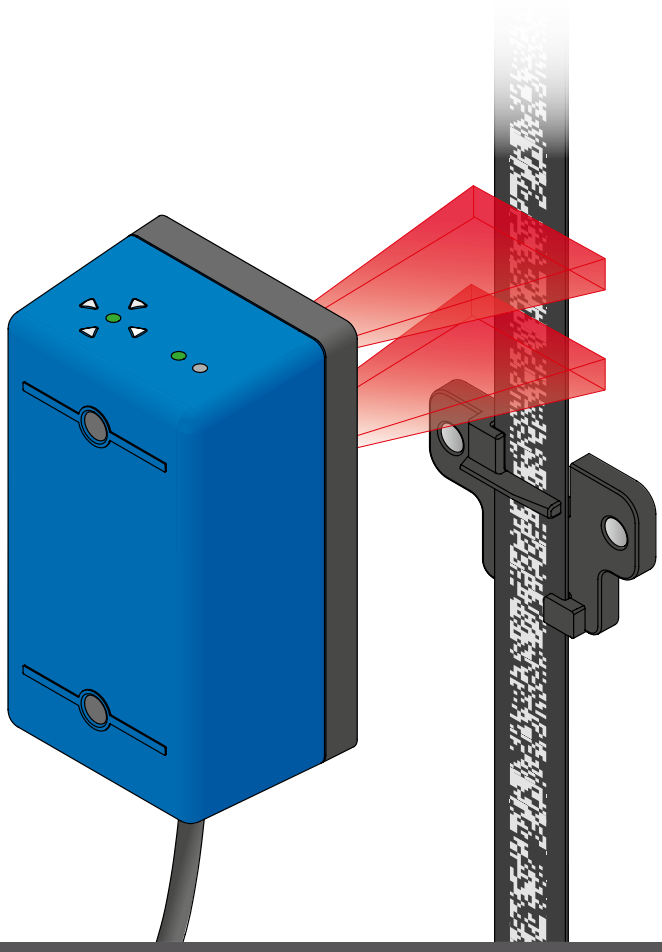
APS – Absolute Positioning System

Installation and Operation Manual



CEDES AG is certified according to ISO 9001: 2008

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1. About this manual

This “APS manual”, with metric measurements is the original version.
The version number is printed at the bottom of each page.
To make sure you have the latest version, visit www.cedes.com where this manual and related documents can be downloaded.

1.1 Measurements

Measurements are, if not stated otherwise, given in mm (non-bracketed numbers) and inches (numbers in brackets).

1.2 Related documents

APS datasheet en
Part No. 001 201 en

APS brochure en
Part No. 001 204 en

APS safety manual en
Part No. 113 317 en

1.3 CEDES headquarters

CEDES AG
Science Park
CH-7302 Landquart
Switzerland

2. Safety information

IMPORTANT!
READ BEFORE INSTALLATION!

The APS was developed and manufactured using state-of-the-art systems and technologies. However, injury and/or damage to the sensor can still occur.

To ensure safe conditions:

- Read all enclosed instructions and information and make sure you have understood it.
- Follow the instructions given in this manual carefully.
- Observe all warnings included in the documentation and attached to the sensor.
- Do not use the sensor if it is damaged in any way.
- Keep the instruction manual on site.

It is the sole responsibility of the planner and/or installer and/or buyer to ensure that this product is used according to all applicable standards, laws and regulations in order to ensure safe operation of the whole application.

The safety of the whole system is the responsibility of the system integrator. For safety-relevant use, the system integrator must only use the APS for the application as defined in this manual and according the instructions given herein or in the APS safety manual.

The manufacturers of the each of the following, system, controller and drive, together with the installer, the operator and those responsible for its maintenance have to follow the system integrator's instructions.

Only personnel authorized and instructed by the system integrator are allowed to operate, install and maintain the APS system.

Any alterations to the system by anyone (e.g. the buyer, installer or user) may result in unsafe operating conditions. CEDES is not responsible for any liability or warranty claim that results from such manipulation.

Failure to follow instructions given in this manual and/or other documents related to the APS may cause customer complaints, serious call backs, damage, injury or death.

2.1 Non-intended use

The APS **must not** be used for:

- Safety applications which do not comply with the regulations contained in the chapter 4.3: Intended use.
- Equipment in explosive atmospheres
- Equipment in radioactive environments
- Equipment in aggressive environments

Use only specific and approved safety devices for such applications, otherwise serious injury or death or damage to property may occur!

2.2 Symbols, safety messages

Symbol	Meaning
▸	Single instruction or measures in no particular order
1. **2.** **3.**	Sequenced instructions
•	List, in no order of importance
→	Reference to a chapter, illustration or table within this document
Important:	Important information for the correct use of the sensor

2.3 Safety message categories

Warning of serious health risks

WARNING
Serious health risks

Highlights critical information for the safe use of the sensor. **Disregarding these warnings can result in serious injury or death.**

- Follow the measures highlighted by the triangle-shaped arrows
- Consult the safety information in Chapter 2 of this manual

Caution of possible health risks

CAUTION
Possible health risks

Highlights critical information for the safe use of the sensor. **Disregarding these warnings can result in injury.**

- Follow the measures highlighted by the triangle-shaped arrows
- Consult the safety information in Chapter 2 of this manual

Notice of damage risk

NOTICE
Risk of damage

Disregarding these notices can lead to damage to the sensor, the door controller and/or other devices.

- Follow the measures highlighted by the triangle-shaped arrows

3. Introduction

The Absolute Positioning System (APS) determines the absolute position and velocity of the elevator car by reading a fixed installed code tape in the hoistway. It transmits this safety related information using a specified interface e.g. CAN2.0A to the downstream processing unit (e.g. elevator controller).

The APS system consists of the APS sensor, the APS code tape, the APS guide clips and APS position indicator clips. The sensor is mounted on the elevator car and the code tape is mounted with the clips within the elevator hoistway.
The information of the absolute position is encoded on the code tape. The APS sensor is based on a dual camera system which scans the code tape with its own IR illumination. The sensor evaluates the position information from the code tape and also calculates the velocity of the elevator car using two positions at two different times. The position and velocity information is transmitted over the interface to the downstream processing unit. The APS is certified according to SIL 3 IEC 61508.

Depending on the implementation, the APS sensor can be used to compensate for building compression relative to the absolute hoistway position as well as detect the floor/door zone. To do so, a special clip, the position indicator clip, is used to mount on the code tape in the hoistway. If the clip is detected by the APS sensor, the corresponding bit is set to high and this information is transmitted as part of the protocol to the downstream processing unit.

As an option, the APS sensor contains two additional inputs to connect external sensors which can be used for the compensation of building compression relative to the absolute hoistway position or floor/door zone detection. As an example, a slot-type light barrier can be mounted on the car with a vane fixed to the building at specific positions (landing door sill or landing door operator). If the vane is detected, the input is triggered and the corresponding bit is set high. This information is transmitted as part of the protocol to the downstream processing unit.

In order to make use of functions such as detection of building compression or floor/door zone detection, the downstream processing unit must be capable of processing this information and set to do so.

3.1 Features

- Position and velocity output
- Absolute position up to 1,500 m with a resolution of 0.5 mm
- Velocity up to 20 m/s with a resolution of 1 mm/s
- Integrated reading of markers for building compression compensation, no additional sensors needed
- Level detection using position indicator clips or additional signal inputs
- Very robust system due to high light reserve and dual camera reading
- Insensitive to dust and smoke
- CAN (customer specific interface on request)
- SIL 3 certified

3.2 Category

SIL 3 certified for

- safely detecting the position
- safely calculating the velocity
- safely transmitting the data to the downstream processing unit

For more details refer to the APS safety manual.

4. Overview

4.1 APS system

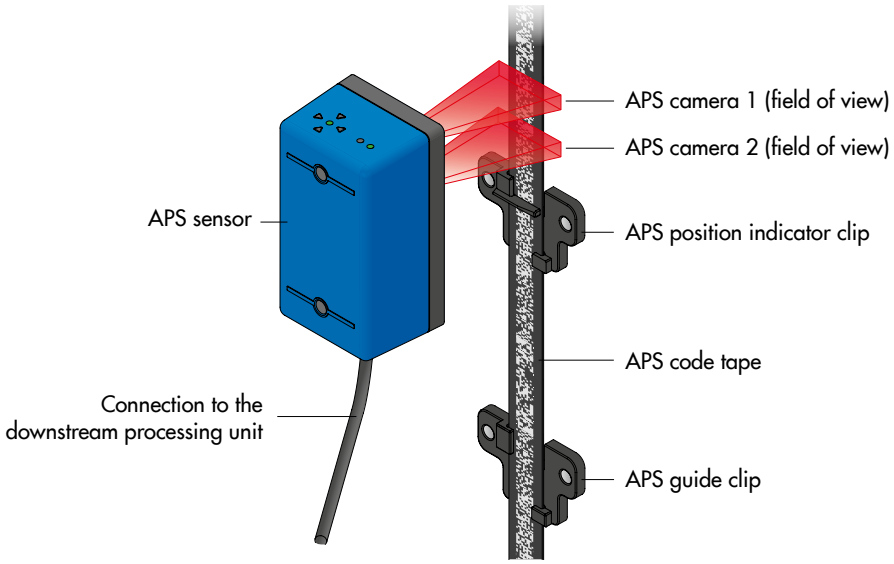


Figure 1: APS system overview

Figure 1 shows the necessary components to build an APS System with building compression compensation.

4.2 APS system integration

The APS system can easily be integrated into the elevator hoistway. It can be done along the guide rail as an absolute positioning system as in Figure 2. An installation along the landing door sill or landing door operator allows also precise detection of the floor or door position and/or to compensate for building compression. Refer to Figure 3 and Figure 4.

