

# User's guide

## ATI



Incremental magnetic tape

- Resistant to dust, liquids, and oils
- Cover strip included (not attached)
- Standard rolls up to 20m

### Suitable for the following models:

- ATI incremental tape

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The logo for Lika Electronic s.r.l. features the word "lika" in a bold, lowercase, sans-serif typeface. The letter "i" is stylized with a dot that is slightly offset to the right. The letters are black and set against a plain white background.

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# Typographic and iconographic conventions

In this guide, to make it easier to understand and read the text the following typographic and iconographic conventions are used:

- parameters and objects both of Lika device and interface are coloured in **GREEN**;
- alarms are coloured in **RED**;
- states are coloured in **FUCSIA**.

When scrolling through the text some icons can be found on the side of the page: they are expressly designed to highlight the parts of the text which are of great interest and significance for the user. Sometimes they are used to warn against dangers or potential sources of danger arising from the use of the device. You are advised to follow strictly the instructions given in this guide in order to guarantee the safety of the user and ensure the performance of the device. In this guide the following symbols are used:

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | This icon, followed by the word <b>WARNING</b> , is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment. |
|  | This icon, followed by the word <b>NOTE</b> , is meant to highlight the parts of the text where important notes needful for a correct and reliable use of the device can be found. User must pay attention to them! Failure to comply with instructions could cause the equipment to be set wrongly: hence a faulty and improper working of the device could be the consequence.                                                                                     |
|  | This icon is meant to highlight the parts of the text where suggestions useful for making it easier to set the device and optimize performance and reliability can be found. Sometimes this symbol is followed by the word <b>EXAMPLE</b> when instructions for setting parameters are accompanied by examples to clarify the explanation.                                                                                                                           |

# Preliminary information

This guide is designed to provide the most complete and exhaustive information the operator needs to correctly and safely install and use the **ATI magnetic tape** for incremental and absolute linear encoders.

Lika Electronic's range includes the following models of magnetic tapes:

- ATI-...: magnetic tape designed for use with quadrature incremental and Sine-Cosine linear encoders, available in several versions having pole pitch of 5.0 mm / 0.197”;



## **WARNING**

Always refer also to the user's guide of the matched sensor before installing the magnetic tape.

# 1 Safety summary



## 1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.



## 1.2 Warnings



**Equipment that produces strong magnetic fields must be kept as far from the tape as possible. Do not bring magnets close to the tape.**

- Install the magnetic tape following strictly the information in the “Mechanical installation” section;
- mechanical installation has to be carried out with stationary mechanical parts;
- respect the environmental characteristics of the product;
- do not tool or machine the unit unless otherwise indicated;
- do not twist or bend the magnetic tape;
- always comply with the tape's bending radius values indicated in this manual;
- we suggest installing the tape and the sensor providing protection means against waste, especially swarf as turnings, chips, or filings; should this not be possible, please make sure that adequate cleaning measures such as brushes, wipers or compressed air jets are in place in order to prevent the sensor and the tape from jamming;

- protect the tape from acid solutions and chemicals that may damage it. Please check in the following table the chemicals that have no or low impact, the chemicals that have low to medium impact and the chemicals that have high impact on the magnetic material of the tape, chemicals marked in red must never come into contact with the magnetic tape.

| No or low impact chemicals |                 |                     |
|----------------------------|-----------------|---------------------|
| Acetic acid 20%            | Acetic acid 30% | Cotton seed oil     |
| Formaldehyde 40%           | Formic acid     | Glacial acetic acid |
| Glycerine (93°C)           | Hexane          | Isooctane           |
| Kerosene                   | Lactic acid     | Linseed oil         |
| Mineral oil                | Oleic acid      | Soy bean oil        |
| Steam heat                 | Stearic acid    |                     |

| Low to medium impact chemicals |                 |                   |
|--------------------------------|-----------------|-------------------|
| Acetone                        | Acetylene       | Anhydrous ammonia |
| Isopropyl ether                | Lacquer solvent | Petrol            |
| Seawater                       | Turpentine      |                   |

| High impact chemicals |                      |                              |
|-----------------------|----------------------|------------------------------|
| Benzene               | Carbon tetrachloride | Hydrochloric acid 37% (93°C) |
| Nitric acid 70%       | Nitrobenzene         | Red fuming nitric acid       |
| Tetrahydrofuran       | Toluene              | Trichloroethylene            |
| Xylene                |                      |                              |

