INSTRUCTION MANUAL

CEGELEC ZA757

PRECISION APPROACH PATH INDICATOR (Style A)

BATTERY SUPPLY (no tilt switch)

Revision: 1.00

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SECTION ONE

SITING AND INSTALLATION

1.10 Signal Presentation

The precision approach path indicator (PAPI) is a system of either four or two identical light units placed on the left of the runway aimed outward into the approach zone on a line parallel to the runway. The front face of each unit is perpendicular to the runway centerline. The boxes are positioned and aimed to produce the signal presentation described below.

A. 4-Box System: When making an approach, the pilot will:

(1) When on or close to the established approach path, see the two units nearest the runway as red and the two units farthest from the runway as white; and
(2) When above the approach path, see the unit nearest the runway as red and the three units farthest from the runway as white; and when further above the approach path see all the units as white; and
(3) When below the approach path, see the three units nearest the runway as red and the unit farthest from the runway as white; and when further below the approach path see all units as red.

B. 2-Box System: when making an approach, the pilot will:

(1) When on or close to the established approach path, see the unit nearest the runway as red and the other unit as white; and
(2) When above the approach path, see both units as white; and
(3) When below the approach path, see both units as red.

FIGURE 1. PAPI SIGNAL PRESENTATION

1.2O General Siting Considerations

When viewed from the approach end, the PAPI system shall be located on the left side of the runway. In the event of siting problems, such as conflicts with runways or taxiways, the PAPI may be located on the right side of the runway. The PAPI must be sited and aimed so that it defines an approach path with adequate clearance over obstacles and a minimum threshold crossing height. If the runway has an Instrument Landing System (ILS) glideslope already established, the PAPI is installed as described in 1.3 below so that the visual glideslope will coincide (as much as possible) with the electronic one produced by the ILS. If there is no ILS on the runway, the PAPI glideslope is chosen as described in 1.4 below. Aiming of the light units is described in paragraph 1.50. Other siting tolerances and considerations which are common to all PAPI installations are described in 1.6.

1.30 Siting PAPI on a Runway With an ILS Glideslope

When siting the PAPI on a runway with an established ILS glideslope, the PAPI visual approach path should coincide as much as possible with the one produced electronically by the ILS. To accomplish this, the PAPI is placed at the same distance from the threshold as the virtual source of the ILS glideslope within a tolerance of +/- 30 feet (+/- l0m). The PAPI is aimed at the same angle as the ILS glideslope. For these locations, the distance to the ILS glideslope source plus an additional 300 feet +50, -0 (90m + 15, -0).

1.40 Siting PAPI on a Runway Without an ILS Glideslope

When an ILS glideslope is not present, the designer must determine a position and aiming for the PAPI which will produce the required threshold crossing height and clearance over obstacles in the approach area.

1.41 Threshold Crossing Height (TCH)

Thee TCH is the height of the lowest on-course signal at a point directly above the intersection of the runway centerline and the threshold. The minimum allowable TCH varies according to the height group of aircraft that uses the runway. The PAPI approach path must provide the proper TCH for the most demanding height group that uses the runway.

1.42 Glidepath Angle

The visual glidepath angle is the center of the on-course zone, and is normally 3 degrees when measured from horizontal. For non-jet runways, this may be raised to 4 degrees if required to provide obstacle clearance. If used, the higher angle must be specified in a Notice to Airmen (NOTAM) and published in the Airport Facility Directory.

