

Test Procedures to Verify Operation of the OL 750-NVG to MIL-L-85762A, Appendix 30

Tests verifying spectroradiometer performance to MIL-L-85762A are required within 6 months to ensure conformity. These tests are part of MIL-L-85762A, but each are described in terms of what to do rather than how to do them. This Information Sheet describes how these tests may be performed on the OL 750-NVG system and ensure conformity.

Descriptions below assume only the NVIS option to the standard software is available. Easier routines are possible if other options are supplied, and the user should consult Optronic Laboratories, Inc. for more information. Also, slits of 2.5 mm specified apply to the OL 750D-NVG double monochromator system. For the OL 750S-NVG single monochromator, use 1.25 mm slits instead.

B30.2.1 Spectroradiometer Sensitivity Calibration

1. Ensure the system, including the PMT temperature and high voltage is stable for at least 15 minutes.
2. Calibrate the system from 380 nm to 930 nm in 5 nm increments using the 5 mm aperture in the OL 600-NVG, 2.5 mm entrance and exit slits and the normal calibration procedure described in the manuals. Save this file.
3. Select instrument control from the main menu.
4. Set the integration time to 5 seconds and filter wheel in the closed position.
5. Set the logging interval to 10 seconds and define the log file name.
6. Start logging.
7. After 10 minutes, stop logging.
8. Import or load the logged data into a spreadsheet program such as Excel or Quattro Pro. The data contains time information and may require rearrangement to a single column.
9. Find the standard deviation of the data using the @STDS() or similar function.
10. In the OL 750 software, under file arithmetic, multiply the calibration file (obtained in step 2 above) x the standard deviation x 10. This is the spectroradiometer sensitivity and can be compared to values in B30.2 directly.

B30.3.1 Wavelength Accuracy and Repeatability Verification

The following method is covered by B30.3.1.1, Scanning technique.

1. Provide a low pressure discharge source giving emission lines at the relevant wavelengths. The table below may be useful as a guide but is not exhaustive.

Wavelength range	Mercury source	Neon source	Sodium source
350-500 nm	365.015	352.047	
	366.328	475.273	
	404.656	488.491	
	435.835		
500-650 nm	546.074	602.999	588.995
	576.959	626.649	589.592
	578.966	640.225	
650-800 nm	734.637	650.653	
		703.241	
800-950 nm	(809.312)	865.438	819.481
	(871.67)		

2. Select one wavelength for each wavelength range according to source. The table above does not indicate intensity, and although commonly strong lines are cited a large intensity variation is expected. Typical mercury sources include fluorescent lights and neon sources include electrical indicators. Some lines in the actual source may be absorbed by the glass of filter materials around the discharge. Calibration sources without these problems do exist, but are expensive. It is often therefore easier to use more than one source to provide the total wavelength range. Alternatively, wavelengths in parenthesis are second-order lines. To observe these the blocking filters, which absorb second orders, must be temporarily disabled (set to OPEN position).
3. Insert 0.125 mm slits at the entrance and exit of the monochromator.
4. Set the OL 600-NVG aperture to 5 mm.
5. If the grating calibrations have not been done since installation, set up the OL 455 at <1 fL and do them now.
6. In manual data entry within the OL 750 software, create a file from 5 nm below the peak to 5 nm above the peak in 1 nm intervals. Interpolate this file to 0.05 nm intervals and save it with the extension .cal.
7. Select Measurement/Radiance/Measure in the software and select the cal file created.
8. In scan options, ensure that grating or blocking filter changes do not occur during the scan range. Move them to some other wavelength if they do.
9. Set up the light source in front of the OL 600-NVG. If room lights are used, a white card angled at about 45 degrees is sufficient and much easier. This approach can be used for other sources if required, but bear in mind the card may absorb the UV lines.
10. Run the scan 3 times, saving each spectrum.
11. Graph these files. Using the cursor, determine the peak position of each scan. Each peak should be within 1 nm of the wavelengths given in the table. The differences between adjacent peaks should be within 0.5 nm.
12. Repeat steps 6 to 11 for each wavelength range, changing the source if necessary.