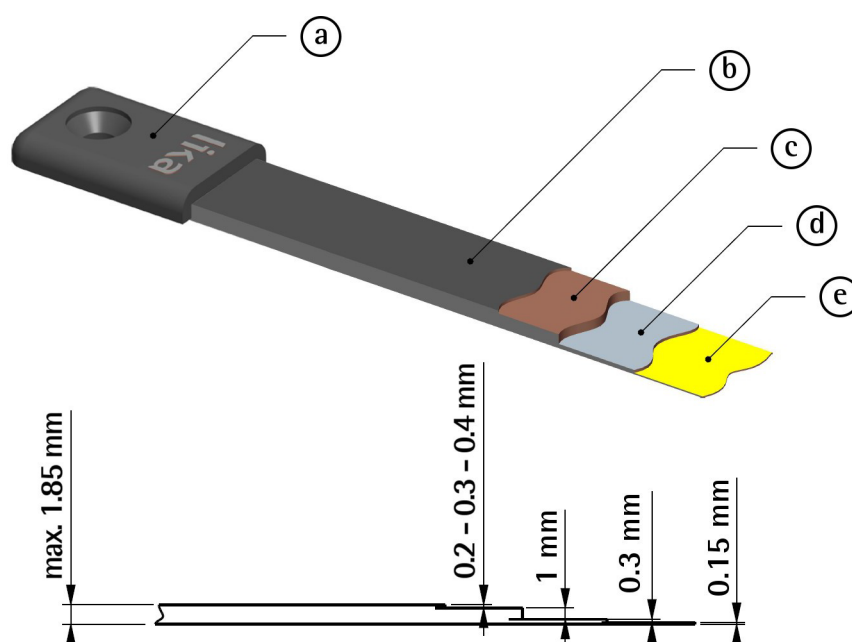
## 2 Mechanical installation



### WARNING

Installation has to be carried out by qualified personnel only, with power supply disconnected and mechanical parts compulsorily in stop. Do not tool or machine the unit unless otherwise indicated.

### 2.1 Magnetic tape structure



### Label

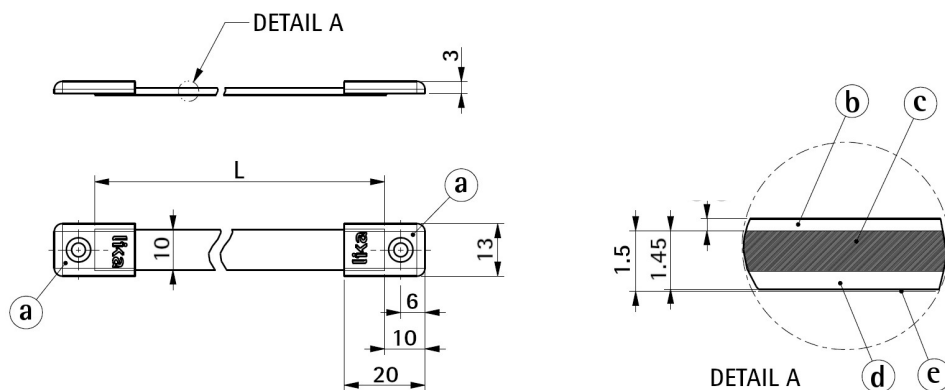
|                                            |                                         |
|--------------------------------------------|-----------------------------------------|
| (a) Tape terminal (optional)               | (d) Ferromagnetic stainless steel strip |
| (b) Stainless steel cover strip (included) | (e) Adhesive backing                    |
| (c) Polymer-ferrite composite strip        |                                         |



### NOTE

Parts (c), (d) and (e) are delivered already stuck together. The stainless steel cover strip (b) is optional but included with the order, thus it must be applied by the customer. The tape terminal (a) is optional and purchased separately.

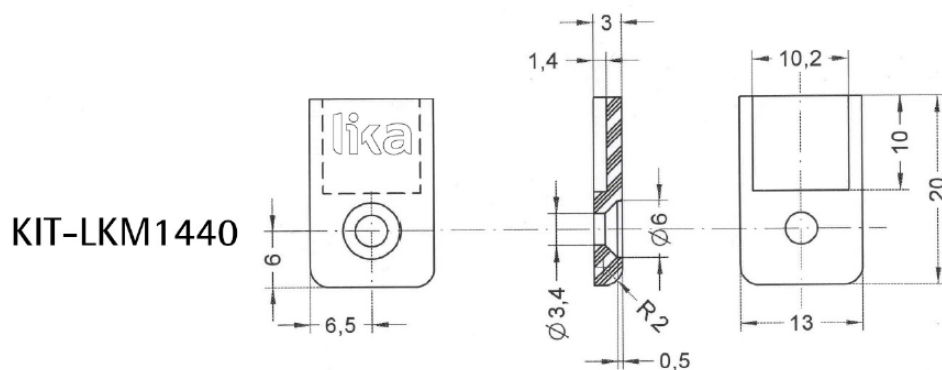
### 2.1.1 ATI tape overall dimensions



#### NOTE

Thickness of the (b) cover strip: = 0.3 mm / 0.012".

