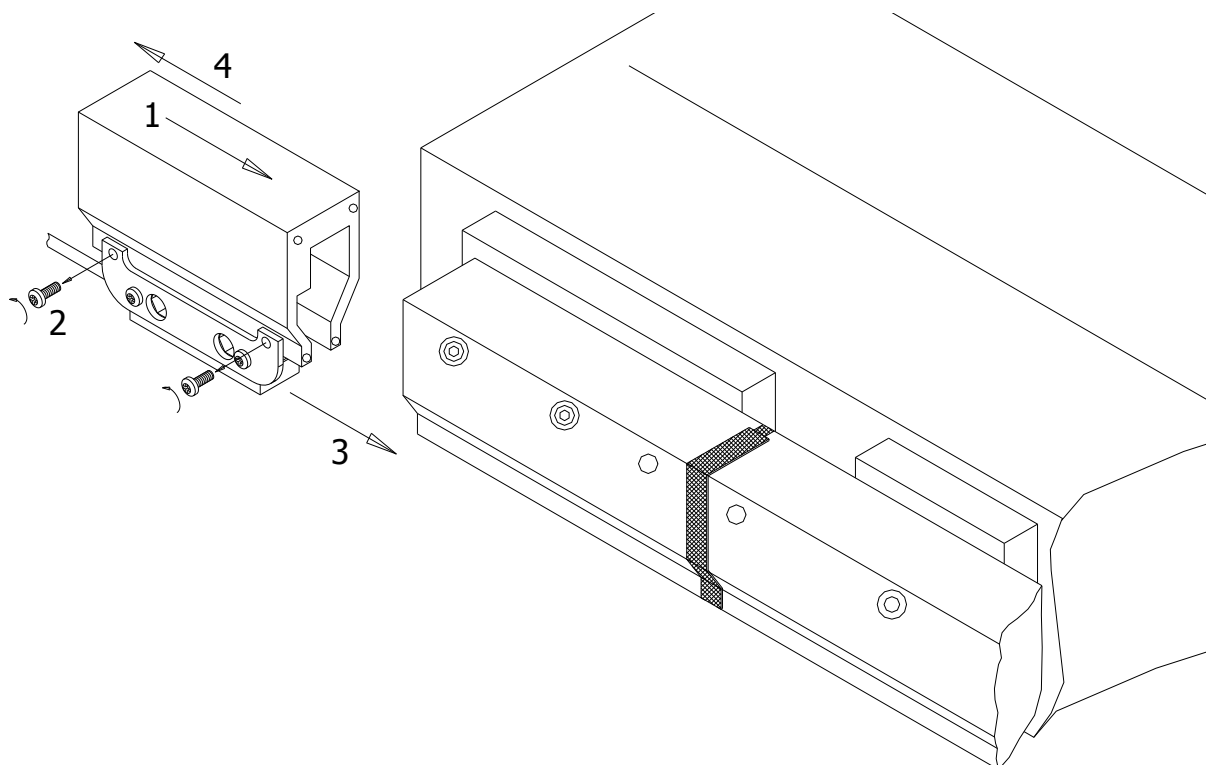


Figure 2.18

3. Fix the reader head:

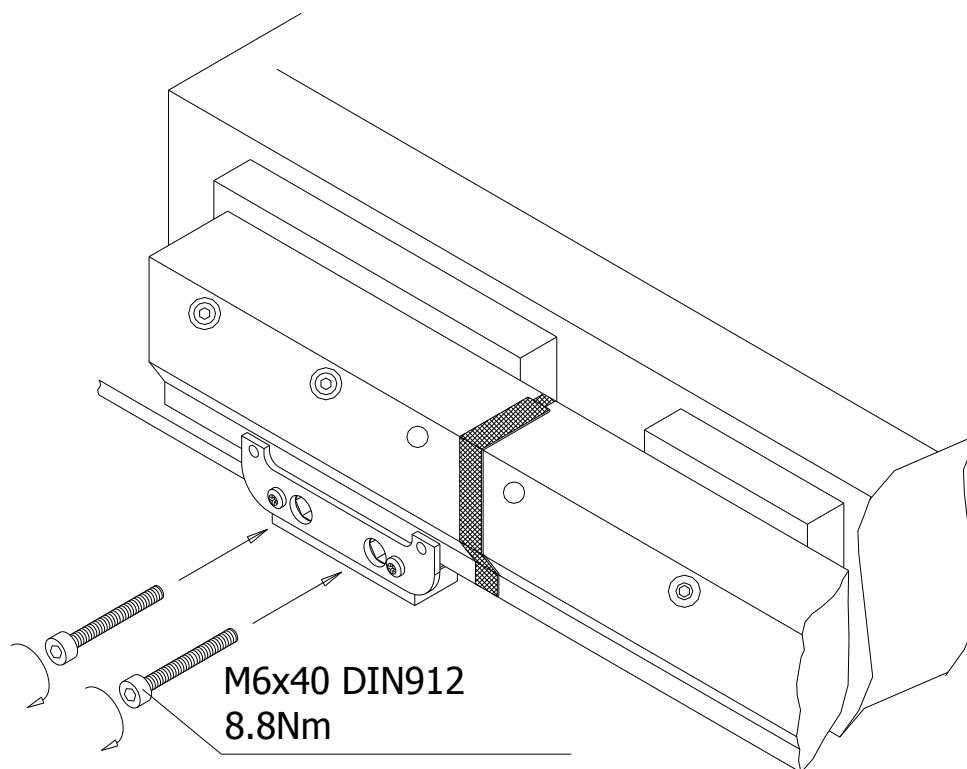


Figure 2.19

4. Remove the reader head holder:

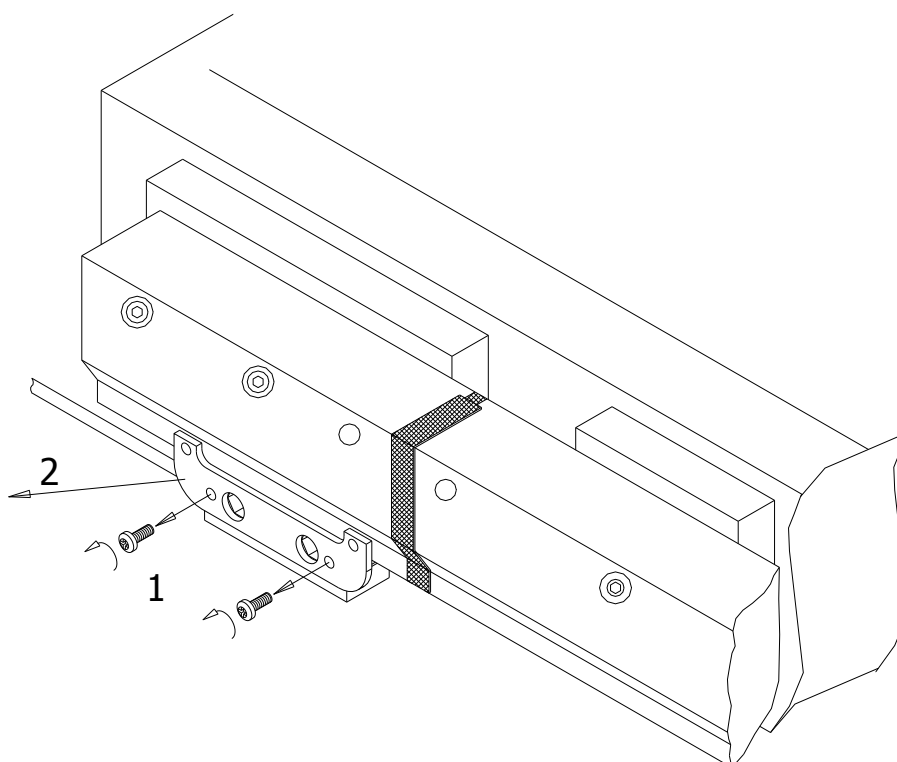


Figure 2.20

5. Fix the initial end cap:

Repeat the operation of cutting the sealing lips, as described in paragraph 2.4.2. Secure the sealing lips with screw A in plaque B (see Figure 2.16).
Fix the initial end cap.

6. Fix the cable:

Fix the cable to the reader head with M2.5 screws.
Secure the cable with cable clamps.

Note: The cable should be long enough to allow the machine to move freely during operation.

2.4.4 Final controls

Check the correct mechanical installation, that must respect the tolerances indicated in the dimensional drawing and in the entire manual.

