TKH AIRPORT SOLUTIONS

Installation and Operation Manual

LED PAPI 803 - CEDD

CEDD AGL

Airfield Ground Lighting

V1.0

Preface

- Please read carefully and understand the contents of this manual.
- Failure to read the manual may result in serious injury, or serious damage to equipment.
- Make sure these instructions are always accessible for all users and ensure that you have read and understood the contents

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1. About this manual

This manual contains information about the installation, de-installation, maintenance and troubleshooting of the LED PAPI 803 - CEDD.

1.1 Symbols used

The following marking conventions are used in this manual to draw attention to specific topics or actions:

DANGER! - This sign indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING - This sign indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION - This sign indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE – This sign indicates a situation that could result in damage to property or equipment.

The following symbols are used on equipment and in this manual to warn of potential hazards:

DANGER of electrical shock or arc flash. Failure to observe this warning will result in serious injury or death.

WARNING or **CAUTION**: where this symbol is used on the equipment, it is mandatory to consult the manual to find out the nature of potential hazards and any actions which have to be taken to avoid them.

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1.2 Storing the manual

- This manual is a part of your product. Store the manual in a location that can be easily accessed by personnel working on the product.
- It is the responsibility of the company operating this equipment to ensure that its personnel is provided with a copy of this manual.

1.3 Limitations of the Document

TKH Airport Solutions reserves the right to revise this document without prior notice.

The data provided in this document is based on the most recent information at the time of publication. TKH Airport Solutions continually ensures its products meet current technological standards. As a result, it is possible that there may be some differences between the product and the information in this manual.

For further information regarding adjustment, maintenance or repair which is not described in this document, please contact the Service department of TKH Airport Solutions via service@tkh-airportsolutions.com.

The information in this document concentrates solely on use of the products as intended by the manufacturer.

1.4 Terms and Abbreviations

This document may include the terms and abbreviations as listed below.

AGL	Airfield Ground Lighting
CEDD	Contactless Energy and Data Distribution
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
HPS	High Power System
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Committee
LED	Light Emitting Diode
NUID	Node Unique Identification
PAPI	Precision Approach Path Indicator

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1.5 Trademarks

CEDD® is a registered trademark of USE System Engineering Holding B.V. in the European Union. Other product names mentioned may be trademarks of TKH Airport Solutions B.V., USE System Engineering Holding B.V., or their affiliated companies.

1.6 Liability and Warranty

TKH Airport Solutions cannot be held responsible for injuries or damage resulting from non-standard, unintended use, faulty or improper installation of its equipment, or failure to follow the instructions and safety guidelines in this manual. The safety of any system incorporating the LED PAPI 803 is the responsibility of any site installation, commissioning, maintenance, and operations personnel using the system.

Unintended uses include the following actions:

1. Making changes to equipment that have not been recommended or described in this manual or using parts that are not genuine TKH Airport Solutions replacement parts or accessories.
2. Failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards if not in contradiction with the general rules.
3. Using materials or auxiliary equipment that are inappropriate or incompatible with your TKH Airport Solutions equipment.
4. Allowing unskilled personnel to perform any task on or with the equipment.

Disregarding the safety instructions in this manual will result in the loss of warranty in case of damage.

Refer to the general TKH Airport Solutions Terms and Conditions document supplied with your sales order contract for a complete liability and warranty description.

Before operating the PAPI (4 units) system, a UK-CAA CAP168, appendix 6D compliant flight check must be conducted.

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1.7 Manufacturer Details

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2. Safety

This section contains general safety instructions for using your TKH Airport Solutions equipment. Some safety instructions may not apply to the equipment in this manual. Note all warnings and follow all instructions carefully. Failure to do so may result in personal injury, death, or property damage.

To use this equipment safely,

- Refer to the International Standard IEC 61820, Electrical installation for lighting and beaconing of aerodromes - Constant current series circuits for aeronautical ground lighting - System design and installation requirements, and to the International Standard IEC 61821, Electrical installations for lighting and beaconing of aerodromes - Maintenance of aeronautical ground lighting constant current series circuits for instructions on safety precautions.
- Observe all safety regulations. To avoid injuries, always remove power prior to making any wire connections and touching any live part. Refer to the International Standards IEC 61820 & IEC 61821.
- In addition, for a parallel power supply also consider the International Standard IEC 60598 (for Class I equipment)
- Read and become familiar with the general safety instructions provided in this section of the manual before installing, operating, maintaining, or repairing this equipment.
- Read and carefully follow the instructions given throughout this manual for performing specific tasks and working with specific equipment.
- Store this manual within easy reach of personnel installing, operating, maintaining, or repairing this equipment.
- Follow all applicable safety procedures required by your company, industry standards, and government or other regulatory agencies.

Thoroughly read and observe all safety instructions in this document.

WARNING: Switch the main power off at the CEDD HPS Basestation when any installation, maintenance or replacement is done on the LED PAPI 803 - CEDD. Or use a Break Out Box to ensure power is off at the CEDD system.

WARNING: Disregarding the safety instructions in this manual could result in serious injury or death.

2.1 Qualified Personnel

Only qualified and authorized personnel are allowed to install, operate or maintain this equipment.

The term ‘qualified personnel’ is defined here as individuals who thoroughly understand the equipment and its safe installation, operation or maintenance. Qualified personnel are physically capable of performing the required tasks, are familiar with all relevant and local safety rules and regulations, and have been trained to safely install, operate or maintain the equipment. It is the responsibility of the

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company installing, operating or maintaining this equipment to ensure that its personnel meet these requirements.

2.2 Intended Use

The LED PAPI 803 - CEDD is designed and intended only for the purpose of Airfield Ground Lighting (AGL) at airfields and airports as described in this manual. Intended use also includes the observance of all procedures, inspection and maintenance instructions described in this manual.

Any other usage that is not described in this manual is considered unintended use. Unintended use includes but is not limited to the following actions:

- allowing unskilled personnel to perform any task on or with the equipment
- making changes to the equipment that have not been recommended or described in this manual or using parts that are not approved by TKH Airport Solutions.
- using materials or auxiliary equipment that are inappropriate or incompatible with TKH Airport Solutions equipment.
- failing to make sure that auxiliary equipment complies with approval agency requirements, local codes, and all applicable safety standards, provided that they are not in violation of national regulations.

WARNING: Using this equipment in ways other than described in the manual could result in serious injury or death and/or material damage.

The LED PAPI 803 - CEDD may only be used with CEDD system components approved by TKH Airport Solutions:

- CEDD Elevated Base
- CEDD Cable
- CEDD HPS Terminator
- CEDD HPS Basestation
- CEDD Master CMS
- CEDD Master AM

NOTICE: It is not allowed to connect the CEDD Fixtures to components other than approved CEDD components.

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2.3 Installation

A thorough understanding of system components and their requirements will help you install the system safely and efficiently. Failure to follow these safety procedures can result in personal injury or death.

Read the safety and installation sections of all system component manuals before installing your equipment.

- Allow only qualified personnel to install TKH Airport Solutions equipment and auxiliary equipment. Use only approved equipment. Using unapproved equipment in an approved system may void agency approvals and will void the warranty.
- Make sure all equipment is rated and approved for the environment in which you are using it.
- Follow all instructions for installing components and accessories.
- Install all electrical connections according to local codes and regulations, provided they are not in contradiction with the general rules.
- Use only electrical wire of sufficient gauge and insulation to handle the rated current and voltage demand. All wiring must meet local codes.
- Route electrical wiring along a protected path. Make sure the wires will not be damaged by moving equipment and animals (e.g. rodents).
- Protect components from damage, wear, and harsh environmental conditions.
- Allow sufficient room for maintenance, panel accessibility (power products), and cover removal (power products).
- Protect equipment with safety devices as specified by applicable safety regulations.
- If safety devices must be removed for maintenance, re-install them immediately after the work is completed and check them for proper functioning.

2.4 Operation

Only qualified personnel (see section Qualified Personnel) should operate this equipment. Read all system component manuals before operating this equipment. A thorough understanding of system components and their operation will help you operate the system safely and efficiently.

- Before starting this equipment, check all safety interlocks, fire-detection systems, and protective devices such as panels and covers. Make sure all devices are fully functional. Do not operate the system if these devices are not working properly. Do not deactivate or bypass automatic safety interlocks or locked-out electrical disconnects or pneumatic valves.
- Never operate equipment with a known malfunction.
- Do not attempt to operate or service electrical equipment if standing water is present.
- Use this equipment only in the environments for which it is rated. Do not operate this equipment in humid, flammable, or explosive environments unless it has been rated for safe operation in these environments.
- Never touch exposed electrical connections on equipment while the power is ON. Verify that exposed electrical connections are de-energized.
- Never look directly in the light source while the power is ON.

