The American College of Radiology, with more than 30,000 members, is the principal organization of radiologists, radiation oncologists, and clinical medical physicists in the United States. The College is a nonprofit professional society whose primary purposes are to advance the science of radiology, improve radiologic services to the patient, study the socioeconomic aspects of the practice of radiology, and encourage continuing education for radiologists, radiation oncologists, medical physicists, and persons practicing in allied professional fields.

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.

ACR–AAPM TECHNICAL STANDARD FOR MANAGEMENT OF THE USE OF RADIATION IN FLUOROSCOPIC PROCEDURES

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 of 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

This standard was revised collaboratively by the American College of Radiology (ACR) and the American Association of Physicists in Medicine (AAPM).

Fluoroscopy is a technique for generating X-ray images and presenting them simultaneously and continuously as visible images. Fluoroscopy is intended to observe moving objects for relatively long periods of time (seconds to minutes) without the intent of preserving the images.

Fluoroscopy is frequently used to assist in a wide variety of medical diagnostic and therapeutic procedures, both within and outside of radiology departments. Fluoroscopic equipment capabilities have changed dramatically in recent years. The same fluoroscope may provide a number of operational modes, each of which is tailored to a specific clinical task. Modern fluoroscopic equipment is capable of delivering very high radiation doses during prolonged procedures. There have been reports of serious skin injuries in some patients undergoing certain fluoroscopically guided procedures [1-3]. Intervventional procedures that do not result in a skin injury are not risk free to the patient. The risk of a stochastic injury later in life is elevated for pediatric patients who have a longer projected life span and are more radiosensitive in the first decade of life than are adults [4]. Therefore, the use of fluoroscopy in medical institutions must be proactively managed so that the levels of patient radiation exposures to levels that are as low as reasonably achievable consistent with are appropriate for the medical demands of the procedures, taking into account risks and benefits, for which fluoroscopy is used. Management of the use of radiation must also ensure adequate safety of the medical personnel involved in these procedures. The goal intent of this standard is to assist physicians, Qualified Medical Physicists, radiologic technologists, and other ancillary personnel in achieving the above goal, managing the use of radiation in fluoroscopic procedures to reduce radiation exposures to levels that are as low as reasonably achievable consistent with the medical demands of the procedures.

II. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL

A. Physician

Each facility should have a policy for credentialing granting fluoroscopic privileges to all physicians who perform or supervise fluoroscopy. Local credentialing and privileging processes should include review of training records and of procedures.
that utilize fluoroscopy to determine that the physician is both properly trained and qualified in fluoroscopy. Physicians must comply with all applicable state and federal laws and regulations, and with institutional policies and procedures for fluoroscopy licensure or certification [5].

The physician performing or supervising fluoroscopically guided procedures must have the following initial qualifications:

Certification in Radiology, Diagnostic Radiology or Radiation Oncology by the American Board of Radiology, the American Osteopathic Board of Radiology, the Royal College of Physicians and Surgeons of Canada, or the Collège des Médecins du Québec.

or

Completion of a residency/fellowship program approved by the Accreditation Council for Graduate Medical Education (ACGME), the Royal College of Physicians and Surgeons of Canada (RCPSC), the Collège des Médecins du Québec, or the American Osteopathic Association (AOA) that includes 6 months of training in fluoroscopic imaging procedures. Documentation of the successful completion of didactic course lectures and laboratory instruction in radiation physics, radiobiology, radiation safety, and radiation management applicable to the use of fluoroscopy, including passing a written examination in these areas.

or

Be credentialed privileged for specific fluoroscopically guided procedures. The following is recommended:

Physicians whose residency did not include radiation physics, radiobiology, radiation safety, and radiation management may still be considered as satisfying having met the qualifications if they have performed at least 10 procedures of each type for which they intend to use fluoroscopic guidance under the direction of a qualified physician who has met these standards and who certifies that the trainee meets minimum fluoroscopy safety standards. These Physicians must also have documented evidence of at least 4 hours of didactic course lectures and laboratory instruction in radiation physics, radiobiology, radiation safety, and radiation management – including imaging pediatric patients and pregnant patients [6,7], applicable to the use of fluoroscopy, and should have satisfactorily passed an examination in these areas. Physicians who perform interventional procedures (e.g., vascular, cardiovascular, neurological) vascular, cardiovascular, biliary tract, genitourinary tract, or neurological procedures should have at least 45 8 hours of didactic lectures and laboratory instruction training in radiation physics, radiobiology, radiation safety, and radiation management applicable to the use of fluoroscopy, and have satisfactorily passed an examination in these areas.