CAUTION
Possible health risks

It is the system integrator's responsibility to define the exact location for, and the correct way of installing the APS system. The installer must strictly follow the system integrator's instructions, as the correct installation is part of the system safety, which, depending on system integration, may be required to fulfill SIL 3. Only trained personnel are allowed to install the APS system. During regular operation of the elevator no installations or alterations of the system are permitted.

APS installation location

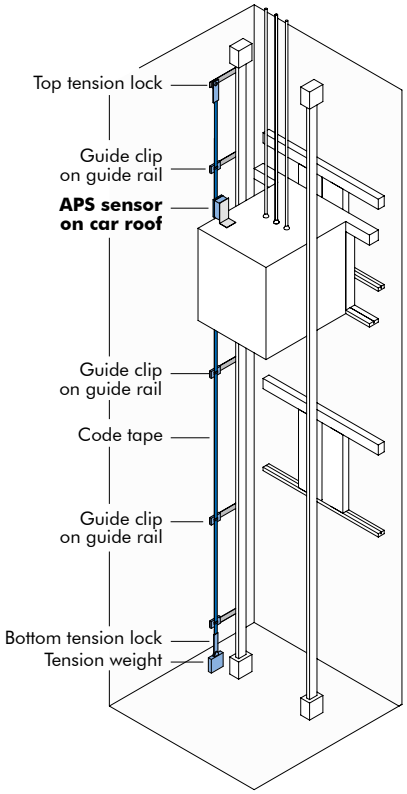


Figure 2: APS on guide rail

Features

+ Ideal for short and medium distance elevators
+ Easy to install

• Possible replacement of other absolute positioning system
• Possible mismatch to the landing door sills

- No or limited compensation for building compression (e.g. differences in thermal expansion factors)

APS installation location

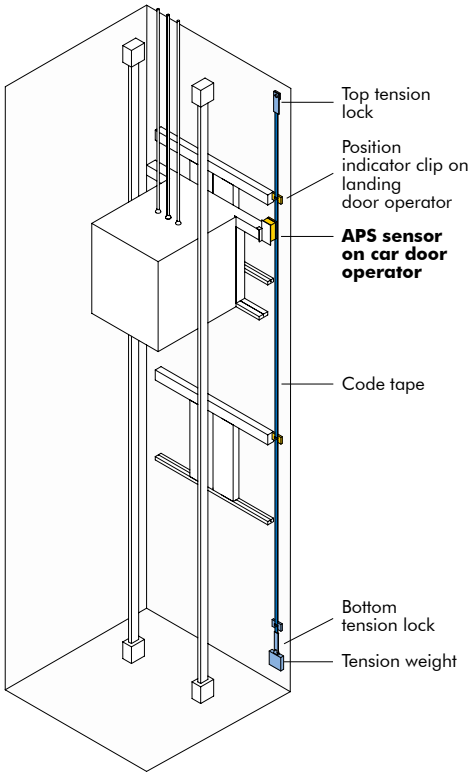


Figure 3: APS on car door operator

Features

+ Ideal for medium and long distance elevators
+ Referenced to landing door sill
+ Compensation for building compression (e.g. differences in thermal expansion factors)
+ Easy installation and adjustment due to fact that the position on the car roof is easy accessible

• Pre-installation of position indicator clips is possible on the landing door operators

- Possible mismatch of landing door operator to landing door sill

APS installation location

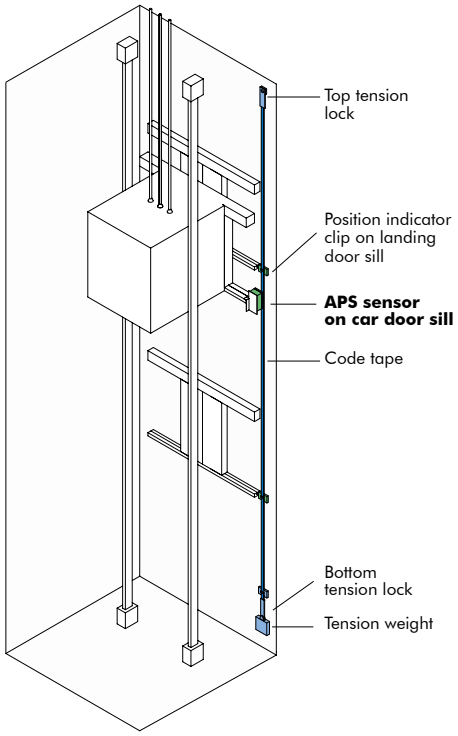


Figure 4: APS on car door sill

Features

+ Ideal for medium and long distance elevators
+ Optimally referenced to landing door sill
+ Easy to adjust the position indicator clips to the landing door sill
+ Compensation for building compression (e.g. differences in thermal expansion factors)

• Pre-installation of the position indicator clips is possible on the landing door sills

- More complex installation and adjustment due to fact that the position below the car is not easily accessible

4.3 Intended use

The APS is designed and approved for the use in elevator applications according to EN81-1/-2 and ASME 17.1 and 17.5.

Three SIL 3 safety relevant functions are provided:

1. To safely detect the sensor‘s absolute position relative to the code tape (2 independent position values).
2. To safely calculate the velocity of the sensor compared to the code tape (2 independent velocity values).
3. Safely transmit the acquired values.

The two positions and velocities are derived by two independent channels; therefore the APS fulfills the requirements of A17.1 (2.25.2.xx and 2.25.4.xx).
For SIL safety, the APS must only be used for the SIL listed functions. If the APS is used in other applications or for other functions, safety is not guaranteed. For more details refer to the APS safety manual.

4.4 System segregation

The safety of the whole system is the responsibility of the system integrator. For safety-relevant use, the system integrator must only use the APS for the application as defined in the safety manual and according the instructions given herein.

The manufacturers of the each of the following, system, controller and drive, together with the installer, the operator and those responsible for its maintenance have to follow the system integrator‘s instructions.
Only personnel authorized and instructed by the system integrator are allowed to operate, install and maintain the APS system.

4.5 APS sensor

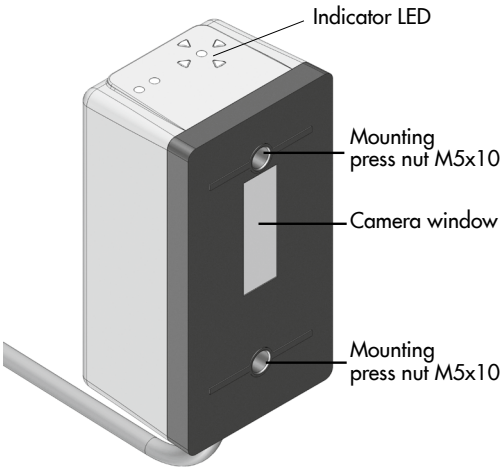


Figure 5: APS sensor

The APS sensor contains a dual camera system to determin the position of the elevator car. When the APS code tape is illuminated by short infrared pulses, the APS sensor records the pattern in front of the cameras. Based on that data, the sensor's processor then calculates the position and velocity of the elevator car and crosschecks the results for increased reliability. This data (one set of position and velocity values per camera) is transmitted to the downstream processing unit via two separate CAN interfaces, one for each camera.

4.5.1 Interface from the APS sensor to the downstream processing unit

The interface of the APS sensor uses a CAN protocol (independent channel for each camera) and is connected to the downstream processing unit through an RJ45 connector. For technical details and data protocol, refer to the APS safety manual.

4.5.2 APS sensor external compression compensation inputs (optional)

The APS sensor features two additional inputs for external sensors which can be used to measure building compression relative to the absolute hoistway position or for floor/door zone detection.
In order to make use of functions such as detection of building compression or floor/door zone detection, the downstream processing unit must be capable of processing this information and set to do so.

Application example:
A slot-type light barrier is mounted on the elevator car with vanes fixed to the building at specific positions (landing door sills or landing door operators). If the vane is detected, the input is triggered and the corresponding bit is set high. The signals from the light barrier are transmitted to the downstream processing unit as part of the CAN interface protocol.

4.6 APS code tape

Material	Stainless steel / PC
Max. manufacturing length	1,500 m
Width of code tape	19 mm
Thickness of code tape	0.6 mm
Weight per meter	37.5 g

Table 1: Technical data for APS code tape

CAUTION
Possible health risks

- Use only the original CEDES APS code tape.
- Repairs to the APS code tape are not permitted.

The APS code tape is the reference for the system and carries the absolute and unique code information for identifying the position of the actual sensor position. The touchless and wear-free operating principle of the APS system ensures an almost maintenance-free service.

The code tape can be mounted at any position in the hoistway (for example, on the guide rail, C-profiles, landing door operator or landing door sill). It is installed free-hanging. The APS sensor needs to have uninterrupted sight of the APS code tape over the entire length of the travel distance.

4.7 Elongation of the APS code tape

Two factors influence the length of the code tape (and installation length) and therefore the incremental distance between two consecutive code elements:

- The dead weight as a function of the length of the code tape and the tension weight.
  This elongation is fixed and does not change during operation.
- The thermal expansion factor of the code tape material.
  The elongation changes during the operation depending on the environmental conditions.

LENGTH	**ELONGATION CAUSED BY**					
	DEAD WEIGHT incl. tension weight 10 kg		**THERMAL EXPANSION** Temperature difference [deg C]			
	RELATIVE	**ABSOLUTE**	**20**	**40**	**60**	**80**
			(+10 ... +30)	(0 ... +40)	(-20 ... +40)	(-20 ... +60)
[m]	[%]	[mm]	[mm]	[mm]	[mm]	[mm]
10	0.012	1.2	3.2	6.4	9.6	12.8
20	0.012	2.4	6.4	12.8	19.2	25.6
50	0.013	6.4	16.0	32.0	48.0	64.0
70	0.013	9.3	22.4	44.8	67.2	89.6
100	0.014	14.0	32.0	64.0	96.0	128.0
200	0.016	32.5	64.0	128.0	192.0	256.0
500	0.023	115.9	160.0	320.0	480.0	640.0
			Thermal expansion factor: 1.6 x 10^{-5} K^{-1}			

Table 2: Elongation as a function of the code tape length and of the temperature

It is the system integrator‘s responsibility to consider these influences regarding the application. For more details, refer to the APS safety manual.