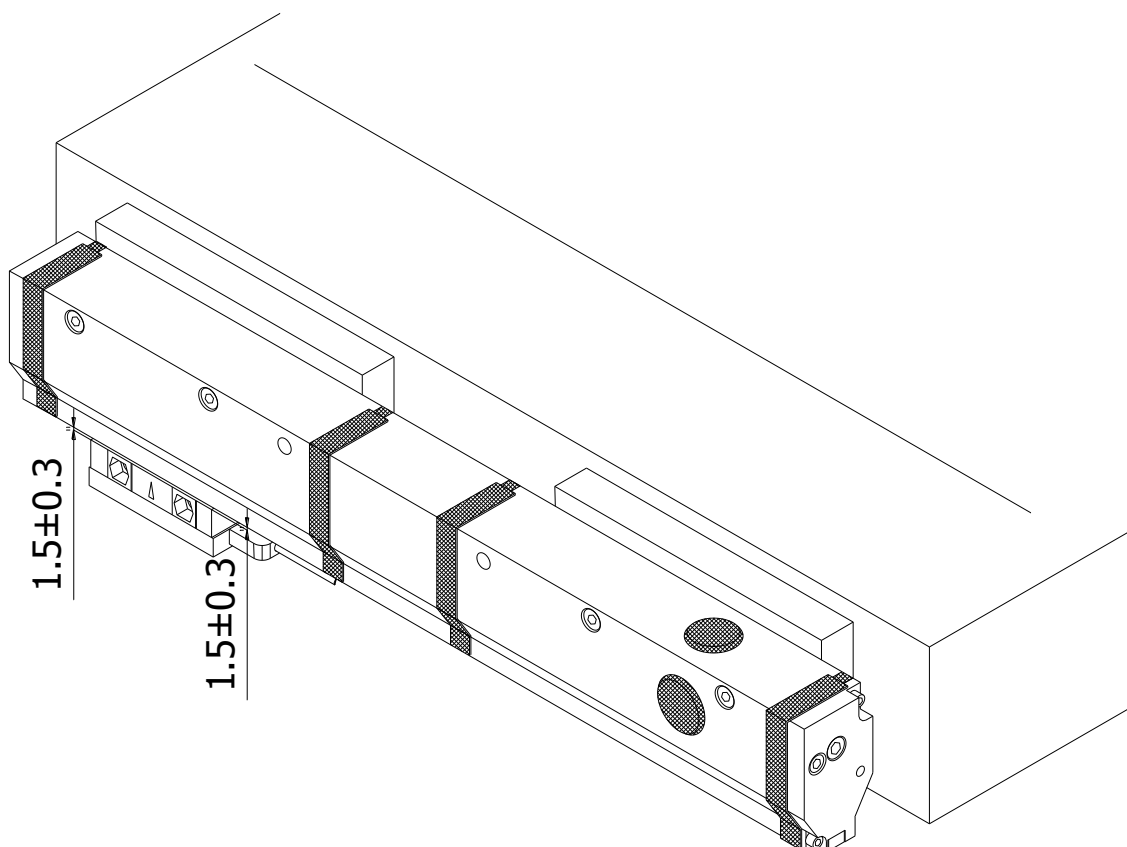


Figure 2.21

Note: Make sure a distance of 1.5 ± 0.3 mm between the reader head and the housing segments is present along the entire measuring length.