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2.5 Action in the Event of a System or Component Malfunction

Do not operate a system that contains malfunctioning components. If a component malfunctions, turn the system OFF immediately.

- Disconnect and lock out electrical power.
- Repair or replace the malfunctioning component according to instructions provided in its manual. Allow only qualified personnel to perform maintenance, troubleshooting, and repair tasks. Only persons who are properly trained and familiar with TKH Airport Solutions equipment are permitted to service this equipment.
- Always use safety devices when working on the equipment.
- Follow the recommended maintenance procedures in your equipment manuals.
- Do not service or adjust any equipment unless another person trained in first aid and Cardiopulmonary Resuscitation (CPR) is present.
- Connect all disconnected equipment ground cables and wires after servicing equipment. Ground all conductive equipment.
- Use only approved TKH Airport Solutions replacement parts. Using unapproved parts or making unapproved modifications to equipment may void agency approvals, impair specified performance and create safety hazards.
- Check interlock systems periodically to ensure their effectiveness.
- Do not attempt to service electrical equipment if standing water is present. Use caution when servicing electrical equipment in a high-humidity environment.
- Use tools with insulated handles when working with electrical equipment.

2.6 Electrical hazards

The CEDD AGL system components (e.g. CEDD cable, CEDD AGL LED Fixtures, and CEDD HPS Terminator) should not be touched or worked on if the CEDD AGL system is operational (meaning constant current AGL series circuit energized). The constant current AGL series circuit must be de-energized before any (maintenance/service) work on the CEDD AGL system and its components can start. Before any work can start the CEDD HPS Basestation must be switched off and must be protected against accidental re-energizing.

When installing this equipment always follow these safety rules:

Switch the power supply **OFF** at the location of the CEDD HPS Basestation when any installation, maintenance or replacement is done on the LED PAPI 803 - CEDD.

The use of a disconnecting device is mandatory. The **OFF** position at the CEDD HPS Basestation must be clearly marked and the disconnection device must be easily accessible. A switch or other disconnecting device for functional purposes may be provided.

Never open the equipment while the power supply is switched ON.

Never touch exposed electrical connections on this equipment while the power supply is switched ON.

Do not attempt to operate or service electrical equipment if standing water is present.

When working on the equipment always wear appropriate protective clothing.

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2.7 Photobiological Safety

Photobiological safety conforms to IEC 62471 for beams emitted in white color:

RISK GROUP 2: Possibly hazardous optical radiation emitted from this product. Do not stare at the operating lamp. May be harmful to the eyes.

1. For viewing distances greater than 1600 mm, the product is Risk Group 1 or lower.
2. Use protection goggles or any similar protection method.

Photobiological safety conforms with IEC 62471 for beams emitted in other colors:

RISK GROUP 0 or 1: Optical radiation emitted from LED lights may be harmful to the eyes. Do not stare with bare eyes at a fixture operating at high intensity. Use protection goggles or any similar protection method.

Goggles with a transmission factor of 5% or less in the 400-530 nm band have been tested and provide adequate protection.

2.8 Transport and Storage

If the equipment is stored before installation, it must be protected from the weather in a dry and secure environment, free of condensation and dust.

Keep the equipment in the original packing it was shipped in, until it is going to be installed.

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3. About the LED PAPI 803 - CEDD

3.1 About CEDD

CEDD is an innovative contactless energy and communication technology. Energy and data transport are combined in a two-wire cable system, a base station, and contactless user points. With this structured cable concept, lighting on airfields can easily be installed or replaced without making electrical contact with the power or data cable.

The CEDD system has been specifically designed for the operation of Airfield Ground Lighting (AGL) systems on airports, with the highest possible reliability.

3.2 About the LED PAPI 803 - CEDD

The TKH Airport Solutions PAPI System is designed to provide pilots with a clear visual reference for maintaining the correct approach angle during landing. The system comprises four lighting units, working together to indicate whether the aircraft's approach path is too high, too low, or on the correct glide path, ensuring safer landings.

Fully compliant with ICAO (International Civil Aviation Organization) regulations, the PAPI System is installed adjacent to the runway threshold. This advanced system enhances runway safety, particularly in challenging environments and weather conditions, offering reliable visual guidance to pilots.

3.2.1 Specifications

Enclosure:	Aluminium powder coated RAL1028 (yellow) / double glass
Mounting:	Rigid, 12x M12
Ambient Temperature:	-40° C to +55° C
IP rating:	IP 66
Weight:	30 kg
Input:	CEDD, 24-28 Vdc from CEDD Basestation
Power Consumption:	2 x 46 Watt (92 W total)
Life expectancy:	100.000+ hours
Dimensions:	L 946 mm x W 534 mm x H 426 mm

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3.2.2 Standards

The LED PAPI 803 - CEDD is developed in compliance with:

- ICAO Annex 14 Volume 1
- FAA L-880 / L-881 & E-3007

3.2.3 Light Characteristics

Light source:	LED, steady burning
Light color:	White 5700 K / Red 630 nm
Light intensity:	+ 30.000 cd / + 15.000 cd ICAO
Vertical beam profile:	as per ICAO
Color chromaticity:	as per ICAO
Photometry:	According ICAO Annex 14 Volume I

3.2.4 Dimensions

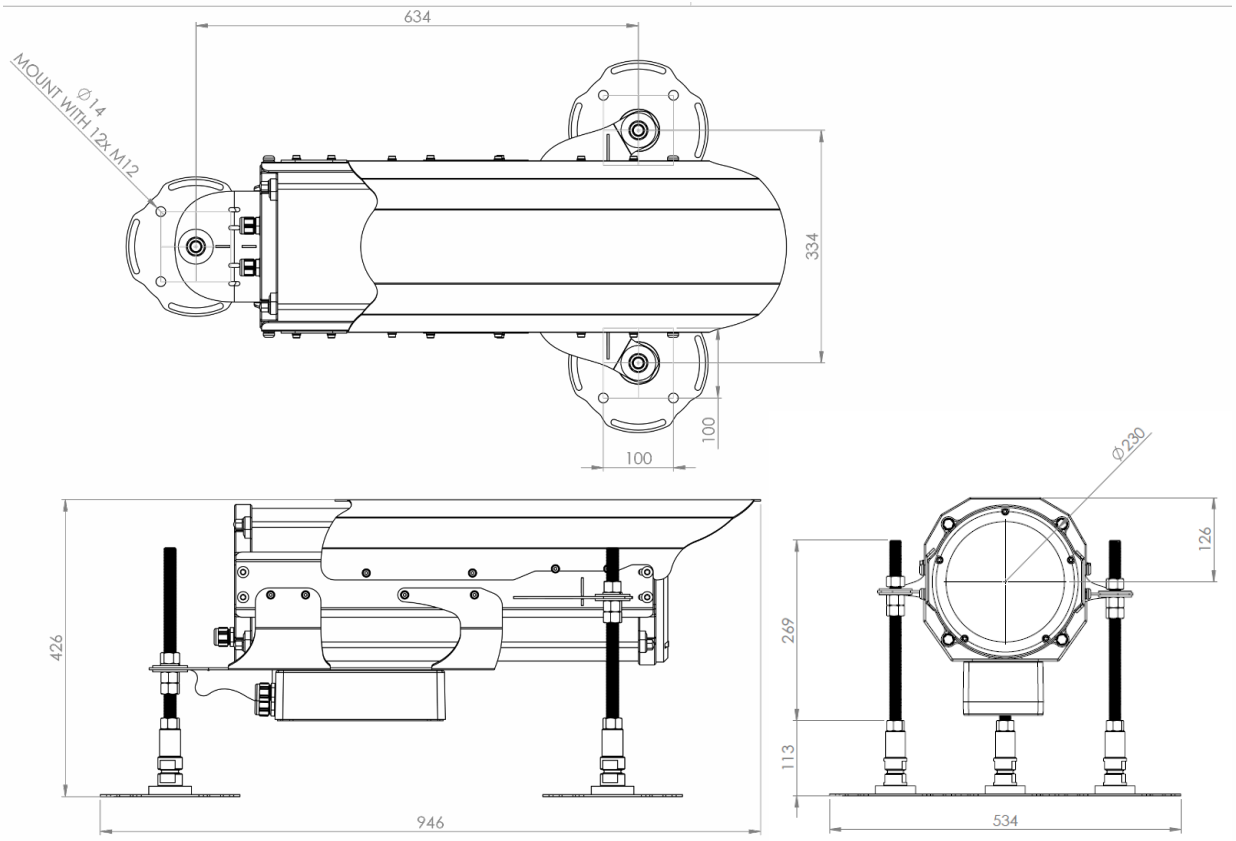

Figure 1: PAPI Dimensions

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3.3 About the CEDD Elevated Base

The CEDD Elevated Base (CPS) receives power and data from the CEDD Cable and transmits it to elevated fixtures, PAPIs, signs and cameras either directly or via a secondary extension cable.

