

Acceptance Tests, Performance Tests, and Quality Control

Acceptance tests must be performed on systems when they are installed. A qualified practicing medical physicist may perform these tests. Alternatively, the acceptance tests may be performed by a qualified nuclear medicine technologist or medical physicist in-training using National Electrical Manufacturers Association (NEMA) protocols and other testing protocols developed and approved by the qualified practicing medical physicist. The test results must be reviewed by the qualified medical physicist and documented in the annual survey report.

At least annually thereafter, the performance tests listed below should be performed on all units. These tests do not need to be as rigorous as acceptance tests but must be a comprehensive suite of individual measurements that ensure adequate sensitivity to detection of detrimental changes in performance. As with acceptance tests, qualified practicing medical physicist, a qualified nuclear medicine technologist or medical physicist in-training may do the performance tests. Again, the test results must be reviewed by the qualified medical physicist and documented in the annual survey report. As a part of this annual survey the qualified practicing medical physicist should meet with the supervising physician and the QC technologist to review the results of the survey, the effectiveness of the technologist QC program and to make any recommendations for corrective action or repairs. The responsible supervising physician has the responsibility for assuring compliance with the recommendations of the medical physicist.

The nuclear medicine technologist is responsible for verifying day-to-day operation of instruments and performing a few additional tests on a quarterly basis. These requirements represent the standard of practice and are in compliance with requirements and recommendations of the Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) and State and Federal agencies. Documentation of compliance with all quality control tests and corrective action is required as part of the application process.

Nuclear Medicine Performance Tests - At Least Annually

1. **Intrinsic Uniformity** - Performed to ensure that the intrinsic detector integral and differential uniformity is sufficient to minimize the production of artifacts and ensure that patient abnormalities can be visualized without interference from the imaging system. These tests also monitor a scintillation unit for electronic problems and crystal deterioration (hydration).
2. **System Uniformity** - Performed to check all commonly used collimators for defects that might produce artifacts in planar and tomographic studies.
3. **Intrinsic or System Spatial Resolution** - Performed to ensure that the detector resolution is sufficient to provide satisfactory lesion detectability and delineate detail in clinical images.
4. **Relative Sensitivity** - Performed to verify that count rate per unit activity is satisfactory to maintain image quality and preserve the integrity of quantitative studies.
5. **Energy Resolution** - Performed to verify that scatter rejection is sufficient to provide optimal contrast in clinical studies. *Note: On some unit systems, precise measurements of energy resolution are very difficult to make.*
6. **Count Rate Parameters** - Performed to ensure that the time to process an event is sufficient to maintain spatial resolution and uniformity in clinical images acquired at high-count rates.

7. **Formatter/Video Display** - Performed to ensure that systems used to produce hard copy and monitors that are used for interpretation of clinical studies provide satisfactory image quality in terms of uniformity and spatial resolution.
8. **Overall System Performance for SPECT Systems** - Performed to quantitatively verify that SPECT systems provide satisfactory tomographic uniformity, contrast and spatial resolution.
9. **System Interlocks** - Performed to verify that all system interlocks are operating as designed and that the system is safe and reliable for the nuclear medicine technologist to operate and for imaging patients.
10. **Dose Calibrators** - A test must be performed annually to verify that readings from this instrument are accurate (accuracy test). All basic measurements of performance must be done at the time of installation and repeated after major repair. This test must be done according to protocols accepted by the appropriate State regulatory agencies or the Nuclear Regulatory Commission (NRC).
 - “Test” measurement of battery voltage (if applicable)
 - Zero adjustment (if applicable)
 - Background adjustment
 - Constancy test
 - Linearity
 - Accuracy with NIST traceable standards
 - Geometry
11. **Thyroid Uptake and Counting Systems** - Performed to verify energy calibration, energy linearity, energy resolution, sensitivity, and reliability (Chi-squared test) for the measurement of organ function and the assay of patient samples.
 - I-123 capsule or long-lived standard calibration check
 - Count of background
 - High voltage/gain checks
 - Energy resolution
 - Chi-square test