2.5 Tensioning the tape

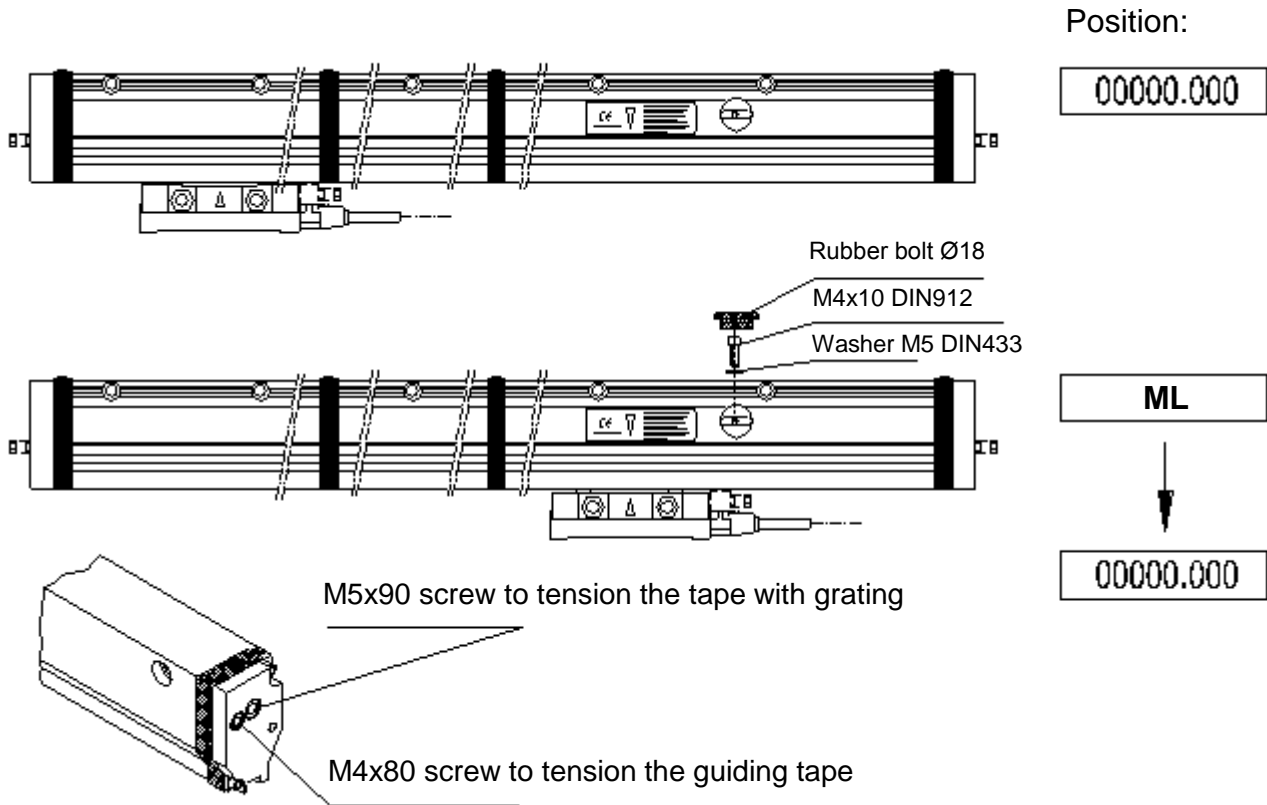


Figure 2.22

Procedure:

1. Place the reader head at the beginning of the measuring length and set the value of 0.000 on the CNC / DRO.
2. Place the reader head at the end of the measuring length and take note of the measured value (ML).
3. Loosen the tensioning screw of the tape with grating up to the end of the regulation range.
4. Select the position 0.000.
5. Tighten the tensioning screw of the tape with grating until the value ΔL is displayed, where $\Delta L = ML \times 0.01/1000$
E.g.: $ML = 6640 \text{ mm}$, $\Delta L = 6640 \times 0.01/1000 = 0.0664 \text{ mm}$
6. Secure the tensioning mechanism with M4x10 screw and cover the profile with the rubber bolt Ø18.
7. Secure the guiding tape with M4x10 screw and cover the profile with the rubber bolt Ø18.

2.6 Index selection

L50 models with selectable indexes (model E) allow the user to select the reference index position, according to his needs.

To select the index position, a magnet A is used. This will have to be inserted in the segments groove B (see Figure 2.23).

The first available index is positioned at 121 ± 2 mm from the end cap. Following indexes are placed along the entire measuring length, with a constant pitch of 50 mm.

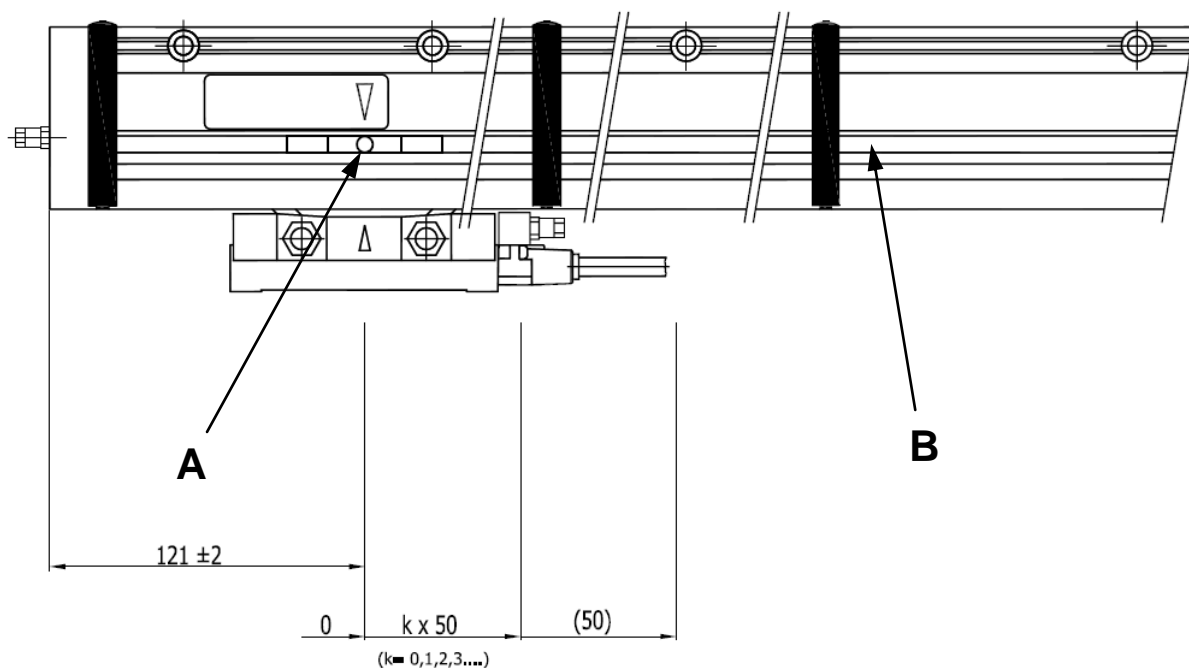


Figure 2.23

Warning:

Do not place magnets or magnetic bodies close to the scale, to prevent reference indexes from being accidentally activated in undesired positions.