3.3.1 Specifications

- 8” outer diameter
- Dust and water resistance: IP 69 and IP 69
- Certification: ICAO/EASA
- Ambient temperature: -40° C to +75° C

3.3.2 Dimensions

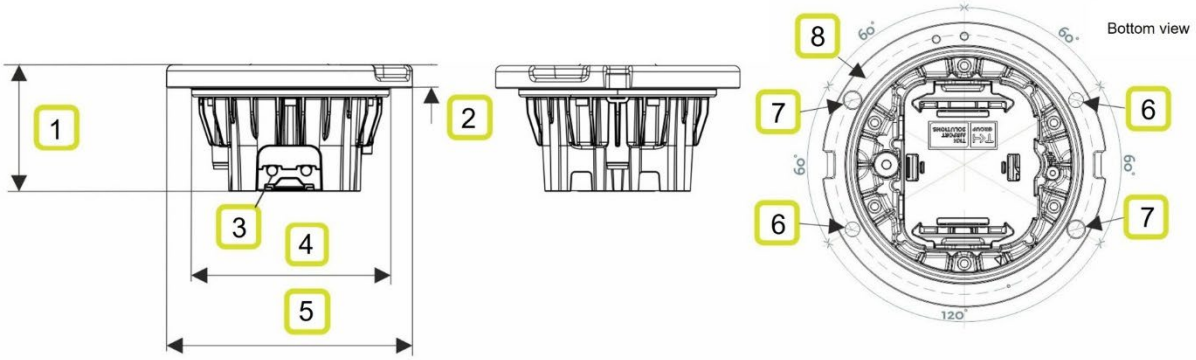

Figure 2: CEDD Elevate Base dimensions

Pos.	Description	Values
1	Elevated base height	105.7 mm
2	Elevated base cover thickness	19 mm
3	Cable diameter	Max. 7.9 mm
4	Flange diameter	164.9 mm
5	Elevated base cover diameter	201.7 mm
6	Elevated base diameter of mounting bolt holes (2x)	Ø 10.8 mm
7	Elevated base diameter of pilot holes (2x)	Ø 12 mm
8	Elevated base mounting hole center line	184 mm

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4. PAPI Operation

This chapter will explain the operation of the PAPI system.

4.1 Theory of PAPI placement

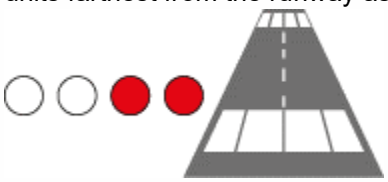
The PAPI system shall consist of a wing bar with four equally spaced sharp-transition lamp units. The system shall be located on the left side of the runway unless it is physically impracticable to do so.

NOTICE

Where a runway is used by aircraft requiring visual roll guidance which is not provided by other external means, then a second wing bar may be provided on the opposite side of the runway.

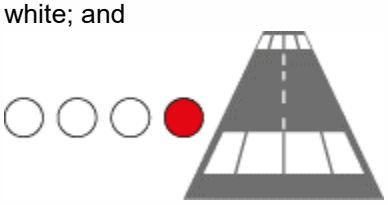
The wing bar of a PAPI shall be constructed and arranged in such a manner that a pilot making an approach will:

a. when on or close to the approach slope, see the two units nearest the runway as red and the two units farthest from the runway as white;



[CORRECT]

b. when above the approach slope, see the one unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach slope, see all the units as white; and



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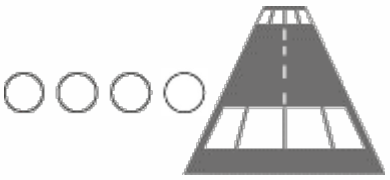
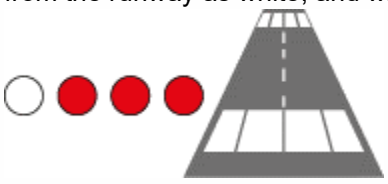
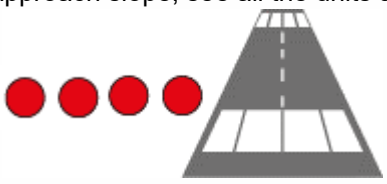


[TOO HIGH]

c. when below the approach slope, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach slope, see all the units as red.



[SLIGHTLY LOW]



[TOO LOW]

The light units shall be located as in the basic configuration illustrated in Figure below. Installation tolerances given.

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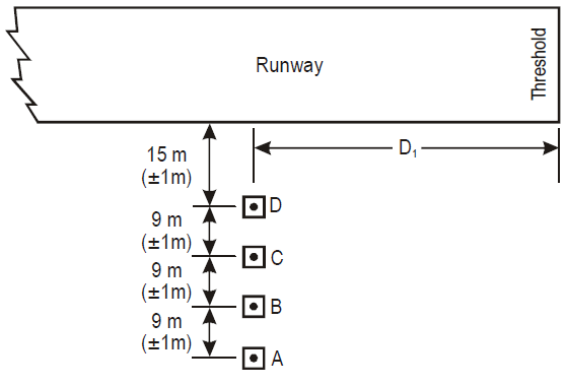

Figure 3: Typical PAPI wing bar

The units forming a wing bar shall be mounted so as to appear to the pilot of an approaching aeroplane to be substantially in a horizontal line. The light units shall be mounted as low as possible and are frangible due to their ball joint mounted feet.

For determining the exact locations of the PAPI units, please follow the relevant ICAO and/or local aviation authority standards.

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5. Inspection

Inspect the transport boxes

Before installation, the transport boxes must be inspected for damage and defects. If the transport box appears to be damaged, keep the transport box and cushioning material until the contents of the box have been checked for completeness and the equipment is checked mechanically and electrically.

NOTICE

If the equipment has been damaged during transport, put the product and all other parts back into the transport box and contact your shipper and carrier.

Inspect the contents of the transport boxes

Inspect the contents of the transport boxes. Compare the contents of the transport boxes with the applicable order. A PAPI system comes as a set of four units. In case an APAPI system was ordered, the system comprises out of a set of two units.

For this manual we will focus on a PAPI system of 4 units. Parts that are inside the shipment are at least:

- 4 PAPI units
- 12 PAPI legs (300 mm standard length)
- 1 Digital Inclination meter
- 4 CEDD Elevated bases
- 4 CEDD extension cables

If any item is missing, or if there is any visible damage or defect, contact your local TKH Airport Solutions agent or TKH Airport Solutions Service via service@tkh-airportsolutions.com.

CAUTION

Do not unpack the equipment before it reaches the installation site to avoid damage due to transportation and handling.

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6. Mechanical Installation

This chapter contains instructions for installing the LED PAPI 803 - CEDD.

Before installing the LED PAPI 803 - CEDD read the Installation Safety instructions below.

NOTICE

Disregarding these safety instructions will result in the loss of warranty in case of damage. TKH Airport Solutions is not liable for any injuries to personnel or any equipment damage.

6.1 Installation Safety

WARNING

The CEDD AGL system components (e.g. CEDD cable, CEDD AGL LED Fixtures, and CEDD HPS Terminator) should not be touched or worked on if the CEDD AGL system is operational (meaning constant current AGL series circuit energized). The constant current AGL series circuit must be de-energized before any (maintenance/service) work on the CEDD AGL system and its components can start. Before any work can start the CEDD HPS Basestation must be switched off, and must be protected against accidental re-energizing.

High voltage may still be present in the system after switching off. Wait for at least 15 minutes before starting installation.

WARNING

The CEDD AGL system must be installed in a restricted access area.

In any of the following cases the equipment must not be installed and must be kept out of reach from unauthorized use:

- if the CEDD cable or Fixtures are visibly damaged
- after storage under unfavourable circumstances (for example, outdoors or in moist environments)
- after excessive transportation stress (for example in damaged packaging)
- if the equipment is not in the original packaging

CAUTION

It is recommended to earth the shallow base in locations presenting a high risk of lightning strikes. Refer to the Installation Instructions for the shallow base.

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6.2 Mount the legs

Place the PAPI unit on its top side and mount legs to PAPI unit with a 24-mm wrench. For correct leg position see figure 6.

Figure 5: Mount legs on PAPI unit

6.3 Concrete foundation

In order to fix the PAPI lighting units to the ground, the use of a concrete foundation is recommended. For the exact location of the PAPI please follow chapter 4.

