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The American College of Radiology will periodically define new practice guidelines and technical standards for radiologic practice to help advance the science of radiology and to improve the quality of service to patients throughout the United States. Existing practice guidelines and technical standards will be reviewed for revision or renewal, as appropriate, on their fifth anniversary or sooner, if indicated.

Each practice guideline and technical standard, representing a policy statement by the College, has undergone a thorough consensus process in which it has been subjected to extensive review, requiring the approval of the Commission on Quality and Safety as well as the ACR Board of Chancellors, the ACR Council Steering Committee, and the ACR Council. The practice guidelines and technical standards recognize that the safe and effective use of diagnostic and therapeutic radiology requires specific training, skills, and techniques, as described in each document. Reproduction or modification of the published practice guideline and technical standard by those entities not providing these services is not authorized.

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Amended (Res. 13)  
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## **ACR TECHNICAL STANDARD FOR DIAGNOSTIC MEDICAL PHYSICS PERFORMANCE MONITORING OF RADIOGRAPHIC AND FLUOROSCOPIC EQUIPMENT**

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### **PREAMBLE**

These guidelines are an educational tool designed to assist practitioners in providing appropriate radiologic care for patients. They are not inflexible rules or requirements of practice and are not intended, nor should they be used, to establish a legal standard of care. For these reasons and those set forth below, the American College of Radiology cautions against the use of these guidelines in litigation in which the clinical decisions of a practitioner are called into question.

The ultimate judgment regarding the propriety of any specific procedure or course of action must be made by the physician or medical physicist in light of all the circumstances presented. Thus, an approach that differs from the guidelines, standing alone, does not necessarily imply that the approach was below the standard of care. To the contrary, a conscientious practitioner may responsibly adopt a course of action different from that set forth in the guidelines when, in the reasonable judgment of the practitioner, such course of action is indicated by the condition of the patient, limitations on available resources, or advances in knowledge or technology subsequent to publication of the guidelines. However, a practitioner who employs an approach substantially different from these guidelines is advised to document in the patient record information sufficient to explain the approach taken.

The practice of medicine involves not only the science, but also the art of dealing with the prevention, diagnosis,

alleviation, and treatment of disease. The variety and complexity of human conditions make it impossible to always reach the most appropriate diagnosis or to predict with certainty a particular response to treatment. Therefore, it should be recognized that adherence to these guidelines will not assure an accurate diagnosis or a successful outcome. All that should be expected is that the practitioner will follow a reasonable course of action based on current knowledge, available resources, and the needs of the patient to deliver effective and safe medical care. The sole purpose of these guidelines is to assist practitioners in achieving this objective.

### **I. INTRODUCTION**

The performance of all radiographic and fluoroscopic equipment shall be evaluated upon installation and monitored at least annually by a Qualified Medical Physicist to ensure that the equipment is functioning properly and that patients are not exposed to unnecessary doses of radiation. Additional or more frequent monitoring may be necessary after repairs that might change the radiation exposure to patients or personnel or the imaging performance of the equipment. Although it is not possible to consider all possible variations of equipment performance to be monitored, adherence to this standard will assist in maximizing image quality and in reducing patient radiation doses. Key points to consider are: performance characteristics to be monitored, patient

radiation dose, qualifications of the personnel, and follow-up procedures.

## II. GOALS

The goals are to produce the highest quality diagnostic image at the lowest reasonable radiation dose consistent with the clinical use of the equipment and the information requirement of the examination and to establish and maintain performance standards.

## III. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A Qualified Medical Physicist is an individual who is competent to practice independently one or more of the subfields in medical physics. The American College of Radiology (ACR) considers that certification and continuing education in the appropriate subfield(s) demonstrate that an individual is competent to practice one or more of the subfields in medical physics, and to be a Qualified Medical Physicist. The ACR recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR) or for MRI, by the American Board of Medical Physics (ABMP) in magnetic resonance imaging physics.

The appropriate subfields for this standard are Diagnostic Radiological Physics and Radiological Physics.