1.43 The PAPI Obstacle Clearance Surface

The PAPI obstacle clearance surface is established to provide the pilot with a minimum clearance over obstacles during approach. The PAPI must be positioned and aimed so that no obstacles penetrate this surface. The surface begins 300 feet (90m) in front of the PAPI system (closer to the threshold) and proceeds outward into the approach zone at an angle 1 degree less than the aiming angle of the third light unit from the runway (for a 4-Box), or the outside light unit (for a 2-Box). For a 4-Box with a 3 degree glidepath and 20 minute separation between light units, the third light unit from the runway would be aimed at 2 degree 50' elevation. The surface extends 10 degrees on either side of the runway centerline extended, and extends 4 statute miles from its point of origin. If a site survey determines that there is an obstacle which penetrates the obstacle clearance surface, and cannot be moved, then the glidepath angle must be changed or the PAPI system moved further from the threshold. By moving or re-aiming the PAPI, the designer must reposition the PAPI obstacle clearance surface so it will not be penetrated by an obstacle.

Table 1. Visual Threshold Crossing Heights

1.50 Aiming

After the visual glidepath angle has been selected, the PAPI units are aimed to define that path. The standard aiming angles for the 4-Box and the 2-Box systems are shown in Tables 2 and 3 of the FAA CIRCULAR AC 150/5345-28D dtd. 5/23/85, and are reflected in these instructions.

Table 2. Aiming of the (4-Box) PAPI
Relative to a Preselected Glidepath, Chapter 2, par. 20, page 15.

Table 3. Aiming of the (2-Box) PAPI
Relative to a Preselected Glidepath, Chapter 2, par. 20, page 15.

1.60 Other Siting Dimension and Tolerances

1.61 Distance From Runway Edge

The inboard light unit shall be no closer than 50 feet, +10, -0 (15m, +3, -0) from the runway edge or to other runways or taxiways. This dimension may be reduced to 30 feet (10m) for small general aviation runways used by non-jet aircraft.

1.62 Separation Between Light Units

The PAPI Units shall have a lateral separation of between 20 and 30 feet (6 to 9m) for a 4-Box system because it increases the usable range of the system. For the 4-box system the distance between boxes shall not vary by more than 1 foot (0.3m).

1.63 Azimuthal Aiming

Each light unit shall be aimed outward into the approach zone on a line parallel to the runway centerline within a tolerance of +/- 1/2 degree.

1.64 Mounting Height Tolerances

The beam centers of all light units shall be within +/- 1 inch of a horizontal plane. This horizontal plane shall be within +/- 1 foot (0. 3m) of the elevation of the runway centerline at the intercept point of the visual glidepath with the runway (except for the condition in point 1.67 below).

1.65 Tolerance Along Line Perpendicular to Runway

The front face of each light unit in a bar shall be located on a line perpendicular to the runway centerline within +/- 6 inches.

1.66 Correction for Runway Longitudinal Gradient

On runways where there is a difference in elevation between the runway threshold and the runway elevation at the PAPI, the location of the light units may need to be adjusted with respect to the threshold in order to meet the required obstacle clearance and TCH. Where such conditions exists, the following steps are taken to compute the change in the distance from the threshold required to preserve the proper geometry. Please refer to FAA CIRCULAR AC 150/5345-28D CHG 1 dtd. 11/1/91, Figure 3.

(1) Obtain the runway longitudinal gradient. This can be done by survey or obtained from "as-built,'drawings or airport obstruction charts.
(2) Determine the ideal (zero gradient) distance from the threshold in accordance with the instructions above.
(3) Assume a level reference plane at the runway threshold elevation. Plot the location determined in (2) above.
(4) Plot the runway longitudinal gradient (RWY)
(5) Project the visual glidepath angle to its intersection with the runway longitudinal gradient (RWY). Then solve for the adjusted distance from threshold either mathematically or graphically.
(6) Double-check to see that the calculated location gives the desired threshold crossing height.

1.67 Other Siting Consideration

(1) Where the terrain drops off rapidly near the approach threshold and severe turbulence is experienced, the PAPI should be located farther from the threshold to keep the aircraft at the maximum possible threshold crossing height.
(2) On short runways, the PAPI should be as near the threshold as possible to provide the maximum amount of runway for braking after landing.
(3) At locations where snow is likely to obscure the light beams, the light units may be installed so the top of the unit is a maximum of 6 feet (2m) above ground level. This may require locating the light units farther from the runway edge to ensure adequate clearance for the most critical aircraft. Since raising the light units also raises the threshold crossing height for the visual glidepath, the lights may also have to be relocated closer to the threshold to remain within specified tolerances.