For the individual mounting, a minimum concrete foundation of $1000\ (mm\ Length)\ x\ 800\ (mm\ Width)\ x\ 250\ (mm\ height)$ is advised as shown in the image below.

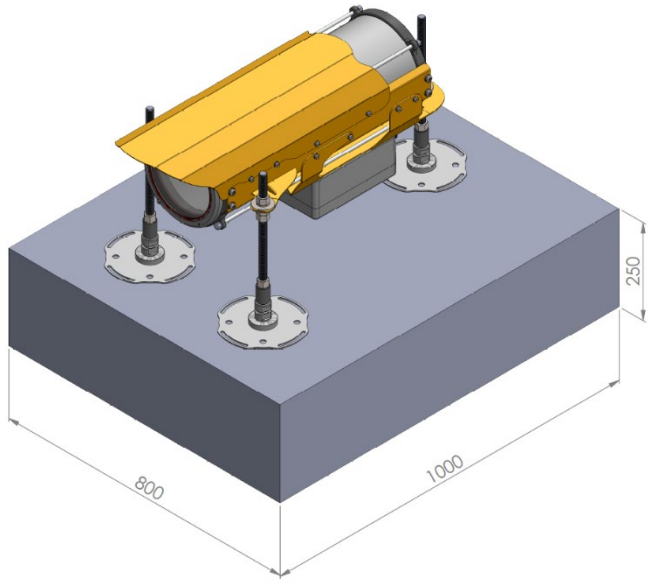

Figure 6: Concrete foundation.

NOTICE

The requirement for the concrete construction is a general requirement. The concrete construction can vary based on the soil type of the airport. Always consult local civil engineering for the correct dimensions.

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6.4 Height difference

When constructing the concrete bases, make sure the height of the concrete base is the same from A to B. The PAPI system provides up to 100 mm of standard adjustment to counter any level changes in the concrete bases.

NOTICE

Follow ICAO 5.3.5.28 "*…The light units shall be mounted as low as possible and shall be frangible."* Minor differences in height are permitted.

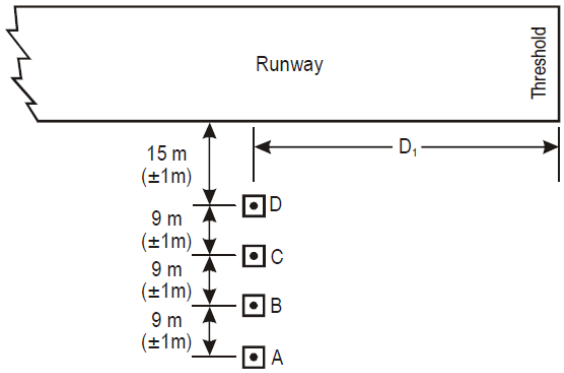

Figure 7: Concrete base locations

The nuts in the legs can be used to adjust the PAPI height, as explained in chapter 6.8. When there is a variation in the concrete slab surface, optional PAPI legs can be purchased in order to raise the PAPI for each unit to be horizontally aligned (at the same height). There are 3 configurations:

Standard A: 39-49 cm **Optional B: 42-65 cm** **Optional C: 65-87 cm**

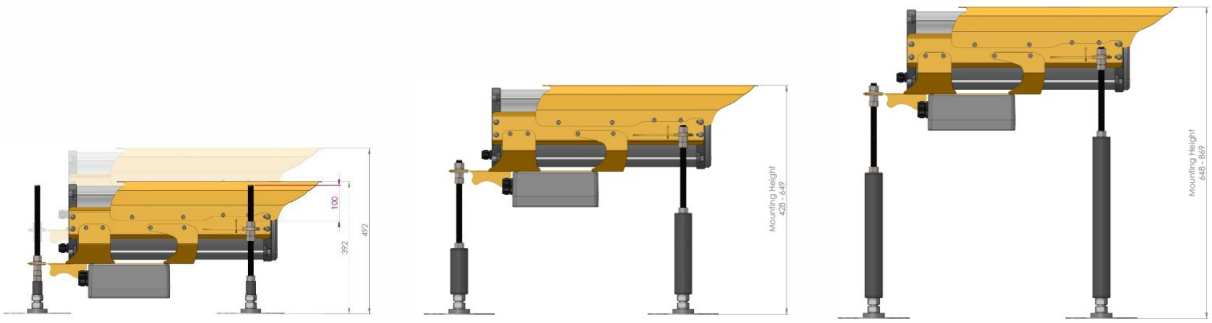

Figure 8: PAPI height configurations

CAUTION

When the PAPI system is not horizontally aligned, the operation will be affected.

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6.5 Mounting of a PAPI Unit

Mount all PAPI units on their concrete bases. The dimensions of the PAPI unit are shown in the image below. The mounting feet of the PAPI are rotatable.

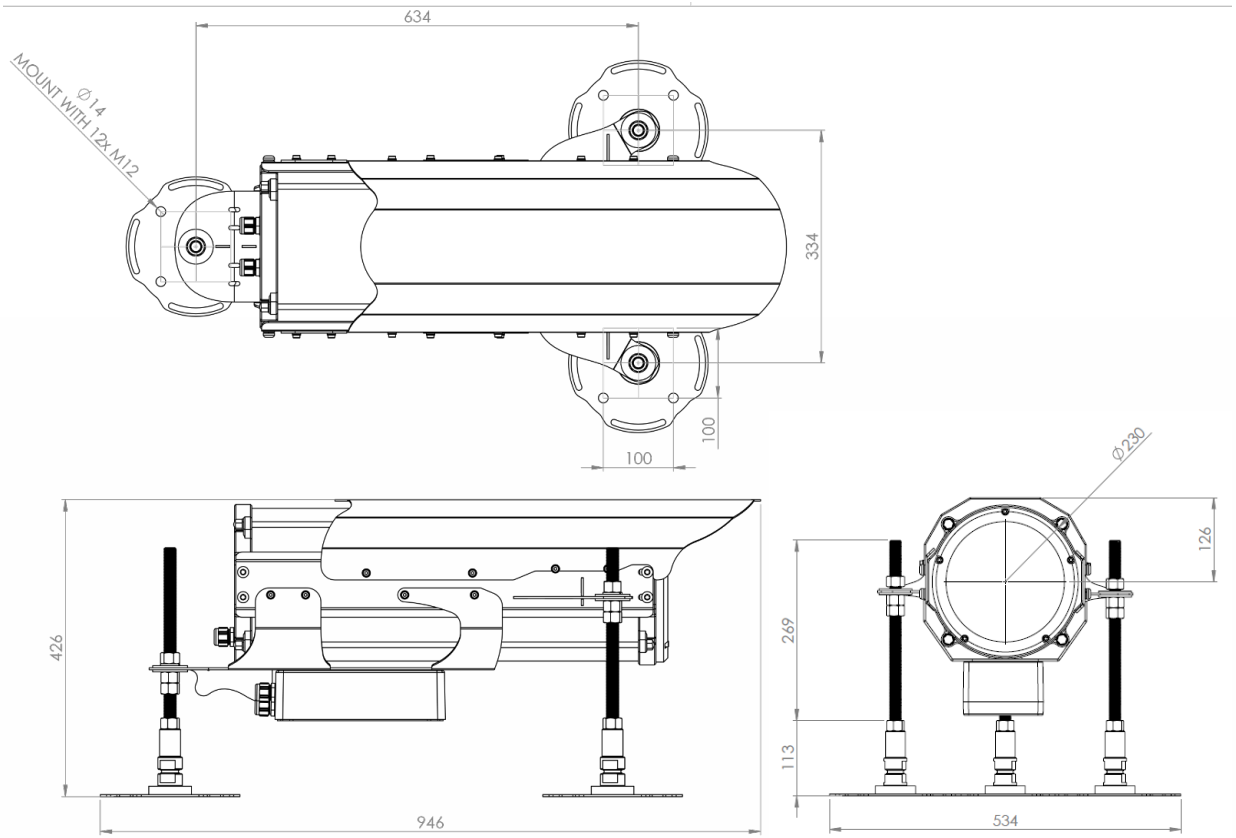

Figure 9: Dimensions

Ensure that, once all PAPI units are installed, every foot is properly fastened and secured. Label the units A through D. Unit A is the unit farthest from the runway.

