2007

Diagnostic Imaging Training Course

CATALOG

Focused On Excellence

20th ANNIVERSARY
1985 RSTI 2005

RSTI

Radiological Service Training Institute
State of Ohio Reg. No. 93-09-1377T

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Radiological Service Training Institute (RSTI)
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Ohio State Registration No. 93-09-1377T

The Radiological Service Training Institute (RSTI) is dedicated to providing the finest quality training in the diagnostic imaging industry. Since its founding in 1984, RSTI has provided technical training for thousands of in-house hospital, shared service, government, independent, and major OEM service personnel. Our programs in R/F, vascular imaging, computed tomography, ultra-sound, nuclear, and MRI service training will provide you with the continuing education required to keep up with the rapidly expanding medical technology found in today's sophisticated diagnostic imaging systems.

The RSTI training facility has a complete complement of classrooms and labs. Included are a CT scanner, R/F X-ray rooms, radiographic rooms, tomography rooms, diagnostic ultrasound systems, nuclear medicine systems, and cardiac catheterization labs. Additional systems such as MRI and therapy are made available through RSTI's affiliation with local hospitals and industries.

RSTI's instructional staff consists of professional curriculum design experts who have instructed for various major medical equipment manufacturers. Each is technically versed on many major manufacturers' products, state-of-the-art instructional technology, and curriculum design. We believe we have the most qualified and versatile staff in the industry today.

We at RSTI are sensitive to system performance, and we possess a sense of urgency at all levels of the training process. Our program offerings are designed to provide today's service professional with the skills and technical advances for peak clinical performance. And through our follow-up programs we can ensure that our curriculum continually meets the needs of today's image modalities. Our commitment to you is strong, and we're working hard to meet the challenge of enhancing system performance by providing the finest diagnostic service training in our industry.

At RSTI, our future is your future. Your future depends on quality education in a rapidly growing technological field. Our programs in R/F, Vascular Imaging, CT, Ultrasound, Nuclear, and MRI service training can provide manufacturers, distributors, hospital groups, service organizations, and service professionals with alternatives to solving their training requirements. At RSTI we offer:

- Capital equipment asset management programs
- Training programs for veterans and newly hired service professionals
- Seminars and conferences
- Custom designed in-house training
- Formal classroom programs
- Service professional certification programs
- Technical and administrative consulting services

Our training programs are custom designed to meet your service needs. We offer programs for entry level, intermediate, and advanced service personnel. These programs include both conceptual and specific product training. All theory and lab exercises are based on practical service applications. Each program has been designed using a systematic approach and contains a full complement of quizzes, final exams, and other performance criteria.

RSTI was the first diagnostic imaging service training institute to be registered by the State of Ohio as a proprietary school. Our commitment to providing the medical imaging industry with the finest training available is evidenced by our Diploma and Certificate Programs, which are recognized by the State of Ohio.

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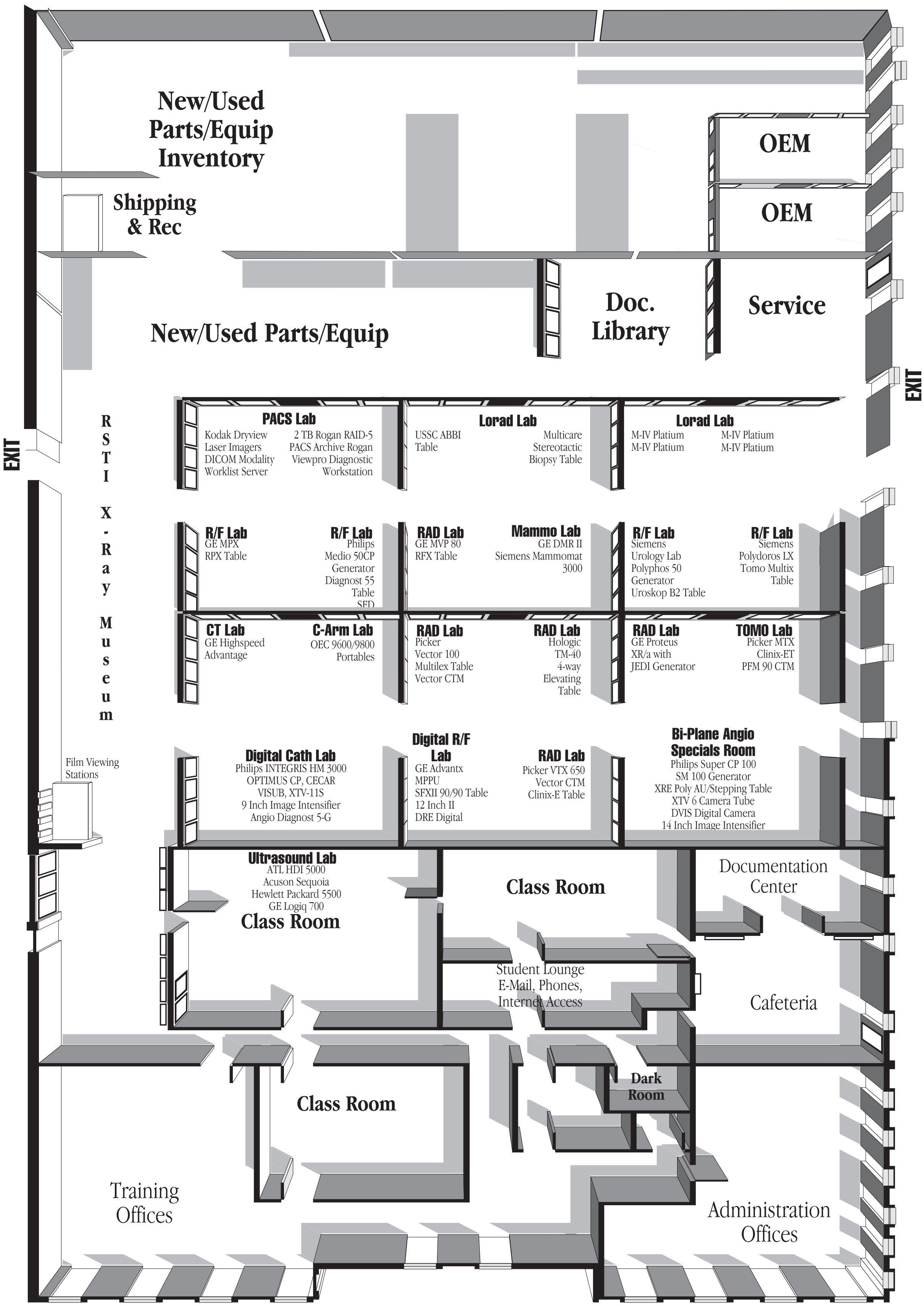
TAKE A CLOSER LOOK AT OUR TRAINING LABS

- State-of-the-Art Equipment
- Dedicated for Hands-On Training
- In-Depth Labs
- Specialized Test Equipment
- Four-to-One Equipment Ratio
- Comprehensive Lab Manuals
- Dedicated Lab Instructors



Training Programs Overviews

All our comprehensive training programs provide the quality training demanded by the industry. Training programs are conducted at our facility in Solon, Ohio or at major medical institutions throughout the country. In addition to a specially designed manual and course handouts, all participants will also receive where appropriate:

- Document package of each lecture
- Flow diagrams
- Troubleshooting charts
- CDRH compliance information
- Performance evaluation forms
- Certificate of completion

X-Ray Certificate Series

RSTI provides the only independent, comprehensive radiographic/fluoroscopic hands-on X-ray training programs in the industry. These programs are conducted at our facility in Solon, Ohio or at major medical centers throughout the country. They provide an excellent opportunity for service organizations and hospital personnel to develop their service staff in the diagnostic X-ray field. From the biomedical equipment specialist who require entry level training, to the seasoned X-ray service specialist who requires on-going training, these programs will best meet your needs. The programs are divided into four modules, from basic X-ray servicing to advanced microprocessor controlled equipment maintenance and imaging technology. All modules include lecture, testing, lab activities, and certification from RSTI upon satisfactory completion of appropriate examinations. In addition, continuing education units (CEUs) are awarded upon satisfactory completion of each module. A complete course description is included in this catalog for each module.

The course offerings provide the balance necessary in servicing 70%–80% of today's radiographic and fluoroscopic imaging systems. Included are:

Principles of Servicing Diagnostic X-Ray Systems (Phase I)

Advanced Radiographic Systems Maintenance (Phase II)

Advanced Fluoroscopic Systems Maintenance (Phase III)

Advanced Diagnostic Imaging System Analysis (Phase IV)

Filmless Integration: PACS, Networking, DICOM, MCSE Preparation (Phase V)

Advanced Specialty Products Systems Maintenance (product specific courses)

The first four course offerings are designed to provide the service professional with the cognitive skills necessary for an excellent foundation in the maintenance of today's diagnostic imaging systems. The Specialty Products Courses will provide the specific product training necessary to complement the educational process and thus provide the service professional with full qualifications to service specific generators and/or imaging systems.

Each course participant will receive a specially designed documentation package which includes, where appropriate:

- Class manual
- Lab manual
- Course handouts
- Performance evaluation forms
- Microprocessor and computer information
- Troubleshooting charts and procedures
- Flow diagrams
- Block diagrams
- Logic diagrams
- CDRH testing procedures

We recommend that the new service professional attend the Phase I–IV modules. Once qualified in the basics, students may attend the more advanced Specialty Product courses in other modalities such as nuclear medicine, ultrasound, CT, and MRI.

Each course is designed to assure proper entry level. Be sure to check the course descriptions for the prerequisites for each course.

And finally, the Computer Networking and Digital Information Management courses are designed to providing the state-of-the-art technology necessary for servicing today's filmless diagnostic imaging departments, and prepare the student to pass the MCSE certification exams. Our industry is going filmless, and Imaging Service Professionals graduating from Phase V and our other DICOM, PACS and Networking courses will gain knowledge of PACS integration, R.I.S. and H.I.S. technology, network strategies and DICOM compatibility.

Principles of Servicing Diagnostic X-Ray Systems (Phase I)

Course Length: 2 Weeks
CEUs Awarded: 8

Introduction

Principles of Servicing Diagnostic X-Ray Systems is a skills development program that teaches the new service professional the cognitive skills necessary to understand the X-ray system and its applications in the medical community. The program is divided into six major learning units:

- Introduction to radiography
- Radiation safety
- The production of X-rays
- Formation of the X-ray image
- Film and film processing
- Introduction to imaging

The course contains lecture, demonstration, and hands-on training, which teach participants proper operation, calibration, and preventive maintenance of the X-ray system. Upon completion of the course, the student will be able to perform first level service on the radiographic/fluoroscopic system.

Prerequisites

To attend this course, the service professional must have a two year associate degree in electronics or equivalent service experience.