B30.6.1 Linearity Verification

1. Set up the OL 455 in front of the OL 600-NVG, and allow the intensity to stabilize for at least 15 minutes before continuing.
2. Set the entrance and exit slits of the monochromator to 2.5 mm.
3. Set the OL 600-NVG aperture to 1 mm.
4. Select Instrument Control from the main menu and ensure the blocking filter wheel is in the SHUT position.
5. Select an integration time of 5 seconds and wait for at least 10 seconds before continuing.
6. Click on the zero subtraction to remove the dark current contribution.
7. Set the wavelength to 555 nm.
8. Set the blocking filter wheel position to AUTO.
9. Ensure the fixed focus tube is in place and adjust the OL 455 to 0.1 fL.
10. After 10 seconds, read the signal and record this value.
11. Adjust the OL 455 to 0.5 fL, and after 10 seconds again record the signal.
12. Repeat step 11 at the lamp outputs specified in B30.6.1 up to and including 10 000 fL.
13. Enter the light levels and signals into a spreadsheet program. Most spreadsheets have built-in regression analysis routines. Using these tools or functions provided, calculate the regression coefficient between the two sets of data, ensuring a zero-intercept algorithm is used.
14. Using the slope from this regression, calculate the linear values for each lamp output.
15. Calculate the spectroradiometer output errors according to:
16. Compare these values to the percentage variation allowed in B30.6.1 for each lamp output level.

$$\%error = \frac{(\text{observed values} - \text{linear values})}{\text{linear values}} \times 100$$

B30.8.1 Stray Light Verification

1. Set up the conditions as for the spectroradiometer sensitivity calibration (B30.2.1).
2. Set the OL 455 to around 100 fL. Exact setting is not required.
3. Using the calibration file from the spectroradiometer sensitivity calibration, measure the spectral radiance of the OL 455 source. Save this file.
4. Insert a filter meeting B60 specifications in the front filter holder of the OL 455, and repeat the measurement. Save this file.
5. In file arithmetic, divide 100 times the filtered source file by the unfiltered source file. The result is the percentage transmission of the filter, which should be >50% in the 380 to 500 nm region and <0.2% in the 690 to 930 nm region.

B30.11.1 Spectroradiometer Accuracy Verification

1. Two recently calibrated sources, similar to the OL 455 are required. These should have valid NIST traceable spectral radiance calibrations, in units of W/(cm² nm sr) at around 100 fL intensity, over the wavelength range of 380 nm to 930 nm in 5 nm steps.
2. Set up the source to exactly reproduce the lamp current and intensity reported in the calibration certificate, making sure these parameters are entirely stable before continuing.
3. Using 2.5 mm slits and a 5 mm OL 600-NVG aperture, calibrate the system according to the procedure described in the manual with one of these sources.
4. Remove the calibration source and replace it with the second source, again making sure the conditions applying to its calibration are reproduced exactly.
5. Measure the second source using the calibration obtained from the first.
6. Accuracy errors of the measured spectrum, relative to the NIST certified values of the second source, can be calculated using

$$\% \text{ error} = \frac{(\text{measured} - \text{certified})}{\text{certified}} \times 100$$

to give percentage accuracy error at each wavelength. Values of this result should be between -5% and +5%.

Other specifications, specifically B30.4, B30.5 and B30.7, can be based on manufacturer's information:

B30.4 Current resolution depends on integration time but is better than 0.000002% under all conditions.

B30.5 Zero drift depends on scan time, but is less than 0.1% for scans of less than 2 hours.

B30.7 Full user-programmable control over signal-to-noise ratio is provided.

B30.10.1. Spectroradiometer viewing system verification is not required since the viewing optics and measuring optics are one.