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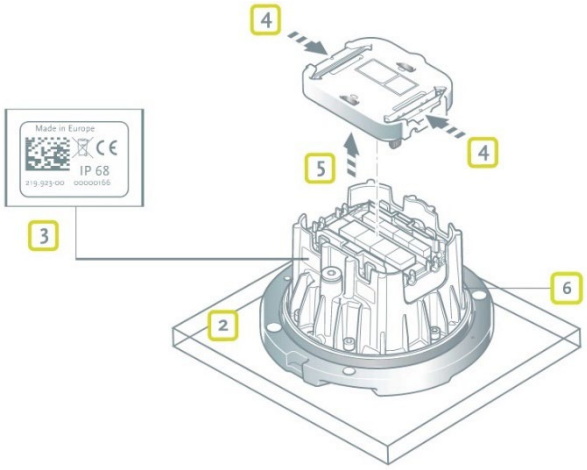
6.6 Mounting of a CEDD Elevated Base

1. Remove the CEDD Elevated Base from its packaging and carefully put it upside down on a clean, flat working surface. Use a piece of foam packaging material with a hole in the center to support the collar.

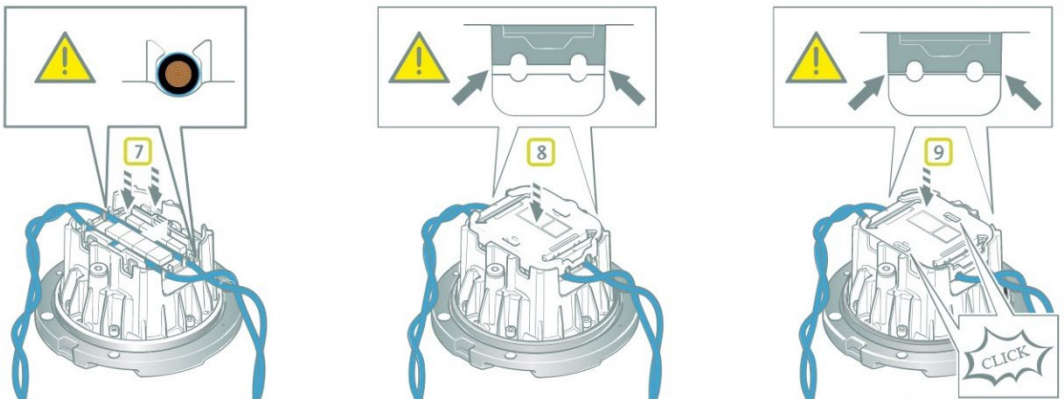


NOTICE Avoid applying excessive force on the rubber receptacle.

2. Record the NUID of the CEDD Elevated Base (QR-code on the sticker) and its aeronautical name.

NOTICE Information about NUIDs and their related aeronautical names is vital for commissioning and operation of the CEDD AGL system.

3. Unlock the CEDD inductive clamp by pressing the two flanges on both sides inwards.
4. Lift the inductive clamp lid with small tilting movements and remove it.
5. Make sure the O-ring is properly seated in the groove in the top cover of the CEDD Elevated Base.
6. Align the CEDD cables with the two slots and click these into the small clamps on both sides.



7. Reposition the CEDD inductive clamp lid. The inductive clamp lid only fits in one way. The rounded notch on one side and the plastic retention protrusions make sure of this.

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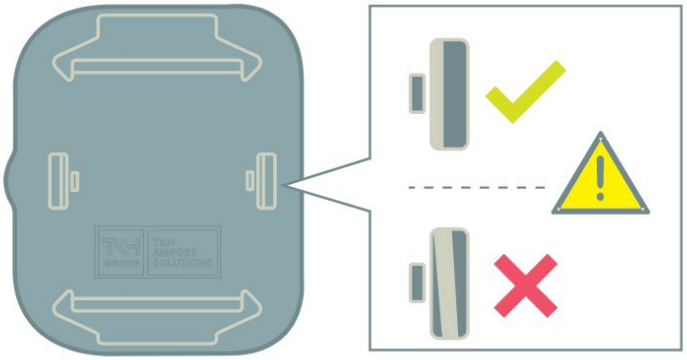
8. Firmly push down the inductive clamp lid until you hear the metal retention brackets click into place.

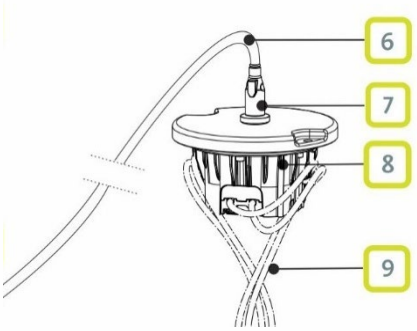
NOTICE

NOTICE: Do not apply excessive force on the inductive clamp lid, as this could damage the CEDD Elevated Base and ferrite parts.

9. Verify that the two metal retention brackets are visible and aligned straight



The CEDD Elevated Base units (8) are positioned in a box or manhole near the PAPI units. A CEDD extension cable (6) connects the CEDD Elevated Base to the PAPI unit.



NOTICE

NOTICE: Avoid any sharp bending of the CEDD cables (9) and (6). Avoid any sharp edges around the CEDD cable. Refer to the Cable Manual how to install and handle the CEDD cables.

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6.7 Electrical Installation

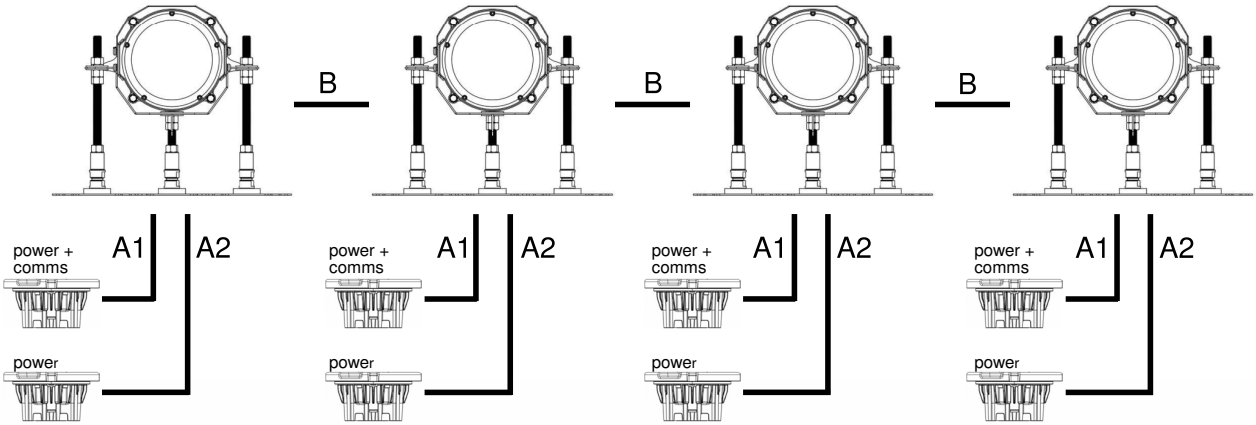

Figure 10: Electrical Installation

The cable marked as “A” in the above diagram:

For every PAPI unit, 2 CEDD elevated power supplies (base units) are required. The PAPI units come with 2 pre-mounted cable leads that should be connected to the 2 CEDD base units using CEDD extension cables **(A1 + A2)**. Make sure that the cable lead marked as “primary cable” (**A1**) is connected to the main (communicating) CEDD base unit, and the cable marked as "secondary cable” (**A2**) is connected to the power base unit.

The cable marked as “B” in the above diagram:

This is an interconnecting twisted pair cable that should have an outer diameter of 5-9 mm. This cable communicates internal faults of the PAPI and ensures all PAPI units are switched off when a fault is detected.

→ For this interconnection the following cable can be used, or similar:
LAPP - UNITRONIC® Li2YCYv (TP) – 0031366 - data cable; 1X2X0.5

Cable **B** should be connected inside the junction box where the cables are marked ‘A’ and ‘B’.

After completing all connections, check that all wiring is installed correctly and connect the external earthing to the M4 facility on the unit (see section 6.11 for the location) before starting the calibration. The wiring and earthing must not be changed after the calibration is completed.

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6.8 Calibration

Once all lighting units are connected, power on the PAPI units one by one. Calibrate each light using an inclination meter, adjusting to the desired angle as described in chapter 4 and in the steps outlined below. Ensure that each PAPI lighting unit is in an upright position; otherwise, the unit will not start.

If a problem occurs with any unit, always switch off the power before inspecting or adjusting the connections.

When all lights illuminate, the PAPI is ready for calibration. The use of a digital inclination meter is advised for this process. The image below shows this digital inclination meter.

Figure 11: Digital inclination meter

NOTICE

This inclination meter is preliminary alignment only. The flight check inspector will use calibrated tools to set the PAPI into its final alignment.

6.8.1 Position X & Y angle

The X angle of the PAPI is the Elevation and the Y angle is the Roll of the PAPI unit, as shown in the image below.