### 2.1.2 KIT-LKM1440 tape terminals overall dimensions

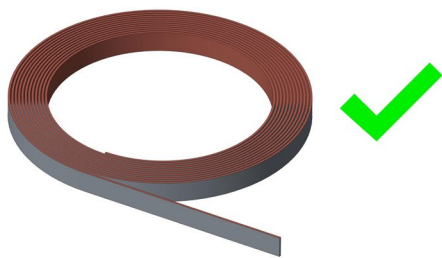


To install the tape terminals, please refer to the "2.9 Mounting the KIT-LKMI440 tape terminals" section.

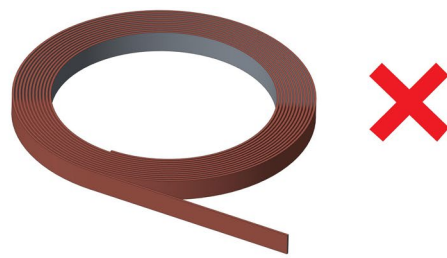
## 2.2 Transport and handling

The tape is delivered wound on coils, the magnetized side facing inwards. If supplied, the stainless steel cover strip is delivered separately; it must be applied to the magnetic tape by the customer as described in this manual (refer to the “2.8 Applying the cover strip” section).

Do not wind the tape with the magnetized side facing outwards.

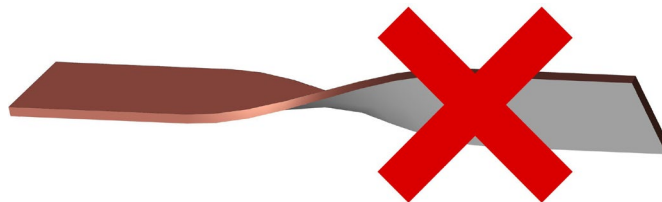


Magnetized surface  
facing inwards

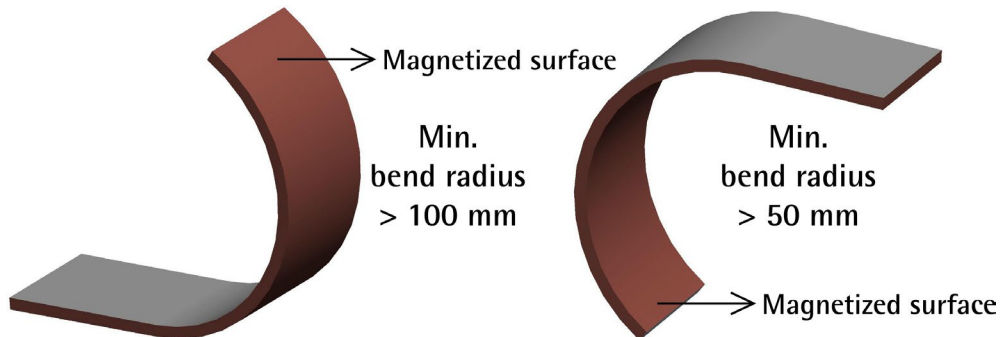


Magnetized surface  
facing outwards

Do not twist or bend the magnetic tape.



Always comply with the minimum bending radius values shown in the following Figure:



### 2.3 Preliminary information before installation



#### **WARNING**

Always refer also to the user's guide of the matched sensor before installing the magnetic tape.

Before mounting the tape and the cover strip, you must:

- clean carefully the bonding surface as detailed in the “2.4 Information on sticking the tape” and in the “2.5 Information on applying the cover strip” section;
- cut the tape and the cover strip at the required length as explained in the “2.6 Shortening and cutting the tape and the cover strip” section;
- do not apply the cover strip to the magnetic tape before they are both cut at the required length;
- do not cut the tape and the cover strip if they are already bonded together;
- stick the magnetic tape first, then apply the cover strip to the tape;

- check carefully the mounting direction of the tape; please refer also to the “User’s manual” of the encoder; mounting direction is crucial;
- check carefully the counting direction and the information printed on the surface of the absolute code tapes as well; please refer also to the “User’s manual” of the encoder; please note down the information on the print and the arrow direction before applying the cover strip.