Objectives

At the conclusion of this course, participants will be able to:

- Have a thorough understanding of X-rays and X-ray production
- Follow safety procedures for patients, physicians and individuals
- Describe the criteria for high quality radiographs
- Understand overtable radiographic, fluoroscopic, and special procedures system operation
- Describe the parameters of film and processing

Course Outline

DAY 1

I. Introduction to radiography
   A. X-rays: an overview
      1. What they are
      2. How they are produced
      3. What they do
   B. The radiographic system, an overview
   C. The radiograph, an overview
   D. Factors that measure radiographic quality
      1. Density
      2. Contrast
      3. Sharpness
   E. Factors that affect radiographic quality
   F. Operation of the overtable system
   G. Operation of the undertable system

Lab Activities

I. Operate overtable and undertable equipment
II. Take conventional and phototimed radiographs
III. Perform experiments using factors that affect image quality
IV. Process film and analyze results

DAY 2

I. Introduction to radiography (cont'd)
   A. Basic single purpose radiographic system
      1. Cine radiography
      2. Photo spot cameras
      3. High speed film changers
      4. Cassetteless radiography
      5. Tomography
      6. Mobile units
      7. C.T.
   B. Radiographic studies
      1. Common non-contrast media
      2. Common contrast media
      3. Special radiographic studies
   C. Introduction to troubleshooting the X-ray system
      1. Processor checkout
      2. Isolation of major areas
II. Radiation safety, principles and practices
   A. Radiation and its biological effects
      1. Atom
      2. X-ray beam
      3. Compton effect
   B. Radiation safety, working with radiation
      1. Rules governing working with radiation
      2. Time, distance, and shielding
      3. Radiation protective devices

Lab Activities

I. Operate cine and photo spot cameras
II. Operate tomo and mobile units
III. Troubleshoot R/F system to sub-assembly level
IV. Safety rules in working with radiation

DAY 3

I. The production of X-rays
   A. How X-rays are produced
      1. Where X-rays are produced
      2. How X-rays are controlled
      3. Bremmsstrahlung radiation theory
   B. The X-ray tube
      1. X-ray tube construction
      2. Functions of basic elements
      3. Electrical and mechanical requirements
      4. Proper usage
      5. Problems and cures
      6. Installation and evaluation

Lab Activities

I. Identify applications and types of X-ray tubes

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Principles of Servicing Diagnostic X-Ray Systems (Phase I) continued

Course Length: 2 weeks
CEUs Awarded: 8

II. X-ray tube evaluation
  A. Proper stator resistance
  B. Filament continuity
  C. Direction of anode rotation
  D. Standby/max. filament using dummy load
  E. Anode speed using a reed tachometer
III. Evaluate focal spot size using a lead star
IV. Predict and observe instantaneous and accumulated anode heat
V. Identify common X-ray tube problems
VI. X-ray tube alignment

DAY 4

I. The production of X-rays (continued)
  A. H.V. cables and terminations
    1. Composition and conductors
    2. Federal terminations
  B. H.V. transformers (single phase)
    1. Ratio
    2. Stick rectifiers
    3. R/F changeover
    4. Full wave/half wave rectification
    5. Circuit failure and cause
  C. Generation of three phase
    1. Wye and delta
    2. Six and twelve-pulse generation
    3. Line-to-neutral versus line-to-line voltage
    4. Relationship of input to output voltages

Lab Activities

I. Grease and terminate X-ray cable
II. Measure primary and secondary kV
III. Follow safety rules for discharging cables, sticks, and transformer connections

DAY 5

I. The production of X-rays (cont'd)
  A. The X-ray generator
    1. kV circuitry
    2. Time/logic circuits
    3. mA control
    4. Troubleshooting

Lab Activities

I. Overall troubleshooting to sub-assembly level

DAY 6

I. Formation of the X-ray image
  A. Control of the X-ray image
    1. Techniques
    2. Technique charts
    3. Inverse square law
  B. Control & production of secondary and scatter radiation
    1. Photoelectric effect
    2. Compton effect
    3. Collimators
    4. Grids
  C. Intensifying screens
    1. Types
    2. Effect on quantity and quality
    3. Resolving capabilities
    4. Care and handling
  D. Measuring quantity and quality of the X-ray beam
    1. Ionization chambers
    2. Half-value layers

Lab Activities

I. Use technique charts to properly expose film
II. Evaluate the effect of scatter with and without grids
III. Perform "R" measurements
IV. Perform half value layer tests

DAY 7

I. X-ray film
  A. X-ray film and effects on radiographic quality
    1. Construction of X-ray film
    2. Formation of a latent image
    3. Sensitometric properties
    4. H & D Curve
    5. Speed, contrast, latitude, and base fog

Lab Activities

I. Evaluate speed, contrast, average gradient, latitude of different films
II. Plot H & D curves
III. Utilize sensitometer and densitometer
IV. Evaluate the effect of high speed screens on different films

DAY 8

I. Film processing
  A. Processing cycle
    1. Time versus temperature
    2. Chemical replenishment

Lab Activities

I. Adjust temperature and replenishment rates of processor
II. Perform routine maintenance on processor

DAY 9

I. Introduction to imaging
  A. The eye and what it sees
    1. Visual acuity
    2. Intensity discrimination
    3. Rod and cone vision
  B. Image intensifiers
    1. Construction
    2. Operation
  C. Optics
  D. Television

Lab Activities

I. Identify the major components of an imaging system
II. Operation of imaging system
III. Routine adjustments of the television

DAY 10

I. System review
II. Final exam
III. Course evaluation

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Advanced Radiographic System Maintenance (Phase II)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Advanced Radiographic System Maintenance is a hands-on course designed for those charged with the duties of repairing radiological equipment but having limited knowledge of the radiographic systems. Through attendance in this course, the service professional will become self-confident in working on various types of radiographic systems. Upon completion of the course, the service professional will be able to identify and repair malfunctions of a radiographic system as well as perform preventive maintenance and compliance tests on the system.

Prerequisites

To attend this course, the service professional must have good fundamental knowledge of radiological physics and procedures as taught by our Principles of Servicing Diagnostic X-Ray Systems (Phase I) course.

Objectives

At the conclusion of this course, participants will be able to:

- Determine if the X-ray generator system meets the manufacturer's specifications
- Use proper test procedures to ensure optimum performance
- Isolate malfunctions to circuit level
- Perform complete preventive maintenance and system performance checks
- Perform complete CDRH compliance tests on the system

Course Outline

DAY 1

I. Introduction
  A. X-ray control block diagram
  B. Three phase generator circuit block diagram
  C. Single phase generator
  D. Terminology and symbology

Lab Activities

I. Knobology
II. Circuit identification and location
III. Test equipment operation and identification

DAY 2

I. Single- and three-phase H.V. secondary
  A. X-ray tube parameters
  B. Rectifier circuitry
    1. Full wave
    2. Half wave
  C. Constant potential
  D. Feedback circuitry
  E. Pulsed secondary
  F. Regulation circuitry
  G. H.V. divider circuitry
  H. Safety circuitry
  I. kV and mA overload protection devices

Lab Activities

I. H.V. calibration
II. Stick rectifier location and verification
III. Waveform analysis
IV. kV, mA overload verification and calibration
V. Midpoint overcurrent inspection and calibration
VI. H.V. secondary troubleshooting

DAY 3

I. kV control
  A. H.V. primary single phase
    1. kV metering
    2. Terminology and calibration
  B. H.V. primary three phase: 2 SCRs
    1. Auto transformer versus variac control
    2. Motor driven circuitry and feedback
    3. Static and regulation compensation
  C. Forced commutation
  D. H.V. primary three phase: 6 SCRs
    1. Bit selectors
    2. R.F. changeover
    3. Safety circuitry
  E. High Frequency kV Production

Lab Activities

I. kV primary identification and calibration
II. Waveform analysis
III. Motor driven circuitry maintenance and calibration
IV. Static and regulation calibration
V. kV primary troubleshooting

DAY 4

I. mA filament control
  A. Basic filament control
    1. Focal spot selection
    2. Modes of operation
    3. Preheat circuitry
    4. Space charge compensation
  B. Saturable reactor
    1. Filament feedback
    2. Real mA feedback
    3. Safety circuitry
  C. Chopper stabilization
    1. Max. filament limitations
    2. Filament overcurrent protection
  D. High frequency mA control

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Advanced Radiographic System Maintenance (Phase II) *continued*

Course Length: 2 weeks
CEUs Awarded: 8

Lab Activities

I. X-ray tube filament inspection
II. Waveform analysis
III. Type identification
IV. Preheat calibration
V. Max. filament limitation calibration
VI. Space charge calibration
VIII. Filament control troubleshooting

DAY 5

I. Time control
   A. Core memory
   B. Exposure start and stop
   C. Digital timers
   D. mAs Integration
   E. A.E.C.
   F. A.B.C.

Lab Activities

I. Timer identification and location
II. Waveform analysis
III. Timer calibration
IV. A.E.C. calibration
V. Timer troubleshooting

DAY 6

I. Control logic
   A. Tube protectors
      1. Allowable kW
      2. Programmed kW
      3. Auto rotor
   B. Rotor starters
   C. Relay control logic modes of operation
   D. Digital control logic
   E. Microprocessor control logic

Lab Activities

I. Identification and verification
II. Interfacing and signal tracing
III. Control logic troubleshooting

DAY 7

I. Ancillary equipment
   A. Tube stands
   B. Collimators
      1. Identification and modes of operation
      2. CDRH performance testing
      3. Bucky sensing
      4. Central ray
      5. Beam alignment
      6. Servo drive system

Lab Activities

I. Identification and verification
II. Servo drive locations and calibration
III. Mechanical and electrical alignment
   A. Light field versus radiation field
   B. Central ray
   C. S.I.D. shutter tracking calibration

DAY 8

I. Ancillary equipment
   A. Bucky table
   B. R.F. tables
      1. Two- and four-way table top
      2. Table tilt and safety
   C. Undertable tube alignment and shutter tracking
   D. Spot filmers
      1. Mechanical
      2. Electrical

Lab Activities

I. Tube alignment
II. Table calibration and verification
   A. Mechanical
   B. Electrical
III. Spot filmer alignment and verification
   A. Mechanical
   B. Electrical

DAY 9

I. System troubleshooting
   A. System diagrams
      1. Digital system
      2. Microprocessor system
   B. System documentation

Lab Activities

I. System troubleshooting
II. System verification
III. System documentation

DAY 10

I. System review
II. Final exam
III. Course evaluation

Advanced Fluoroscopic System Maintenance (Phase III)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Advanced Fluoroscopic System Maintenance is a formal hands-on course that provides a comprehensive approach to servicing fluoroscopic and vascular imaging systems. Emphasis is placed on system performance and image evaluation. Each sub-component of the imaging system is thoroughly analyzed, and methods of optimizing system performance are applied.

Participants perform complete system alignment and calibration while evaluating each sub-component for its specific modulation transfer function. Participants also have the opportunity to troubleshoot all phases of the imaging system chain.