and, in addition to certification education, and other credentials for
A fundamental clinical knowledge base and specific skills are required to perform fluoroscopic procedures to be performed safely. Certain fundamental clinical knowledge and skills are required. In addition to a basic understanding of anatomy, physiology, and pathophysiology, the physician should have sufficient knowledge of the clinical and imaging evaluation of patients to identify those patients for whom a specific procedure is indicated. The physician should also be able to evaluate each patient’s clinical status in order to anticipate those patients who might be at increased risk for complications, who require additional preprocedure or postprocedure care, and or who have relative contraindications to the procedure. The physician must also have undergone sufficient training in understand the operation of the specific types of fluoroscopic equipment that he or she operates or supervises in sufficient detail to be able to use available dose management and image quality features effectively.

Maintenance of Competence

Maintenance of competence for fluoroscopy is no different than maintenance of competence for any other medical procedure. The physician should regularly perform fluoroscopic procedures in sufficient numbers to maintain success rates and limit complications consistent with the difficulty of and risk associated with the procedures.

Competence must also be assured by requiring training for all individuals who will be using newly installed pieces of equipment as they arrive in department or division and for all individuals who are newly introduced to existing equipment.

Continuing Medical Education

Continuing education should be in accordance with the ACR Practice Guideline for Continuing Medical Education (CME) and should include continuing education in radiation protection and other areas related to the use of fluoroscopy.

B. Qualified Medical Physicist

A Qualified Medical Physicist is an individual who is competent to practice independently in one or more of the subfields in medical physics. The American College of Radiology (ACR) considers certification, continuing education and experience in the appropriate subfield(s) to 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 strongly recommends that the individual be certified in the appropriate subfield(s) by the American Board of Radiology (ABR), the Canadian College of Physicists in Medicine, or the American Board of Medical Physics (ABMP).
The appropriate subfield of medical physics for this standard is Diagnostic Medical Physics. (Previous medical physics certification categories including Radiological Physics, Diagnostic Radiological Physics and Diagnostic Imaging Physics are also acceptable.)

A Qualified Medical Physicist should meet the ACR Practice Guideline for Continuing Medical Education (CME). (ACR Resolution 17, adopted in 1996 – revised in 2012, Resolution 42.)

CME should include education in radiation dosimetry, radiation protection, and equipment performance related to the use of fluoroscopy.

The Qualified Medical Physicist must be familiar with the principles of imaging physics, radiation dosimetry, and radiation protection; the current guidelines of the National Council on Radiation Protection and Measurements (NCRP); laws and regulations pertaining to the performance of fluoroscopic equipment; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments used for radiation measurement. The Qualified Medical Physicist should also have sufficient knowledge of the clinical methods and goals of relevant medical procedures to critically evaluate the use of the equipment with regard to patient and personnel safety as well as image quality.

The Qualified Medical Physicist should regularly perform a sufficient number of radiation measurements, dosimetric calculations, and equipment performance evaluations of fluoroscopic equipment of the types being used to maintain competence in the performance of these activities. The Qualified Medical Physicist should maintain experience in the clinical applications of equipment by periodically observing clinical procedures.

The medical physicist must be familiar with the principles of imaging physics, radiation dosimetry, and radiation protection; the current guidelines of the National Council on Radiation Protection and Measurements (NCRP); laws and regulations pertaining to the performance of fluoroscopic equipment; the function, clinical uses, and performance specifications of the imaging equipment; and calibration processes and limitations of the instruments used for radiation measurement. The medical physicist should also have sufficient knowledge of the clinical methods and goals of relevant medical procedures to critically evaluate the use of the equipment with regard to patient and personnel safety as well as image quality.

