

NVIS Lighting Evaluation Guide

- I. NVG's are an aide to visual flight
- II. NVIS lighting installations must:
 - A. Meet applicable 14 CFR 27 or 29 requirements as listed in AC 27-1B and AC 29-2C MG16
 - B. Summary of regulatory requirements:
 1. Allow pilots to perform duties without undue concentration or fatigue.
 2. Allow pilots to easily identify and read all instruments, markings, indicators, switches, and switch labels
 - a. Day
 - b. Night
 - 1) While looking out from underneath NVG's
 - 2) While not wearing NVGs
 3. Allow pilots to adjust and balance the NVIS lighting so that they can see instruments, markings, indicators, switches, and switch labels while
 - a. Looking at instrument panel from underneath NVG
 - b. Not wearing NVGs
 - c. See outside the aircraft while wearing NVGs unhindered by glare or reflections from instrument or other cockpit or cabin lighting.
 4. Provide uniform colors across the cockpit for warnings, cautions, and indicators that use green for advisories or status.
 - a. There can be no confusion between ambers, oranges (NVIS Red), and reds
 - b. No confusion between NVIS Yellows and greens
 - C. Should include:
 1. Cabin lighting
 2. Position light modifications
 - D. Be compatible with Class B NVG's
 - E. Be installed and conform to a supplemental type certificate.
- III. Safety/Inspection/Post-Maintenance NVIS lighting-NVG compatibility evaluation
 - A. Objectives
 1. Ensure aircraft cockpit, cabin, position lights are still NVG compatible after
 - a. STC holder specified inspection interval (ICA)
 - b. Maintenance to the aircraft instruments or cabin equipment that are NVG compatible.
 - c. Safety inspections (Company)
 - B. Overview
 1. Three phases of evaluation
 - a. Daylight
 - 1) Ensure the pilot can read NVIS modified equipment in daylight and bright sunlight conditions
 - b. Night – Unaided

- 1) Unaided means viewing the instrument panel by looking underneath the NVG when they are in the operational position.
- c. Night – Aided
 - 1) Ability to see through the windscreen forward, right, and cross cockpit to the left.
2. Evaluators
 - a. NVG trained and qualified pilot
 - b. Maintainer or Maintenance QC/QA

c.