4.8 Mounting clips

The APS code tape is fixed to the elevator hoistway using special clips that allow for vertical movement of the code tape but prevent any horizontal or twisting movements.

4.8.1 Guide clip

This clip is for the horizontal positioning (guiding) of the code tape. It guarantees the free vertical sliding of the code tape.

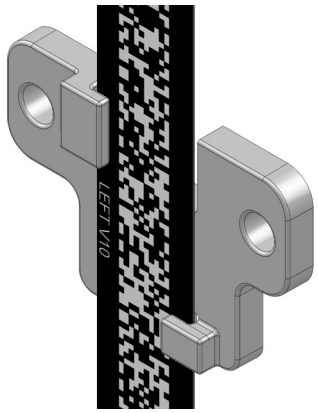


Figure 6: Guide clip without positioning bridge

4.8.2 Position indicator clip

In addition to the functionality of the guide clip, the position indicator clip allows the APS sensor to detect the absolute position using the positioning bridge of the clip.

The APS sensor reliably detects clips with positioning bridges at elevator speeds of less than +/- 0.3 m/s (e.g. when approaching the destination floor). An additional clip bit is then set in the data protocol (refer to the APS safety manual). The information can be used to determine the exact position of the floor on a teaching ride and to compensate for building shrinkage (building compression).

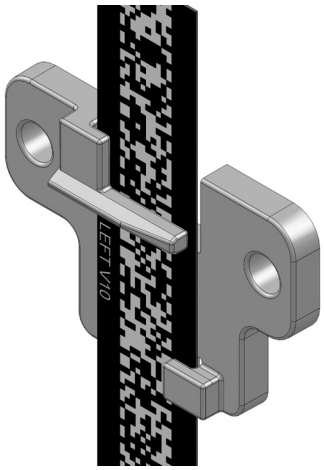


Figure 7: Position indicator clip with positioning bridge

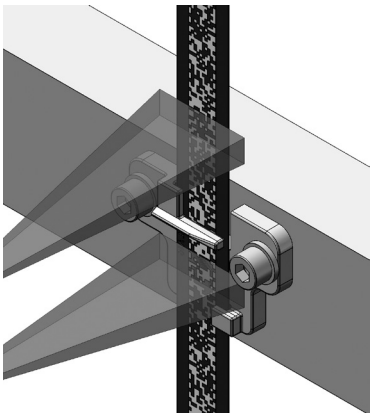


Figure 8: Reading of the position indicator clip

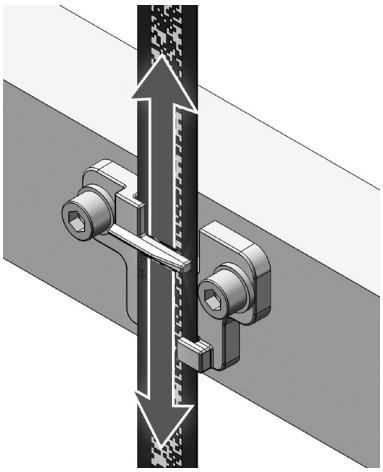


Figure 9: Detection of building compression

Where floor/door zone detection with the position indicator clips is required, it must be ensured that the clips have the same offset on each floor relative to the landing door sill. It is therefore important that the usage of such functions is implemented into the downstream processing unit. The mounting of the code tape and APS sensor must then follow the guidelines given by the system integrator.

4.9 Code tape presence control

The APS system provides a safe position and velocity as long as the APS code tape is correctly installed all along its operational length.

It is the system integrator’s responsibility to check and guarantee this during regular operation as well as after any exceptional event, e.g. a power down, before restarting any regular operation. The APS system itself is not able to detect e.g. a vertical movement of the code tape. The integrator can do this either via a “Code tape presence sensor”, another adequate mechanism fulfilling this function (e.g. control routines with position indicator clip) or an appropriate mounting of the APS code tape. For more details, refer to the APS safety manual.

4.10 Environmental requirements

The creepage and clearance distances are designed according IEC 60664-1 for operational altitudes below 5,000 m above sea level (uppermost height of application e.g. top of the building). Do not use the product above this.

4.11 System component overview

NO. OF PIECES	ITEM	SUPPLY	REMARK
1	APS sensor	Mandatory	Incl. 5 m cable and a RJ45 connector
1	Mounting bracket	Optional	For the APS Sensor; incl. assembly material for the APS sensor
1	APS code tape	Mandatory	In APS code tape box; refer to the price list for standard lengths
2	Tension lock	Mandatory	For APS code tape; incl. cable tie
1	Tension weight 10 kg	Optional	Incl. assembly material
3	Code tape end cover	Mandatory	
1	Guide clip	Mandatory	Customer-specific version on request
1	Position indicator clip	Mandatory	Customer-specific version on request
1	APS manual	Mandatory	
1	APS safety manual	Mandatory	
1	TÜV certificate	Mandatory	

Table 3: APS component overview

Note: All parts in the “SUPPLY” column, which are listed as mandatory, must be original parts from CEDES.

The detailed list of material required for the installation of the APS system is provided by the system integrator.

5. Installation and adjustment

The installation of the system has always to be adapted to the type of elevator used. Depending on this, there can be alterations to the standard installation procedure. In all cases, the installer must follow the instructions of the system integrator. The following section describes the standard installation of the system as typically used.

5.1 Installation overview

- Step 1-1 … Step 1-4: Unpack and prepare the code tape for final installation → chapter 5.2.
- Step 2: Installation of the APS sensor → chapter 5.3.
- Step 3-1 … Step 3-5: Clip installation and adjustment of the APS system → chapter 5.4.

Figure 10: Step 1-1

Install top tension lock. Begin to unroll code tape from box

Figure 11: Step 1-2

Continue to unroll code tape until it reaches required length

Figure 12: Step 1-3

Cut code tape to length, mount bottom tension lock and tension weight

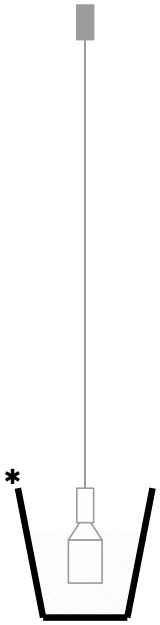


Figure 13: Step 1-4

Use an adjustment aid for code tape

Figure 14: Step 2

Install APS sensor on cabin (side view)

*** INSTALLATION TIP:** Use adjustment aid for code tape

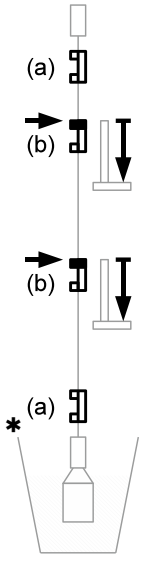


Figure 15: Step 3-1

Install guide clips (a) to fix code tape; align position indicator clips (b) to door sills (side view)

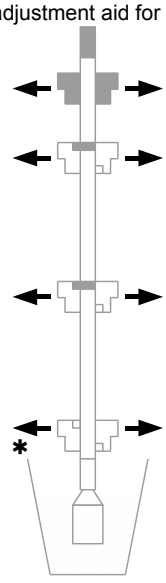


Figure 16: Step 3-2

Align clips left / right (front view)

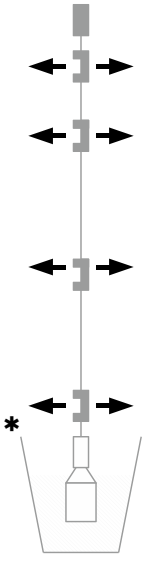


Figure 17: Step 3-3

Align clips far / near (side view)

Figure 18: Step 3-4

Install anti-swing, recommended

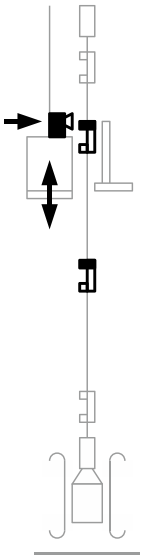


Figure 19: Step 3-5

Read position indicator clips via teaching ride (side view)

WARNING
Risk of cuts

The edges of the APS Code tape can be sharp. Careless handling of the APS code tape can cause serious injury.

- Never grab the APS code tape at the edges.
- Wear appropriate protection when handling APS code tape.
- Always, use/wear cut protection gloves to protect your hands (e.g. cut level 5).

5.2 Unpack and prepare the code tape for final installation

The APS code tape is delivered so that it is possible to install it directly from the box. Never fully unpack the code tape initially; otherwise the coding orientation of the code tape can be lost or the code on the code tape can be damaged. Follow the following procedure carefully to prevent damage to the code tape and injury to the installer during installation.

