



# The Fluoroscopy Examination

The purpose of the American Registry of Radiologic Technologists® (ARRT®) Fluoroscopy Examination is to assess the knowledge and cognitive skills required to safely operate a fluoroscopy unit. The ARRT administers the examination at a licensing state's request under contractual arrangement and provides the results directly to the state. The contract includes prerequisite educational and clinical requirements that a candidate should satisfy to assure qualification. ARRT does not issue a certification based upon the examination and it is not intended to replace the Fluoroscopy sections on ARRT's other examinations.

To identify the knowledge and cognitive skills covered by the examination, the ARRT conducted a practice analysis study using input from subject matter experts and related published documents such as the *California Department of Health Service's Syllabus of Fluoroscopy, 6<sup>th</sup> edition (1995)* and the *ASRT Fluoroscopy Educational Framework for Physician Assistants (2009)*.<sup>1</sup> The practice analysis resulted in a task list which serves as the basis for these content specifications and appears in the appendix of this document.

The table below presents the four major content categories, along with the percentage and number of test questions appearing in each category. The remaining pages provide a detailed listing of topics addressed within each major content category.

This document is not intended to serve as a curriculum guide. Although testing programs and educational programs may have related purposes, their functions are clearly different. Educational programs are generally broader in scope and address subject matter not included in these content specifications.

Content Category	Percent of Test	Number of Questions <sup>2</sup>
A. Radiation Biology and Physics	24%	22
B. Exposure Reduction	27%	24
C. Equipment Operation	24%	22
D. Image Evaluation, Quality Control & Patient Considerations	25%	22
<b>Total</b>	<b>100%</b>	<b>90</b>

<sup>1</sup> A special debt of gratitude is due to the hundreds of professionals participating in this project as committee members, survey respondents and reviewers.

<sup>2</sup> Each exam includes up to an additional 30 unscored (pilot) questions. On the pages that follow, the approximate number of test questions allocated to each content category appears in parentheses.



## A. Radiation Biology and Physics (22)

### I. Radiation Biology (10)

- A. Radiosensitivity
  - 1. dose-response relationships
  - 2. relative tissue radiosensitivities
  - 3. cell survival and recovery
- B. Somatic Effects
  - 1. short-term versus long-term effects
  - 2. acute versus chronic effects
  - 3. carcinogenesis
  - 4. organ and tissue response (e.g., eye, thyroid, breast, bone marrow, skin, gonadal)
- C. Embryonic and Fetal Risks
- D. Genetic Effects

### 2. Radiation Physics (12)

- A. Photon Interactions with Matter
  - 1. Compton effect
  - 2. photoelectric absorption
  - 3. coherent (classical) scatter
  - 4. attenuation by various tissues
    - a. thickness of body part
    - b. type of tissue (e.g., atomic number, density)

### B. X ray Production

- 1. source of free electrons
- 2. acceleration of electrons
- 3. focusing of electrons
- 4. deceleration of electrons
- 5. x ray spectrum
  - a. bremsstrahlung
  - b. characteristic

### C. X ray Beam

- 1. frequency and wavelength
- 2. beam characteristics
  - a. quality
  - b. quantity
  - c. primary versus remnant (exit)
- 3. scatter
- 4. inverse square law
- 5. fundamental properties (e.g., travel in straight lines, ionize matter)

## B. Exposure Reduction (24)

### I. Minimizing Patient Exposure (13)

- A. Technical Factors
  - 1. kVp
  - 2. mA
  - 3. time
  - 4. automatic brightness control (ABC)
  - 5. automatic exposure control (AEC)
  - 6. automatic exposure rate control (AERC)
- B. Shielding
  - 1. rationale for use
  - 2. types
  - 3. placement
- C. Beam Restriction
  - 1. purpose of primary beam restriction
  - 2. collimators

### D. Filtration

- 1. effect on skin and organ exposure
- 2. effect on average beam energy
- 3. NCRP recommendations (NCRP #102, minimum filtration in useful beam)

### E. Equipment Features

- 1. last image hold
- 2. cumulative timer
- 3. magnification mode
- 4. dose mode
  - a. low dose
  - b. cine
  - c. high-level control
  - d. pulsed