**WARNING**

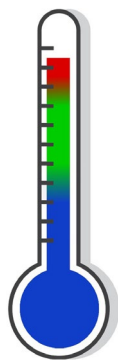
The measuring system cannot work if the encoder and the magnetic tape are mounted otherwise than indicated in the manuals.

**2.4 Information on sticking the tape**

The adhesion of the tape to the bonding surface depends on a variety of factors such as the cleaning, the temperature at application, the roughness of the materials, and the smoothness of the bonding surface. To obtain optimum and safe adhesion, the bonding surfaces must be well unified, clean, and dry. The ideal application temperature range is +21°C to +38°C (+70°F to +100°F).

**2.4.1 Cleaning the bonding surfaces**

Most substrates are best prepared by cleaning with a soft and clean cloth and one of the following solvent-based cleaners (alcoholic solvents or hydrocarbon solvents): isopropyl alcohol (IPA), heptane, trichloroethylene (please do not use on aluminium surfaces not to provoke a reaction generating chlorine acids), toluene, acetone and methyl ethyl ketone (MEK). Typical surface cleaning solvent is 50:50 mixture of isopropyl alcohol (IPA) and water (rubbing alcohol). In case of oxidation, Scotch-Brite hand pads or similar products, followed by cleaning with IPA/water, allow to abrade the surface and can increase surface area to improve adhesion.

**2.4.2 Application temperature**

+ 38°C  
+ 21°C  
+ 10°C MIN

Ideal application temperature range is +21°C to +38°C (+70°F to +100°F). The minimum suggested application temperature is +10°C (+50°F). Initial tape application to surfaces at temperatures below the suggested minimum +10°C (+50°F) is not recommended because the adhesive becomes too firm to adhere readily. However, once properly applied, low temperature holding is generally satisfactory. After application, the bond strength will increase as the

adhesive flows onto the surface. At room temperature 100% of ultimate bond strength will be achieved after approximately 72 hours.

#### 2.4.3 Bonding surface finish

As a general rule, we suggest sticking the tape on bonding surfaces that are as much smooth as possible. The surface roughness parameter (surface finish) should be  $Ra \leq 3.2$  (Class N8).

#### 2.4.4 Pressure

Bond strength is dependent upon the amount of adhesive-to-surface contact developed. Firm application pressure develops better adhesive contact and helps improve bond strength. Typically, good surface contact can be attained by applying enough pressure to insure that the tape experiences approximately 15 psi (100 kPa) pressure. Either roller or platen pressure can be used. Note that rigid surfaces may require 2 or 3 times that much pressure to make the tape experience 15 psi.

### 2.5 Information on applying the cover strip

To obtain optimum and safe adhesion of the cover strip, the polymer-ferrite surface must be well clean and dry; the ideal application temperature range is +21°C to +38°C (+70°F to +100°F). Should the polymer-ferrite material require additional surface cleaning, we suggest using a soft and clean cloth with 50:50 mixture of isopropyl alcohol (IPA) and water (rubbing alcohol), then wait for the surface to dry.



#### WARNING

Protect the tape from acid solutions and chemicals that may damage it, see on page 6.



#### NOTE

Tolerances also depend on temperature, air supply, duration of impact, liquid consistency, and several other factors. Therefore it is always advisable to test the material under real conditions.

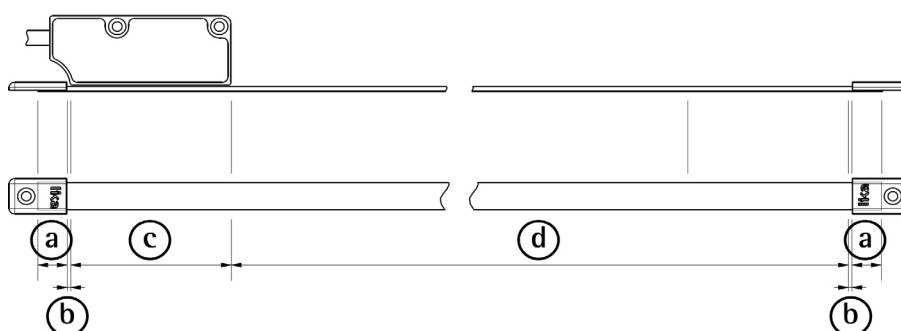
## 2.6 Shortening and cutting the tape and the cover strip

### 2.6.1 Shortening the tape and the cover strip

All the magnetic tapes both incremental and absolute can be shortened and cut at the desired length and according to needs. No limitations are imposed within the maximum length indicated in the datasheet.