C. Registered Radiologist Assistant

A registered radiologist assistant is an advanced level radiographer who is certified and registered as a radiologist assistant by the American Registry of Radiologic Technologists (ARRT) after having successfully completed an advanced academic program encompassing an ACR/ASRT (American ...
Society of Radiologic Technologists) radiologist assistant curriculum and a radiologist-directed clinical preceptorship. Under radiologist supervision, the radiologist assistant may perform patient assessment, patient management, and selected examinations as delineated in the Joint Policy Statement of the ACR and the ASRT titled “Radiologist Assistant: Roles and Responsibilities” and as allowed by state law. The radiologist assistant transmits to the supervising radiologists those observations that have a bearing on diagnosis. Performance of diagnostic interpretations remains outside the scope of practice of the radiologist assistant. (ACR Resolution 34, adopted in 2006)

ARRT registered radiologist assistants as recognized by the ACR and ASRT Joint Statement on the Radiologist Assistant, Roles and Responsibilities may perform specific fluoroscopic procedures under the direct supervision\(^1\) of a radiologist.

They ARRT registered radiologist assistants performing specific fluoroscopic procedures under the direct supervision\(^1\) of a radiologist should have received formal training in radiation management and should undergo a formal credentialing privileging process, administered by the facility, for fluoroscopically guided interventional procedures.

D. Radiologic Technologist and Radiation Therapist

Certification by the ARRT and/or unrestricted state license is required for radiologic technologists and radiation therapists.

Technologists or radiation therapists assisting with fluoroscopy should be thoroughly trained in radiography of the organ systems involved in a fluoroscopic procedure.

Radiologic technologists and radiation therapists should have received formal training in radiation management. Those assisting with fluoroscopy for fluoroscopically guided interventional procedures should undergo a formal credentialing privileging process, administered by the facility, for fluoroscopically guided interventional procedures.

E. Other Ancillary Personnel

Other ancillary personnel who are qualified and duly licensed or certified under applicable state law may, under supervision by a radiologist or other qualified physician, perform fluoroscopic examinations or fluoroscopically guided imaging procedures. Supervision by a radiologist

\(^1\) For the purpose of this guideline, direct supervision means that the physician must be present and immediately available to furnish assistance and direction throughout the performance of the procedure. It does not mean that the physician must be present in the room where the procedure is performed.
or other qualified physician must be direct or personal\(^2\), and must comply with local, state, and federal regulations.

All ancillary personnel using fluoroscopy should be credentialed for those fluoroscopic examinations or procedures and should have completed 40 hours of didactic education or its equivalent in digital image acquisition and display, contrast media, fluoroscopic unit operation and safety, image analysis, radiation biology, radiation production and characteristics, and radiation protection; and 40 hours of clinical experience supervised by a radiologist or medical physicist. Required CME for other ancillary personnel performing fluoroscopy should include education in radiation dosimetry, radiation protection, and equipment performance related to the use of fluoroscopy. (ACR Resolution 52, adopted in 2010)

### III. PROCEDURAL SPECIFICATIONS

The written or electronic request for fluoroscopic procedures should provide sufficient information to demonstrate the medical necessity of the examination and allow for the proper performance and interpretation of the examination.

Documentation that satisfies medical necessity includes 1) signs and symptoms and/or 2) relevant history (including known diagnoses). The provision of additional information regarding the specific reason for the examination or a provisional diagnosis would be helpful and may at times be needed to allow for the proper performance and interpretation of the examination.

The request for the examination must be originated by a physician or other appropriately licensed health care provider. The accompanying clinical information should be provided by a physician or other appropriately licensed health care provider familiar with the patient’s clinical problem or question and consistent with the state scope of practice requirements. (ACR Resolution 35, adopted in 2006)

\(^2\) The American College of Radiology approves of the practice of certified and/or licensed radiologic technologists performing fluoroscopy in a facility or department as a positioning or localizing procedure only, and then only if monitored by a supervising physician who is personally and immediately available*. There must be a written policy or process for the positioning or localizing procedure that is approved by the medical director of the facility or department/service and that includes written authority or policies and processes for designating radiologic technologists who may perform such procedures. (ACR Resolution 26, 1987 – revised in 2007, Resolution 12-m)

*For the purposes of this guideline, “personally and immediately available” is defined in manner of the “personal supervision” provision of CMS—a physician must be in attendance in the room during the performance of the procedure. Program Memorandum Carriers, DHHS, HCFA, Transmittal B-01-28, April 19, 2001.
When practicable, the request should include key information on recently performed related procedures including modality, date, findings and location of the images.