Prerequisites

To attend this course, the service professional must have good fundamental knowledge of radiological physics and procedures as taught by our Principles of Servicing Diagnostic X-Ray Systems (Phase I) course, or two years equivalent experience.

Objectives

At the conclusion of this course, participants will be able to:

- Perform complete calibration on fluoroscopic imaging systems
- Evaluate overall performance of imaging system components
- Troubleshoot imaging problems on all components of the imaging chain
- Use proper test equipment to evaluate system performance
- Perform complete CDRH testing of the imaging system

Course Outline

DAY 1

I. Introduction
  A. Introduction to fluoroscopic imaging
  B. Contrast, resolution, and sharpness
  C. Subject matter contrast and resolution
II. The X-ray beam
  A. X-ray tube operation
  B. Quantity and quality
  C. Filtration
  D. Grids and scatter
  E. X-ray tube resolution
III. Radiation entrance and exit doses
  A. Max. "R"
  B. Half value layer
  C. Absorption characteristics
  D. Stabilized level

Lab Activities

I. Max. "R" calibration
II. Half value layer measurements
III. Central ray alignment
IV. Shutter alignment
V. Focal spot measurements
VI. Input radiation levels (I.I.)

DAY 2

I. Image intensifiers
  A. Image tube construction and operation
  B. Conversion factor
  C. Quantum detection efficiency
  D. Resolution, contrast, and sharpness
  E. Multiple mode image tubes
  F. Contrast ratio
II. Optical system
  A. Collimating lenses and infinity focus
  B. Focal length versus image size
  C. Beam splitters

Lab Activities

I. Low contrast resolution evaluation
II. High contrast resolution evaluation
III. Electronic I.I. focus with pie mesh
IV. Quantum sink evaluation (input radiation)

DAY 3

I. Brightness stabilization
  A. kV, mA, and secondary switching
  B. Light distributors and brightness pickup
  C. Center scanning and shutter tracking
  D. Photo tube alignment
  E. Stabilizer circuits

Lab Activities

I. Light distributor alignment
II. Photo tube alignment
III. Stabilized level adjustments
IV. Center scan evaluation

DAY 4

I. Video stabilization
  A. Composite video
  B. Video sampling
II. Photospot
  A. Circuit operation
  B. Density runs
  C. Focus runs

Lab Activities

I. Beam splitter alignment
II. Camera loading
III. Photospot density runs
IV. Input radiation adjustments

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ADVANCED FLUOROSCOPIC SYSTEM MAINTENANCE (PHASE III) *CONTINUED*

Course Length: 2 weeks
CEUs Awarded: 8

DAY 5

I. Cine radiology
   A. Circuit operation
   B. Focus and density runs

Lab Activities

I. Overall system calibration
II. Overall system troubleshooting

DAY 6

I. Introduction to television
   A. Principles of television
   B. Raster formation
   C. Composite video
II. Television system block diagram
   A. Television camera block diagram
   B. Monitor block diagram
III. Camera tube construction and operation
   A. Vidicon, lead oxide, saticon, newvicon
   B. Camera tube supplies

Lab Activities

I. System troubleshooting
   A. Isolating camera from monitor
   B. Evaluating the composite video signal
II. Camera tube alignment
   A. Beam current/alignment, target voltage
   B. Mechanical, electrostatic and electromagnetic focus

DAY 7

I. System timing circuit operation
   A. Master oscillator and counter operation
   B. Vertical and horizontal timing
   C. Line rate conversions
II. Vert and horiz blanking and sync generation
   A. Mixed sync
   B. Standard and circular blanking
   C. Front and back porch delays
III. Vertical and horizontal camera sweep generation
   A. Vertical sweep circuit operation
   B. Horizontal sweep circuit operation
   C. Sweep loss protection circuits

Lab Activities

I. Master oscillator and counter adjustments
   A. Line rate conversion
   B. Free run/line lock calibration
   C. Troubleshooting master timing circuits
II. Sync and blanking
   A. Circular blanking calibration
   B. Vertical and horizontal sync adjustments
III. Sweep size and positioning
   A. Aspect ratio
   B. Overscanning
   C. Sweep size and positioning

DAY 8

I. Video chain
   A. Camera signal and preamp
   B. Input video processing
   C. Output video processing
II. Preamplifier
   A. Circuit operation
   B. Signal to noise ratio
III. Input video
   A. Aperture and streaking correction
   B. Standard and circular video clamping
   C. Bandwidth selection
   D. Normal and automatic gain control
IV. Output video
   A. Standard and automatic pedestal insertion
   B. Gamma correction circuit operation
   C. Sync and blanking signal insertion

Lab Activities

I. Video chain alignment
II. Video chain troubleshooting

DAY 9

I. Monitor operation
   A. Video circuits
   B. Sync amp and separator
   C. Vertical and horizontal sweep circuits
II. Monitor alignment

Lab Activities

I. Complete camera and monitor calibration
II. Complete camera and monitor troubleshooting

DAY 10

I. System review
II. Final exam
III. Course evaluation

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ADVANCED DIAGNOSTIC IMAGING SYSTEM ANALYSIS (PHASE IV)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

This course is designed to provide the service professional with the skills and knowledge necessary to restore an X-ray imaging system to optimum performance after replacing the system glassware. This will include hands on installation and calibration of the X-ray tube, the image intensifier, the photo multiplier tube, the TV camera tube and CRT of the monitor. The course will conclude with a discussion of customer satisfaction skills.

Prerequisites

To attend this course, the service professional must have good fundamental knowledge and understanding of the principles gained through attendance at our Phase I, Phase II, and Phase III X-ray courses or equivalent field experience.

Objectives

At the conclusion of the course, participants will be able to:

- Use proper test procedures to determine the need for glassware replacement
- Select the proper glassware for application
- Perform proper de-installation procedures
- Perform proper pre-installation inspections
- Perform proper installation procedures
- Perform the calibration procedures necessary to restore the system to optimum performance
- Perform the necessary compliance tests
- Complete all necessary paperwork
- Apply the appropriate customer satisfaction skills for opening and closing the service call

Course Outline

DAY 1

I. Introduction
  A. X-ray tube fundamentals
    1. Construction
    2. Electrical and mechanical requirements
    3. X-ray tube failures
    4. Cables and terminations
  B. Isolating X-ray tube failures
    1. Evaluating system performance
    2. Evaluating the X-ray tube

Lab Activities

I. Knobology and system familiarization
II. Evaluate system performance
III. Evaluate X-ray tube performance

DAY 2

I. X-ray tube selection
  A. Resolution vs. focal spot size
  B. Target angle/area of coverage
  C. Instantaneous/cumulative ratings
  D. Stator/housing considerations
II. Preinstallation
  A. Visual inspection of system
  B. Visual inspection of replacement tube
  C. Tools and test equipment

Lab Activities

I. Preinstallation checks on system
II. Preinstallation checks on replacement tube
III. Documentation, tools, and test equipment
IV. Removal of the old X-ray tube

DAY 3

I. Installing the new X-ray tube
  A. Mounting the new tube
    1. Overhead installation
    2. Undertable installation
  B. Pre-hookup
    1. Cables, terminations, receptacles
    2. Filament limits
      a. Maximum/peak/rms
    3. Tube protector circuitry
  C. Hookup
    1. Electrical/mechanical considerations
      a. Wavy washers
    2. Verifying filament operation
    3. Verifying anode rotation/speed
  D. Rotor controllers
    1. European style
    2. American style
  E. X-ray tube seasoning
  F. Calibrating the X-ray generator
    1. kVp, mA, time
    2. AEC
    3. Fluoro considerations

Lab Activities

I. Mounting the replacement tube
II. Pre-hookup checks and calibrations
III. Replacement X-ray tube hookup
IV. Verify filament operation
V. Calibrate filament limits/standby/prelight levels
VI. Check anode rotation/speed; stator voltages
VII. Calibrate the tube protector
VIII. Season the tube
IX. Calibrate kV, mA and time circuits
X. Check AEC operation
XI. Fluoro calibrations

DAY 4

I. System performance tests
  A. Lead star radiograph (resolution)
  B. Beam quality (HVL)
  C. Beam alignment (central ray)
  D. X-ray field and image receptor center alignment
  E. Light field to X-ray field

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ADVANCED DIAGNOSTIC IMAGING SYSTEM ANALYSIS (PHASE IV) *CONTINUED*

Course Length: 2 weeks
CEUs Awarded: 8

II. Completing the installation
  A. Required forms
  B. Record keeping
  C. Closing the service call

Lab Activities

I. Beam quality (HLV)
II. Beam alignment (central ray)
III. X-ray field to image receptor center alignment
IV. Light field to X-ray field alignment
V. Focal spot resolution (lead star radiograph)
VI. Complete the paperwork

DAY 5

I. Image tube (I.I.) fundamentals
  A. Construction
  B. Conversion factor (G_X)
  C. Resolving capabilities
  1. High/low contrast resolution
  D. Contrast ratio
  E. Quantum detection efficiency

Lab Activities

I. Evaluate present I.I. performance
  A. Conversion factor measurement
  B. Resolution determination
  C. Contrast ratio measurement

DAY 6

I. Installing new I.I
  A. Old I.I. removal
  B. Mounting new I.I. in housing
  C. Electrical considerations
    2. High voltage power supply
      a. Check out
      b. Replacement

Lab Activities

I. I.I. Replacement
  A. Remove present I.I.
  B. Install new I.I.
  C. Mount housing on system
  D. Focusing

DAY 7

I. Imaging system evaluation
  A. Optics system
    1. Lens
    2. Image splitting/coupling
    3. Focusing
  B. Auto brightness stabilization systems
    1. Types of controls
      a. kV
      b. mA
      c. Pulse width
      d. Isowatt
    2. Feedback controls
      a. Video
      b. PMT
      c. Solid state
    3. Stabilized input dose
      a. Quantum sink/mottle

Lab Activities

I. Replacing the PMT
II. Align the PMT

DAY 8

I. Video systems
  A. TV camera
    1. Composite video
    2. Camera tubes construction/ selection
      a. Vidicon
      b. Plumbicon
      c. Hybrids
    3. Camera tube selection

Lab Activities

I. Evaluate present camera tube performance
  A. Resolution
  B. Saturation point
  C. Video levels
II. Removing camera tube
III. Installing new tube
IV. Video levels

DAY 9

I. Video systems
  A. Monitors
    1. CRT evaluation
      a. Resolving capabilities
      b. Saturation point
      c. Linearity
    2. CRT removal
    3. Installation
    4. Set-up

Lab Activities

I. Evaluate present CRT
II. Remove CRT
III. Install new CRT
IV. Align sweeps/linearity

DAY 10

I. Customer satisfaction skills
  A. Opening the service call
  B. On call communications
  C. Closing the service call
II. Course review
III. Final exam
IV. Course evaluation

SERVICING TODAY'S FILMLESS IMAGING DEPARTMENTS:

PACS INTEGRATION, NETWORKING & TCP/IP FUNDAMENTALS, DICOM COMPATIBILITY, DICOM TROUBLESHOOTING (PHASE V)

Course Length: 2 Weeks
CEUs Awarded: 8

Introduction

Our Updated Phase V is developed for graduates of Phase IV and seasoned service professionals, providing state-of-the-art technology necessary for servicing today's filmless diagnostic imaging departments.

