# **Functional Safety -** Absolute linear encoders

The absolute linear encoder types LMKA 2010 and LMKA 3010 with **SSI +1Vpp interface**, which provide an analog 1Vpp signal in addition to the absolute position, can be used in safety related applications under following conditions:

For the use in safety related applications all encoder types with ordering code „FA" (see also the option „Functional Safety" in the ordering code) are applicable. These are scanning heads with an purely analog 1Vpp output signal. The signal period corresponds to the grating period.

In order to be able to implement a linear encoder in a safety-related application, a suitable control is required. The control assumes the fundamental task of communicating with the encoder and safely evaluating the encoder data. AMO provides on request a technical information with MTTF values and a fault model with comments to table D8 (Motion and position feedback sensors) of the standard EN 61800-5-2.

For all linear encoders without a specified value („FA" or „FS") for Functional Safety in the ordering code, no suitable fault-detection measures are implemented. Those encoders provide no or a synthetical 1Vpp output signal. Therefore the assumed faults in accordance with EN 61800-5-2, table D8 can lead to an incorrect but plausible position value.

To what extent such linear encoders can be used in safety-related applications depends on the architecture of the safety system and the fault-detection measures in the evaluating safety module.

## Fault exclusion for the loosening of the mechanical connection

The machine manufacturer is responsible for the dimensioning of mechanical connections in a drive system. The OEM should ideally consider the application conditions for the mechanical design. Providing objective evidence of a safe connection is time-consuming, however.

For this reason, AMO has developed and confirmed by a type examination a mechanical fault exclusion for the linear encoders. The qualification of the mechanical fault exclusion was performed for a broad application range of the encoders. This means that fault exclusion is ensured under the operating conditions listed below.

All information is given with respect to a mounting temperature of 15°C to 35°C. Mounting surfaces must be clean and free of burrs. Thread surfaces must be secured with materially bonding thread-locking fluid. All mounting screws have to be tightened torque controlled.

## Fault exclusion LMBA 2010 - Scale tape to stick

The installation of the scale tape must be carried out according to the assembly instructions. As guidance for the measuring tape in the direction of travel, an insertion or stop shoulder can be provided in the machine base.

If this is not possible, an auxiliary stop can also be used to achieve sufficient straightness of the measuring tape in the direction of travel.

| **LMBA 2010 - Scale tape to stick** | |
|---|---|
| **Machine base** | |
| Coefficient of thermal expansion α | (10 to 16) $10^{-6}$ $K^{-1}$ |
| **Environmental conditions** | |
| Pollution | dry environment, no oils, cutting fluid or other liquid substances |
| Operating temperature | -10 °C to 85 °C |
| Max. acceleration | ± 50 $m/s^2$ in direction of movement |
| Shock 6ms | < 1000 $m/s^2$ (EN 60068-2-27) |

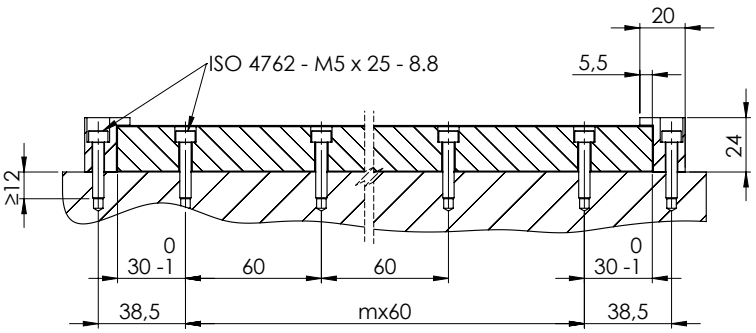
## Fault exclusion LMFA 3010 - Measuring rail

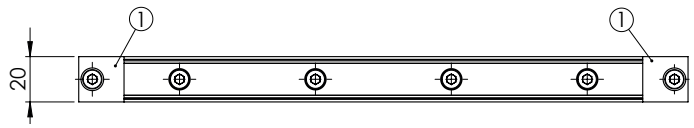
The mounting of the measuring rail must be carried out according to the installation instructions. The screws and the end clamps, necessary to achieve the mechanical fault exclusion are not included in the scope of delivery.