The minimum length of the magnetic tape must be calculated as follows (see the Figure):

measuring length ① + sensing head bottom side length ② + the dimension of 2 pole pitches at least ③ + 1 cm (0.4") ④ if you install the optional tape terminals. The sum of ④ + ③ values must be doubled as it is intended for each end of the tape.

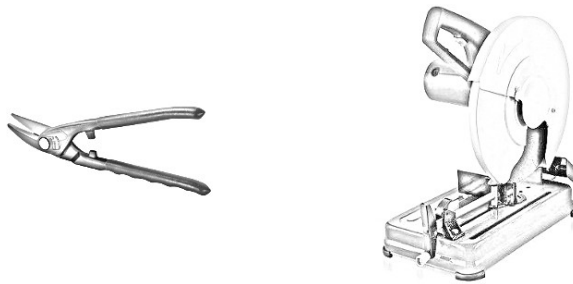


#### NOTE

Should you install both the optional tape terminals and the cover strip, please take care to cut the cover strip 2 cm / 0.79" shorter than the tape as it cannot be fixed under the terminals.

### 2.6.2 Cutting the tape and the cover strip

Use shears or a metal cutting chop saw to cut the tape and the cover strip. Please consider that the shears' blades will make a clear cut in one side and a warped cut in the other side.



#### WARNING

Please always cut the tape and the cover strip separately. Do not cut the tape and the cover strip if they are already bonded together.

### 2.7 Mounting the magnetic tape



#### WARNING

The active side of the magnetic tape (polymer-ferrite composite dark side) must always face the active side of the linear encoder (sensor's location in the enclosure).



#### WARNING

We suggest installing the tape and the sensor providing protection means against waste, especially swarf as turnings, chips, or filings; should this not be possible, please make sure that adequate cleaning measures such as brushes, wipers or compressed air jets are in place in order to prevent the sensor and the tape from jamming.

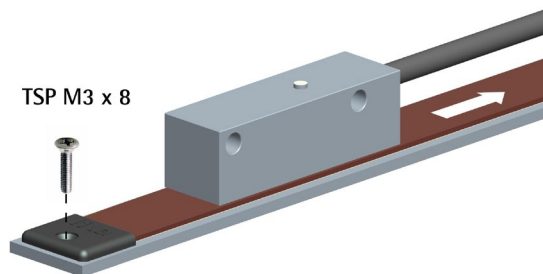


#### WARNING

Please ensure that the tape is kept in a straight line!



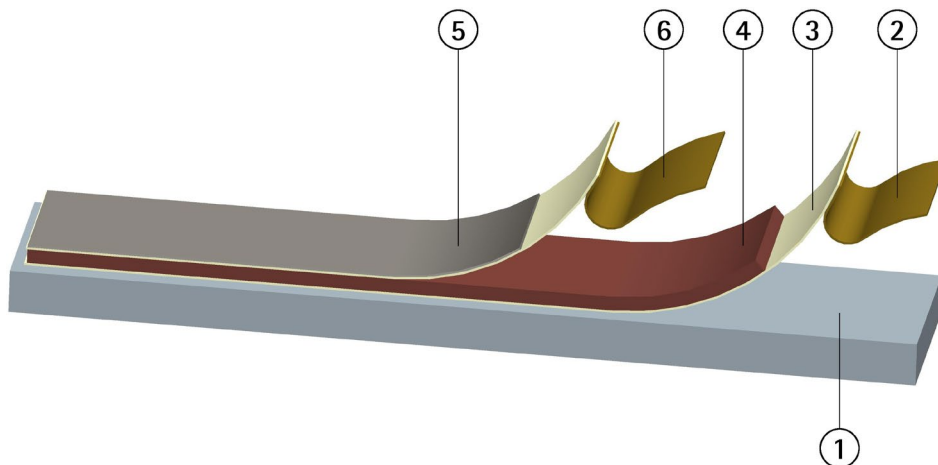
### 2.7.1 Mounting the scale with adhesive tape (Figure 1 and Figure 2)



**Figure 1 - Mounting the scale with adhesive tape**

To prevent the ends of the tape from peeling off, we suggest always mounting the optional tape terminals (refer to the “2.9 Mounting the KIT-LKMI 440 tape terminals” section).