IV. Evaluations:

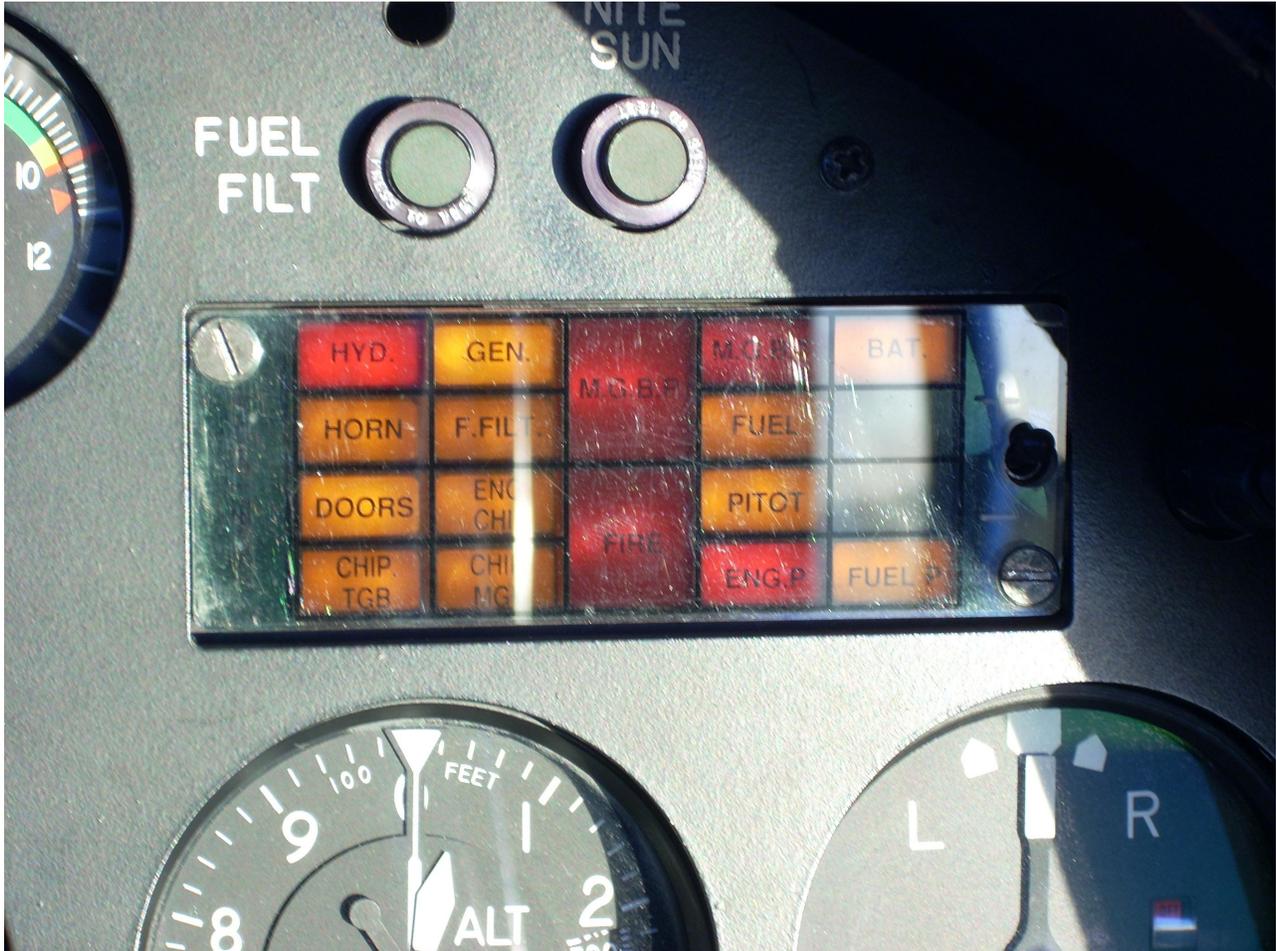
A. Daylight readability: Flight/Nav displays legible

1. PRIMARY FLIGHT/NAVIGATION DISPLAYS (§§2x.1321, 1323, 1381, 1543, 1545)

- a. All display are legible from pilot station(s) with sunlight shining on the display at different angles
 - 1) Evaluate with sun shining on the displays from different angles
- b. Photograph the cockpit and displays
- c. Document hard to read or questionable displays



- d.
2. (a., b.) Warning, Caution, Advisory Lights (§§ 2x.1322)
- a. Filtered master warning and CAS warning lights that use NVIS Red are distinguishable as “Red” (Not Orange/Amber) compared to other lights on the instrument panel



- b. Filtered Master Caution and CAS Caution lights are distinguishable as amber/yellow compared to NVIS red lamps.
 - 1) These lights should not appear green, white, or orange
- c. Photograph the CAWS panel with indicators lit and Master Warning and Caution lights