2.7 Pressurization

In particularly aggressive environments, characterized by dusts, fluids, etc., the pressurization of the scale is recommended to guarantee an **IP 64** protection class. Compressed air can be injected from both ends of the scale (inlet A in the end caps) or, alternatively, from the reader head (inlet B to be required in the order).

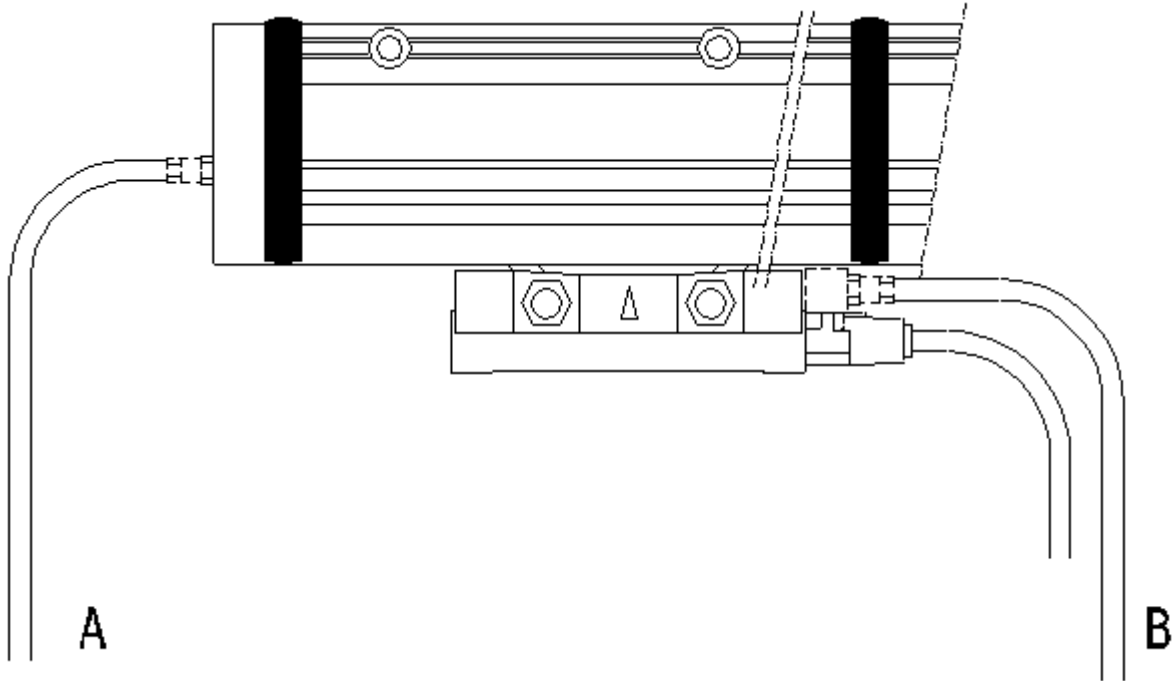


Figure 2.24

Pressurization needs to be always active. If this is not possible, wait at least 30 minutes from the last machining, before interrupting the air flow.

The necessary compressed air flow varies between 8 and 11 l/min per optical scale.

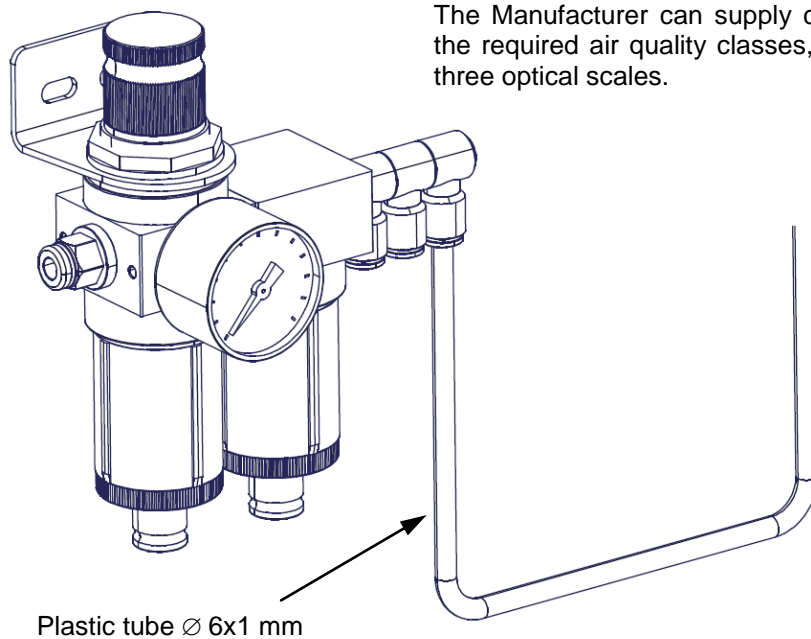
Depending on the length of the measuring system, the recommended pressures are between 0.9 and 1 Bar (13 ÷ 14.5 psi).

