



Research Engineers

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Ground verification checks for PAPI.

Synopsis: The performance and calibration of the PAPI projectors, clinometer, and veracity of the relationship between the two can be verified on the ground. The method used is to observe the transition, note the mid point, construct a parallel with it, and to measure this with a theodolite.

Equipment required:

- Surveyor.
- Theodolite.
- Surveyor's staff.
- Engineer's square.
- Pencil.
- Tape measure.
- PAPI maintenance tool kit and clinometer.

Method.

1. Liaise with ATC to obtain formal approval for access to the movement area and to the PAPI light units specifically. Access will be required for personnel on foot, with a minimum 5 minute recall time. Similarly, arrange with ATC to take control of the PAPI.
2. Key to this process is the observation of the transition by an observer on the ground at short range, typically 20 to 30 paces from the light. The observer must be able to look directly into each PAPI light in turn without discomfort. In order to do this, the field current should not exceed 2.8A maximum, and the CCR output should be adjusted to this. Where this adjustment is not possible, select the lowest intensity setting. The observer will need to wear dark glasses or possibly welding goggles of the type used for gas welding.



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3. Experience shows that if the observer suffers any glare, or finds any difficulty in observing the transition, then the intensity is too great. Reflex response from observers is to seek more light, when less is required. In the event that you do not derive satisfactory results from this process, try first reducing the intensity at the observer's eye, either by reduction of current or increase in filtering. In extreme cases, two sets of dark lenses may be required in the welding goggles.
4. Have the observer walk out from the PAPI to a distance such that when standing comfortably he sees white signals from each projector, yet sees red signals when slightly stooped. By "bobbing" up and down, the observer will be able to judge the beginning and end of the transition. Some practice is required to develop useful acuity. Each optic should start and finish transition concurrently with others of that particular light, although the progression may not be identical.
5. At this very low intensity and short range, the white signal will appear very yellow, and the transition slow. At greater intensity and distance, the transition will appear to an approaching pilot to occur within 3' of arc.
6. Using the PAPI maintenance kit, ensure that the lights are correctly set to their nominal setting angle.
7. The surveyor positions his theodolite directly on the cover of the subject PAPI and levels it. Using the measuring tape, record the height from the top of the PAPI cover to the theodolite telescope datum, typically the order of 240mm. Add to this the distance between the outside of the top cover and the transition plane of the PAPI. This is the dimension to the middle of the lens, to the bottom edge of the filter, or to the centre of the lamp filament, and is 64mm.
8. Holding the surveyor's staff in one hand, the observer bobs the transition. Two points are to be observed: the point at which the



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first red is seen in the white signal, and the point at which the last white is seen in an otherwise red signal. This is entirely subjective, but if bobbed up from red into white and bobbed down from white into red is quite repeatable.

9. Holding the survey staff vertical, slide the square until the edge aligns with the observed start or finish of the transition. Pencil mark the staff. Double check. With practice, this will become easy and self evident. Repeat for the other end of the transition. You should have two lines 60 – 70mm apart. Dimension maybe more or less, depending on observer acuity, but should not exceed 90mm. If it does, check technique, perhaps change observer.
10. It is important not to move the staff once the marking has commenced.
11. Measure the mid point between the two lines, mark on the staff.
12. Add the theodolite datum height plus 64mm to the centre mark, and mark this point on the staff. Hold the square with the top edge at this point. This establishes a parallel with the transition.
13. The surveyor now reads directly the angle to the top of the square, and repeats for the second face of the instrument.
14. Expect coincidence of clinometer and theodolite readings within 3 minutes of arc, which is a reasonable tolerance.
15. Uncertainties that need to be considered in the event of discrepancy:
 - 15.1. Observer performance, try a different observer. Use the same observer for all lights of any system for consistency.
 - 15.2. Intensity too great will give consistently low observations.
 - 15.3. Check that clinometer setting is correct.
 - 15.4. Check lamps. Old lamps near the end of life may suffer filament sag, which de-focuses.
 - 15.5. Re-check measurements; over the short range, 2mm is significant.



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Theodolite in place on a PAPI light unit





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Sighting the transition.





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Reading the parallel of the transition angle.