Only physicians, radiologist assistants, or other ancillary personnel participating in specific interventional fluoroscopically guided procedures as described in II.E who have the qualifications outlined in this standard should operate a fluoroscopic system while exposing a patient to radiation, with the following exception: registered and/or licensed radiologic technologists or radiation therapists may perform fluoroscopy only as a positioning or localizing procedure provided they are monitored directly supervised by a supervising physician, who is personally and immediately available. The supervising physician must meet the qualifications outlined in this standard. The procedure must have prior written approval by the medical director of the appropriate department or service, and there must be written authority, policy, and procedures for designating technologists who perform such procedures.

The radiation exposure to the patient shall must be limited to that required for the procedure being performed [8]. Clinical management of radiation is essential for every procedure [5,9,10]. Appropriate collimation should be used for the imaging task to reduce the size of the irradiated area when possible. The distance between the patient and the X-ray tube should be maximized to the extent practicable. The patient image receptor should always be positioned as close as reasonably possible to the patient. The distance between the patient and the X-ray tube should be maximized to the extent practicable. Electronic magnification modes and high-dose-rate modes should be used only when necessary. The lowest dose rate that is clinically acceptable should be used at all times. When electronic magnification is necessary, the lowest acceptable magnification factor mode should be used.

Elective procedures should not be performed on pregnant patients. If it is necessary to perform a fluoroscopic or fluoroscopically guided procedure on a pregnant patient, it should be performed in accordance with the ACR Practice Guideline for Imaging Pregnant or Potentially Pregnant Adolescents and Women with Ionizing Radiation and international guidelines [6,7].

In order to reduce exposure rates, special attention should be given to the proper adjustment of the equipment setup fluoroscope with regard to the type of patient procedure. Because fluoroscopes may not automatically accommodate small body parts, special attention may be needed to optimize radiation dose and image quality. While automatic exposure control is always preferred, if manual settings are used, the proper adjustment of X-ray tube voltage, current, and spectral filtration technical factors is essential. Fluoroscopy should be used sparingly and only when real time imaging guidance is needed. The last-image-hold feature or loop replay should be used when possible to minimize additional fluoroscopic exposure. Image Acquisition modes should be activated used only when higher quality image review and documentation is essential and it should be limited to the frame rate and run duration necessary to
accomplish the immediate task. In some cases, retrospectively stored fluoroscopy may reduce the need for image acquisition.

All personnel participating in the procedure share a responsibility for achieving both patient and staff radiation management and safety goals. Personnel should be able to recognize and correct unsafe practices or bring them to the attention of other personnel who can correct the situation [5].

All personnel in the room during fluoroscopic procedures must wear radiation protective garments appropriate to the procedure [11]. Careful attention should be given to the attenuation of the protective garments under the conditions of use. kVp rating of the lead apron. The Qualified Medical Physicist or radiation safety officer should be consulted regarding selection of radiation protective garments. In addition to a standard personnel personal radiation monitor, other monitors should be used at least periodically to measure radiation exposure under protective garments to ensure the adequacy of their protection, especially when lightweight or nonstandard garments are legally used, [11] as they may not afford the same degree of protection at higher effective beam energies. Auxiliary shielding, including ceiling, machine mounted or freestanding, may be substituted in whole or in part for personal protective garments.

Each person routinely involved in fluoroscopic procedures must also be provided with at least one personnel personal radiation monitor approved by the National Voluntary Laboratory Accreditation Program (NVLAP). Individuals must comply with state regulations regarding wearing of radiation monitors. Monitor placement. If a single monitor is normally worn outside the apron at the collar level, the institution or facility should consider providing an additional monitor to be worn behind underneath the apron for personnel involved in vascular complex interventional procedures and use of a method to estimate occupational dose that accounts for the protection provided by the garments [5,12].