The continuing education of a Qualified Medical Physicist should be in accordance with the [ACR Practice Guideline for Continuing Medical Education \(CME\)](#). (2006 - ACR Resolution 16g)

Understanding of the relationship between image quality and patient radiation dose is essential to proper monitoring of equipment performance. The medical physicist must be familiar with the principles of imaging physics and radiation protection; the current guidelines of the National Council on Radiation Protection and Measurements (NCRP); laws pertaining to the performance of the equipment being tested; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments used for testing performance.

The medical physicist may be assisted by other properly trained individuals in obtaining test data for performance monitoring. These individuals must be properly trained and approved by the medical physicist in the techniques of performing the tests, the function and limitations of the imaging equipment and test instruments, the reasons for the tests, and the importance of the test results. The medical physicist must be available at the facility during initial and annual surveys and must review, interpret, and

approve all data measurements and provide a signed report.

## IV. SPECIFICATIONS OF THE MONITORING PROCESS

### A. Equipment Characteristics to be Monitored

The following characteristics shall be evaluated for the equipment to which they apply:

1. Integrity of unit assembly
2. Collimation and radiation beam alignment
3. Fluoroscopic system resolution
4. Automatic exposure control system performance
5. Image artifacts
6. Fluoroscopic phantom image quality
7. KVp accuracy and reproducibility
8. Linearity of exposure versus mA
9. Exposure reproducibility
10. Timer accuracy
11. Beam quality assessment (half-value layer)
12. Fluoroscopic exposure rates
13. Image receptor entrance exposure
14. Fluoroscopic alignment test
15. Equipment radiation safety functions
16. Patient dose monitoring system calibration, if present
17. Video and digital monitor performance
18. Digital image receptor performance

### B. Monitoring of Technologist's Quality Control Program

The following aspects of a technologist's quality control program shall be reviewed as deemed applicable:

1. Appropriateness of technique factors
2. Darkroom and screen cleanliness
3. Processor quality control
4. Film-screen speed matching
5. Viewboxes and viewing conditions
6. Phantom images
7. Visual equipment checklists
8. Repeat analysis
9. Analysis of fixer retention
10. Darkroom fog
11. Screen-film contact
12. Laser film printer quality control
13. Personnel radiation monitoring

### C. Radiation Dose and Patient Safety

Patient radiation dose shall be evaluated for radiographic and fluoroscopic equipment at least annually. Tables of patient radiation exposure for representative examinations shall be prepared and supplied to the facility. These tables shall be prepared using measured radiation output data

and imaging techniques provided by the facility. These results shall be compared with appropriate guidelines or recommendations when they are available. The medical physicist should assist facilities in developing policies and procedures to evaluate risks to patients, personnel, and physicians from studies and interventions requiring prolonged radiation exposure. Electrical safety of the equipment should be tested by appropriate personnel prior to its initial clinical use and periodically thereafter.

#### D. Acceptance Testing

Acceptance testing shall be performed upon installation and should be completed before clinical use. This testing shall be more comprehensive than periodic performance and compliance testing and shall be consistent with current acceptance testing practices.

#### E. Follow-up Procedures

The medical physicist shall report the findings to the responsible professional in charge of obtaining or providing necessary service to the equipment and, if appropriate, initiate the required service. Action shall be taken immediately by verbal communication if there is imminent danger to patients or staff using the equipment due to either unsafe conditions or unacceptably poor image quality. Written reports shall be provided in a timely manner consistent with the importance of any adverse findings. The medical physicist shall confirm that the unit is performing in a safe or acceptable fashion as soon as possible after the required service has been performed.

### V. RADIATION SAFETY IN IMAGING

Radiologists, medical physicists, radiologic technologists, and all supervising physicians have a responsibility to minimize radiation dose to individual patients, to staff, and to society as a whole, while maintaining the necessary diagnostic image quality. This is the concept "As Low As Reasonably Achievable (ALARA)".

Facilities, in consultation with the medical physicist, should have in place and should adhere to policies and procedures, in accordance with ALARA, to vary examination protocols to take into account patient body habitus, such as height and/or weight, body mass index or lateral width. The dose reduction devices that are available on imaging equipment should be active or manual techniques should be used to moderate the exposure while maintaining the necessary diagnostic image quality. Patient radiation doses should be periodically measured by a medical physicist in accordance with the appropriate ACR Technical Standard. (2006 - ACR Resolution 17)

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