### F. Pediatric Dose Reduction

### G. Patient Positioning

- 1. impact on dose
- 2. patient immobilization devices



## B. Exposure Reduction (continued)

### 2. Personnel Protection (11)

- A. Sources of Radiation Exposure
  - 1. primary x ray beam
  - 2. secondary radiation
    - a. scatter
    - b. leakage
  - 3. patient as source
- B. Basic Methods of Protection
  - 1. time
  - 2. distance
  - 3. shielding
- C. Protective Devices
  - 1. protective drapes
  - 2. Bucky slot cover
  - 3. shields (e.g., aprons, gloves, eye, face, floating, thyroid)
  - 4. attenuation properties
- D. Minimum Lead Equivalent (NCRP #102)
- E. Fluoroscopy Exposure Rates (NCRP #102, 21 CFR)

### F. Recommendations for Personnel Monitoring (NCRP #116)

- 1. occupational exposure
- 2. public exposure
- 3. embryo/fetus exposure
- 4. ALARA and dose equivalent limits
- 5. evaluation and maintenance of personnel dosimetry records

### G. Units of Measurement\*

- 1. absorbed dose
- 2. dose equivalent
- 3. exposure
- 4. effective dose

### H. Dosimeters

- 1. types
- 2. proper use

\* Conventional units are generally used, however, questions referenced to specific reports (e.g., NCRP) will use SI units to be consistent with such reports.

## C. Equipment Operation (22)

### 1. Image Receptors (4)

- A. Image Intensifier
- B. Flat Panel

### 2. Image Display (5)

- A. Viewing Conditions (e.g., luminance, ambient lighting, eye physiology, ergonomics)
- B. Spatial Resolution
- C. Contrast Resolution/Dynamic Range
- D. DICOM Gray Scale Function
- E. Window Level and Width Function

### 3. Recording Systems (5)

- A. DSA (digital subtraction angiography)
- B. Cine
- C. Image Capture
- D. Spot Imaging (digital spot)

### 4. Technical Factors (8)

- A. kVp
- B. mA
- C. OID
- D. SID
- E. Focal Spot Size
- F. Grids
- G. Filtration
- H. Beam Restriction
- I. Automatic Brightness Control (ABC)
- J. Automatic Exposure Control (AEC)
- K. Automatic Exposure Rate Control (AERC)
- L. Anatomic Alignment
- M. Exposure Compensation
- N. Magnification Mode
- O. Cine
- P. Spot Imaging (digital spot)
- Q. High Level Control (boost, high dose rate)
- R. Pulse Rate



## D. Image Evaluation, Quality Control & Patient Considerations (22)

### 1. Image Characteristics (4)

- A. Spatial Resolution
  - 1. sampling frequency
  - 2. DEL (detector element size)
  - 3. receptor size and matrix size
- B. Image Signal (exposure related)
  - 1. quantum mottle (noise)
  - 2. SNR (signal to noise ratio)  
or CNR (contrast to noise ratio)

### 2. Image Criteria (5)

- A. Demonstration of Anatomical Structures  
(e.g., positioning, motion)
- B. Identification Markers  
(e.g., anatomical, patient, date)
- C. Patient Considerations  
(e.g., pathologic conditions)

### 3. Recognition and Reporting of Malfunctions (4)

- A. Image Artifacts (e.g., grid lines,  
dead pixels, distortion)
- B. Quality Control
  - 1. display monitor
  - 2. shielding accessory testing  
(e.g., lead apron and glove testing)
  - 3. exposure rate output
  - 4. spot imager
  - 5. image quality (e.g., resolution)
- C. Recording and Reporting of Overexposure

### 4. Patient Care and Education (9)

- A. Patient Identification and Procedure Verification
- B. Components of Informed Consent
- C. Risk versus Benefit
- D. Procedural Understanding to Reduce Exposure
- E. Procedure Radiation Exposure (NCRP #160)
- F. Cumulative Dose Education
- G. Pregnancy Status (e.g. tests and limitations)
- H. Contrast Reactions
  - 1. allergy history
  - 2. types of reactions (mild to severe)
- I. Patient Record Information
  - 1. patient dose/technical factors
  - 2. PACS
  - 3. HIS
  - 4. RIS
- J. Standards of Care
- K. HIPAA