The institution or facility should provide a radiation monitor, to be worn underneath any protective garments used, for formally declared pregnant personnel individuals who have declared their pregnancy. Physicians who perform procedures requiring their hands to be close to or in the radiation field should be aware of the doses delivered to their hands to assure that help minimize radiation exposures. Levels do not exceed standards for safety defined by applicable laws and regulations. Finger monitors should be used during all fluoroscopically guided interventional brachytherapy procedures e.g., yttrium 90 radioembolization. All monitors should be worn consistently, in the same location, and returned for collection at the appointed time. Physicians who perform interventional procedures regularly should wear radiation protective eyewear or use ceiling-mounted shields to minimize the risk of developing radiation-induced cataracts [5,11,13,14].

Mobile X-ray fluoroscopic equipment shall should be used only in an appropriately shielded environment.
IV. EQUIPMENT SPECIFICATIONS

Examinations must be performed only with fluoroscopic image intensification or with solid state flat panel image receptors and with radiographic equipment meeting that meets all applicable federal and state radiation requirements. Equipment that will be used to image small or pediatric patients should provide operational modes with technical factors that are appropriate [5,15-20].

All fluoroscopy equipment that is equipped with cumulative-air-kerma meters displays and/or air kerma-area-product meters displays should have the meter calibrations verified periodically by a Qualified Medical Physicist. All interventional fluoroscopy equipment should be equipped with displays of air kerma rate, kerma area product and cumulative air kerma [21,22], and calibrations should be verified periodically by a Qualified Medical Physicist.

Equipment must provide fluoroscopic image quality and recording (film, video, or digital) capability that is adequate for the procedures performed. Fluoroscopic equipment requirements for specific radiologic examinations are found in the guidelines or standards for those examinations. Equipment incapable of operating at tube voltages of at least 100 kVp or having a maximum source-image receptor distance of less than 45 cm must not be used for examinations other than for distal extremities. All equipment must have spacers to maintain the minimum source-to-skin distance (SSD) and should have spacers to achieve the recommended SSD [5,21-23].

Equipment performance monitoring should be performed in accordance with the ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Radiographic and Fluoroscopic Equipment.

V. DOCUMENTATION

Documentation of informed consent should be performed as outlined in the ACR–SIR Practice Guideline on Informed Consent for Image-Guided Procedures.

It is desirable that all available radiation dose data should be recorded in the patient’s medical record [5,24,25], for all fluoroscopy procedures. Direct patient care radiation dose-related information provided by dosimetry systems should be recorded in the patient’s medical record. If cumulative air kerma or air kerma-area-product data are not available, the fluoroscopic exposure time and the number of acquired images (radiography, cine or digital subtraction angiography) acquired should be recorded in the patient’s medical record.

If the cumulative air kerma at the reference point exceeds the Substantial Radiation Dose Level (SRDL), which is typically set at 3.5 gray (Gy), provisions should be made for patient follow-up of those areas for determination of radiation effects to allow for detection and management of possible radiation effects [5,10,26]. (For specific classes
of procedures if a different SRDL is chosen it should be supported by published literature [24]. A different threshold for action can be established at individual institutions when supported by published literature. In such circumstances, if follow-up for possible radiation injury is indicated, the patient should be advised of the potential for radiation injury to the skin, should be given instructions for proper follow-up, and these steps should be documented in the medical record [5]. In When repeat potentially high-dose procedures are performed repeatedly, e.g., TIPS, neuroembolization, previous skin exposure should be considered [27].

Any fluoroscopically induced tissue reactions should be investigated by the institution’s quality processes.

VI. QUALITY CONTROL AND IMPROVEMENT, SAFETY, INFECTION CONTROL, AND PATIENT EDUCATION

Policies and procedures related to quality, patient education, infection control, and safety should be developed and implemented in accordance with the ACR Policy on Quality Control and Improvement, Safety, Infection Control, and Patient Education appearing under the heading Position Statement on QC & Improvement, Safety, Infection Control, and Patient Education on the ACR web page (http://www.acr.org/guidelines).