Our industry is going filmless, and Imaging Service Professionals graduating from Phase V will gain knowledge of PACS integration, R.I.S. and H.I.S. technology, network strategies and DICOM compatibility.

Prerequisites

Fundamental knowledge of basic Windows operation. Completion of Phases I-IV is **not** a prerequisite.

Objectives

At the conclusion of this course, students will be able to:

- Understand the fundamentals of computer networks
- Build and understand computers and networks at the component level
- Understand the extensive terminology for PACS systems, CR, DR and digital spot systems
- Understand the TCP/IP protocol
- Design a network using TCP/IP
- Develop and monitor administrative networking functions
- Understand the DICOM standard and its importance to PACS systems
- Troubleshoot digital image related problems, including hardware, software, DICOM level packet troubleshooting
- Understand R.I.S., H.I.S. and HL7 integration and today's digital images

Course Outline

DAY 1

I. Introduction
II. Networking Basics
III. Topologies & Hardware
IV. OSI Model overview
V. Hospital Workflow Overview
VI. DICOM Overview
VII. HL7 Standard Overview
VIII. Hospital Imaging Network basics

DAY 2

I. Networking basics Quiz
II. Network Architecture
III. Network Security
IV. Authentication
V. Authorization
VI. Encryption
VII. Users & Groups
VIII. Profiles
IX. Policies

DAY 3

I. Protecting Your Data
II. Network Performance Monitoring
III. DOS review
IV. TCP/IP intro
V. Network Troubleshooting
VI. Subnetting
VII. FTP
VIII. Role of TCP/IP in PACS
IX. PACS Hardware

DAY 4

I. IP Addressing Basics
II. Invalid/Reserved Addresses
III. Invalid/Reserved Addresses
IV. Routing
V. Custom Subnetting
VI. Configuring TCP/IP
VII. TCP/IP Utilities
VIII. DHCP

DAY 5

I. UNIX
II. TCP Packet Sniffing
III. TCP Packet analysis
IV. DICOM Standard overview

Course materials

CD ROM distributed during class includes:

- FTP Client software
- Entire updated DICOM Standard
- DICOM Emulator
- DICOM TCP Packet Sniffer
- DICOM Transmission Analyzer

Students are recommended to bring a laptop if one is available to them

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RSTI
Radiological Service Training Institute

Servicing Today's Filmless Imaging Departments:
PACS Integration, Networking & TCP/IP Fundamentals, DICOM Compatibility, DICOM Troubleshooting (Phase V)

Course Length: 2 Weeks
CEUs Awarded: 8

DAY 6

I. DICOM Introduction
II. DICOM Vocabulary
III. Functions of DICOM
IV. DICOM Files
V. DICOM Storage
VI. DICOM Standard Breakdown
VII. DICOM Information Objects
VIII. DICOM Services
IX. DICOM Viewers

DAY 7

I. DICOM SOP Classes
II. UID's
III. SCU/SCP Devices Roles
IV. DICOM Transmission Sequence
V. DICOM Association
VI. DICOM Workflow
VII. Transfer Syntax/Presentation Context
VIII. Grayscale Standard Display Function
IX. Application Entities
X. Network Configuration
XI. DIMSE Commands
XII. Command Sets/Data Sets

DAY 8

I. DICOM Message Structure
II. DICOM Message Dumps
III. Configure DICOM Emulators
IV. Sending Images to PACS
V. Send images to be Printed
VI. Query PACS for images
VII. Query HIS/RIS for Patient Worklist
VIII. Reading/Comparing DICOM Conformance Statements

DAY 9

I. Test DICOM Connectivity
II. Troubleshooting image transfer related problems with laptop
III. Troubleshooting image printing related problems with laptop
IV. Troubleshooting worklist polling related problems with laptop

DAY 10

I. DICOM Troubleshooting Cont'd
II. Overall Review
III. Final Exam

Lab Activities

I. Identify components that make up the network
II. Design and build TCP/IP network
III. Design and administor custom subnets
IV. Configure TCP/IP address
VI. Read and compare DICOM Conformance Statements
VI. Use DICOM emulator to act as DICOM SCU/SCP Device
VII. Promiscuous Mode packet analysis
VIII. Send/Query/Print/Worklist related transmisions using DICOM Emulator
IX. Capture DICOM Message Dumps non-invasively
X. Analyze captured DICOM message dumps for troubleshooting

RSTI Introduces our Training Center's Newly Integrated PACS, Archive and Workstation

RSTI Radiological Service Training Institute

Students are recommended to bring a laptop if one is available to them

State of Ohio Registration. No: 93-09-1377T

RSTI Radiological Service Training Institute

SERVICING TODAY'S FILMLESS IMAGING DEPARTMENTS:
PACS INTEGRATION, NETWORKING FUNDAMENTALS, TCP/IP AND DICOM CONNECTIVITY (ONE WEEK PHASE V)

Objectives

At the conclusion of this course, students will be able to:

- Understand the fundamentals of network computers
- Understand the extensive terminology for PACS systems, CR, DR and digital spot systems
- Understand the TCP/IP protocol
- Design a network using TCP/IP
- Understand the DICOM standard and its importance to PACS systems
- Understand R.I.S., H.I.S. and H.L.7 integration and today's digital images

Course Outline

DAY 1

I. Introduction
II. Networking Basics
III. Topologies & Hardware
IV. Networking protocols
V. Hubs,Switches & Routers

DAY 2

I. Overview of TCP/IP
II. IP Addressing Basics
III. Subnetting
IV. Custom Subnetting
V. Invalid/Reserved Addresses
VI. Routing
VII. TCP/IP Utilities
VIII. Network Troubleshooting

DAY 3

I. Network Security
II. Network Performance Monitoring
III. Protecting Your Data
IV. DHCP
V. DNS/WINS
VI. Role of TCP/IP in PACS
VII. PACS System Network Layouts
VIII. PACS Hardware

DAY 4

I. DICOM Introduction
II. Understanding DICOM
III. Functions of DICOM
IV. DICOM Files
V. DICOM Storage
VI. DICOM Connectivity
VII. SCU/SCP Roles
VIII. SOP Classes

DAY 5

I. 7 Steps to DICOM Conformance
II. **Lab:** Reading and Understanding your DICOM Conformance Statements
III. **Lab:** Reading DICOM Headers
IV. **Lab:** Send DICOM Images
V. **Lab:** Emulate DICOM PACS
VI. **Lab:** Using DICOM Echo
VII. **Lab:** Setting up Modality Worklist
VIII. **Lab: DICOM Packet level Trouble-shooting (Invasive/Non-Invasive levels of troubleshooting)**

Lab Activities

- Identify components that make up the network
- Configure and troubleshoot TCP/IP
- Network laptops for image acquisition
- Install DICOM emulation software
- Receive and evaluate images from DICOM Modality (RSTI Site Labs only)
- Read DICOM Conformance Statements

Course materials

CD ROM distributed during class includes:

- FTP Client software
- Entire updated DICOM Standard
- DICOM Emulator
- DICOM TCP Packet Sniffer
- DICOM Transmission Analyzer

RSTI Introduces our Training Center's Newly Integrated PACS, Archive and Workstation

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RSTI
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FUNDAMENTALS OF NETWORKING

Course Length: 1 Week
CEUs Awarded: 4

Introduction

Fundamentals of Networking will provide you with the basic knowledge of how today's computers will function in a networked environment. This includes basic components of a computer, cabling and network architectures, OSI model and other standards, LAN and WAN technologies, understanding the basics of a heterogeneous network.

Objectives

At the conclusion of this course students will be able to:

- Define common networking terms for LANs and WANs
- Compare a file-and-print server with an application server
- Compare user-level security with access permission assigned to a shared directory on a server
- Compare a client/server network with a peer-to-peer network
- Compare the implications of using connection-oriented communications with connectionless communications
- Distinguish whether SLIP or PPP is used as the communications protocol for various situations
- Define the communication devices that communicate at each level of the OSI model
- Describe the characteristics and purpose of the media used in IEEE 80II.3 and IEEE 80II.5 standards
- Explain the purpose of NDIS and Novell ODI network standards

Lab Equipment

- Intel x86 based computers
- Microsoft Windows NT/98/2000/ME, MS-DOS, Linux, Novell, and Apple OS Operating Systems

Course Material

RSTI Training Manual, Lab Manual, Power Point Presentation CD

DAY I

Overview

I Introduction to networking
II. Two major types of networks
  A. Peer-to-peer
  B. Server based
III. Hardware considerations
IV. Network design (basic topologies)
  A. Bus
  B. Ring
  C. Star

Lab Activities

I. Hardware identification
  A. Components
  B. Slot identification

DAY 2

Connectivity

I. Network cabling
  A. Coax
    1. Thicknet
    2. Thinnet
  B. UTP/STP
    1. IBM cabling system
  C. Fiber optic
II. Signal transmission
III. Wireless network transmission
  A. Infrared
  B. Laser
  C. Narrow band radio
  D. Spread-spectrum radio
IV. NIC (Network interface cards)
  A. Bus types
  B. IRQ
  C. DMA
  D. I/O port
  E. Connections
  F Network architecture

Lab Activities

I. Building a computer

DAY 3

Network Interoperability

I. OSI and IEEE standards
  A. Layers
  B. Additions to the layers
II. Drivers
  A. ODI
  B. NDIS
III. Protocols
  A. TCP/IP
  B. NetBEUI
  C. IPX/SPX
  D. AppleTalk
IV. Access methods
V. Common network architectures
  A. Ethernet
    1. Xbase X
  B. Token ring
  C. AppleTalk and ArcNet

Lab Activities

I. Operating systems setup
  A. Windows NT
  B. Linux
  C. Novell Netware

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RSTI
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FUNDAMENTALS OF NETWORKING *CONTINUED*

Course Length: 1 Week
CEUs Awarded: 4

DAY 4

Network Operating Systems

I. Network OS Setup
  A. NIC Setup
II. File Sharing
III. Printer Sharing
  A. Redirectors
IV. Shared Applications
  A. Centralized
  B. Client/Server
V. Security
  A. Local vs. Network
  B. Peer to Peer vs. Centralized
  C. Access Permissions
  D. Access Rights
  E. FAT vs. NTFS / Others

Lab Activities

I. Network Setup
  A. Protocol Selection
  B. Redirector Selection
  C. Services / Clients
II. Security Setup
  A. Permissions
  B. Rights
  C. Auditing

DAY 5

Advanced Networking Concepts

I. Network Administration And Support
  A. Managing Network Accounts
  B. Managing Network Performance
  C. Avoiding Data Loss
    1. Backup
    2. RAID Systems
  D. Avoiding Computer Virus Infections
II. Larger Networks
  A. Creating Large Networks
    1. Repeaters / Hubs
    2. Bridges
    3. Routers
    4. Gateways
  B. Wide Area Network Transmission
    1. Analog Connectivity
      a. Dial-up Lines
      b. Dedicated Lines
      c. Line Conditioning
    2. Digital Connectivity
      a. TI and T3
      b. Multiplexing
    3. Packet Switching
      a. Switched 56K lines
III. Advanced WAN Technologies
  A. X.II5
  B. Frame Relay
  C. ATM
  D. ISDN
  E. FDDI
  F. SONET
  G. SMDS
  H. DSL
  I. Cable Modems
IV. Network Troubleshooting
  A. Steps
  B. Tools

DAY 5

Conclusion

I. Final Exam
II. Overall Review
III. Questions and Answers

Hands-On Training Course

INTRODUCTION TO DIGITAL IMAGING AND COMMUNICATION IN MEDICINE

Course Length: 3 Days
CEUs Awarded: 2

INTRODUCTION TO DICOM AND ITS ROLE IN FILMLESS IMAGING

Introduction

Our DICOM Introduction is developed for engineers new to the field as well as seasoned service professionals providing state-of-the-art technology necessary for servicing today's filmless diagnostic imaging departments.