	ITEM	SECTION	CHECK
1.	Whenever handling the code tape, use cut protection gloves to prevent potential injury.		☐
2.	Prepare anchor point for the top tension lock.		
2.1.	Go with the elevator car to the top of the shaft.		☐
2.2.	Insert screw into the elevator shaft / the pit brow as anchor point for the top tension lock. Follow the system integrator‘s instructions.	5.2.1	☐
3.	Prepare the code tape for installation.		
3.1.	Remove the top end of the code tape from the box.	5.2.2	☐
3.2.	Check orientation of the code tape.	5.2.3	☐
3.3.	Attach the top tension lock to the code tape.	5.2.4	☐
3.4.	Fasten the code tape with a cable tie.	5.2.4	☐
3.5.	Attach the code tape end cover.	5.2.4	☐
4.	Unroll the code tape		
4.1.	Mount the top tension lock onto the anchor point.	5.2.5	☐
4.2.	Remove some more of the code tape from the box.	5.2.1	☐
4.3.	Do a “service ride” top-down to unroll the code tape. **Safety advice:** Unroll a specific length of the code tape; then travel that specific distance. Never unroll and travel at the same time.		☐
4.4.	Let the code tape hang freely.		☐
5.	Prepare the end of the code tape at the bottom of the elevator shaft		
5.1.	Cut the code tape to the final operational length as detailed in the system integrator‘s instructions. Remember to leave an additional length for the code tape end loop. Apply a code tape end cover to the end of the remaining code tape in the box.	5.2.6	☐
5.2.	Attach the bottom tension lock to the code tape.	5.2.6	☐
5.3.	Fasten the code tape with a cable tie.	5.2.6	☐
5.4.	Mount the tension weight.	5.2.7	☐
5.5.	Apply code tape end cover.	5.2.6	☐
5.6.	Let the code tape hang freely.	5.2.7	☐
5.7.	For safety and adjustment reasons, protect the code tape against swing and vibrations e.g. use a bucket filled with water as a vibration damper.	5.2.7	☐
6.	The code tape is ready for final installation (clips, tension weight holder, ...) and adjustment.	5.4	

Table 4: Checklist: Unpacking and preparation of the APS code tape

5.2.1 Fixation of the top tension lock

CAUTION
Possible health risks

It is the system integrator's responsibility to define the exact location for, and the correct way to install, the APS code tape as described in Chapter 4.5. The installer must strictly follow the system integrator's instructions, because the correct installation is part of the system safety (depending on system integration, it can be SIL 3).

- The system integrator can chose to mount the APS code tape on any place in the elevator hoistway.
- The mounting must fulfill the criteria for the code tape presence control given in the APS Safety Manual.
- The installer has strictly to follow the system integrator's instructions.
- Make sure the APS code tape hangs straight down without twisting.
- **Important:** To read the APS code tape, the sensor needs to maintain an uninterrupted sight of it and a constant distance of 105 mm ±10 mm.
- **Important:** Make sure the APS sensor can read the APS code tape at every possible elevator position, including where it crosses into the emergency limit switch.

5.2.2 Removing the code tape from the box

- The APS code tape box is used as a reel when uncoiling.
- Open the box exactly as instructed to ensure comfortable and fast APS installation.
- The APS code tape uncoils with the highest position first and the lowest position last. The highest value is equal to the top position, the lowest value is equal to the bottom position.
- The code starts at any arbitrary value.

1. Open the APS code tape box at the latch → Figure 20

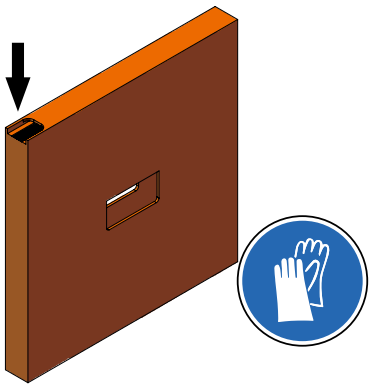


Figure 20: APS code tape box: Open here

2. Hold the APS code tape on the end piece. Carefully pull out the APS code tape.

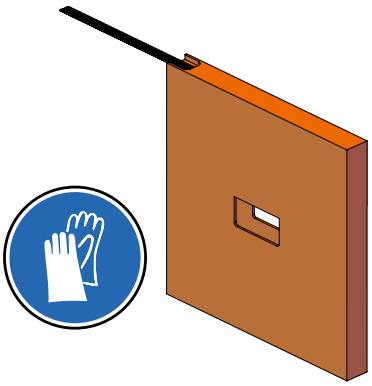


Figure 21: Carefully pull the code tape from the box

3. The APS code tape is now ready for uncoiling.

5.2.3 Orientation of the APS code tape

Important: Before mounting the APS code tape, make sure that the "LEFT markings" on the APS code tape are on the left side → Figure 22.

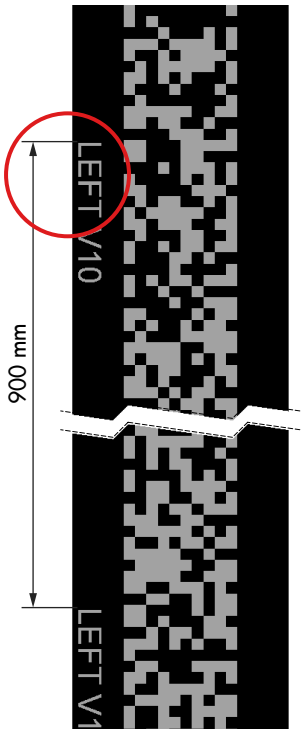


Figure 22: APS code tape markings (left side)

NOTICE **Risk of damage**
Do not use the code tape if the “LEFT markings” is on the right side. It is packed the wrong way. Return it to CEDES for replacement. Due to safety reasons, the installer is not allowed to unpack the code tape in any other way.

1. Thread the end of the APS code tape into the top tension lock → Figure 23.

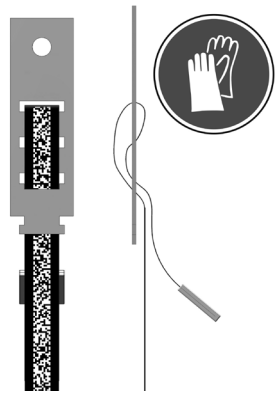


Figure 23: Top tension lock threading

2. Straighten the APS code tape. Fasten it with a cable tie around the tension lock → Figure 24.

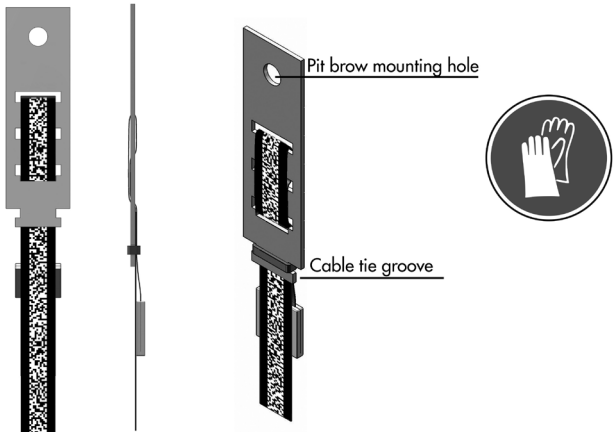


Figure 24: Top tension lock

3. Cut off the excess APS code tape. Use a tinsnip which can cut a minimum of 0.7 mm of stainless steel. Attach the provided code tape end cover to the end of the code tape to prevent potential injury → Figure 25.

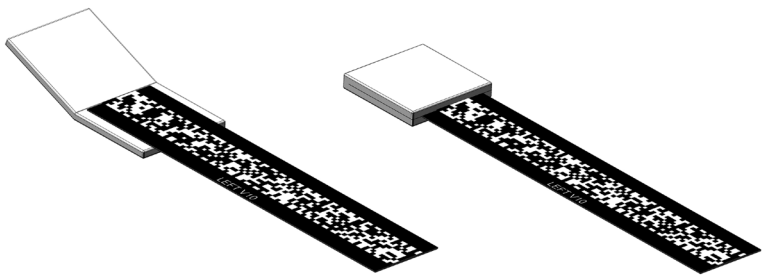


Figure 25: Code tape end cover

5.2.4 Unroll the APS code tape

- Mount the top tension lock with the code tape onto the pit brow. There must be an unobstructed view of the code on the code tape.
- Carefully uncoil the APS code tape. Guide it to the bottom of the elevator.
- Unroll the code tape with a “service ride”. Never drop the code tape. This could damage the code tape and have potentially dangerous consequences.
- Important: Keep a minimum radius of 500 mm when uncoiling the APS code tape → Figure 26.

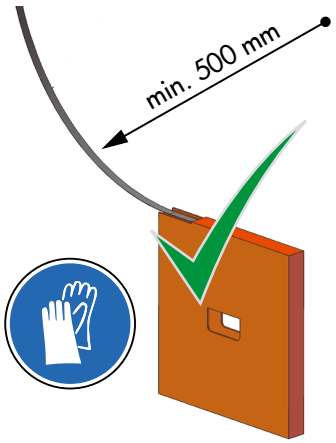


Figure 26: Minimum bending radius for APS code tape

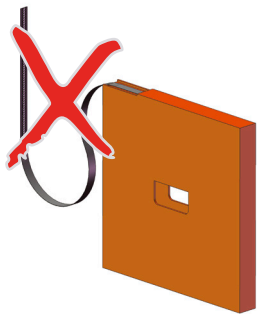


Figure 27: Do not over-bend APS code tape

5.2.5 Attaching the bottom tension lock

Important:
- Make sure to leave enough spare APS code tape for mounting the bottom tension lock when cutting the code tape after reaching the bottom of the elevator hoistway.
- Make sure the code tape is short enough so that it never touches the floor with the tension weight under any environmental conditions (e.g. temperature change).
- Make sure the code tape has enough operational range so that it can be accurately read under all environmental conditions (e.g. temperature change).

1. Cut the APS code tape to the final operational length including code tape end loop.
   Use a tinsnip which can cut a minimum of 0.7 mm of stainless steel.
   Apply a code tape end cover to the remaining code tape in the box; otherwise the code tape could be damaged by penetrating dust and humidity.