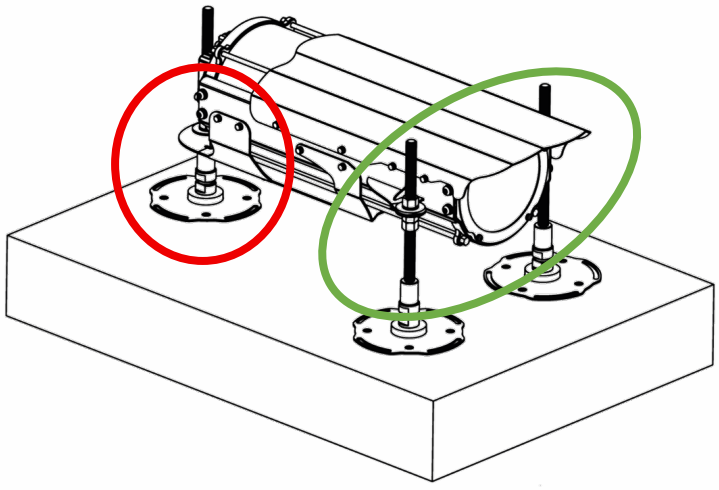

Figure 12: position X & position Y and adjustment

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6.8.2 Adjusting the angle value

In order to adjust the Roll angle of the PAPI, place the meter perpendicular on top of the glare cap as shown in the image below. First use the front two legs in order to adjust the Y-Angle to 0.0. When this is done, tighten the bolts, then adjust the X-Angle to the desired angle, following the flight path.

Figure 13: Y-angle, perpendicular *X-angle, collinear*

To adjust the legs, loosen the M16 nuts by using a 24 mm wrench.

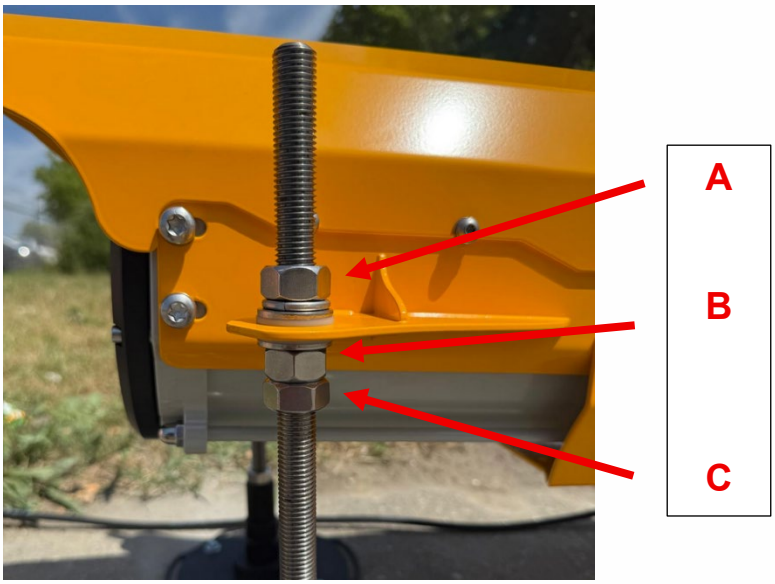

Figure 14: loosen the M16 nuts

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Each PAPI leg has 3 nuts used for the levelling of the PAPI unit. Loosen nut A and C to give appropriate clearance. Use nut B to level the unit. Once the desired angle is achieved, tighten nut A first, making sure the angle stays. When the nuts A & B are tightened, tighten nut C.

When replacing a PAPI unit, make sure nut B and C do not move.

6.8.3 Adjusting POS. X value

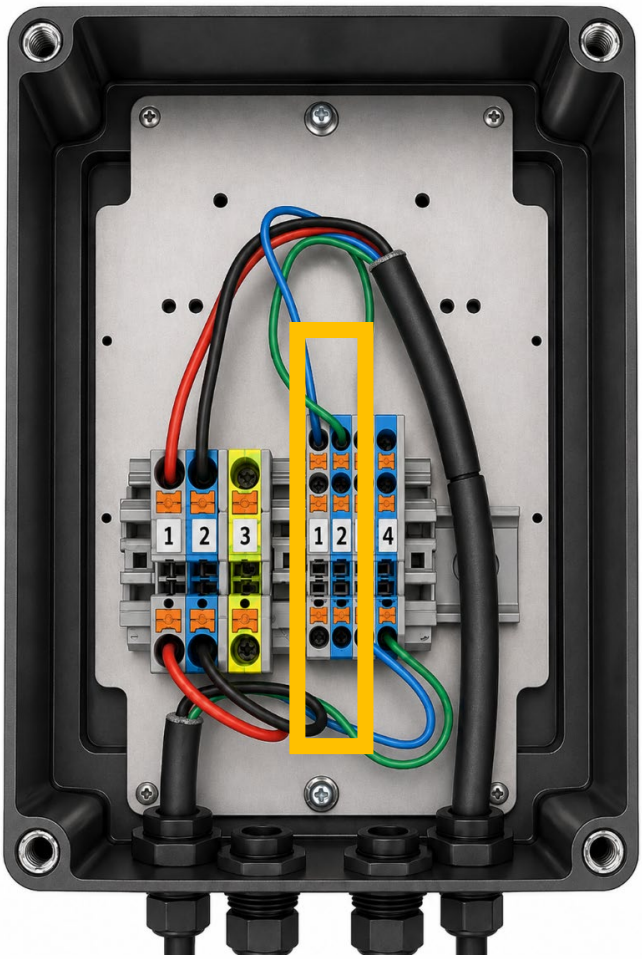
Now adjust the elevation angle, marked by POS. X on the PAPI by turning the back foot of the PAPI.

Repeat all these steps for each PAPI lighting unit.

6.9 RS485 Connection

The connection for the RS485 has to be made in the junctionbox underneath the PAPI. The cables are marked:

- Signal terminal-1. RS485.A
- Signal terminal-2. RS485.B



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6.10 Software for adjustment

After mechanically installing the PAPI, the PAPI system's internal angle sensor needs to be set to the desired glide path angle. In order to do this, there are two ways:

Option 1: Via RS485 interface
The PAPI is accessible via a freeware serial communication program, such as **CoolTermWin64Bit** which can be downloaded online. We recommend using an RS485 to USB converter such as the **Olimex LTD USB-RS485** to connect a laptop via USB to the RS485 cables.

The RS485 communication cables are located in the grey junction box underneath the PAPI. Screw the cap off the bottom of the junction box and connect the RS485 wires to the converter as described in chapter 6.9.

When connecting via the CoolTermWin64Bit software, set the baud rate to 19200.

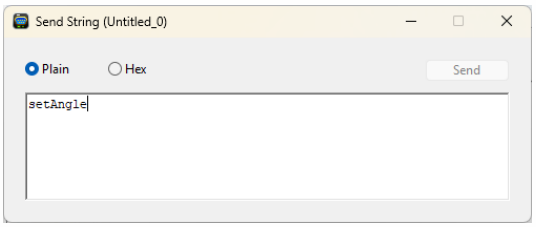
To set the PAPI internal angle, make sure all connections are made and you are connected to the PAPI. Use the following commands:

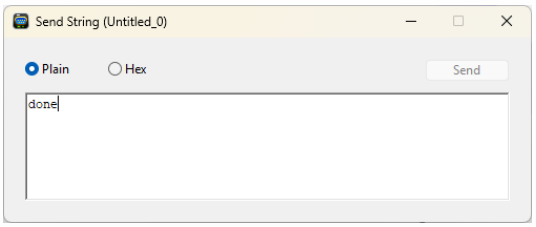
"setAngle" → (wait 5 seconds → confirm that angle information is sent) → **"done"**

NOTICE

The PAPI will not switch on if the saved angle is different from the current angle and the unit will enter error mode. Doing the above procedure will save the current angle into the saved angle.