Our industry is going filmless, and Imaging Service Professionals are being forced to gain the knowledge of DICOM that this class provides. H.I.S., R.I.S., Broker, Jukebox, and PACS are among the technology discussed throughout. Knowledge of DICOM is no longer a bonus but a necessity with the growth of filmless modalities industrywide. This class is a must for managers, service engineers and materials management personnel.

Prerequisites

Fundamental knowledge of networking and basic TCP/IP principles

Objectives

At the conclusion of this course, students will be able to:

- Understand what DICOM functions are necessary in PACS implementation.
- Communicate with outside sources such as DICOM vendors and technical support personnel.
- Determine the level of DICOM Connectivity between any 2 modalities.
- Recognize key components of a Conformance Statement and determine where problem areas might occur for future DICOM implementation.
- Identify what DICOM components your facility requires for sending out bid specifications.

Course Outline

DAY 1

- DICOM Introduction
- History of DICOM
- DICOM Standard Overview
- Role of TCP/IP in DICOM
- TCP/IP Utilities
- TCP/IP Troubleshooting
- Understanding DICOM
- Communication Requirements
- DICOM Terminology
- Functions of DICOM

DAY 2

- Modality Association
- DICOM Files
- DICOM Storage
- PACS Hardware
- PACS System Network Layouts
- DICOM Service Classes
- SCU/SCP Roles
- SOP Classes
- Transfer Syntax
- Connectivity

DAY 3

- 7 Steps to DICOM Conformance
- Reading and Understanding DICOM Conformance Statements.
- DICOM Test Tools
- Emulation Software
- DICOM Validation
- DICOM Test Tools
- DICOM Simulation
- Overall Review

Lab Activities

- Identify components that make up the network
- Configure and troubleshoot TCP/IP
- Network laptops for image aquisition
- Install DICOM emulation software
- Receive and evaluate images from DICOM Modality (RSTI Site Labs only)
- Read DICOM Conformace Statements

Note: Students will receive DICOM emulation software (Full Unrestricted Version) and a free DICOM Viewer to be used in lab activities as well as in the field.

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RSTI
Radiological Service Training Institute

X-Ray Family Courses

Designed for **experienced** diagnostic imaging professionals. All equipment is installed at the RSTI training center and is dedicated to training activities. This ensures maximum hands-on opportunities without interruptions.

The RSTI learning environment is tailored to the student's needs. Classrooms and labs are together in one section of our learning center. There is no need to be transported to an off-site facility (hospital or freestanding clinic) to accomplish hands-on training. Lab instructors are always available.

SERVICING THE GENERAL ELECTRIC MPX/SPX AND MVP

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

The G.E. MPX/SPX, MVP X-ray Controls course is a skills development course designed to provide the experienced service professional with the skills necessary to fully service and calibrate the X-ray controls of the MPX/SPX, and the MVP generators.

Prerequisites

To attend this course, the service professional must have a good understanding of the principles gained through attending Phase II or four years equivalent experience. The service professional must also possess a good working knowledge of microprocessors and their associated support components.

Objectives

At the conclusion of this course, the participants will be able to :

- Perform complete calibration of the G.E. MPX/SPX, and MVP X-ray controls
- Load and alter any associated software (When applicable)
- Load and alter anatomical programs
- Evaluate system performance
- Troubleshoot the majority of the systems to component level
- Perform CDRH testing of the generator systems

SPECIAL NOTE:

Classroom sessions will cover all systems simultaneously. Laboratory exercises will be conducted in a “round-robin” fashion to give exposure to all systems.

Course Outline

DAY 1 (Classroom)

I. Introduction
   A. Basic Operation
      1. Knobology
      2. Symbology
      3. Terminology
   B. Specifications
II. X-ray control block diagrams
   A. MPX/SPX
   B. MVP
   C. Advantx
III. Physical layouts
IV. Using G.E. documentation
   A. Manual layout
   B. Signal tracing
   C. Getting from unit to unit

DAY 2 (Lab)

I. Systems operation
II. Physical layout
   A. System identification
   B. Component location
      1. Physical location
      2. Schematic location
      3. Signal tracing
III. CPU access
   A. Hexadecimal entry
   B. CD4 entry
   C. Software entry

DAY 3 (Classroom)

I. On-Off circuits
II. Power-up sequences
III. kV control
   A. Voltpac control
      1. DC drive
      2. Pulse width modulation
   B. Primary contacting
      1. Force commutation
   C. Pre-contacting
      1. Relay controlled
      2. Software controlled
   D. High tension secondary
IV. Feedback circuitry
V. Safety circuits

DAY 4 (Lab)

I. kV Calibration
   A. Load/slope
   B. Servo boost
   C. Pre-contacting
   D. Damping
   E. Internal kV meter
II. Waveform analysis
III. Troubleshooting

DAY 5 (Classroom)

I. mA/filament stabilization
   A. Saturable reactor
      1. Current regulation
   B. Pulse width modulation
      1. Drive signals
      2. Chopper circuits
   C. Filament feedback
   D. Real mA feedback
   E. Filament correction
   F. CPU update

DAY 6 (Lab)

I. mA Calibration
   A. Baseline
   B. Space charge
   C. Feedback
   D. Overdemand
   E. Auto/manual
   F. Max. filament current
II. Waveform analysis
III. Troubleshooting

DAY 7 (Classroom)

I. Timer
   A. Timing sequences
      1. Prep release
      2. Exposure release
      3. Time stop
   B. High voltage detection
II. Tube limits
III. Control logic
IV. Control console

DAY 8 (Lab)

I. Timer calibration
   A. Tailing compensation
   B. Anticipation time
   C. AEC
      1. Pick-up sensitivity
      2. Balance
      3. Screen compensation
   D. Tube limits
II. Waveform analysis
III. Troubleshooting

DAY 9 (Classroom/Lab)

Classroom

I. Anatomical programming
II. Rotor controls
   A. SARC
   B. TIRC
   C. Initial turn-on
   D. Start to run
   E. Brake
   F. Inverter drives

Lab

I. Anatomical programming customization
II. Rotor waveforms
III. Troubleshooting

DAY 10 (Classroom)

I. Systems Review
II. Final Exam
III. Course Evaluation

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RSTI
Radiological Service Training Institute

Servicing the Philips Family of Generators: CP/Super CP 50/100, Classic 850/1050, Medio, Maximus

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

The Philips OEM Family course includes detailed theory of operation, installation and calibration of Philips generators. Systems covered in this course include Philips Medio 50, Super CP, and Classic generators.

Prerequisites

To attend this course, students must have completed Phase IV or have equivalent experience through on-the-job training. The service professional must also possess a good working knowledge of computer concepts, addressing, and associated support circuits.

Objectives

- Describe circuit operation of Philips generator systems
- Perform complete calibration of Philips generators
- Troubleshoot Philips systems

Course Outline

DAY 1

I. Overview of Philips systems
  A. Reading Philips documentation
  B. Philips nomenclature
  C. Reading German documentation

DAY 2

I. Philips Classic generator
  A. System block diagram
  B. Turn on and safety
  C. kV circuits

Lab Activities

I. Waveform analysis
II. Calibration

DAY 3

I. Philips Classic generator (continued)
  A. mA circuits
  B. Timer/phototimer
  C. Generator logic

Lab Activities

I. mA circuit lab
II. Phototimer lab

DAY 4

I. Philips Medio 50
  A. System description
  B. kV/mA circuits

Lab Activities

I. kV calibration
II. mA calibration

DAY 5

I. Medio 50 system (continued)
  A. Timer/logic
  B. Phototimer

Lab Activities

I. System calibration
II. Troubleshooting

DAY 6

I. Philips CP generators
  A. CP System overview
    1. Block diagrams
    2. Software/firmware
  B. Hardware programming
    1. Tube selection
    2. Image receptor selection
    3. AEC options
  C. Switch settings
  D. System communications

Lab Activities

I. Component identification
II. Signal tracing
III. Software/firmware verification
IV. Hardware programming
  A. Verification
  B. Manipulation
V. Translating CPU bus error codes

DAY 7

I. Philips CP generators (continued)
  A. System logic
  B. software operation
  C. diagnostics
II. kV circuit operation

Lab Activities

I. Software checkout
II. kV calibration
III. Waveform analysis
IV. HV circuit troubleshooting

DAY 8

I. mA circuit operation
  A. Tube adaptation
  B. filament calibration requirements
II. Phototiming
  A. AEC/RAD
  B. AEC/photospot and cine
  C. AEC/digital captures
  D. Brightness stabilization

Lab Activities

I. mA calibration
II. Filament drive calibration
  A. Standby level
  B. Boost
  C. Dose rate controls
III. Waveform analysis
IV. Filament control troubleshooting

DAY 9

I. Rotor controls
  A. YA group
  B. YC extension
  C. YD extension
  D. YG continuous high speed

Lab Activities

I. Rotor control setup
II. Waveform analysis
III. Rotor control troubleshooting
IV. X-ray tube change requirements
  A. Tube prom selections
  B. Rotor connections
  C. Oil cooler
V. Oil cooler maintenance

DAY 10

I. Course Review
II. Final Exam

Advanced Specialty Products Systems Maintenance

Fast-paced, generator-only courses designed for the experienced service professional. Detailed course outlines not included in this catalog are available upon request.