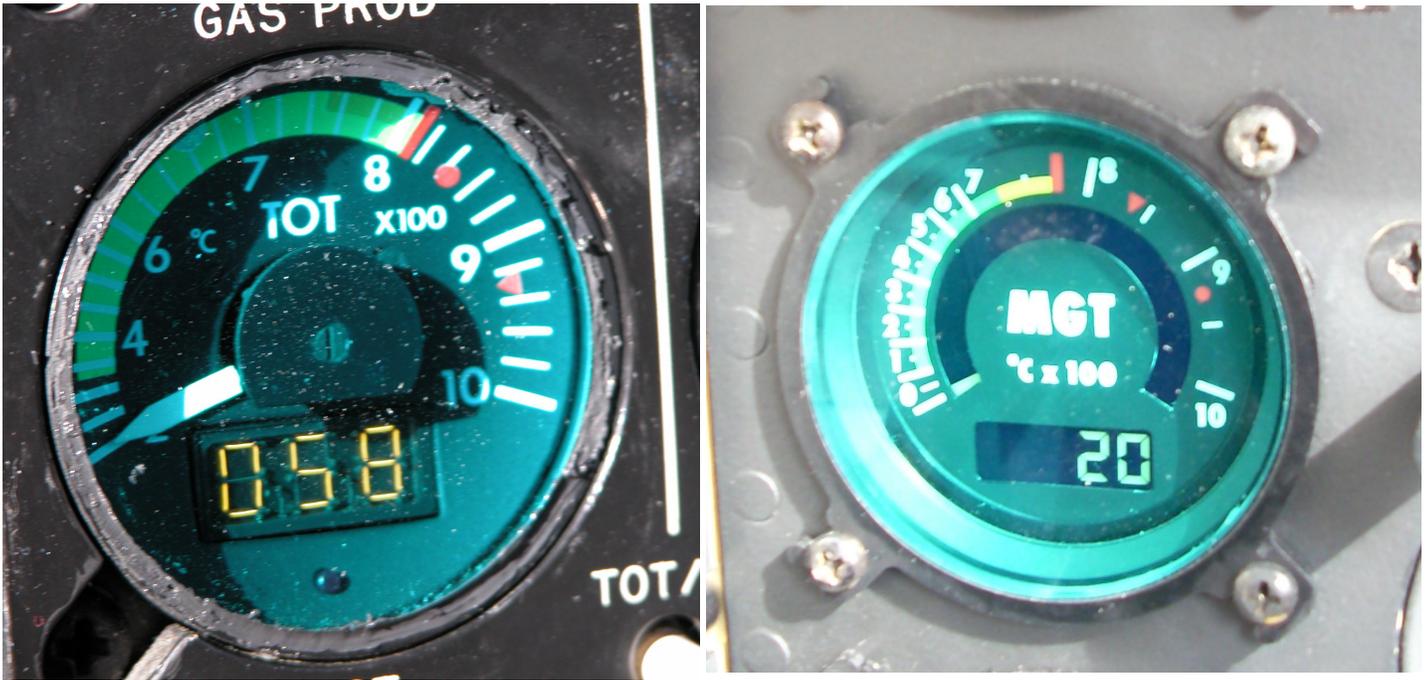
- 1) Note the similarity of colors between the caution lights below the fire panel and on the RADALT vs. the warning lights on the CAWS panel.

- d. (2.c.) All CAWS lighting is bright and distinguishable enough to capture pilot's attention at daylight illumination levels and in all sun angles.
 - 1) If it is difficult to read individual segments, what workarounds do pilots use?
 - a) If pilot removes hands from controls to shade the panel or has to move closer to the panel to read the segments, it is not acceptable.



- b) This panel is borderline acceptable. The filter material has decreased the amount of light transmitted, making the daylight legibility of the CAWS panel marginal. The panel was also modified early in the NVIS lighting program and has older filter technology that is not as good as filter material currently available.

3. Powerplant Instruments (§§ 2x.1337, 1381, 1549)
 - a. Gauges with filtered material are legible including any colored arcs, limit markings with sun shining of them from different angles.
 - 1) The colors must be distinguishable through the filter material.
 - b. Photograph filtered displays with questionable, or no color legibility



- c. The gauge on the left appears to have NVIS Green A filter glass that filters the green out of the gauge. The ability to see the boundary line between the green and yellow band is obscured and does not meet requirements.
 - 1) The gauge on the right has a different filter glass material that allows the pilot to see the colors. Note the ability to see the boundary between the green and yellow bands.