#### Step by step procedure for mounting the scale with adhesive tape



**Figure 2 - Mounting the magnetic tape**

- Cut the magnetic tape **4** at the required length as described in the “2.6 Shortening and cutting the tape and the cover strip” section;
- clean carefully the bonding surface **1** as described in the “2.4 Information on sticking the tape” section;

- stick on the magnetic tape **4** first: peel away just a short part of the protection backing (liner) **2** from the adhesive tape **3** and stick on the first part of the tape; go on sticking short sections until bonding the whole length; apply enough pressure to insure that the tape experiences approximately 15 psi (100 kPa) pressure. Either roller or platen pressure can be used; for more information refer to the “2.4.4 Pressure” section;



**WARNING**

Make sure that the tape is always kept in a straight line. We suggest sticking on the tape inside a groove or against an edge.

- if supplied, mount the optional tape terminals **7** at both ends of the tape as described in the “2.9 Mounting the KIT-LKMI439 tape terminals” section.
- if supplied, apply the cover strip **5** as described in the “2.8 Applying the cover strip” section.

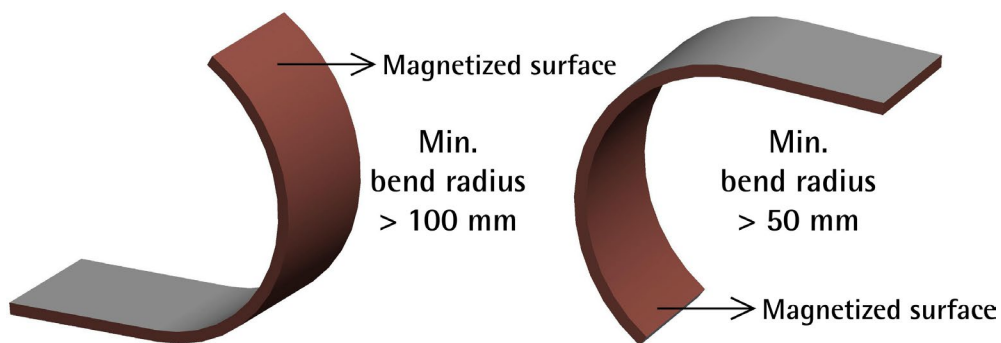


**WARNING**

While mounting the magnetic tape, the minimum bending radius cannot be less than 350 mm (14”).

**WARNING**

When you install the profile please consider that the maximum sensor gap must be calculated from the magnetized surface of the tape, not from the aluminium profile.

**2.7.2 Mounting the tape on arcs and round surfaces (Figure 3)**

**Figure 3 - Minimum bend radius**

The ATI tapes can be installed in curved structures, in arcs and even in circular surfaces.

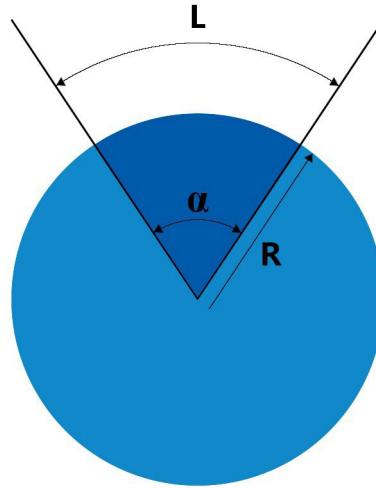
If you need to read the outer surface of the arc / circumference, the minimum bend radius must be greater than 100 mm / 3.94". If you need to read the inner surface of the arc / circumference, the minimum bend radius must be greater than 50 mm / 1.97".

The mounting procedure for circular / angular applications is the same as for linear applications, refer to the "2.7.1 Mounting the scale with adhesive tape (Figure 1 and Figure 2)" section.

**WARNING**

Please consider that the angular resolution depends on the radius of the curved support.

### 2.7.2.1 Calculating the angular resolution



The **angular resolution** can be defined as the spacing expressed in degrees (°) between two consecutive discrete points, i.e. the sequence of information provided by the encoder.

