NASA STANDARD TEST PROCEDURE

*TEST PROCEDURE DOCUMENT **RSP.001.***

Test Title: Raman Spectrometer Performance Evaluation
Test Identifier: RSP-001
Test Date: [Insert Date]
Test Location: [Insert Location]
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Quality Engineer: Berhane

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1. OBJECTIVE

To evaluate the performance of a Raman spectrometer using a 527 nm excitation laser and verify spectral accuracy, resolution, and efficiency.

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2. EQUIPMENT & MATERIALS

- Raman spectrometer (Czerny-Turner configuration)
- 527 nm laser source
- Calibration sample (e.g., silicon wafer)
- Optical alignment tools
- CCD detector
- Data acquisition software
- Optical table and mounts
- Safety goggles (laser protection)
- **[NEW] Spectral calibration lamp (e.g., Hg-Ar) for multi-point wavelength calibration**

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3. PROCEDURE

3.1 Setup & Calibration

1. Secure all optical components on an optical table to minimize vibrations.
2. Align the 527 nm laser source with the spectrometer entrance slit.
3. Verify collimating and focusing mirrors are correctly positioned.
4. Use a calibration sample (e.g., silicon) to adjust wavelength calibration.
5. Adjust diffraction grating position to optimize spectral resolution.
6. **[NEW] Perform multi-point wavelength calibration using the spectral calibration lamp to refine accuracy across the detection range.**

3.2 Data Collection

1. Place the sample in the designated holder and align with the laser beam.
2. Adjust exposure time and gain on the CCD detector.
3. Capture Raman spectra from 530 to 630 nm.
4. Record data in a structured format for analysis.
5. **[NEW] Capture baseline spectra without a sample to assess background noise and instrument response.**

3.3 Analysis & Validation

1. Generate a spot diagram and verify spectral separation.
2. Analyze intensity distribution and compare with expected Raman peaks.
3. Compute the Modulation Transfer Function (MTF) to evaluate imaging efficiency.
4. Compare measured Raman shifts with reference spectra for accuracy validation.
5. **[NEW] Evaluate spectral resolution by measuring Full Width at Half Maximum (FWHM) of known peaks and comparing against theoretical values.**

3.4 Optimization & Troubleshooting

1. Adjust the slit width and mirror alignments if spectral resolution is suboptimal.
2. Verify detector sensitivity and correct for noise if necessary.
3. Ensure proper beam focusing to maximize Raman signal detection.
4. **[NEW] Check for second-order diffraction artifacts and apply filters or software correction if needed.**

3.5 Final Reporting

1. Summarize key findings, including spectral resolution, efficiency, and noise levels.
2. Document any discrepancies and corrective actions taken.
3. Store raw data and analysis results for future reference.
4. **[NEW] Include calibration curves and spectral deviation plots in the final report to validate instrument performance.**

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4. SAFETY REQUIREMENTS

- Ensure proper use of laser safety goggles.
- Verify that all personnel are trained on laser safety procedures.
- Keep flammable materials away from the laser path.

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5. ACCEPTANCE CRITERIA

- Spectral peaks should match reference Raman spectra within ±0.5 nm.
- MTF values should remain above 0.8 at 10 cycles/mm.
- Signal-to-noise ratio (SNR) must be within acceptable limits for clear spectral resolution.
- **[NEW] FWHM values of known peaks should be within 10% of theoretical values for the given slit width and grating configuration.**

6. CONCLUSION

This procedure ensures accurate and efficient measurement of Raman spectra, optimizing system performance for real-world applications. Further refinements can be made based on experimental outcomes.

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