2. Thread the APS code tape into the bottom tension lock → Figure 28.

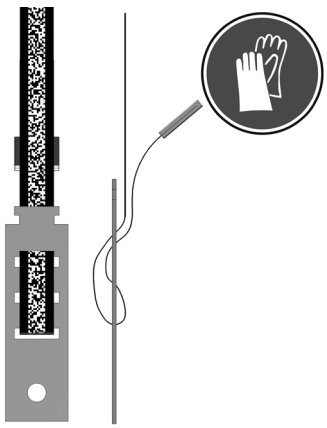


Figure 28: Bottom tension lock threading

3. Straighten the APS code tape. Fasten it with a cable tie around the tension lock → Figure 29.

4. Cover the end piece with the second provided code tape end cover in order to avoid injury on the sharp edge → Figure 25.

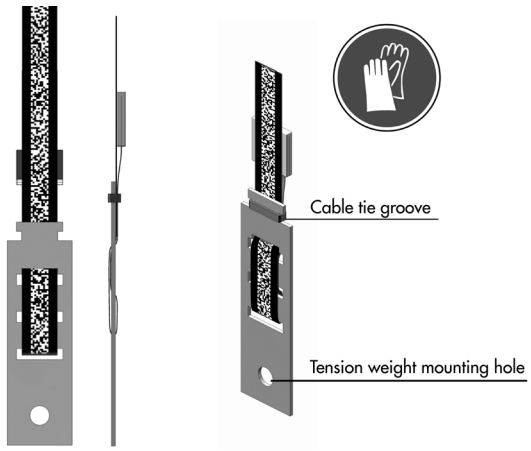


Figure 29: Bottom tension lock

5.2.6 Mounting the tension weight

1. Mount the tension weight (10 kg) to the bottom tension lock using the screws and bolts provided.

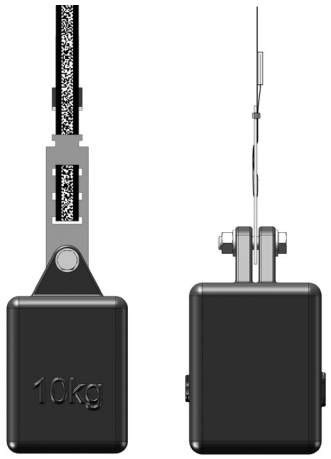


Figure 30: APS tension weight

2. Make sure the tension weight does not touch the ground and fulfills the criteria mentioned in the previous before.

3. Let the code tape hang freely.

4. **Safety advice:**
   Ensure no part of the elevator comes into contact with the code tape at any time.

5. **Safety advice:**
   For safety and adjustment reasons, protect the code tape against swing and vibrations e.g. use a bucket filled with water as a vibration damper; refer to Figure 18. Ensure the pre-installed code tape does not cause any hazard at any point during the installation process.

6. The code tape is now ready for final installation (clip, tension weight holder, ...) and adjustment.

5.3 Installation of the APS sensor

CAUTION
Possible health risks

It is the system integrator's responsibility to define the exact location for, and the correct way to install, the APS code tape. The installer must strictly follow the system integrator's instructions, because the correct installation is part of the system safety (depending on system integration, it can be SIL 3 level).

5.3.1 Mechanical mounting

- The system integrator can choose to mount the APS sensor on different places on the elevator cabin.
- The installer must strictly follow the system integrators instructions.
- Mount the APS sensor using the mounting bracket provided; see below for correct alignment.
- Ensure the LEDs on the top of the sensor can be seen at all times during installation and maintenance work.
- **Important:** To read the APS code tape, the sensor needs to maintain an uninterrupted sight of it and a constant distance of 105 mm ± 10 mm.
- **Important:** Make sure the APS sensor can read the APS code tape at every possible elevator position, including where it crosses into the emergency limit switch.
- Mount the cable so that it is not put under any strain e.g. with a cable conduit.

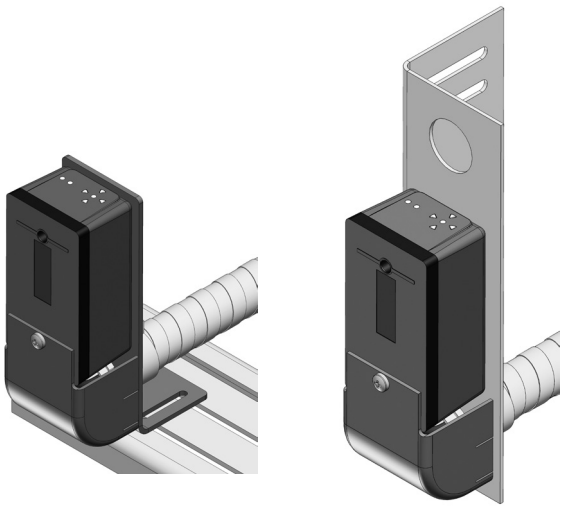


Figure 31: Examples of APS mounting brackets

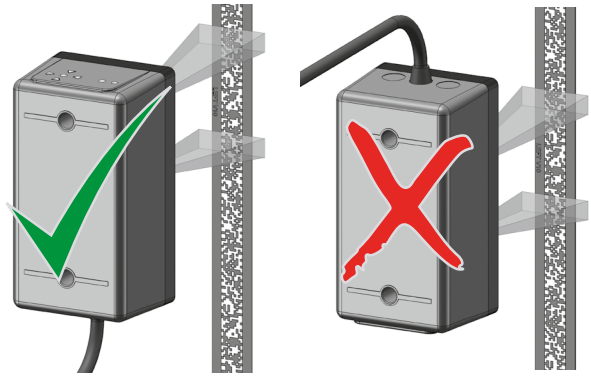


Figure 32: APS sensor cable entry

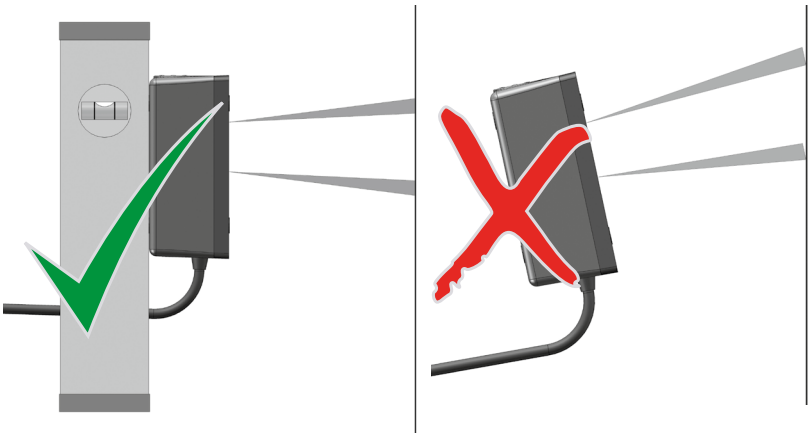


Figure 33: Alignment parallel to code tape (side view)

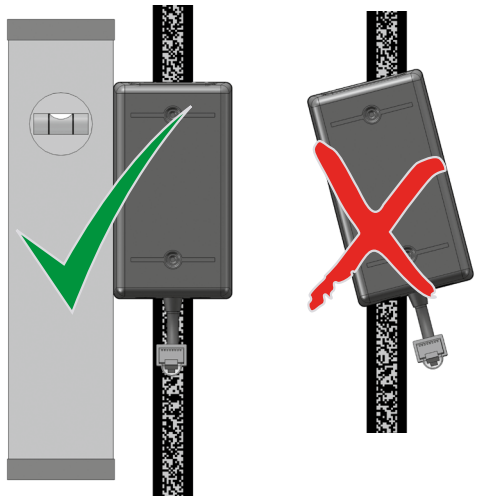


Figure 34: Alignment parallel to code tape (front view)

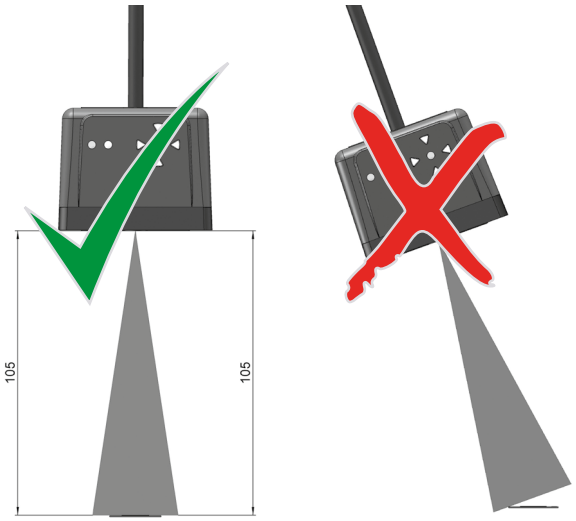


Figure 35: Alignment parallel to code tape (top view)

5.3.2 Power and status LED

- Plug the RJ45 connector of the APS system into the downstream processing unit. The installer must follow the system integrator‘s installation instructions as the correct installation is part of the system safety (depending on system integration, it can be SIL 3 level).
- Details for the electrical connection are described in the APS safety manual.

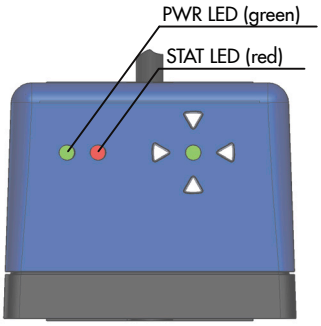


Figure 36: Power (PWR) and status (STAT) LED

The green and red LEDs located to the left (refer to Figure 36) indicate the status of the APS.

- The green PWR LED indicates if the supply voltage for the APS sensor is okay.
- The red STAT LED reports internal and communication errors.
- For safety relevant operation, read the APS error and APS status via the CAN bus (for details refer to the APS safety manual).