## Appendix: Task List for Fluoroscopy Examination

Activity	Content Area
1. Advocate radiation safety and protection.	A., B., B.1.B., C., D.4.A., D.4.G.
2. Assess the patient's radiation dose and history.	A., D.4.E., D.4.F.
3. Assess alternative procedures based on patient dose.	D.4.C.
4. Assess risk factors that may contraindicate the procedure (e.g., health history, medications, pregnancy, psychological indicators, alternative medicines).	A.1.C., D.4.A., D.4.G.-H.
5. Examine imaging examination requisition to verify accuracy, completeness of information and exam appropriateness (e.g., patient history, clinical diagnosis).	D.4.A., D.4.H., D.4.K.
6. Verify or obtain patient consent as necessary (e.g., contrast studies).	D.4.B.
7. Explain effects and potential side effects to the patient regarding the radiation required for the examination.	A.1.B.4., D.4.F.
8. Take appropriate precautions to minimize occupational exposure.	B.2.
9. Select immobilization devices, when indicated, to prevent patient's movement and/or ensure patient's safety.	B.1.G.2.
10. Observe patient after administration of contrast media to detect adverse reactions.	D.4.H.2.
11. Take appropriate precautions to minimize radiation exposure to patient.	B.1.
12. Restrict beam to limit exposure area, improve image quality and reduce radiation dose.	B.1.C., C.4.H.
13. Set kVp, mA and time or automatic exposure system to achieve optimum image quality, safe operating conditions and minimum radiation dose. a. Use pulse fluoroscopy b. Document fluoroscopy time and technical factors or patient dose	B.1.A., B.1.E., C.4., D.4.I.1.
14. Remove all radiopaque materials from patient or table that could interfere with the image.	D.2., D.4.D.
15. Add electronic annotations/radiopaque markers on images to indicate anatomical side, position and other relevant information.	D.2.B.
16. Select equipment and accessories (e.g., grid, compensating filter, shielding) for the examination requested.	B.1.B., B.1.D., C.4.F.-G.
17. Prevent all unnecessary persons from remaining in area during x ray exposure.	A.1., A.2., B.2.
18. Wear a personnel monitoring device as required.	B.2.H.
19. Operate a fixed/mobile fluoroscopic unit.	A.2., B., C.
20. Explain breathing instructions prior to making the exposure.	D.2.B., D.4.D.
21. Position patient to demonstrate the desired anatomy using body landmarks.	B.1.G., D.2.A.
22. Modify technical factors for circumstances, such as involuntary motion, contrast media, pathological conditions or patient's inability to cooperate.	C.4., D.2.A.-C.
23. Modify technical factors for pediatric patients.	B.1.A., B.1.F., C.4.
24. Document required information on patient's medical record (e.g., imaging procedure documentation, images).	D.4.I.



## Appendix: Task List for Fluoroscopy Examination (continued)

Activity	Content Area
25. Evaluate individual occupational exposure reports to determine if values for the reporting period are within established limits.	B.2.F.-H.
26. Operate electronic imaging and record keeping devices. a. Picture Archival and Communication System (PACS) b. Hospital Information System (HIS) c. Radiology Information System (RIS)	D.4.I.2.-4.
27. Verify accuracy of patient identification on image.	D.2.B.
28. Evaluate images for diagnostic quality.	C.2., D.2.
29. Determine corrective measures if image is not of diagnostic quality and take appropriate action.	C.4., D.1.-3.
30. Store and handle imaging equipment in a manner which will reduce the possibility of artifact production.	C.1., C.3., D.3.A.
31. Visually inspect, recognize and report malfunctions in the imaging unit and accessories.	D.3.
32. Recognize the need for basic evaluations of shielding accessories (lead aprons and gloves).	B.2.D., D.3.D.
33. Operate fluoroscopic equipment in compliance with Standards of Care, regulatory requirements and medical ethics.	B.1.D., B.2.D., B.2.E., D.4.J.