1.70 Siting the Typical 2-Box System

1.71 Select the Desired Threshold Crossing Height (TCH)

1.72 Select the Desired Visual Approach Angles

Legs for the light box should be cut from 2" EMT to provide for mounting the light box unit so that the center of the lens is at the elevation of the crown of the runway at the RRP.

(a) Siting Station Displaced Toward Threshold
(b) Siting Station Displaced From Threshold

Symbols
Dl=ideal (zero gradient) distance from the threshold
RWY=Runway longitudinal gradient
TCH=Threshold Crossing Height
T=Threshold
E=Elevation difference between threshold and

RRP=Runway reference point (where aiming angle or visual approach path intersects runway profile)
D=Adjusted distance from threshold
O=Aiming angle

SECTION TWO

INSTALLATION INSTRUCTIONS

2.00 Installation

The ZA757 PAPI system requires several steps to insure proper installation and maximum performance. These steps should not be bypassed.

* Determination of proper location of the light boxes.
* Installation of the footers and mounting pads.
* Interconnect wiring and home run wiring.
* Alignment of the light box assemblies.
* Electrical adjustments.
* Flight check.

2.10 Determination of Proper Light Boxes

To obtain an optimized approach system, several factors must be considered. These are:

* What is the distance between the pilot's eyes and the wheel of the largest aircraft to use the runway?
* What is the desired threshold crossing height?
* What is the desired glideslope angle?
* Will the selection of the above parameters satisfy the required obstacle clearance angle?

2.11 For general aviation, small commuters and corporate turbo jets, the wheel-to-eye distance in landing configurations is generally 10 feet or less. The required threshold crossing height (TCH) is the range between 20' minimum and 45' maximum. It must be set high enough that adequate clearance is available to the aircraft when crossing the threshold. However, as the TCH is raised, the runway reference point (RRP) also moves down the runway away from the threshold. Additionally, as the glideslope angle is increased, the RRP moves back towards the threshold. Therefore, you must select the desired TCH, and the desired glideslope, locate these points on the runway, then check whether or not they satisfy the obstacle clearance angle.

To test for adequate obstacle clearance, you must take a surveyor's transit to a point 300 feet towards the threshold from the proposed runway reference point, set up the transit on the centerline of the runway at pavement height, adjust the transit for the required obstacle clearance angle, and then look into the approach area at all angles up to 10 feet each side of the centerline to assure that no obstacle penetrates the obstacle clearance angle. If obstacles do penetrate the obstacle clearance angle, then either the TCH must be increased, or the glideslope must be increased to clear the obstructions.

NOTE:

If nearby trees are an obstacle to your approach, allowances should be made in siting your system, because the trees will continue to grow and could become a serious hazard.

2.12 The tabulation of glideslope angle vs. TCH will assist in optimizing the approach and RRP.

2.13 After suitable RRP and the glideslope angle are determined, the PAPI light box location indicated on the tabulation will be satisfactory provided the mounted height of the light boxes will be at an elevation equal to the elevation of the crown of the runway at the RRP +/- 1 foot.

If the elevation restriction cannot be maintained, the location of the light boxes should be moved closer to or away from the threshold, in order to maintain the same RRP.

The boxes should be moved up or down the runway according to the tabulation for "deviation of the light box height vs. deviation of the light box position".

2.20 Installation of Footers and Mounting Pads

Once the elevation and exact physical location of the light boxes has been determined, footers should be prepared as depicted in drawing 6020262 (attached).

After the footers have been set up, the EMT (2") legs should be cut. Because of the legs and mounting hardware, 16" is the minimum height that the center of the light box will be above the mounting surface.