LED	COLOR	FUNCTION	OFF	ON	SLOW BLINKING (1 HZ)	FAST BLINKING (5 HZ)
PWR	Green	Supply voltage	No power	Power OK	-	-
STAT	Red	Status signal	No errors	Reading error	APS internal error	Communication error

Table 5: Power and status LED

5.3.3 APS alignment assistant

To be able to read the APS code tape, the APS system must be properly aligned. Two alignment aides help to position the APS system:

- Alignment spotlights
- Electronic alignment assistant

Alignment spotlights
The alignment spotlights are two red LED beams along the optical axis of the APS sensor. They help to align the APS sensor and the APS code tape.

The alignment spotlights can be activated by either:

- Powering up the sensor (while the APS code tape is not in view of the cameras).
  The alignment spotlights deactivate 5 min after first recognizing the APS code tape.
- Waving a clean sheet of paper in front of the cameras:
  Do not use hand gestures as these may smudge the optics of the APS sensor or the APS code tape.

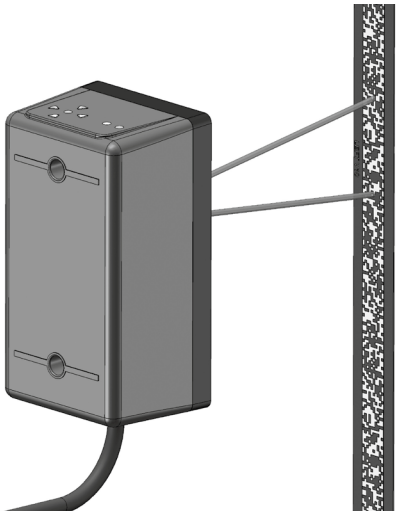


Figure 37: Alignment spotlights in use

Electronic alignment assistant

To fine-tune the APS system's alignment, use the electronic alignment assistant. Four red directional LEDs (triangular in shape) and one green center LED (circular) indicate the exact APS sensor reading position compared to the vertical centre line of the APS code tape.

- The electronic alignment assistant is automatically activated as soon as the APS sensor is supplied with power and can partially read the APS code tape.
- The four triangles pointing to the centre are the direction indicator for the sensor‘s movement to the optimal adjustment. Move the sensor in the direction indicated by the triangular head for better alignment.

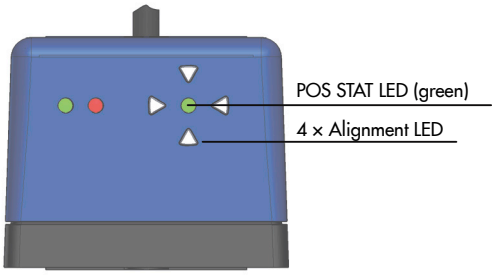
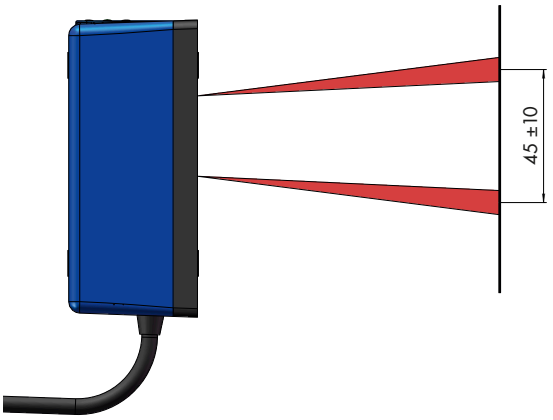


Figure 38: Indicator of the electronic alignment assistant



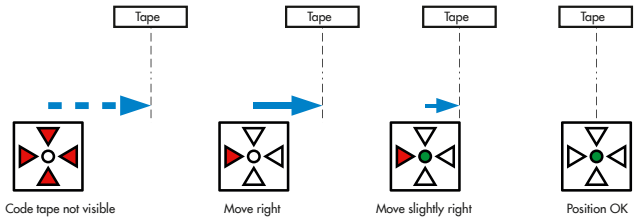


Figure 39: Interpretation of the electronic alignment assistant

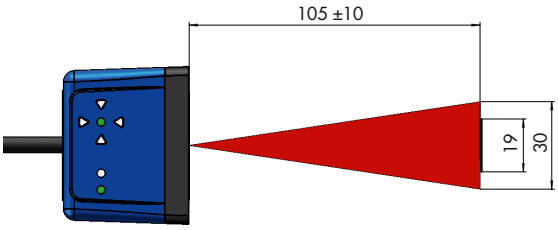


Figure 40: Field of view of the APS cameras

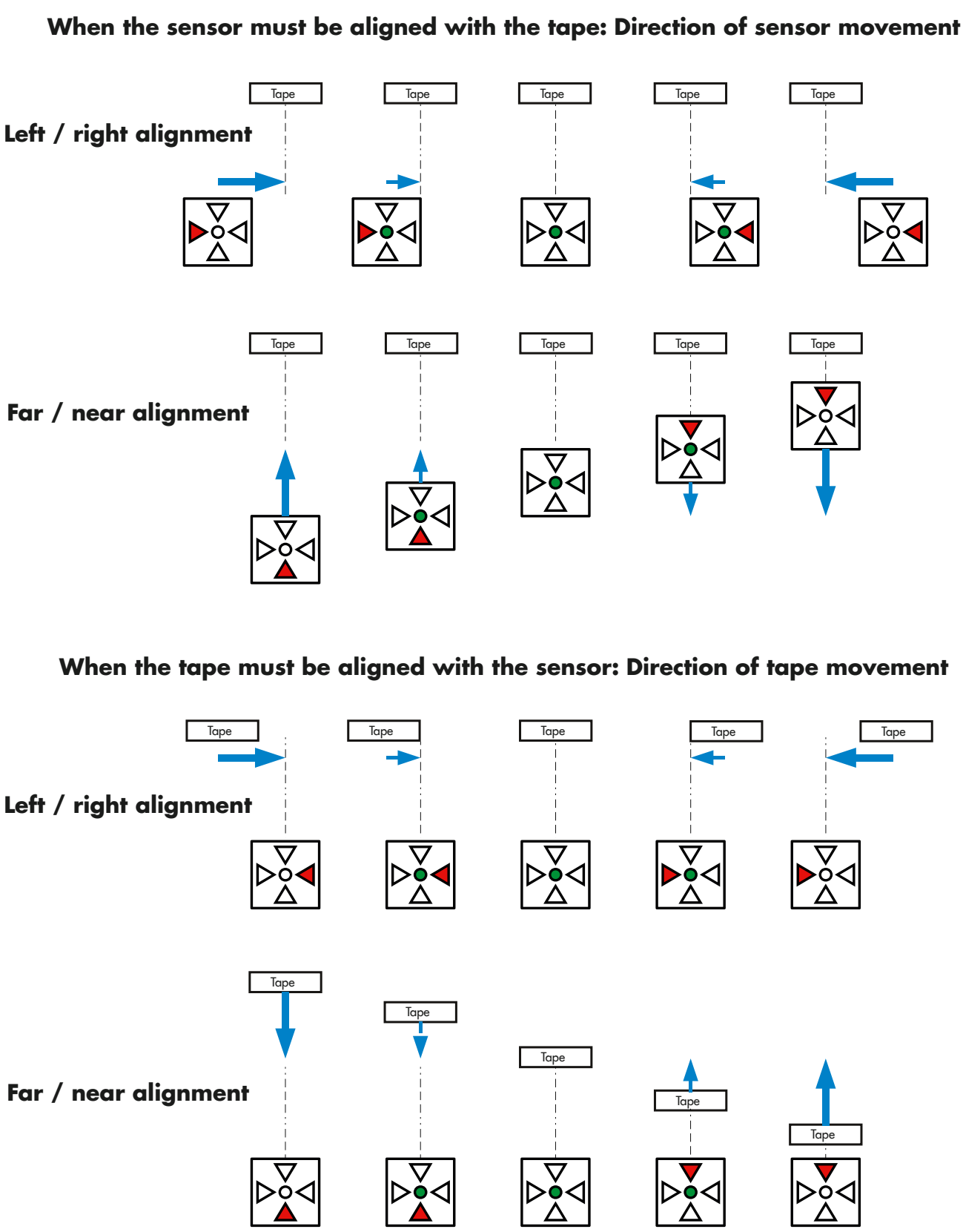


Figure 41: Alignment procedures: APS sensor to APS code tape and vice versa (The arrow indicates the moving direction)

ALIGNMENT	ALIGNMENT LEDS				ALIGNMENT	ALIGNMENT LEDS			
Left (-) / right (+)	Signaling	Limits LED [mm]			Near(-) / far (+)	Signaling	Limits LED [mm]		
Cannot read tape			... <	-10.0	Cannot read tape			... <	-16.5
Too left		-10.0	< ... <	-9.0	Too near		-16.5	< ... <	-10.0
Slightly left		-9.0	< ... <	-3.0	Less than ideal distance		-10.0	< ... <	-3.0
Position OK		-3.0	< ... <	+3.0	Position OK		-3.0	< ... <	+3.0
Slightly right		+3.0	< ... <	+9.0	More than ideal distance		+3.0	< ... <	+10.0
Too right		+9.0	< ... <	+10.0	Too far away		+10.0	< ... <	+16.5
Cannot read tape		+10.5	< ...		Cannot read tape		+16.5	< ...	

Table 6: Alignment indication from the sensor to the code tape and vice versa

5.4 Clip installation and adjustment of the APS system

The clips serve the following functions:

- Guide clip:
  - Guides/aligns the code tape along the optical axis of the APS sensor.
  - Prevents the APS code tape from swinging and twisting.

- Position indicator clip:
  - Guides/aligns the code tape along the optical axis of the APS sensor.
  - Prevents the APS code tape from swinging and twisting.

  Depending on the downstream processing unit, the APS sensor can detect the exact position of the position indicator clip. The downstream processing unit can use this information
  - to detect doors and floors.
  - to compensate for building shrinkage.