Product specific training is available on the following systems:

General Electric

G.E. AMX IV Portable X-Ray Controls System Maintenance

G.E. Advantx

G.E. AMX IV

Philips

Philips Maximus Classic X-Ray Control System Maintenance

Philips MCRT/Classic X-Ray Controls System Maintenance

Philips Modular SM/MM 80/85/100/150 X-Ray Controls System Maintenance

Philips Optimus M200 X-Ray Controls System Maintenance

Picker

Picker Beta Camera/UFRC

Picker GX850/1050 Generator Maintenance

Picker Vector 80/100 X-Ray Control System Maintenance

Picker Vector Imaging System Maintenance

Siemens

Siemens Polydoros 50S/80S X-Ray Control System Maintenance

Siemens Tridoros 712/Gigantos 1012/Polyphos X-Ray Controls

Other

CCD Camera Maintenance

RSTI's training expertise extends through a complete range of specific products from the leading manufacturers of diagnostic imaging equipment. These and other product-specific courses are offered on a demand basis, and can be presented "closed door" at your facility. Detailed course outlines and pricing may be obtained by contacting us at

(800) 229-RSTI.

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Hands-On Training Course

GENERAL ELECTRIC AMX 4

Course Length: 1 Week
CEUs Awarded: 4

Introduction

Portable X-ray units are found in most radiological/diagnostic imaging departments. They are typically exposed to a higher abuse level due to elevator openings, tight room entrances, limited patient access, and lack of space for maneuverability. This constant abuse will cause premature mechanical failure if not properly identified and corrected early. The trained service professional will be taught the skills necessary for mechanical, electromechanical, and electronic maintenance of the AMX 4. Each sub-system of the mechanical unit and the generator is thoroughly analyzed.

Prerequisites

To attend this course, the service professional must have a good understanding of the principles gained through attending Phase II, or four years equivalent experience. The service professional must also possess a good mechanical aptitude.

Objectives

At the conclusion of this course participants will be able to:

- Evaluate overall system performance
- Troubleshoot mechanical and electronic problems on all components of the unit
- Perform a complete and thorough preventive maintenance inspection on each portable unit
- Follow circuit operations of system detail block diagrams

Course Outline

DAY 1

I. Introduction
   A. Basic operations
      1. Knobology
      2. Terminology
   B. Specifications
II. Basic system/unit differences
   A. Mechanical
   B. Electronic
   C. Documentation
III. AMX 4 block diagram

Lab Activities

I. Basic operation
II. Circuit identification and location

DAY 2

I. Charging circuit
II. 60Hz DC-AC inverter
   A. Tube stator
   B. Forced commutation circuits
   C. Filament control circuits
   D. Collimator lamp circuits

Lab Activities

I. Charger calibration
II. Filament calibration

DAY 3

I. 500Hz DC-AC inverter
   A. Inverter driver circuits
   B. Inverter circuits
II. Logic circuit
   A. Safety circuits
   B. Exposure start/stop circuits

Lab Activities

I. kV calibration
II. Timer calibration
III. Timer waveform analysis

DAY 4

I. Drive circuits
   A. Speed control
   B. Braking system
II. AMX 4 block diagram
   A. Filament control circuits
   B. kV control circuits
   C. Charger control circuits

Lab Activities

I. Drive control circuits
II. Major component disassembly
   A. Tube replacement
   B. Extension column
   C. Vertical column
   D. High voltage transformer

DAY 5

I. System troubleshooting
   A. Mechanical
   B. Electronic
II. Overall system review
III. Final exam
IV. Course evaluation

State of Ohio Registration. No: 93-09-1377T

RSTI
Radiological Service Training Institute

SERVICING THE GE ADVANTX R/F SYSTEM

Course Length: 2 Weeks
CEUs Awarded: 8

Introduction

The GE Advantx RF Systems course is a skills development course designed to provide the experienced service professional with the skills necessary to fully service and calibrate this control.

Prerequisites

To attend this course, the service professional must have a good understanding of the principles gained through attending Phase II and Phase III or four years equivalent experience in servicing RF equipment. The service professional must also possess a good working knowledge of microprocessors and their associated support chips.

Objectives

At the conclusion of this course, participants will be able to:

- Perform complete calibration of the GE Advantx X-ray control, image chain, and peripheral equipment
- Evaluate system performance
- Troubleshoot the majority of the system to component level
- Perform CDRH testing on the GE Advantx system

Course Outline

DAY 1

I. Introduction
  A. Basic operation
    1. Knobology
    2. Software controls
    3. Operation
II. Using GE documentation
  A. Manual layout
  B. Signal tracing
  C. Getting from unit to unit
III. Block diagram
  A. Modular structure
  B. System architecture

Lab Activities

I. System operation
II. Physical layout
III. Component location
IV. Software loading
  A. Restore
  B. Back-up
V. Service mode

DAY 2

I. On-off circuits
II. Power-up sequence
III. kV control
  A. kV control block diagram
    1. Voltpac drive
    2. Feedback circuitry
    3. Limit circuitry
    4. Compensation circuitry
  B. Calibration
IV. Primary contacting
  A. Force commutation
  B. Pre-contacting control
V. HT transformer

Lab Activities

I. kV calibration
  A. Load/slope
  B. Servo boost
  C. Pre-contacting
  D. Damping
  E. Internal kV metering
II. Waveform analysis

DAY 3

I. Filament control
  A. Drive signals
  B. Oscillator circuit
  C. Chopper circuit
  D. Metering
II. Real mA feedback
  A. Mid-secondary circuitry
  B. mA stabilization
    1. Filament drive correction
    2. CPU update

Lab Activities

I. mA calibration
  A. Baseline
  B. Space charge
  C. Feedback
  D. Overdemand
  E. Auto/manual
  F. Waveform analysis

DAY 4

I. Timer
  A. Timing sequence
  B. HV on detection
II. Exposure Logic
  A. Prep cycle
  B. Exposure release logic requirements
  C. Exposure stop
III. Rotor controller
  A. Power control
    1. Initial turn on
    2. Start to run
    3. Brake
  B. Inverter drive
    1. Frequency
    2. Modulation
  C. Microprocessor
    1. Communication
    2. Error LEDs

continued

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RSTI
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SERVICING THE GE ADVANTX R/F SYSTEM *CONTINUED*

Course Length: 2 Weeks
CEUs Awarded: 8

Lab Activities

I. Timer calibration
  A. Tailing compensation
  B. Anticipation time
II. Rotor controller
  A. Waveform analysis
  B. Calibration

Day 5

I. MPPU X-Ray control
  A. High frequency concepts
  B. DC supply
  C. Double "H" bridge
  D. Test points
  E. Monitoring circuits

Lab Activities

I. X-ray control troubleshooting
II. Week 1 lab review

DAY 6

I. Automatic exposure control
  A. Ion chamber select
  B. Master density
  C. Screen compensation
  D. Photo cell calibration
II. Fluoroscopic control
  A. Standard fluoro
  B. Digital fluoro
III. Photospot control
IV. Cine control

Lab Activities

I. AEC calibration
  A. Master density
  B. Screen speed
  C. Fine density tweak
  D. Anticipator calibration
II. Photo cell calibration
III. Waveform analysis

DAY 7

I. VIC module part 1
  A. Power supply module
  B. II control
    1. Grid drives
    2. Drive feedback
    3. Anti "S"ing control
  4. Photo cathode current
  C. High voltage supply
  D. Image gate
  E.. Neutral density filter

Lab Activities

I. Beam evaluation
II. Electronic II focus
III. Mechanical focus
IV. Image tube evaluation
  A. Contrast ratio
  B. Resolution

DAY 8

I. VIC module part II
  A. Camera head
    1. Camera controls
    2. Camera tube voltages
      a. Grid drives
      b. Grid voltage feedback
  B. Iris control
  C. TV rotator
  D. Video processor

Lab Activities

I. Calibration
  A. Camera
    1. Electronic focus
    2. Mechanical focus
    3. Target voltage
    4. Pre-amp
  B. Iris
  C. Video processor
    1. Peak video
    2. Extended dynamic range
II. Waveform analysis

DAY 9

I. Control console
  A. Plasma screen
  B. Power supplies
  C. Console μP
II. Spot filmer 8835
  A. Interface
  B. Control
III. Collimator
  A. Interface
  B. Control
IV. System variations
  A. Positioner
    1. Rad
    2. Rad/fluoro
    3. Vascular
  B. Collimators
  C. "C" Arms
  D. Tables

Lab Activities

I. Spotfilmer calibration
II. Collimator calibration
III. System Wide troubleshooting

DAY 10

I. System review
II. Final exam
III. Course evaluation

ACR Accreditation and Servicing the Lorad MIV Platinum™

Course Length: 2 Weeks
CEUs Awarded: 8

Introduction

Mammography may be the most dynamic of all of today's imaging modalities. With the new regulatory and accreditation procedures, and advancements in technology, the service professional is becoming more involved in maintaining the quality of the mammographic images produced. This course is designed to give the service professional the insight to evaluate image quality problems, determine if the mammographic unit is the source of the image problem and take the appropriate steps to correct the deficiency. Given today's regulatory environment, maintaining the system at peak performance is of the utmost importance.

Objectives

- Describe the current mammographic imaging regulatory environment
- Describe the factors that affect mammographic image quality
- Describe how those factors are optimized to produce the highest quality mammographic images
- Describe the basic components of the LORAD MIV™ Platinum mammographic units
- Describe the function of the basic components of the LORAD MIV Platinum™ mammographic unit
- Demonstrate an understanding of the accreditation process
- Demonstrate an understanding of the Mammographic Quality Standards Act
- Demonstrate an understanding of the installation procedures associated with the MIV Platinum™
- Perform the necessary mammographic performance monitoring and quality assurance procedures utilizing the LORAD MIV Platinum™
- Perform the necessary tests to reproduce the results of the physicist's report to confirm corrective action
- Perform all system calibrations and adjustments to maintain the highest quality images and compliance with MQSA requirements
- Evaluate circuit functions to facilitate troubleshooting

Prerequisites

To attend this course, the service professional must possess fundamental knowledge and understanding of the principles of X-ray and basic electronics.