To determine the length to cut the EMT legs, subtract 11.25" from the height of the proposed mounting center of the light box lens, above the mounting pad.

Mount the light boxes and power supply on the pads.

2.30 Interconnect Wiring and Home Runs

2.31 The home run wiring size should be carefully selected to insure optimum performance of the system. Select the size as indicated by plans and specifications. If the Power Controller is located within 20' of the light box, #10 wire is adequate for the lamp circuit.

2.32 To protect the wiring between the Light Housing Assemblys, the Power Control Unit, and the batter supply box, 1" watertight flex duct and connectors are supplied with this system.

2.33 Wiring Connections

Connect a ground rod ground to each light box assembly's ground lug at TB1. Connect +36/-36VDC supply to TB1A +V-1 and TB1A -V-1 of each Light Housing Assembly. Please refer to FLP28401B, PAPI Battery Powered Controller and FLP 28403D, PAPI Battery Powered Installation Wiriing diagrams which are attached.

2.40 Adjustment of the Light Box Assemblies

Figure 1 - Glide Slope Alignment

2.41 L-881 (two box system)

The light box assembly nearest the runway should be adjusted to the glideslope angle + 1/4 degree (+15 minutes).

The light box assembly farthest from the runway should be adjusted to the glideslope angle - 1/4 degree (-15 minutes).

When the boxes are in place, make sure both are adjusted with the adjustment jacks so that the center of the lens of the boxes are at the same elevation.

Remove the cover from the light box assembly.

** Position the aiming device on the light box assembly(s); refer to drawing #FLP28402 (attached), then place the 6" spirit level on the aiming device at points 1 & 2. Adjust the forward nuts on the adjustment jacks to bring the spirit level to center.

<u>HINT</u>!

For each 1/4 turn executed on the nut on one side, turn the nut on the other side 1/4 turn in the opposite direction. This will keep the lens center at the same elevation at all times during adjustment. Recheck both points.

** Adjust the alignment arrow pointer to the proper glideslope angle using the vertical adjustment screw.

** Place the spirit level on point 5 of the vertical leveling surface (on the alignment arrow).

Adjust the both rear adjustment jacks to bring the spirit level to center.

Next, tighten the bolts holding the pivots. These are accessible underneath the unit at the forward corners.

** Recheck the horizontal adjustment at points 1, 2, 3, & 4 and adjust as required. Tighten all nuts securely.

** Recheck the vertical adjustment at point 5, then tighten all nuts on the new pivot. Last, place the level on top of the tilt switch. Adjust the tilt switch until the spirit level is centered. Tighten the bolts to hold the tilt switch secure.

Replace the cover on the light box assembly.