4. COMM/NAV and Other Displays

a. All filtered displays should be legible from pilot station(s) with sunlight shining on the display from different angles

b. Photograph displays with questionable or no legibility



c. Note the clock on the left. It is close to being illegible from the pilot station. The pilot may have to change position to read the instrument. The rest of the filtered displays in this modification is clean for daylight legibility.

d. (5) GENERAL Daylight readability

- 1) Colors are uniform, there are not different shades of red, amber, yellow, and green among lit annunciators
- 2) Photograph lights if there are differences



- 3) NVIS lighting must not require the pilot to guess whether or not they're looking at and responding to a Warning or Caution. In the picture above, the two caution lights below the fire panel and the RADALT DH light are cautions. The Warning lights on the CAWS panel are NVIS Red and are the same color. There are distinct differences between the NVIS Yellows and green annunciator lights.

B. NIGHT EVALUATION: UNAIDED

1. “Unaided” is the lighting system’s ability to allow the pilot to see and read instruments and gauges from underneath the NVGs in operational position or without NVGs.
2. Brightness settings are slightly brighter than regular, non-NVG night lighting settings
 - a. The pilot’s eyes are not night adapted when wearing NVGs
 - b. Needs more light to see instrument detail
 - c. Lighting should not have to be so bright that it causes glare or reflections
 - d. Lighting should not have to be so bright to read the instruments that the pilot and crew are uncomfortable and they cannot see outside the cockpit unaided.
3. Set Intensity –Balance
 - a. Set the NVIS lighting to brightness level used for viewing the instrument panel from under the NVG.
 - b. Acceptable brightness is a pilot preference. Some will not like it bright and think its uncomfortable. Others may set the lights to a point where they can read the instruments and accept the level if the it is too bright. Still others may like brighter lights.
 - c. The pilot should set the lighting to the point they think the amount of light is acceptable for night flight. Pilot must be able to transition from the NVG to unaided vision to read instruments.
 - d. They must also be able to revert to non-NVG flight with the lighting system
 - 1) Some modifiers do not modify the basic aircraft lighting which means the pilot can deselect the NVIS lighting system and revert to the basic system if required.
4. Photograph the instrument panels and consoles

5. EVALUATION

- a. (1) Lighting design and controls allow for balanced illumination of each portion of the instrument panel with enough light to easily read the instruments and markings.

- 1) Photograph the cockpit with the lighting set and balanced.



- 2) In the picture above, the illumination of the instruments is good and clear, no shadowing or other problems. The design of the system did not allow the engine instruments to be turned down to balance with the flight instruments and were too bright.

b. (2) Night Unaided – Overlays

- 1) If overlays are present, they do not obscure instrument /gauge markings, symbols or limit/range markings
 - a) Assess at different seating heights
- 2) Overlays may block some of the gauge, depending on the viewing angle, pilot size, and seat position.

3) Photograph instruments that are questionable or you think are obscured



- 4) In this example, the use of flood lighting and overlays creates shadows on the instruments. The shadowing on the ADI on the right may be OK for VFR aircraft flying day VMC or night VMC as a public use. However, the shadow would not be acceptable for a Part 135 operator where an ADI is required (EMS, etc)

- c. (3.) Night Unaided – All instruments are lit and legible
 - 1) If post or floodlights are used, all instruments are sufficiently lit so that the entire instrument or instrument panel is legible (at acceptable lighting intensity) including all limit/range markings and colors.
 - 2) Photograph instruments that are questionable or do not meet criteria