Course Outline

DAY 1

I. Mammography process overview
II. Basic terminology
III. Positioning and technique
IV. Screening vs clinical

Lab Activities

I. Dark room conditions
II. Sensitometric properties
III. Photographic density
IV. Characteristic curves
V. Screen considerations
VI. Processing

DAY 2

I. Factors affecting image quality
II. ACR Mammography Accreditation Program
III. Quality assurance in mammography

Lab Activities

I. Collimation
II. Compression devices
III. Bucky/grid devices
IV. AEC tracking
V. Focal spot geometry
VI. Phantom images

DAY 3

I. Troubleshooting image quality problems
II. Mammography quality control, beyond the basic
III. 1999 Mammography Quality Standards Act (MQSA)

Lab Activities

I. kVp
II. HVL
III. Linearity
IV. Reproducibility
V. Glandular dose
VI. Radiation safety

DAY 4

I. Introduction to the LORAD MIV Platinum™ system
II. System specifications
III. Site planning and installation
IV. Operation
V. System controls
VI. Physical layout
VII. Using LORAD documentation

Lab Activities

I. Component location
  A. Schematic location
  B. Physical location
  C. Connector locations
  D. Fuse location/identification
II. Cover removal procedures
III. Locating ID/Compliance labels
IV. Parts identification

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RSTI
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ACR Accreditation and Servicing the Lorad MIV Platinum ™ continued

Course Length: 2 Weeks
CEUs Awarded: 8

DAY 5

I. Turn-on circuits
II. Power distribution
  A. AC supplies/distribution
  B. DC supplies/distributionI.
III. System block diagrams

Lab Activities

I. Input AC voltage adaptation
II. Power supply verification
  A. AC supplies
  B. DC supplies

DAY 6

I. kV control
  A. Manual kV
  B. Auto kV
II. HV secondary
  A. Feedback circuits
  B. Safety circuits
  C. Overload detect
III. mA control
  A. @Manual kV
  B. @Auto kV
IV. Filament drive circuits
  A. Filament control
  B. Filament protect
  C. Grid bias

Lab Activities

I. kV measurement
  A. Invasive
  B. Non-invasive
II. Safety/Overload circuits
III. Waveform analysis
IV. kV Calibration
  A. Manual kV
  B. Auto kV
V. mA/mAS measurement
VI. Filament drive waveform analysis
VII. mA waveform analysis
VIII. mA calibration
  A. @Manual kV
  B. @Auto kV
  C. Grid bias calibration

DAY 7

I. Rotor control
  A. Inverter drive
  B. Rotor status checks
II. Exposure control
  A. Manual
  B. AEC
    1. AEC detect
    2. Auto time
    3. Auto kV
    4. Auto filter
III. Patient data system
IV. Monitor

Lab Activities

I. AEC calibrations
  A. Optical density
  B. Thickness compensation
  C. HTC™ compensation
  D. grid compensation
  E. kV tracking
II. Rotor control programming
III. Rotor verification
IV. Rotor waveform analysis

DAY 8

I. Electromechanical systems
  A. Tube support area
  B. Gantry drive area
  C. Film support area

Lab Activities

I. Auto-filter threshold
II. Compression force calibration
III. Filter calibration
IV. Rotation zero calibration
V. Rotation velocity calibration
VI. Vertical velocity calibration
VII. Stereoloc rotation velocity calibration
VIII. HTC™ thickness threshold

DAY 9

I. Stereoloc
  A. Motor drive
  B. Camera interface
  C. Angle drive
  D. System interface
  E. Feedback
II. Accessory interfacing
III. Tube replacement
IV. Mechanical adjustments

Lab Activities

I. Accessory interface verification
II. Tube type programming
III. Collimator calibration
IV. Mirror calibration
V. System troubleshooting

DAY 10

I. Course review
II. Course evaluation
III. Final exam

Course Length: 2 Weeks
CEUs Awarded: 8

ACR Accreditation and Servicing the Lorad MIV Platinum™, GE DMR,& Siemens Mammomat 3000

Introduction

Mammography may be the most dynamic of all of today's imaging modalities. With the strict regulatory enviroment, accreditation procedures, and advancements in technology, the service professional is becoming more involved in maintaining multiple vendor's mammographic systems. This course is going to cover the Laws, Regulations, Calibration, Service, Troubleshooting & QA of multiple vendor's mammographic equipment. Given today's regulatory environment, maintaining the system at peak performance is of the utmost importance. Please check the schedule for equipment used.

Objectives

Upon completion of this course the student will be able to:

- Describe the current mammographic imaging regulatory environment
- Describe the factors that affect mammographic image quality
- Demonstrate an understanding of the accreditation process
- Describe how those factors are optimized to produce the highest quality mammographic images
- Describe the basic components of various manufactures mammographic units and their functions
- Demonstrate an understanding of the Mammographic Quality Standards Act

Given various manufacturer's systems be able to:

- Demonstrate an understanding of calibration procedures associated with various mammo equipment
- Perform the necessary tests to reproduce the results of the physicist's report to confirm corrective action
- Perform all system calibrations and adjustments to maintain the highest quality images and compliance with MQSA requirements
- Evaluate circuit functions to facilitate troubleshooting

Prerequisites

To attend this course, the service professional must possess fundamental knowledge and understanding of the principles of X-ray and basic electronics.

Course Outline

DAY 1

I. Mammography process overview
II. Basic terminology
III. Positioning and technique
IV. Screening vs clinical

Lab Activities

I. Dark room conditions
II. Sensitometric properties
III. Photographic density
IV. Characteristic curves
V. Screen considerations
VI. Processing

DAY 2

I. Factors affecting image quality
II. ACR Mammography Accreditation Program
III. Quality assurance in mammography

Lab Activities

I. Collimation
II. Compression devices
III. Bucky/grid devices
IV. AEC tracking
V. Focal spot geometry
VI. Phantom images

DAY 3

I. Troubleshooting image quality problems
II. Mammography quality control, beyond the basic
III. 1999 Mammography Quality Standards Act (MQSA)

Lab Activities

I. kVp
II. HVL
III. Linearity
IV. Reproducibility
V. Glandular dose
VI. Radiation safety

DAY 4

I. Introduction to systems
II. System specifications
III. Operation
IV. System controls
V. Physical layout
VI. Using documentation
VII. Using software

Lab Activities

I. Component location
 A. Schematic location
 B. Physical location
 C. Connector locations
 D. Fuse location/identification
II. Cover removal procedures
III. Locating ID/Compliance labels
IV. Parts identification

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Course Length: 2 Weeks
CEUs Awarded: 8

ACR ACCREDITATION AND SERVICING THE LORAD MIV PLATINUM ™ ,GE DMR, & SIEMENS MAMMOMAT 3000 CONTINUED

DAY 5

I. Turn-on circuits
II. Power distribution
III. System block diagrams

Lab Activities

I. Input AC voltage adaptation
II. Power supply verification
   A. AC supplies
   B. DC supplies

DAY 6

I. kV control
   A. Manual kV
   B. Auto kV
II. HV secondary
   A. Feedback circuits
   B. Safety circuits
   C. Overload detect
III. mA control
   A. @Manual kV
   B. @Auto kV
IV. Filament drive circuits
   A. Filament control
   B. Filament protect
   C. Grid bias

Lab Activities

I. kV measurement
   A. Invasive
   B. Non-invasive
II. Safety/Overload circuits
III. Waveform analysis
IV. kV Calibration
V. mA/mAS measurement
VI. Filament drive waveform analysis
VII. mA waveform analysis
VIII. mA/tube heater calibration
   A. @Manual kV
   B. @Auto kV
   C. Grid bias calibration

DAY 7

I. Rotor control
   A. Inverter drive
   B. Rotor status checks
II. Exposure control
   A. Manual
   B. AEC
III. Patient data system
IV. Monitor

Lab Activities

I. AEC calibrations
   A. Optical density
   B. Thickness compensation
   C. HTC™ compensation
   D. grid compensation
   E. kV tracking
   F. Photocell
II. Rotor control
III. Rotor verification
IV. Rotor waveform analysis

DAY 8

I. Electromechanical systems
   A. Tube support area
   B. Gantry drive area
   C. Film support area

Lab Activities

I. Thickness calibration
II. Compression force calibration
III. Filter calibration
IV. Rotation zero calibration
V. Grid Calibration
VI. Collimator Calibration
VII. Stereoloc rotation velocity calibration
VIII. HTC™ thickness threshold

DAY 9

II. Accessory interfacing
III. Tube replacement
IV. Mechanical adjustments

Lab Activities

I. Accessory interface verification
II. Tube type programming
III. Collimator calibration
IV. Mirror calibration
V. System troubleshooting

DAY 10

I. Course review
II. Course evaluation
III. Final exam

SERVICING THE LORAD MULTICARE PLATINUM™ TABLE

Course Length: 1 Week
CEUs Awarded: 4

Introduction

Upon locating suspicious tissues during a mammographic study, it may become necessary to conduct exploratory studies for further diagnosis. In an effort to minimize trauma to the breast, minimally invasive techniques have been developed. Small and large core biopsy can provide samples of suspect tissues. To ensure proper diagnosis, needle placement must be precise. Proper alignment of the imaging system's geometric properties and the needle guidance system is of the highest importance. This course is designed to give the service professional the required information and the hands-on skills needed to make necessary alignments, diagnose service issues and make required repairs. Given the importance of this mammographic modality and the delicate nature of the procedure, the highest calibration standards must be maintained.

Objectives

- Describe the performance specifications of the Multicare table
- Describe the performance specifications of the needle guidance section
- Describe the performance specifications of the stereoguide system
- Describe the performance specifications of the digital imaging system
- Demonstrate an understanding of the various subsystems of the biopsy system
- Perform the necessary performance monitoring and quality assurance tests and performance
- Perform the necessary calibrations and adjustments to maintain the highest degree of accuracy for the biopsy system
- Evaluate circuit and system functions to facilitate troubleshooting

Prerequisites

To attend this course, the service professional must possess fundamental knowledge and understanding of the principles of X-ray, Mammography and basic electronics.

Course Outline

DAY 1

I. System Introduction
II. Specifications
  A. Table
  B. Stereo Guide
  C. Needle guidance
  D. Digital Imaging System
III. Knobology
IV. Physical layout
V. Using system documentation
VI. System instalation
VII. Turn-on and power distibution

Lab Activities

I. System operation
II. Cover removal
III. Component identification
IV. System installation
IV. Power supply verifications

DAY 2

I. X-ray production system
  A. Data port
  B. kV control
  C. mA control
  D. Rotor control

Lab Activities

I. Verify and calibrate kV
II. Verify and calibrate mA
III. Rotor control verification
IV. X-ray tube replacement procedure

DAY 3

I. Table controls
  A. Table motion
  B. C-arm motion
  C. Compression motion and force
  D. Drive belt adjustments
II. Lamp control
III. Stage Controls
  A. X/Y/Z axis control interface
  B. X/Y motor drive
IV. Needle alignment

Lab Activities

I. Table travel limits calibration
II. Stage adjustment
  A. Left/Right/Up/Down/Height
  B. Z-azimuth
  C. Breast platform
  D. Needle gum holders
III. X-ray feild adjustments
IV. Final needle guidance alignment and checks
  A. Pivot pont
  B. Compression trays

DAY 4

I. DSM system
  A. CCD module
  B. X486/NT/Pentium computers
II. Digital imaging theory

Lab Activities

I. Creating White/Black calibration maps
II. Aligning CCD module to X-ray tube
III. Calculaing Coordinates
IV. Final alignment checks
V. System troubleshootng

DAY 5

I. Course review
II. Course evaluation
III. Final exam

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SERVICING THE LORAD AFFINITY™ MAMMOGRAPHIC SYSTEM

Course Length: 5 days
CEUs Awarded: 3

Introduction

Mammography may be one of the most dynamic of all of todays imaging modalities. New regulations, accreditation procedures and advances in technology demand that the service professional have advanced skills. This course is designed to give the service professional the insight and hands-on experience to evaluate image and functional problems as they relate to the Affinity system. Today's regulatory environment and the need for the earliest possible diagnosis, demand that the system operate at peak performance.