5.4.1 Installation of the guide clip

1. Whenever handling the code tape, use cut protection gloves to prevent potential injury.
2. Insert the APS code tape into the clip guide rails → Figure 42.

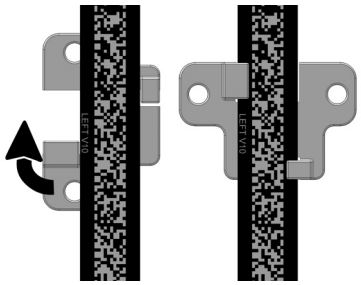


Figure 42: APS guide clip is inserted (left) and turned 90° clockwise

3. Turn the clip by 90°.
4. Fix the clip using appropriate screws and ring washer.

5.4.2 Installation of the position indicator clip

1. For all operations with the code tape use cut protection gloves to prevent of cutting.
2. Insert APS code tape in the clip guide rails → Figure 43.

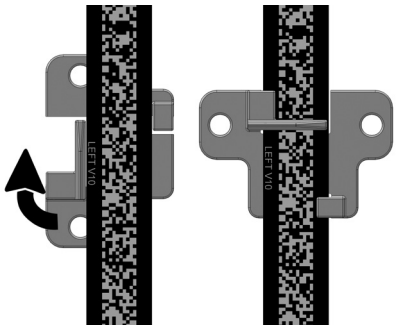


Figure 43: APS position indicator clip is inserted (left) and turned 90º clockwise

3. Turn the clip by 90º.
4. Fix the clip using appropriate screws and ring washer.
5. The recommended distance between the clips depends on the nominal speed of the elevator and other factors such as airflow in the elevator shaft. A typical value is 3 - 5 m. It is important that enough clips are used to prevent the code tape from twisting.

The downstream processing unit can detect floors and compensate for building shrinkage by recognizing the position of each position indicator clip. This may require specific mounting positions. Consult the system integrator‘s installation manual for further information on the positioning of the position indicator clips.

Important: The clip can only be reliably detected if the elevator travels not faster than ±0.3 m/s.

CAUTION
Possible health risks

Where floor/door zone detection with the position indicator clips is required, it must be ensured that the clips have the same offset on each floor relative to the landing door sills. It is therefore important that the usage of such functions is defined by the system integrator.

WARNING

The installer has to strictly follow the system intergrator’s instructions.

5.4.3 Final installation of the code tape and adjustment of the APS system

It is easy to install and align the clips, the APS sensor and the APS code tape. The following checklist outlines a general procedure. However, this may vary according to the elevator type (e.g. length, accuracy of car rail, …).

CAUTION
Possible health risks

It is the system integrator’s responsibility to define the exact location for, and the correct way to install, the APS code tape. The installer must strictly follow the system integrator’s instructions, because the correct installation is part of the system safety (depending on system integration, it can be SIL 3).

6. Electrical connection

6.1 Interface from the APS sensor to the downstream processing unit

The APS sensor is connected to the downstream processing unit via an RJ45 connector.
For detailed pin assignment → Figure 44

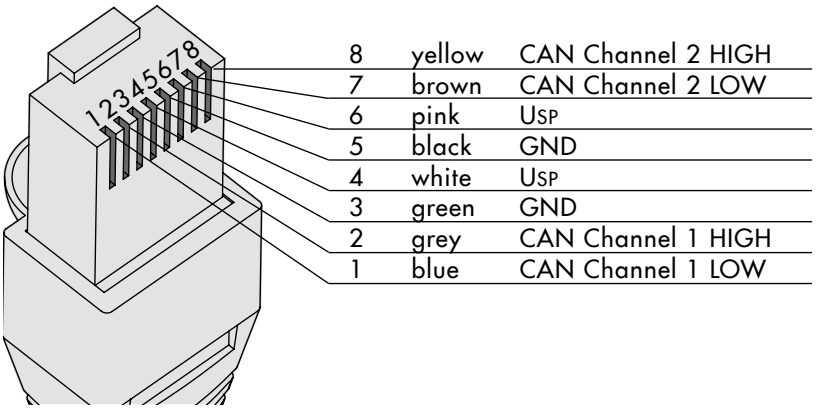


Figure 44: Pin assignment to RJ45 connector

For technical details, refer to the APS safety manual. It is the system integrator's and electrical installer's responsibility to ensure that the cable is installed according to all national and local regulations (e.g. installation in a raceway as required by Clause 38-021 in the Canadian Electrical Code Part 1).

6.2 APS sensor external compression compensation inputs (optional)

PIN	SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
1	24 VDC	Supply for the compression compensation input	The supply is internally direct bridged from the APS supply connector (see safety manual)			
	$I_{24\ VDC}$	Supply current for the external sensor				
2	GND	Ground for the compression compensation input		0		VDC
3	$V_{in\_CC1\_low}$ $V_{in\_CC2\_low}$	Compression compensation input 1 or 2: inactive = 0	GND		2	VDC
3	$V_{in\_CC1\_high}$ $V_{in\_CC2\_high}$	Compression compensation input 1 or 2: active = 1	13		USP	VDC

Table 7: Compression compensation input pin assignment

Customer specific connector plugs are available on request.

7. Start-up

"Start-up" means the first-time operation of the APS system as part of the whole elevator system. This chapter describes the necessary actions for the proper settings prior to start-up. These should also be included in the system integrator's instructions.

Things to do before teaching ride:
- Check the uppermost point of the installation is below 5,000 m above sea level.
- Check if the tension weight has the necessary safety distance according the system integrator‘s instructions.
- Check if the code tape is correctly mounted with the clips.
- Check that the code tape is free to glide within the clips.
- Check if the “LEFT marks” on the code tape are on the left side.
- Check if the APS sensor is installed with the operator panel (status and position LED) facing upwards.
- Check if the APS sensor is connected to the downstream processing unit.
- Check if the APS sensor is correctly aligned to the APS code tape.
- Check if all position indicator clips are aligned.
- Check if the APS sensor has unobstructed sight of the code tape over its entire operational length.
- Check if there is any obstacle which could touch the APS sensor during movement.
- Do all safety checks according the system integrator’s instructions.

During teaching ride:
- Execute the teaching ride according the system integrator’s instruction.
- Teach aligned door positions.

Check after teaching ride, before regular operation:
- Check if the lowest operational point works according to the system integrator‘s instructions.
- Check if the highest operational point works according to the system integrator‘s instructions.
- Check that no door stop is missing.
- Check/verify that the door stops are properly leveled according to the system integrator‘s instructions.
- Perform all safety checks according to the system integrator‘s instructions.

8. Operation

Follow the system integrator’s instructions.

9. Troubleshooting

FAULT - APS SENSOR	ACTION
Green PWR LED does not light	No power: • Check the connection to the downstream processing unit. • Check if the downstream system is powered.
Red STAT LED blinks slowly (1 Hz)	APS internal error: • Switch the system OFF and then ON again. • Check the supply 24 VDC ±20%.
Red STAT LED blinks quickly (5 Hz)	No CAN communication or error. • Switch the system OFF and then ON again. • Check the connection to the downstream processing unit. • Check if the downstream processing unit is powered. • Check the cabling. • Check the data rate of the downstream system. • Check the communication protocol of the downstream processing unit.
RED STAT LED ON or blinks irreguarly	• Check angle (Figure 33, etc.). • Check alignment.
Triangular alignment LED light	Misalignment of the sensor to the code tape: • Check the mounting of the sensor. • Check the mounting of the code tape. • Check the alignment of the sensor to the code tape and opposite.

Table 8: Troubleshooting

For more information, refer also the APS safety manual.
If a problem persists, please contact your local CEDES representative. Visit www.cedes.com for contact data.

10. Maintenance

CAUTION
Possible health risks

- Follow the maintenance instructions given by the system integrator.
- After any maintenance of the APS sensor, APS code tape or any clip, verify correct operation via a service ride.
- After a down-time of 12 months, verify correct operation by a service ride.
- Use only original CEDES spare parts for repair and replacement.
- Use only the original CEDES APS code tape.
- Repairing the APS code tape is prohibited.
- Repair of the components may only be performed by CEDES AG. Repair in the field is prohibited.

Although the APS system, which has a touchless and wear-free operating principle and does not need regular maintenance, a periodical functional check is strongly recommended. In line with the recurring checks defined by the system integrator for the safety related application, the following checks and maintenance must also be performed:

- Check for correct installation.
- Check for the hard- and software version.
- Check if maintenance is according the APS manual.
- Check the mounting position and detection area of the sensor.
- Clean the optical window with a soft towel and a little soapy water.
- Clean the code tape with a soft towel and a little soapy water.
- Clean the guide clips and the position indicator clips with a soft towel and a little soapy water.

NOTICE
Damage to the optical elements

- Never use any solvents, cleaners or mechanically abrasive towels or high-pressure water to clean the sensor or any components of the APS system (sensor, code tape, clips).

11. Disposal

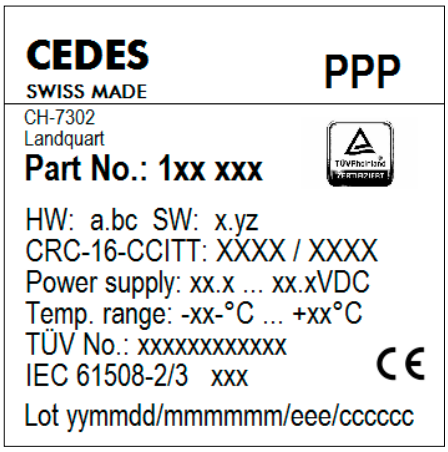
Disposal should be done using the most up-to-date recycling technology according to local regulations and laws. There are no harmful materials used in the design and manufacture of the APS system. Traces of such dangerous materials may be found in the electronic components but not in quantities that are harmful.