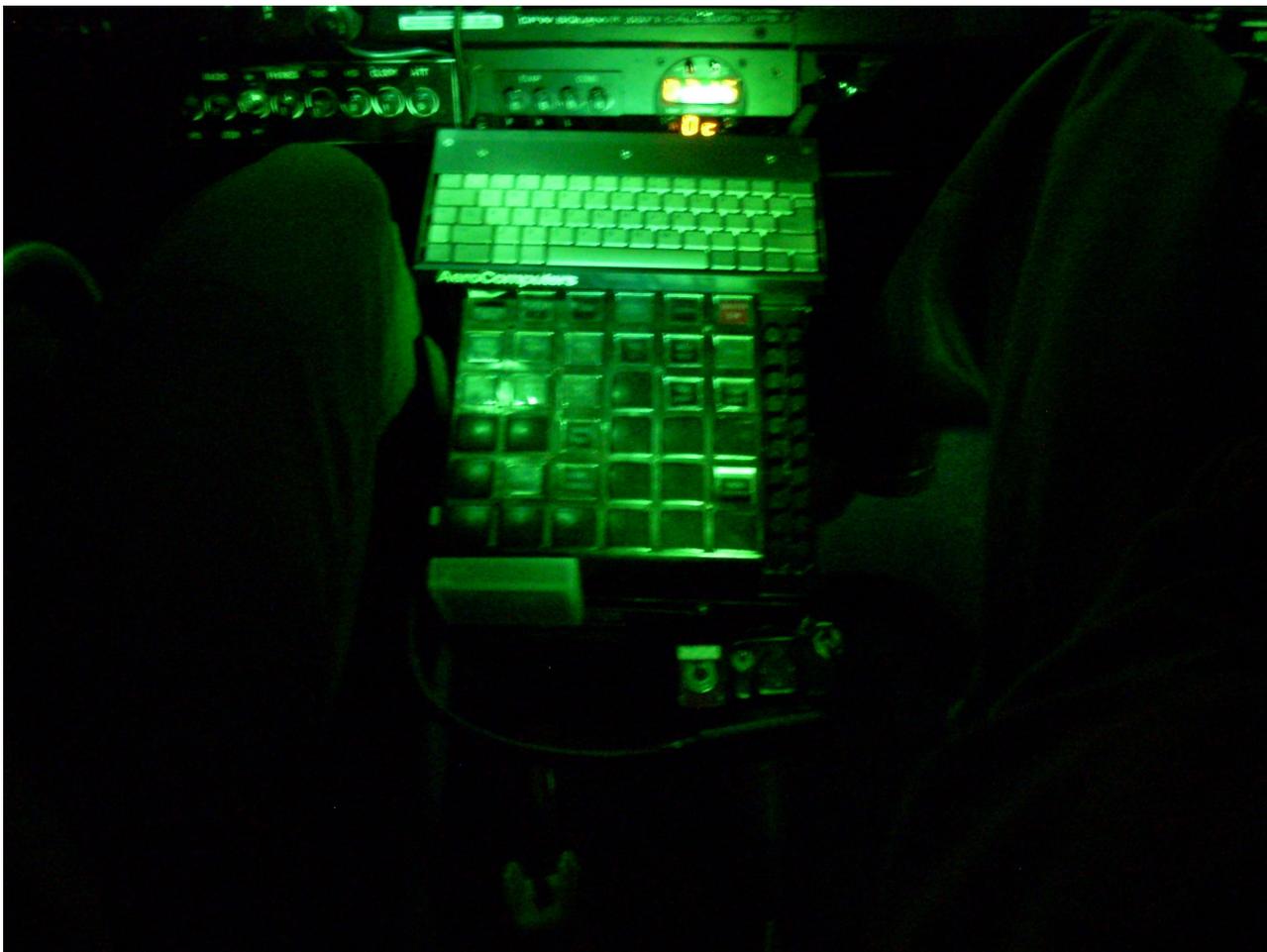
- 3) In this example, the flood lights do not illuminate the delta N1 gauge sufficiently to allow the pilot to read the % RPM in the window.

- d. Ensure the lights fully illuminate all the instruments
 - 1) One technique is to set the light levels to where the pilot is comfortable. Evaluate (and photograph) the instrument panel
 - a) Are instruments and markings legible?
 - 2) IF the instruments are not legible, turn the lights up to a level where the pilot can see the limits markings and color bands
 - a) Photograph this level
 - b) Evaluate whether this level of lighting is too bright for night use and if it is uncomfortably bright.