The angular resolution of a tape applied on either a curved or a circular surface results from the following calculation:

$$\text{Angular resolution} = \frac{\alpha}{\text{Number of information}}$$

where:

$$\alpha = \frac{L \times 360}{2\pi R}$$

$$\text{Number of information} = \text{number of poles} \times \text{interpolation}$$

L is the length of the tape; and R is the radius of the curved or circular surface. The number of information is the number of pulses/counts provided by the measuring system for the whole tape length L.

As you can easily see in the Figure above,  $\alpha$  is the magnitude of the angle corresponding to the length of the tape applied on the circular surface. The formula for calculating the magnitude of the angle  $\alpha$  (i.e. the size of the arc) can be argued considering that, if the magnitude of the circumference ( $2\pi R$ ) is  $360^\circ$ , then the magnitude of the tape angle will be  $360^\circ$  (circumference) or a fraction of  $360^\circ$  (arc).

The number of information depends on the length of the tape and the technical characteristics of the installed sensor.

As far as the incremental sensors and the ATI incremental tapes are concerned, we need to calculate the number of information provided by the measuring unit for the tape length. We must consider the length of the tape, the pole pitch of the tape and the interpolation factor used by the installed sensor.

The incremental tape can be long as you need and up to 20m. The pole pitch is the distance between two consecutive poles. The pole pitch of the read head must match the pole pitch of the tape. The AME95 and ATI-0500 both use 5mm pole pitch. Finally, we must consider the interpolation factor. If you need to know the interpolation factor, then you have to **divide the pole pitch value by the resolution** indicated in the order code.

$$\text{Interpolation factor} = \frac{\text{Pole pitch}}{\text{resolution}}$$

For example: as above, we use the AME95 encoder with the ATI-0500 magnetic tape; as the pole pitch of the tape is 5 mm long and the resolution of the sensor is 0.01 mm, then the interpolation factor is 100 (5mm / 0.01mm = 5).

**EXAMPLE 1****Incremental encoder system: AME95 sensor paired with the ATI-0500 incremental tape**

Let's suppose you mount a 600 mm long ATI-0500 incremental tape on an arc having a size of  $R = 150$  mm. The ATI-0500 tape is paired with an AME95 sensor. As the pole pitch of the ATI-0500 tape is 5 mm and the resolution of the sensor is 0.01 mm, then the interpolation factor is  $100\times$  ( $5 \text{ mm} / 0.01 \text{ mm}$ ).

As stated, the angular resolution results from the following calculation:

$$\text{Angular resolution} = \frac{\alpha}{\text{Number of information}}$$

First of all let's calculate the magnitude of the angle  $\alpha$ .

$$\alpha = \frac{L \times 360}{2\pi R} = \frac{600 \times 360}{2\pi \times 150} = \frac{216,000}{942.48} = 229.18$$

Now let's calculate the number of information provided for the whole tape length.

The ATI-0500 tape being 600 mm long has the number of poles as follows:

$$\text{Number of poles} = \frac{\text{Length of the tape}}{\text{Pole pitch}} = \frac{600}{5} = 120$$

Since the interpolation factor is  $\times 100$  (see above), the measuring system will provided the number of information as follows:

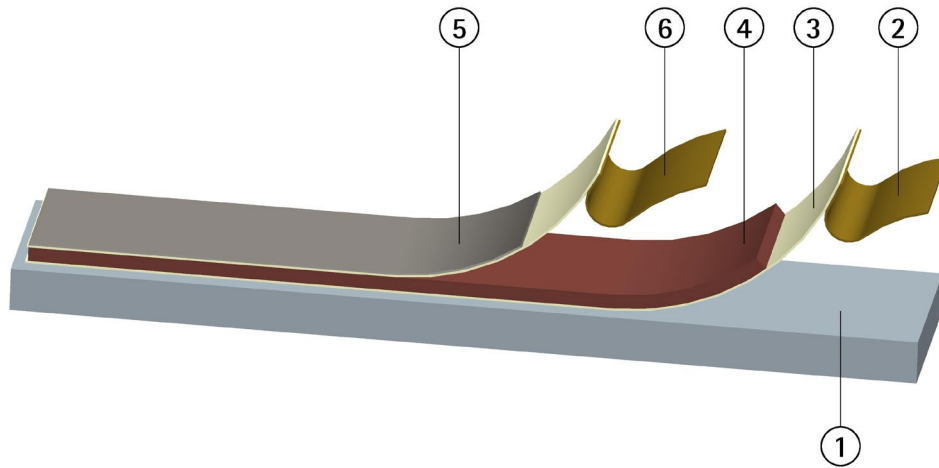
$$\text{Number of information} = \text{number of poles} \times \text{interpolation} = 120 \times 5 = 600$$

Thus it will be:

$$\text{Angular resolution} = \frac{\alpha}{\text{Number of information}} = \frac{229.18}{600} = 0.382^\circ$$

## 2.8 Applying the cover strip

For the overall dimensions of the cover strip refer to the "2.1.1 ATI tapes overall dimensions" section.