2.42 L-880 (four box system)

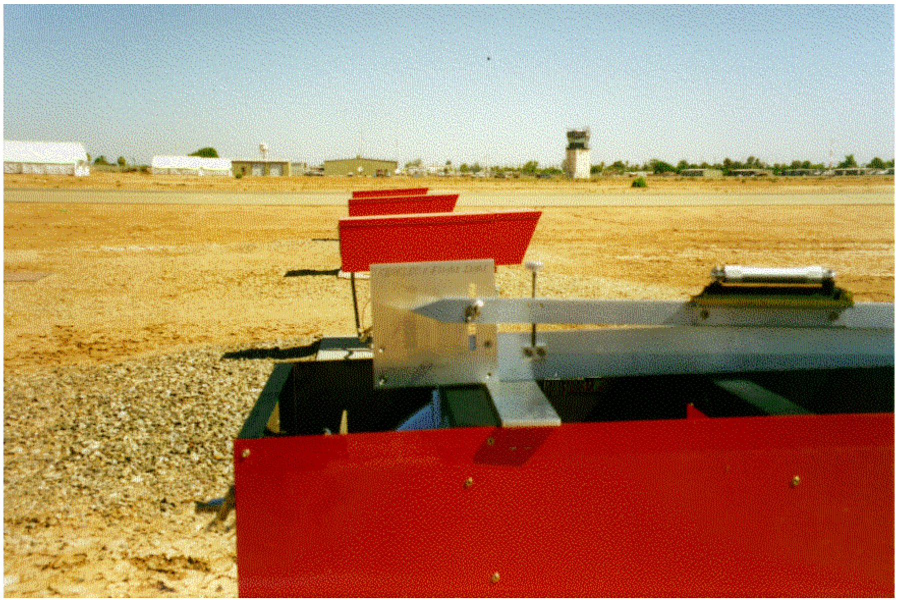

Figure 2 - Alignment Tool Scale

The light box assembly nearest the runway should be adjusted to the glideslope angle + 1/2 degree (+30 minutes).

The next adjacent light box assembly should be adjusted to the glideslope angle + 1/6 degree (+10 minutes).

The next adjacent light box assembly should be adjusted to the glideslope angle - 1/6 degree (-10 minutes).

The next adjacent light box assembly should be adjusted to the glideslope angle - 1/2 degree (-30 minutes).

When the boxes are in place, make sure both boxes are adjusted with the adjustment jacks so that the center of the lens of all boxes are at the same elevation.

Remove the cover from the light box assembly.

** Position the aiming device on the light box assembly(s); refer to drawing #FLP28402 (attached), then place the 6" spirit level on the aiming device at points 1 & 2. Adjust the forward nuts on the adjustment jacks to bring the spirit level to center.

<u>HINT</u>!

For each 1/4 turn executed on the nut on one side, turn the nut on the other side 1/4 turn in the opposite direction. This will keep the lens center at the same elevation at all times during adjustment.

** Recheck both points. Adjust the alignment arrow pointer to the proper glideslope angle using the vertical adjustment screw.

** Place the spirit level on point 5 of the vertical leveling surface (on the alignment arrow).

Figure 3 - Point 5

Adjust the both rear adjustment jacks to bring the spirit level to center.

Next, tighten the bolts holding the pivots. These are accessible underneath the unit at the forward corners.

** Recheck the horizontal adjustment at points 1, 2, 3, & 4 and adjust as required. Tighten all nuts securely.

** Recheck the vertical adjustment at point 5, then tighten all nuts on the new pivot. Last, place the level on top of the tilt switch. Adjust the tilt switch until the spirit level is centered. Tighten the bolts to hold the tilt switch secure.

Replace the cover on the light box assembly.

2.50 Electrical Adjustments

After each light box assembly has been properly aligned the system is ready to be turned on. Energize the Power Control Unit by engaging Circuit Breakers #1 and #2, then depressing the control switch on the top of the Power Control Unit (SW1); all of the Light Housing Assembly lamps should now be 'ON'.

CAUTION!

Do not look directly into the front of the light box because the light beam is very intense at that point.

2.60 Flight Check

Before placing in service, the system should be thoroughly flight checked. The flight check should include flying over any and all obstructions in the approach area to be sure that all light boxes show red whenever you are close to the obstructions.

Several normal approaches should be made to insure good signal at all points in the approach path.

SECTION THREE

SYSTEM DESCRIPTION

3.00 Principle Components

The model ZAZ757 PAPI ‘A’ Style Battery/Solar powered system consists of the following principle components:

Light Box Assemblies (Qty 4 for L880; 2 for L881)
Power Control Unit, (1ea, with adjustable timer)
4 or 2 ea - Power harness and LT kits.
1 lot - Mounting Hardware
1 ea. - Aiming Device with precision 6" Spirit Level. A protective case is included with each device.

3.10 Light Box Assembly

The light box assembly is stable optical platform which supports the lamp, reflector, lenses, color filter, and tilt switch. Light from the lamp is collected and focused into the plano-convex lens set. This combination produces the field of illumination into the approach area. Concurrent with the illumination, a red filter is so located that it is at the focal point of the plano-convex lens set as one would view the light box from the approach area. The transitions zone is factory adjusted so that it agrees with the calibrated scale on the alignment arrow assembly.