- 3) In this installation, the flood lights did not illuminate the upper part of the instrument panel enough to see limitation markings or color bands.
- 4) Do the pilots use workarounds in a situation like this?
 - a) If so, what are the workarounds?
 - i. (Using other lights in the cockpit, like goose-necks or spots to illuminate the gauges)
 - b) Workarounds need evaluation because they indicate that the lighting system is not performing its intended function.
- 5) Document the workarounds.

e. (3.) Night Unaided (cont'd)



- 1) In this example, the center console is lit by a goose neck mounted flood light with its own rheostat. The lamp's brightness was controllable and positioned so the pilot could easily see the labels of the center console buttons.

- f. (4.) Night Unaided – Excessive Glare/Reflections
- 1) Post lights / flood lights do not cause excessive glare or reflections off the gauges, instruments, or windscreen and windows.
 - a) Evaluate across pilot's range of view
 - i. Where the pilot normally looks when performing visual flight maneuvers.
 - b) Also evaluate by looking across cockpit
 - c) Photograph instruments that are questionable
 - 2) Assess reflections on front windscreen and side windows



- 3) Reflections interfere with the pilot's ability to see obstacles or other hazards with or without NVGs. In certain installations with flood lighting, there can be more reflections than in the basic aircraft if the lighting particularly if the floods must be turned up to a brighter intensity to see the instruments.

- 4) Excessive glare and reflections are difficult to evaluate...What is excessive?
 - a) Pilot judgment
 - b) Bright enough to distract pilot or interfere with their outside view
 - c) Seen by the NVG
 - d) Depends on the ambient background lighting
 - i. High external lighting (flying over a city), reflections not as noticeable
 - ii. Dark, remote areas with out high ambient lighting, reflections more noticeable (if they are seen by the NVG)

g. Night Unaided – Standby Instruments lit and legible

“5. Independent lighting systems (such as Standby/Whiskey compass, STBY ADI, and associated placards) illuminate the instruments and do not cause excessive glare or distracting reflections off other gauges, instruments, windscreens/windows.”

- 1) Photograph instruments that are questionable or do not meet criteria
- 2) Ensure the STBY instruments are NVIS modified
- 3) Ensure they are lit and legible
- 4) Ensure their brightness can be balanced with the rest of the cockpit

i. Night Unaided – Map and Emergency Lights

- 1) Map and emergency lights should not be used as primary light sources
- 2) Evaluate to ensure they provide enough light on the instrument panel and do not cause shadows over instruments, switches, labels, etc if needed to be used after NVIS lighting failure.

j. (7 a, b.) CAWS panel lighting, red and ambers are distinct

1) Same as the daylight checklist



C. NIGHT EVALUATION – AIDED

1. Evaluate the NVIS lighting system's compatibility with NVG's
2. Only use ITT 4949 or Northrup-Grumman/Litton M949 NVGs
 - a. Only makes/types of NVG currently authorized for use
 - b. Use a darkened hangar or paint booth, if possible.
3. Evaluate the effects of glare-reflection on the pilot's ability to see outside the cockpit while wearing NVGs.

4. EVALUATION

- a. Set all NVIS lighting (instrument, comm./nav, etc) to NVG operational levels
- b. If there is a curtain separating the cockpit from the cabin
 - 1) Close curtain
 - 2) Set cabin lighting to operational levels
 - a) If the cabin is NVIS modified (please document)
 - b) If there is mission equipment in the cabin that emits light and is on during flight, turn it on.
- c. Record and assess any reflections/glare created by the NVIS lighting through the NVG
 - 1) Pay attention to Warning/Failed/OFF flags
 - 2) Marker beacons and other lights associated with IFR equipment
 - 3) ELT
 - 4) RADALT DH/MINS light
 - 5) Light leakage through curtain
- d. Describe any "blooming" or "veiling" glare seen in the NVG, its source, and where the pilot was looking when they saw it.

V. Documentation and Reporting

- A. Please report your findings to the person identified in the SAIB
- B. Please include photographs of the cockpit and lighting
 1. Include photos of problem areas
- C. Please include contact information

Thank you for your assistance.