The quality assurance (QA) program should include the review of personal radiation monitor results and patient radiation dose-related information and/or complications [5]. Practitioners should compare patient dose-related information against institutional and national benchmarks, if available, and evaluate outliers as part of an ongoing QA program [28].

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REFERENCES


**Suggested Reading** (Additional articles that are not cited in the document but that the committee recommends for further reading on this topic)


10. Important Information: Recording Information in the Patient’s Medical Record that Identifies the Potential for Serious X-ray induced Skin Injuries Following
NOT FOR PUBLICATION, QUOTATION, OR CITATION


APPENDIX A

Quantities and Units – Definitions

Air kerma: The amount of energy released in air by radiation per unit mass of air. The unit of air kerma is the gray (Gy).

Dose (also known as absorbed dose): the amount of energy imparted by radiation to specified matter, (e.g., soft tissue) per unit mass. The unit of dose is the gray. An older unit still used in the literature is the rad (radiation absorbed dose). 1 Gy = 100 rad.

Cumulative air kerma: Air kerma of the primary X-ray beam measured under specific conditions and expressed as the equivalent value at the Patient Entrance Reference Point [29]. It is the air kerma accumulated at a specific point in space relative to the fluoroscopic gantry during a procedure. It does not include backscatter and is measured in units of Gy. Cumulative air kerma is also known as reference air kerma and sometimes referred to as reference dose. Earlier publications used the term “cumulative dose” and the abbreviation “CD” for this quantity [10].

Dose rate: the dose of radiation per unit of time.

Effective dose (E): Effective dose must be calculated. It cannot be measured. It is calculated by multiplying actual organ doses by tissue weighting factors, which indicate each organ’s relative sensitivity to radiation, and adding up the total of all the weighted organ doses. The sum of the products is the effective dose. These weighting factors are designed so that the effective dose represents the dose the total body could receive (uniformly) that would yield the same stochastic risk as various organs getting different doses. The unit of effective dose is the sievert (Sv), though the older unit the rem is still in use.

Kerma-area-product: (More accurately, air kerma-area product, since this quantity is usually determined in air.) The integral of air kerma across the entire X-ray beam emitted from an X-ray tube. Kerma-area product is a surrogate measurement for the entire amount of energy delivered to the patient by the beam. Kerma-area product is measured in units of Gy cm$^2$. The International Commission on Radiation Units and Measurements (ICRU) notation for this quantity is $P_{KA}$ [30]. It is sometimes abbreviated as KAP. Earlier publications used the term dose-area product and the abbreviation “DAP” for this dose metric [10].

Patient entrance reference point (Interventional reference point): The air kerma reference point is also known as the (air) dose reference point. For isocentric fluoroscopy equipment it is defined as a point located $15$ cm in the direction of the X-ray source along the axis central ray of the X-ray beam between the focal spot and the image receptor, where the machine automatically tracks the cumulative air kerma. For
isocentric angiographic equipment that point is located 15 cm from isocenter on the side closest to the X-ray tube. For other Manufacturers of fluoroscopic equipment geometries that is not isocentric may define the reference point as specified by the IEC [21,29] and the location of the reference point is defined by the Food and Drug Administration [31]. [9][32]

Isocenter for a C-arm fluoroscopy system: A point in space, defined by the gantry axis of rotation through which the central ray of the X-ray beam passes regardless of beam orientation. An object placed at the isocenter will not move across the field of view as the C-arm is rotated.

Substantial Radiation Dose Level (SRDL): An appropriately selected reference value used to trigger additional dose management actions during a procedure and medical follow-up of a patient for a radiation level that might produce a clinically relevant injury in an average patient. There is no implication that radiation levels above the SRDL will always cause an injury or that radiation levels below the SRDL will never cause an injury [5].

*Guidelines and standards are published annually with an effective date of October 1 in the year in which amended, revised, or approved by the ACR Council. For guidelines and standards published before 1999, the effective date was January 1 following the year in which the guideline or standard was amended, revised, or approved by the ACR Council.

Development Chronology for this Standard
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Amended 2010 (Resolution 52)