Minimum srew length L is the sum of the length of engagement and the free clamped length.

| LMFA 3010 - Measuring rail | |
|---|---|
| **Machine base** | |
| Coefficient of thermal expansion α | (10 to 16) $10^{-6}$ $K^{-1}$ |
| Tensile strength $R_m$ | ≥ 360 $N/mm^2$ |
| **Measuring rail assambly** | |
| Screws | ISO 4762 - M5 x L - 8.8 |
| Torque $M_d$ | 5,0 ± 0,10 Nm |
| Length of thread engagement | ≥ 10 mm |
| Free clamped length | ≥ 13,2 mm |
| **Environmental conditions** | |
| Operating temperature | -10°C to 85 °C |
| Max. acceleration | ± 50 $m/s^2$ in direction of movement |
| Shock 6ms | < 1000 $m/s^2$ (EN 60068-2-27) |

## Recommended assembly




① Accessory 1244592-04 End Clamp LMFA

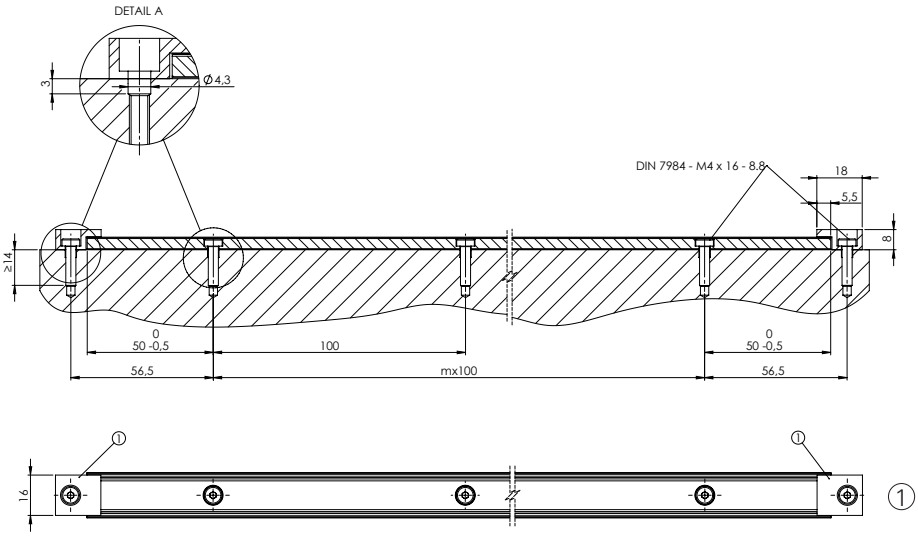
## Fault exclusion LMTA 4010 - Scale tape in stainless steel carrier

The mounting of the stainless steel carrier must be carried out according to the installation instructions. The screws and the end clamps, necessary to achieve the mechanical fault exclusion are not included in the scope of delivery.

Minimum srew length L is the sum of the length of engagement and the free clamped length.

| LMTA 4010 - Scale tape in stainless steel carrier | |
|---|---|
| **Machine base** | |
| Coefficient of thermal expansion α | (10 to 16) $10^{-6}$ $K^{-1}$ |
| Tensile strength $R_m$ | ≥ 360 $N/mm^2$ |
| **Carrier assembly** | |
| Screws | DIN 7984 - M4xL - 8.8 |
| Torque $M_d$ | 2,0 ± 0,05 Nm |
| Length of thread engagement | ≥ 8 mm |
| Free clamped length | ≥ 5 mm |
| **Environmental conditions** | |
| Operating temperature | -10°C to 100 °C |
| Max. acceleration | ± 50 $m/s^2$ in direction of movement |
| Shock 6ms | < 1000 $m/s^2$ (EN 60068-2-27) |

## Recommended assembly




① Accessory 1244592-03 End Clamp LMT(A)