**Figure 4 - Applying the cover strip**

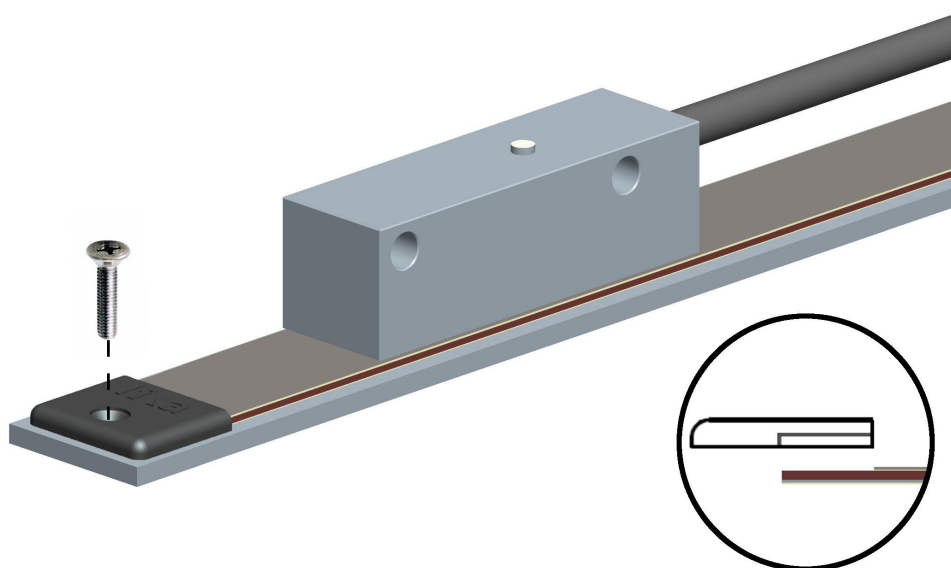
**WARNING**

Please ensure that the cover strip 5 is kept in a straight line!



Proceed as follows when you need to apply the optional stainless steel cover strip:

- cut the cover strip 5 at the required length as described in the “2.6 Shortening and cutting the tape and the cover strip” section;
- clean carefully the magnetic tape surface 4 as described in the “2.5 Information on applying the cover strip” section;
- stick on the cover strip 5: peel away just a short part of the protection backing (liner) 6 from the adhesive tape and stick on the first part of the cover strip; go on sticking short sections until bonding the whole length; apply enough pressure to insure that the tape experiences approximately 15 psi (100 kPa) pressure. Either roller or platen pressure can be used; for more information refer to the “2.4.4 Pressure” section.





**NOTE**

Please note that the cover strip thickness is 0.3 mm / 0.012".

## 2.9 Mounting the KIT-LKM1440 tape terminals

For the overall dimensions of the tape terminals refer to the "2.1.2 KIT-LKM1440 tape terminals overall dimensions" section.

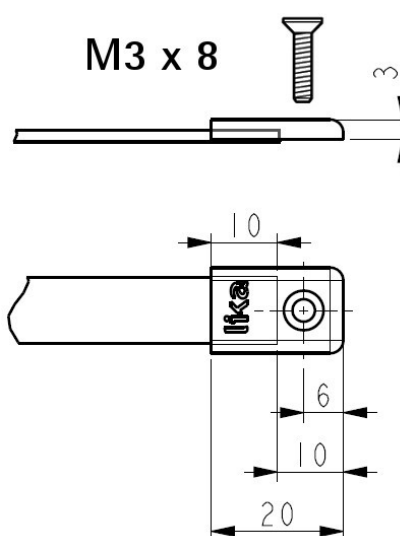
Use the provided **M3 x 8** type screws to fix the tape terminals.



**WARNING**

The terminals are designed to fix the ends of the magnetic tape (not both the tape and the cover strip). **There is not enough space to put the cover strip under the terminals.** Therefore take care to cut the cover strip 2 cm shorter than the tape and apply it to the tape section between the terminals.

For complete information please refer to the "3.6 Shortening and cutting the tape and the cover strip" section on page 16.





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