CAUTION
Possible health risks

- Dismantle the APS code tape carefully.
- Whenever handling the code tape, use cut protection gloves to prevent potential injury.
- Always handle the code tape with care to prevent damage to components within the immediate environment and/or injury to the installer or any other person.

12. Product label

Each APS sensor is labelled as below. The label is attached to the left side of the housing. It contains the following information:



PPP:
Product family

HW/SW a.bc/x.yz:
Increasing digits with the following meaning:
a/x: major changes, e.g. additional functionality
b/y: error correction, bug fix, new compilation, no additional functionality
c/z: 'cosmetic' update, no functional influence

CRC-16-CCITT:
XXXX / XXXX unique firmware identification

Lot No.:
yymmdd: year (2 digits), month, day
mmmmmm: manufacturing job number
eee: employee number responsible for final test
cccccc: incremental count

13. Technical data

Optical

Position resolution		0.5 mm
Velocity resolution		1 mm/s
Range of velocity measurement		±0 ... 20 m/s
Distance between APS sensor and APS code tape		105 mm
Readout tolerance:	Distance	±10 mm
	Left-right	±10 mm

Mechanical

Housing (h × w × d)	103.6 × 56.6 × 45.6 mm
Enclosure rating	IP65
Temperature range	−20 °C ... +60 °C

Electrical

Supply voltage U_{SP}	24 VDC ±20 %
Max. current consumption	100 mA
Max. power-up inrush current	200 mA
Termination of CAN	100 Ω (internally)
Compression compensation input voltage (optional)	13 ... U_{SP} for switching "active"
Scanning rate	200 Hz

Code tape

Max. lenght	1,500 m
Width	19 mm
Thickness	0.6 mm
Material	Stainless steel / PC

General

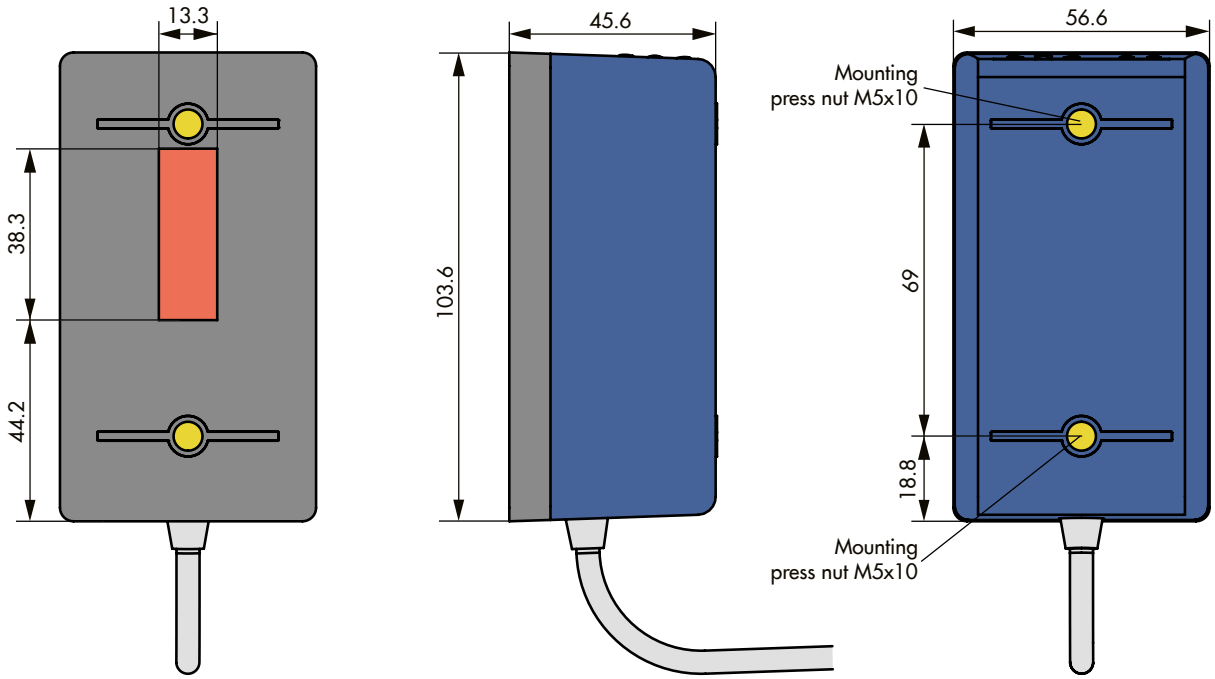
EMC emission	EN 12015:2004
EMC immunity	EN 12016:2004
Vibration	IEC 60068-2-6:2007
Shock	IEC 60068-2-27:2008
RoHS	2011/65/EU
Certificates	CE, TÜV
Safety category	EN 61508:2010, SIL 3 EN 81–1/2 +A3:2009 A17.1/CSA B44:2010, A17.5

Connection cable and electrical connection

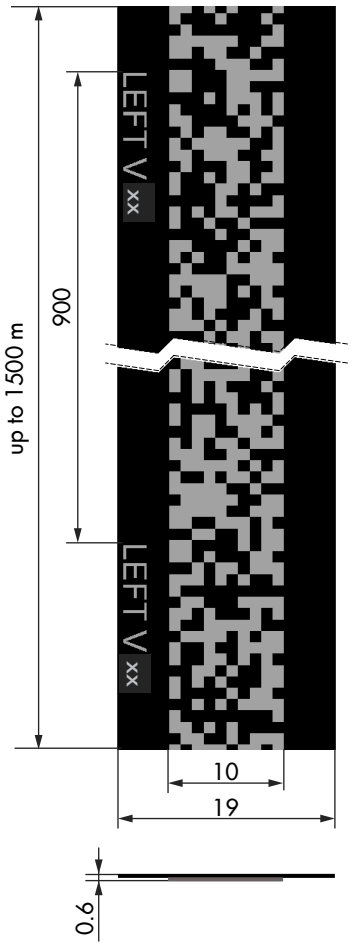
Length	5 m
Connector	RJ45
1 – blue	CAN Channel 1 LOW
2 – grey	CAN Channel 1 HIGH
3 – green	GND
4 – white	U_{SP}
5 – black	GND
6 – pink	U_{SP}
7 – brown	CAN Channel 2 LOW
8 – yellow	CAN Channel 2 HIGH

14. Dimensions

APS sensor

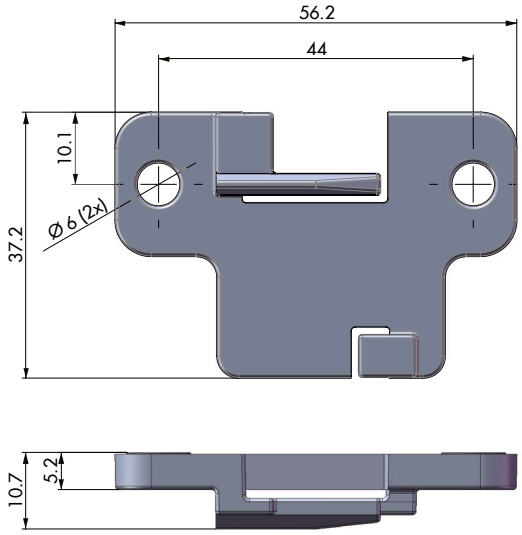


APS code tape

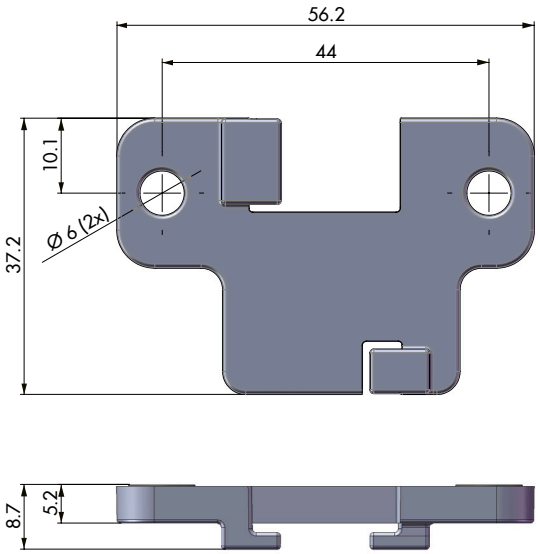


All dimensions in mm

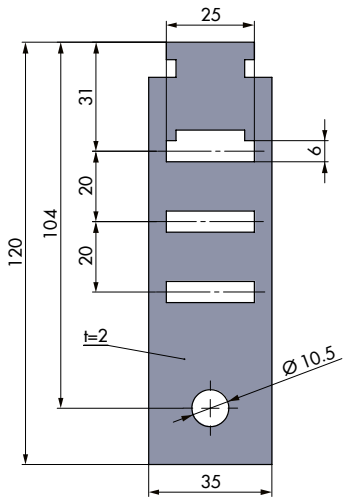
Position indicator clip



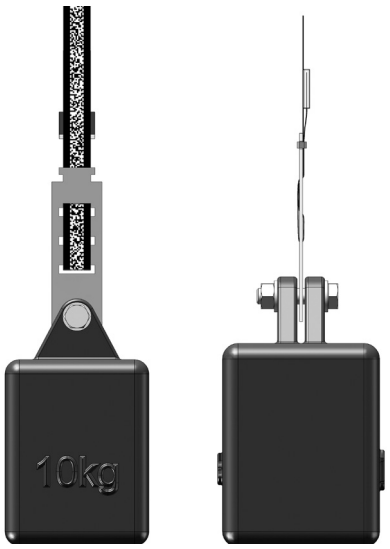
Guiding clip



Top and bottom tension lock



Tension weight (optional)



All dimensions in mm

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