This should look like this:





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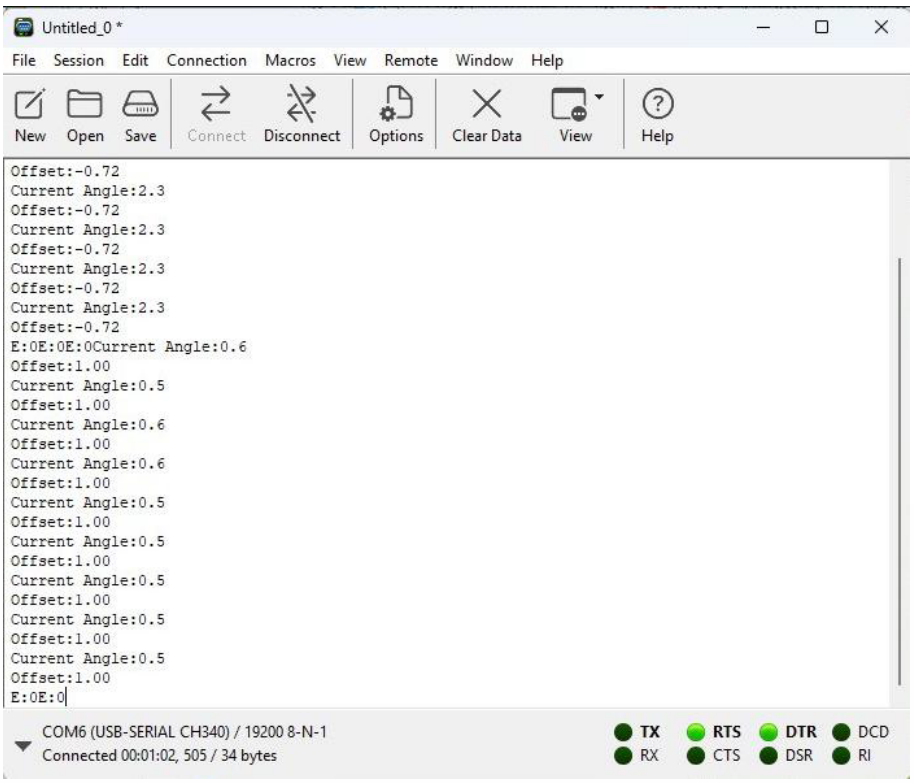
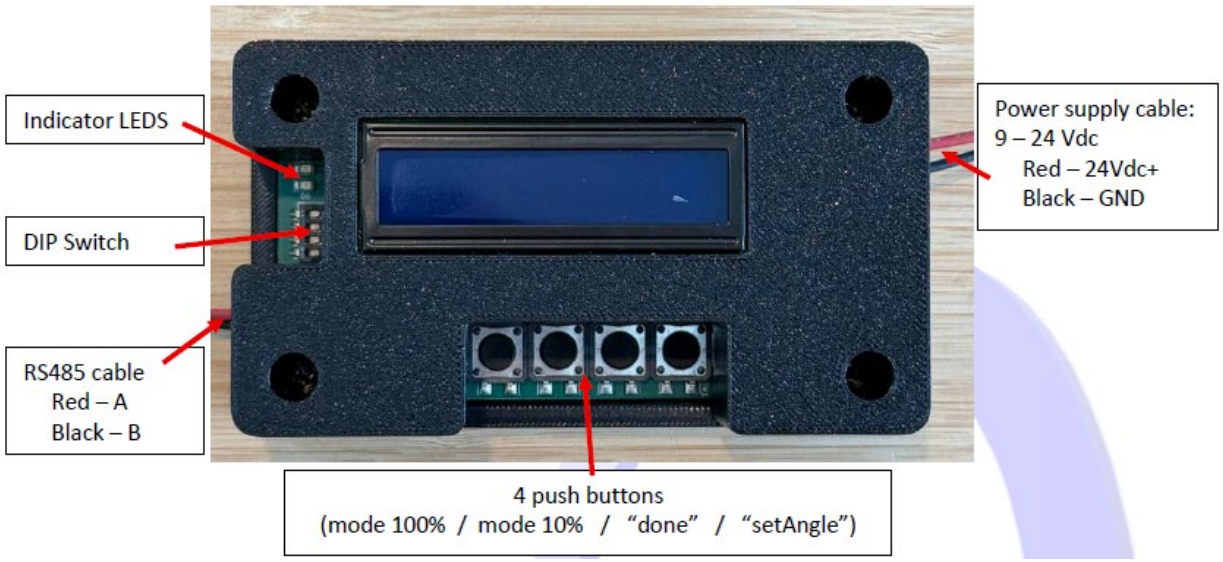


Option 2: Via PAPI Programmer.

Optionally, a handheld programmer can be provided for alignment and commissioning of the PAPI system. The below image shows this handheld programming device and its functionality:



This programmer can be directly plugged into the RS485 cable of the PAPI as described in the previous chapter:

- Signal terminal 1 (blue wire) – RS485.A
- Signal terminal 2 (green wire) – RS485.B

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To set the PAPI internal angle, make sure all connections are made and you are connected to the PAPI. Use the following commands:

"setAngle" → (wait 5 seconds → confirm that angle information is sent) → **"done"**

6.11 Signal list & data

The PAPI has a software that has means to communicate via the primary and secondary power and communication input (see cables A1 and A2 in the electrical diagram as displayed in chapter 6.7). The Primary power supply and communication cable (A1) is directly connected to the CEDD system. The secondary cable (A2) is used for installation, maintenance and shared error verification. This chapter will detail the flow of communication and their functions.

6.11.1 Primary Communications

The primary form of communication of the PAPI is via the CEDD Basestation. The communication is set up to follow the CEDD communication protocol:

0x01 0x06 ……0xXX…….0xFE

Where:

0x01; start bit
0x06; length of message
0xXX…….; the message
0xFE; Checksum

6.11.2 Monitoring data

The PAPI also provides monitoring data to communicate its key sensor input back to the CEDD system. The monitoring data has the following structure and information:

Variable	Type	Default
id	INTEGER	NOT NULL
record_sent	INTEGER	NOT NULL
record_acked	INTEGER	NOT NULL
timestamp	INTEGER	NOT NULL
node_id	INTEGER	NOT NULL
papi_driver_id	INTEGER	NOT NULL
status	INTEGER	DEFAULT NULL
tilt_angle_per_mille	INTEGER	DEFAULT NULL
set_tilt_angle_per_mille	INTEGER	DEFAULT NULL
temperature_celsius	INTEGER	DEFAULT NULL
power_watts	INTEGER	DEFAULT NULL

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heater_status	INTEGER	DEFAULT NULL
elevated_frame_errors	INTEGER	DEFAULT NULL
elevated_sent_msgs	INTEGER	DEFAULT NULL
elevated_recv_msgs	INTEGER	DEFAULT NULL
data_version	INTEGER	DEFAULT NULL

Example of monitoring data and explanation:

“0x01 0x17 0x65 0xA5 0x00 0x00 0x00 0x00 0x11 0x11 0x11 0x11 0x22 0x22 0x22 0x22 0x03 0x04 0x04 0x05 0x05 0x06 0x07 0x08 0x09 0xFE”

Where the following sections mean:

Response data	Frame error	Frame received	Frame set	version	Current Angle PAPI	Saved Angle PAPI	Temperature	Power	Status	Fan status	Checksum
01 17 65 A5	00 00 00 00	11 11 11 11	22 22 22 22	03	04 04	05 05	06	07	08	09	FE

This monitoring data is only sent upon the request from CEDD. This information is regularly updated.

6.11.3 Custom signal list-Primary (CEDD)

The PAPI system has a custom signal list of which the PAPI can perform installation or troubleshooting tasks. The below table shows the commands and descriptions. All of these commands need to be sent via the primary communication/PSU cable (A1).

HEX command	**Description**
0x51 0x02 0x70 0x72 0x6F	*Set programming mode;* Set the PAPI into programming mode. In this mode it does not validate angle misalignment and can be moved freely
0x51 0x02 0x73 0x65 0x74	*Set current angle;* Once the desired angle is set, this command stores the information into the PAPI
0x51 0x02 0x76 0x58 0xDF	*Stop angle validation;* With this command the angle validation is disabled until a complete reset of the PAPI
0x51 0x02 0x66 0x61 0xFE	*Fan+Heater test;* With this command the fan and heater will turn on for 60seconds.
0x51 0x02 0x6D 0x20 0x37	*Mode 7 activated;* Turns the PAPI on at 100% light intensity
0x51 0x02 0x6D 0x20 0x36	*Mode 6 activated;* Turns the PAPI on at 30% light intensity
0x51 0x02 0x6D 0x20 0x35	*Mode 5 activated;* Turns the PAPI on at 10% light intensity
0x51 0x02 0x6D 0x20 0x34	*Mode 4 activated;* Turns the PAPI on at 3% light intensity
0x51 0x02 0x6D 0x20 0x33	*Mode 3 activated;* Turns the PAPI on at 1% light intensity
0x51 0x02 0x6D 0x20 0x32	*Mode 2 activated;* Turns the PAPI on at 0.3% light intensity
0x51 0x02 0x6D 0x20 0x31	*Mode 1 activated;* Turns the PAPI on at 0.1% light intensity

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0x51 0x02 0x6D 0x20 0x30	*Mode 0 activated;* Switched off the PAPI

6.11.4 Installation communication

For the installation of the PAPI the secondary cable (A2) will be used. The secondary cable has a “plain text” communication protocol which can be utilized in order to install and troubleshoot the PAPI. This communication is a RS485 interface to the PAPI.