When the light box assembly is being adjusted, the process elevates the front of the light box assembly so that the transition zone is set to the desired angle of inclination (alignment angle).

It is extremely important that when the light box assembly is aligned in the field, all bolts and nuts are tightened properly, then alignment rechecked to insure accuracy.

3.20 Power

System power is supplied by either a regulated solar charged battery system or another battery system which supplies +36VCD and +24 VDC. The Power Control Unit acts primarily as a timer within a range from 1 to 10 minutes. This is adjustable and may be set by the end user; it was factory set to 5 minutes. The system is activate by a momentary push button switch which is located on the top of the Power Control Unit.

3.30 Day/Night Control

There is no photometric controller in this system.

3.40 Battery Capacity

This is entirely dependent on the user’s options, that is, as battery size and electrical capacity is increase, time between recharge and/or length of life increases. Factory testing indicates optimum operation will continue beyond 3 days usage under most conditions assuming 10 minutes a day for 5 minutes intervals.

NOTE!

Batterys should be recharged when the meter (M1) indicates 12 ampres.

Note that all batterys are temperature sensitive. Please refer to Bulletin #509 - Preventative Maintenance of Batteries for further infomation (attached).

3.50 Tilt Detection Circuit

There is no tilt detection circuit in this system.

3.60 Lens Heater Circuit, Class II only

In severe winter climates, the lens must be heated to insure dependable operation in all weather conditions. This is accomplished by two power resistors in series with each lamp filament. These dissipate approximately 40 watts into the heater mount which insures complete lens heat absorption, and that dependable signal, even at high altitude locations, will be presented to the pilot.

3.70 Alignment & Aiming Device Calibration

This component has two parts. The structural component shown in Figure 2 has no calibration. It has been factory checked for accuracy and cannot be altered without damage to the frame. The adjustable precision spirit level is shown in Figure 3. The level was factory aligned and should not require adjustment, but if this were ever necessary, the check and alignment is quite simple:

A. Use any flat level surface - the more level and stable the better. Insure the surface is clean, and that the bottom of the level is also clean.
B. Place the level on the inspected area, marking its location. Now, reverse the level (turn it 180 degrees). The bubble **MUST** be in the same relative position on the scale.
C. With each movement of the level, give the bubble time to become stable.
D. Should the bubble **NOT** be in the same relative position, loosen the adjustment nuts and correct for **one-half** of the difference in the readings. Re-tighten the nuts. Repeat steps B, C, and D until there is no difference.

This completes the Alignment and Aiming Device's calibration. It should be accomplished before each use, or at least semi-annually.

SECTION FOUR

TROUBLESHOOTING

4.00 Troubleshooting

Very few problems will occur with your system. However, in the case of problems, the following pointers will help you locate and correct the problems. It is assumed that all interconnect wiring is good.

Symptom	**Likely Problem**
Lamp **OUT**	Check lamp (if either lamp burns out, it would not shut off the other lamp).
Lamp still not **ON**	Temporarily short TB1B, R1-1 and R1-2, then R2-1 and R2-2. As each is tested, if the failed lamp turns **ON** , the heater resistors may have failed. Check for .5 ohm (each) resistance - replace if required.
Lamps will not come on	Check for a supply of +36 VDC on Circuit Breaker #1 and for +24 VDC on Circuit Breaker #2. Both should be present. If not check battery supply.
	Check continuity of the Contractor Relay's (CR1) coil. It should indicate approx. 280 ohms.
	Check for continuity of Push Button Switch (SW1) when depressed.
	If all of the above indicate OK, replace The RTE-P11 timer.
Light Box Alignment	Footers not stable
	Mounting hardware is not tight. Check floor flanges, nuts on frangible couplings, bolts & nuts on light box.

** Indicates revised alignment procedure for the improved aiming device.