The compressed air introduced in the measuring system must be cleaned and comply with the following quality classes as per ISO 8573-1.

- Solid contaminants: Class 1 solid particles size $\leq 0.1 \mu\text{m}$
- Pressure dew point: Class 4 $\leq +3 \text{ }^{\circ}\text{C}$
- Oil content: Class 1 $\leq 0.01 \text{ mg/m}^3$

Moreover, the pneumatic circuit has to be endowed with a drying system and controlling devices (sense pneumatic pressure, etc.). The use of a sensor for the air flow control at the scale inlet is recommended.

Replace the filter cartridges when necessary; interrupt pressurization before proceeding with the replacement.



The Manufacturer can supply compressed air units that respect the required air quality classes, allowing the connection of up to three optical scales.

Figure 2.25

How to prevent condensate, when pressurization is not active:

- Clean frequently the machine guides close to the scale, avoiding the use of compressed air.
- Protect the scale against coolants as much as possible, avoiding the stagnation of liquids in the machine's collecting tank.
- Protect, if possible, the scale from the direct contact with vapours developed during the working cycle (with upper covers closed on the side or lower screens to prevent the vapour from laying on the sealing lips).

Possible causes of an ineffective pressurization and remedies:

- Inadequate filtering and air quality. Respect the instructions provided.
- Insufficient air pressure. Respect the pressure values suggested by the Manufacturer.
- Filters blocked by liquids or dust. Use self-draining filters or regularly empty the glasses and replace the filter cartridges.
- Broken, obstructed or blocked air pipes. Verify their integrity.
- Damaged sealing lips. Replace them and verify the respect of the scale's alignment tolerances.
- Deactivation of pressurization during machining. Wait at least 30 minutes from the last machining, before disconnecting pressurization. Make sure that, without pressurization, the scale is not immersed in stagnating liquids.
- Presence of liquid jets that hit the scale directly or indirectly, with a higher pressure if compared to the pressurization one. Use covers to adequately protect the scale from such jets.

3 DEVICE CONNECTION

3.1 Output signals and electrical connections

3.1.1 L50-AV (1 Vpp) model

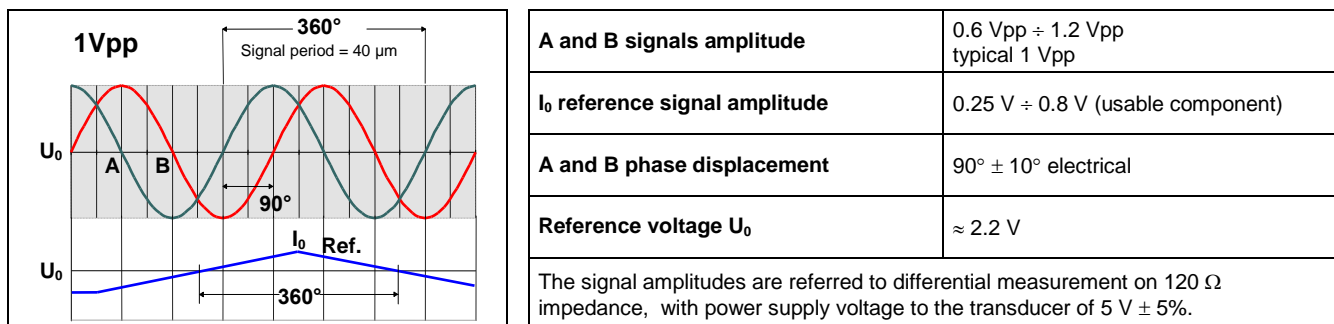


Figure 3.1

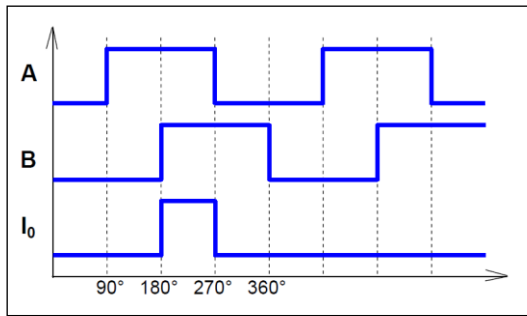
For model **L50-AV (1 Vpp)**, the following output signals are available:

SIGNALS	CONDUCTOR COLOR	Pin layout Connector C12 (round, 12 pins)
A	Green	5
\overline{A}	Brown	6
B	Black	8
\overline{B}	Red	1
I ₀	Grey	3
$\overline{I_0}$	Pink	4
0V	Violet	10
0V sense	Blue	11
5V sense	White	2
0V	Green - White	10
5V	Green - Yellow	12
SHIELD	Shield	*

*Shield is connected to connector body

Table 3.1

3.1.2 L50-F (TTL) model



Signals amplitude	LINE DRIVER ($V_{OH} \geq 2.5 \text{ V}$ $V_{OL} \leq 0.5 \text{ V}$) TTL
Load per channel	$R = 120 \Omega$ $I_L = \pm 20 \text{ mA}_{MAX}$
A and B phase displacement	$90^\circ \pm 5^\circ$ electrical

Figure 3.2

For model **L50-F (TTL)**, the following output signals are available:

SIGNALS	CONDUCTOR COLOR
A	Green
\overline{A}	Brown
B	Red
\overline{B}	Black
I_0	Pink
$\overline{I_0}$	Grey
Not connected	Blue
0V sense	Violet
5V sense	White
0V	Green - White
5V	Green - Yellow
SHIELD	Shield

Table 3.2

3.2 Connecting cable

Avoid placing the cable close to any device that could cause electromagnetic interferences (e.g. motors, solenoid valves, inverters, etc.). If interferences are detected, act directly on the source of disturb using EMC filters.

If cable extensions are needed, it is necessary to use shielded cables with a section of at least 0.5 mm^2 for power supply and 0.14 mm^2 for signals.

The scale is supplied with a standard 4 m-long cable, suitable to continuous movements, but longer cables are available on request.

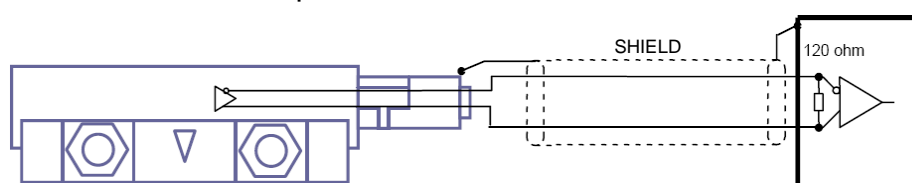


Figure 3.3

The connection between the reader head and the CNC / DRO must be ensured; in case of cable extension, it is necessary to guarantee the electrical connection between the body of the connectors.



Figure 3.4

3.2.1 Voltage drop through the cable

In case of cable extension, on the power supply wires a voltage drop occurs due to cable length. Measure the voltage drop and compensate the value at the origin.

Measure the resistance value on the connector with an ohmmeter (between pin “0V” and pin “5V”, creating a short circuit on the opposite side of the cable).

The voltage drop according to the measured resistance value is depicted in Figure 3.5.