The below table shows the commands and descriptions

TEXT command	Description
setAngle	*Set programming mode;* Set the PAPI into programming mode. In this mode it does not validate angle misalignment and can be moved freely
done	*Set current angle;* Once the desired angle is set, this command stores the information into the PAPI
stopAngle	*Stop angle validation;* With this command the angle validation is disabled until a complete reset of the PAPI
sethf	*Fan+Heater test;* With this command the fan and heater will turn on for 60seconds.
mode7	*Mode 7 activated;* Turns the PAPI on at 100% light intensity
mode6	*Mode 6 activated;* Turns the PAPI on at 30% light intensity
mode5	*Mode 5 activated;* Turns the PAPI on at 10% light intensity
mode4	*Mode 4 activated;* Turns the PAPI on at 3% light intensity
mode3	*Mode 3 activated;* Turns the PAPI on at 1% light intensity
mode2	*Mode 2 activated;* Turns the PAPI on at 0.3% light intensity
mode1	*Mode 1 activated;* Turns the PAPI on at 0.1% light intensity
mode0	*Mode 0 activated;* Switched off the PAPI

When no command is sent over the secondary RS485, it will send the status of the PAPI regularly over the bus communication:

E:0; this means that the PAPI is operating in good and normal operation
E:1; this means that the PAPI has detected an error or misalignment

When E:1 is sent to the other PAPI units, all of them will switch off automatically.

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6.12 Post Installation

After the PAPI light units are installed and calibrated, follow the post-installation checklist:

1. Fasten all M16 nuts used for the adjustment of the PAPI units
2. Check if the PAPI light units are fastened correctly and secured.
3. After fastening the M16 nuts, verify with the inclination meter that the X and Y angles have not changed. Re-calibrate if necessary
4. Check that the external earthing is connected to the M4 facility highlighted in the image below and that all wiring is installed correctly. The earthing and wiring must already be installed during the electrical installation (section 6.7), before calibration.

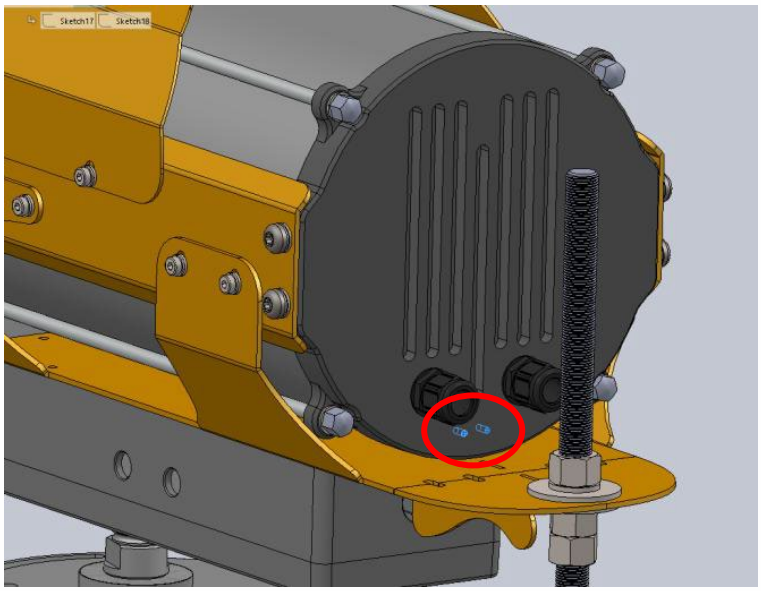

Figure 15: external earthing applied

Do not look into the light output of the PAPI from a distance closer than 5 meters as the PAPI emits radiation caused by a unidirectional focused light source and is very bright. Failure to do so can result in personal injury.

No modification must be made to the enclosure without prior consultation with the manufacturer.

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7. Flight Check

When all the above steps are followed correctly and the PAPI is now in its operating position, a flight check must be conducted according to the UK-CAA CAP168, appendix 6D.

8. Spare Parts List

When there are any defects on parts of the PAPI Lighting units, the below spare parts can be ordered:

- PAPI Lighting Unit
- Housing with front glass and solar/rain protector
- Box with Electronic board
- Set 300 mm / 200 mm foot
- Frangible bolt
- Baseline Digital Inclinometer

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9. Maintenance and Trouble Shooting

9.1 Maintenance LED PAPI 803 - CEDD Unit

To keep the PAPI units operating efficiently, follow a preventive maintenance schedule. Refer to FAA AC 150/5340-26 for more detailed information.

Interval	Maintenance task	Action
Weekly	• Check for proper function. • Check for misaligned fixtures using the inclinometer • Check for dirty lenses	All fixtures have to function. Check X and Y axis of each PAPI unit. Straighten, level, and align light fixture. Clean dirty lenses with glass cleaner.
Twice a year	• Check for presence of corrosion or loose or chipped paint.	Scrape off corrosion and repaint the light fixture.
Annually	• Check the customer-installed wire connections (junction box underneath the unit and CEE/IEC 60309 connector) for loose connections. Do not open the PAPI unit itself since it is sealed (IP66) • Calibration Inclinometer (If applicable)	Test the connections with a multimeter and repair faulty/improper wire connections. Calibrate inclinometer.

Table 2: Maintenance

9.2 Maintenance CEDD Elevated Base

Due to the contactless CEDD technology, minimal preventive maintenance is required. Apart from normal airfield cleaning procedures, perform regular visual inspections of the exterior of the CEDD Elevated Base.

If the CEDD Elevated Base is damaged or defective it must be replaced. De-install the complete base-unit and return it to TKH Airport Solutions.

9.2.1 De-installing a CEDD Elevated Base

1. Lift the CEDD Elevated Base and carefully turn it upside down on a clean, flat working surface. Use a piece of foam packaging material with a hole in the center to support the collar.

NOTICE

NOTICE: Avoid forces on the rubber connector receptacle that may damage the CEDD Elevated Base.

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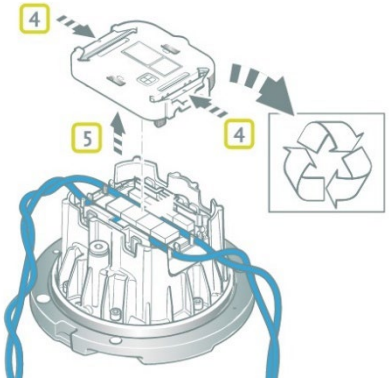
2. Release the CEDD inductive clamp (5) by pressing the two flanges on both sides inwards (4).



3. Lift the CEDD inductive clamp lid (5) with small tilting movements and remove it.
4. Take the cables from the slots and remove the fixture.
5. If the fixture and CEDD Elevated Base will not be replaced immediately, fix a suitable blind plate over the shallow base.
6. Record the NUID of the CEDD Elevated Base (see the QR-code on the sticker (8)) and its aeronautical name.

NOTICE

NOTICE: Information about NUIDs and their related aeronautical names is vital for commissioning and operation of the CEDD AGL system.

9.3 Troubleshooting

CAUTION

Allow only qualified personnel to perform the following tasks. Observe and follow the safety instructions in this document and all other related documentation. Lock out the circuit fuse inside the control system unit to ensure the circuit cannot be energized remotely before or during any attempt to service the light fixture.

NOTICE

Note: the PAPI is a sealed unit (IP66) and cannot be opened. Servicing is limited to the customer-installed wiring and the replacement of complete assemblies as listed in the spare part list (chapter 8).

Problem	Possible cause	Corrective Action
LED will not turn on	Defective supply cable	Check if the supply cable from the controller is undamaged and all wiring to the PAPI unit is in proper working condition.
	Loose connection(s)	Repair any faulty or improper wire connections inside CEE/IEC 60309 power connector for PAPI unit.
	Defective LED module	Verify the power supply and check the status output on the RS485 interface (chapter 6.10). If the unit communicates (E:0/E:1) but emits no light, the LED module is defective. The unit must be repaired by the manufacturer. Contact TKH Airport Solutions for support.

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	Defective electronics	Verify the power supply. If the supply is correct but the unit does not communicate on the RS485 interface (no E:0/E:1 status, section 6.10), the electronics are defective. The unit must be repaired by the manufacturer. Contact TKH Airport Solutions for support.
	Moisture inside the fixture	Inspect the front glass and lens for cracks. The unit is sealed (IP66); in case of moisture ingress, replace the housing with front glass as a complete assembly as described in the spare parts list. Replace all electrically damaged components. Contact TKH Airport Solutions for support.

Table 3: Troubleshooting

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Company profile:

TKH Airport Solutions is an innovator in airfield ground lighting, offering a complete range of LED AGL products. We build upon the know-how from a long and successful tradition of pioneering developments in the AGL and connectivity industry. Being part of the TKH Group, our company can build on a history of more than 90 years in smart connectivity, energy distribution and AGL.

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