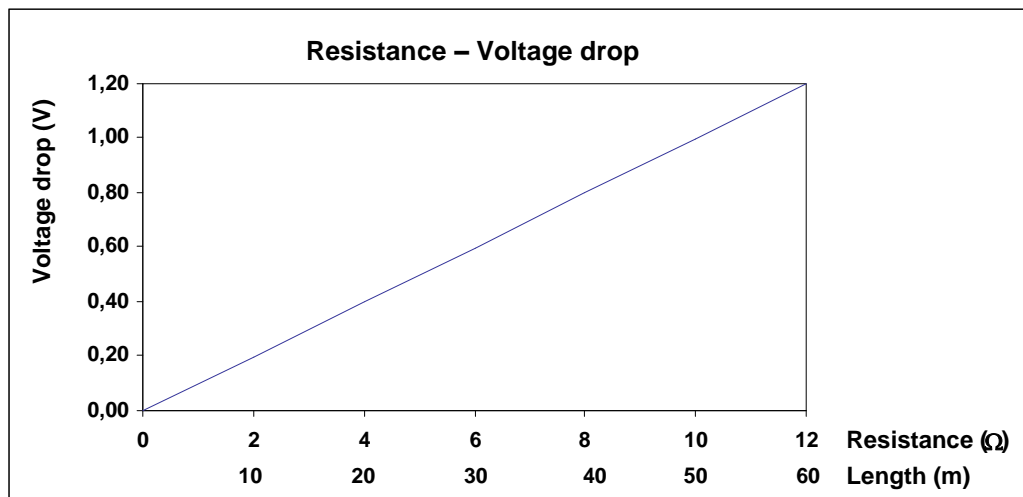


Figure 3.5

4 TECHNICAL SPECIFICATIONS

4.1 L50-AV (1 Vpp) model



Model L50	AV
Measuring support	stainless steel
Grating pitch	40 μm 
Thermal expansion coefficient	$10.6 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$
Reference index (I_0)	C = coded distance (80 mm) P = constant step (50 mm) E = selectable (with magnet)
Resolution	up to 0.1 μm *
Accuracy grade	$\pm 10 \mu\text{m}$ **
Measuring length ML	up to 30040 mm with steps of 200 mm. Segments length: 1000, 1200, 1400, 1600, 1800, 2000 mm
Max. traversing speed	90 m/min
Max. acceleration	30 m/s^2
Required moving force	$\leq 6 \text{ N}$ (0.6 Kgf)
Vibration resistance (EN 60068-2-6)	$\leq 300 \text{ m/s}^2$ [50 ÷ 2000 Hz]
Shock resistance (EN 60068-2-27)	$\leq 300 \text{ m/s}^2$ [11 ms]
Protection class (EN 60529)	IP 53 standard IP 64 pressurized
Operating temperature	0 ÷ 50 $^{\circ}\text{C}$
Storage temperature	-20 ÷ 70 $^{\circ}\text{C}$
Relative humidity	20% ÷ 70% (not condensed)
Sliding block	by ball bearings ◎
Power supply	5 V \pm 5%
Current consumption	100 mA_{MAX} (with $R = 120 \Omega$)
A and B output signals Period	1 Vpp 40 μm 
Max. cable length	150 m
Electrical connections	see Table 3.1
Electrical protections	inversion of polarity and short circuits
Weight	1.8 kg + 3.3 kg/m

Table 4.1

* Depending on CNC division factor.

** The declared accuracy grade of $\pm X \mu\text{m}$ is referred to a measuring length of 1 m.

4.2 L50-F (TTL) model




Model L50	F
Measuring support	stainless steel
Grating pitch	40 μm 
Thermal expansion coefficient	$10.6 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$
Reference index (I_0)	C = coded distance (80 mm) P = constant step (50 mm) E = selectable (with magnet)
Resolution	F100 F50 F10 F05 10 μm 5 μm 1 μm 0.5 μm
Accuracy grade	$\pm 10 \mu\text{m}^*$
Measuring length ML	up to 30040 mm with steps of 200 mm. Segments length: 1000, 1200, 1400, 1600, 1800, 2000 mm
Max. traversing speed	90 m/min
Max. acceleration	30 m/s^2
Required moving force	$\leq 6 \text{ N}$ (0.6 Kgf)
Vibration resistance (EN 60068-2-6)	$\leq 300 \text{ m/s}^2$ [50 ÷ 2000 Hz]
Shock resistance (EN 60068-2-27)	$\leq 300 \text{ m/s}^2$ [11 ms]
Protection class (EN 60529)	IP 53 standard IP 64 pressurized
Operating temperature	0 ÷ 50 $^{\circ}\text{C}$
Storage temperature	-20 ÷ 70 $^{\circ}\text{C}$
Relative humidity	20% ÷ 70% (not condensed)
Sliding block	by ball bearings 
Power supply	5 V $\pm 5\%$
Current consumption	150 mA_{MAX} (with R = 120 Ω)
A and B output signals	LINE DRIVER  PUSH-PULL
Max. cable length	50 m
Electrical connections	see Table 3.2
Electrical protections	inversion of polarity and short circuits
Weight	1.8 kg + 3.3 kg/m

Table 4.2

* The declared accuracy grade of $\pm X \mu\text{m}$ is referred to a measuring length of 1 m.

5 MAINTENANCE AND SERVICE

- L50 linear encoders do not require any particular maintenance and the correct use guarantees quality and good operation.
- During mounting, verify the alignment tolerances and correct any misalignment.
- Do not use compressed air to clean the product.
- Any discrepancy should be reported to the Manufacturer for repairing or replacement of defective parts.
- In case of overrun, cable damage, deformation of the scale unit and/or other conditions detrimental to the functioning of the scale, stop immediately the machine and contact the Manufacturer.



Without prior notice, the products may be subject to modifications that the Manufacturer reserves to introduce as deemed necessary for their improvement.

6 WARRANTY TERMS

The warranty term is 12 months from the day of encoder shipping.

The Manufacturer warrants within the warranty term to replace or repair faulty encoder free of charge on conditions that installation, operation and storage rules have been observed by Customer.

The Manufacturer warranty does not cover faulty encoder if encoder was installed improperly not keeping Operating Instruction requirements, if during encoder operation mechanical and electrical parameters exceeded permissible values and if Customer individually repaired and disassembled an encoder.

The Manufacturer declines any responsibility for damages to people or properties deriving from the use of encoder, including any loss of profit or any other direct, indirect or incidental loss.