Objectives

At the conclusion of this course the service professional will be able to:

- Identify the major components of the Affinity system.
- Describe the functional characteristics of each sub-system of the Affinity system.
- Fully install the Affinity system.
- Complete all operational tasks on the system.
- Conduct image system evaluation to ensure compliance with MQSA requirements.
- Perform all system calibrations to maintain the highest quality images and MQSA compliance.
- Evaluate circuit functions to facilitate troubleshooting.

Course Outline

DAY 1

I. System Introduction
II. Specifications
III. Knobology
IV. Physical layout
V. Using system documentation
VI. Site Planning and Pre-stallation

Lab Activities

I. System operation
II. Functional Checks
III. Component identification
IV. Default Worksheet
IV. System installation

DAY 2

I. Calibration Screens
II. Power Distribution
III. Host μP
IV. Communications Interface
V. C-Arm Safety
 A. Interlock System
VI. Power Control

Lab Activities

I. Covers and Panels
II. Complete System calibration
 A. Verify and calibrate kV
 B. Verify and calibrate mA
 C. C-Arm calibration
 D. Back-up Timer test
III. Rotor control verification

DAY 3

I. AEC Theory
II. AEC calibration

Lab Activities

I. Calibrate AEC

DAY 4

I. Review outlined calibration procedures
II. Test Points
III. LED's

Lab Activities

I. Half Value Layer
II. X-Ray to light alignment
III. Aperture adjustment
IV. Illuminance
V. Reproducibility and Linearity checks
VI. Mechanical Adjustments
 A. Compression Force calibration

DAY 5

I. Course review
II. Course evaluation
III. Final exam

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RSTI
Radiological Service Training Institute

Starting and Managing a Diagnostic Imaging Capital Asset Management Program

Course Length: 4 days
CEUs Awarded: 3

Introduction

Designing, implementing, and managing a Diagnostic Imaging Capital Asset Management program can be extremely difficult. This is primarily due to the complexity of the program and the cooperation necessary from the various departments involved. As a result, many managed care facilities, hospital groups, and service management groups are leaning toward contracted capital asset programs due to time restraints in reducing costs rather than allowing their capital asset program to evolve.

However, hospitals that have implemented fine-tuned Capital Asset Management programs are reaping the fruits of their efforts and are in position or implementing capitated healthcare programs.

This course is designed to provide hospital management, OEM managers, and maintenance providers with the in-depth knowledge necessary to start and manage a diagnostic imaging capital asset management program. It is recommended that the lead people involved in starting and implementing this program attend the same course.

This seminar is specifically designed for

- Radiology Administrators
- Directors of Radiology
- Chief Technologists
- Quality Assurance Managers
- Clinical/Biomedical Engineering Managers
- Lead Service Supervisors/Managers
- OEM Capital Asset Managers
- Third Party Service Providers
- Capital Asset Management Companies

Objectives

- Develop a five-year replacement plan which complements the hospital business plan.
- Use information gathered from the prestudy material to develop the following:
  - · Start-up action plan
  - · Cost benefit analysis
  - · Management audit
  - · Budget
  - · Quality assurance action plan
  - · Technology ownership action plan
- Define the major ten programs within an asset management program

Course Outline

DAY 1

I. Overview of the diagnostic imaging market

II. Define diagnostic imaging capital asset management

- A. Overview of the ten programs that make up a diagnostic imaging capital asset management system
- B. Getting started
  1. Management audit
  2. Equipment audit
  3. Cost benefit analysis
- C. Key elements of capital asset management
- D. Functions and roles of the department heads

III. Components of a diagnostic equipment maintenance program

- A. Preventive and emergency maintenance
- B. Quality control
- C. Projecting annual repair costs
- D. Replacement projections, capital budget, procurement
- E. System performance and compliance
- F. New construction planning
- G. Maintaining and tracking equipment history
- H. Training and development
- I. Behavior patterns before and after starting the program

DAY 2

IV. Planning and developing a 5-year capital replacement plan

- A. How to prepare annual equipment budgets
- B. How to prepare capital replacement plans and budgets
- C. Bid and procurement policies and procedures
- D. Remodeling/new construction
- E. 5-Step process in preparing bid specifications
- F. Analyzing the bidding process
- G. Acceptance testing overview
- H. Process in performing acceptance
  1. Installation
  2. Warranty
  3. Ongoing life cycle

V. Developing an equipment upgrade plan

- A. Acquisition budget
- B. Maintenance budget

VI. Facility requirement

- A. Location and size
- B. Support

DAY 3

VII. Methods of managing diagnostic imaging equipment maintenance

- A. Vendor contracts
- B. Vendor time and material
- C. Insurance companies
- D. Third party service
- E. In-house
- F. Shared services
- G. Selecting the right service providers

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RSTI
Radiological Service Training Institute

Starting and Managing a Diagnostic Imaging Capital Asset Management Program continued

Seminar Length: 4 days
CEUs Awarded: 3

VIII. Analysis of three different hospitals
  A. Analysis of current practices
  B. Analysis of vendor contracts
  C. Review of vendor demand services
  D. Current in-house service practice
  E. Review of asset purchases
  F. Unexpected expenditures

IX. Review of maintenance requirements and selecting the right service plan for each diagnostic imager

X. Organizational model
  A. Proven service models
  B. Cost savings
  C. Roles and responsibilities
  D. Policies and procedures

XI. Key elements of an emerging technology plan
  A. Developing department training plans and implementation
  B. Developing on going information stream
  C. On-site visits
  D. Societies, magazines, etc.
  E. Research and development

XII. Establishing an action plan for effective in-house CAM management
  A. Identifying the type of equipment maintenance required
  B. Identifying organizational chart and staffing
  C. Performing radiological equipment performance audit

XIII. Developing scheduled and nonscheduled maintenance programs
  A. Developing PM schedules
  B. How to analyze department reports, film repeats, equipment utilization
  C. Equipment/tools needs, quality assurance test equipment
  D. How to order vendor parts, second source, etc.

DAY 4

XIV. Integrating the in-house groups into the capital asset management program
  A. Relationships
  B. Response
  C. On call
  D. Overtime
  E. Working hours

XV. Staffing
  A. Selection/interviewing
  B. Technical skills inventory
  C. Training and development
  D. Job descriptions
  E. Salaries
  F. Level of expectation
  G. Percentage of in-house vs. demand vs. contracted
  H. P.A.R.A. theory

State of Ohio Registration. No: 93-09-1377T

NETWORKING, DICOM, PACS FOR CAPITAL ASSET MANAGERS

Course Length: 5 days
CEUs Awarded: 4

Introduction

Hospitals are moving quickly into a digital and filmless world of information. Innovations in technology that are providing better and faster image diagnosis are rapidly showing up in all areas of diagnostic imaging . As a manager in radiology or biomedical engineering, you need to become more familiar with the trends in computer/information networking, DICOM standards, and digital patient archiving.

This course is designed to provide hospital management, OEM managers, and maintenance providers with the in-depth knowledge necessary to start and manage a diagnostic imaging capital asset management program. It is recommended that the lead people involved in starting and implementing this program attend the same course.

The course is recommended for:

- Radiology administrators
- Directors of radiology
- Chief technologists
- Quality assurance managers
- Clinical/biomedical engineering managers
- Lead service supervisors
- OEM capital asset managers
- Third party service providers

Objectives

- Understand general network architecture
- Understand advanced network architecture
- Understand primary functions of TCP/IP and why it works in a hospital environment
- Recognize the key components of a DICOM conformance statement
- Recognize and understand the terminology used in DICOM, PACS, and computer technology
- Understand the DICOM standard and its importance to PACS, RIS, and HIS
- Learn history of patient archiving and the transition to PACS
- Apply the benefits of going filmless, while managing the growth of PACS in your facility
- Stay abreast of new developments in PACS and new technology

Course Outline

DAY 1

Introduction to Networking

I. Two major types of networks
  A. Peer-to-peer
  B. Server based
II. Network design (basic topologies)
  A. Bus
  B. Ring
  C. Star
III. Networking cabling
  A. Coax
  B. Twisted pair
  C. Fiber optics
  D. PDPM-wireless for DICOM
IV. Network interoperability
  A. OSI model
    1. Layers
    2. Additions to the layers
  B. Protocols
    1. TCP/IP
  C. Network operating systems
IV. Network administration
  A. Security
    1. Local vs. network
    2. Peer-to-peer vs. centralized
    3. File systems
IV. Advanced WAN technologies
  A. ATM
  B. FDDI

DAY 2

Introduction to DICOM

I. History of DICOM
  A. ACR/NEMA 1.0
  B. ACR/NEMA 2.0
  C. DICOM 3.0
II. DICOM interoperability
  A. DICOM model
  B. DICOM IODs
    1. Modality worklist
  C. DICOM conformance statements
  D. Integration testing
III. DICOM standard implementation
  A. HIS/RIS interoperability
  B. Structured reporting
IV. DICOM issues
  A. Manufacturer issues
  B. Regulatory issues
  C. Technical issues
V. Display standard
  A. Image consistency
  B. LUTs (Look up tables)
  C. Monitor mapping, calibration and brightness
VI. Current problems with DICOM

Note: Students will receive the Microsoft Certification study guides and CD ROMs.

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RSTI
Radiological Service Training Institute

NETWORKING, DICOM, PACS FOR CAPITAL ASSET MANAGERS

Course Length: 5 days
CEUs Awarded: 4

DAY 3

Introduction to PACS

I. History of PACS
  A. Early entrants
  B. Standardization efforts
  C. Federal government and PACS
II. OEMs and evolution of PACs
  A. GE/IBM
  B. ATT/Philips
  C. Siemens
  D. Other OEMs
III. PACS as a strategic investment for hospitals
  A. Cost justification
  B. Facility integration
  C. System integration
IV. Digital imaging
  A. Modalities
V. Archiving
  A. WORM optical drive
  B. Tape
  C. MOD
VI. Communication methods
  A. Telephone lines (POTS)
  B. Networking (LAN/WAN)
  C. Microwave
VII. Methods of implementation
  A. Department wide PACS
  B. Hospital wide PACS
  C. Mini PACS
  D. Inter-institutional PACS
VIII. Acceptance criteria for PACS
  A. Defining performance objectives
  B. Acceptance of test criteria
  C. Examples of acceptance criteria
  D. Developing system expectations

DAY 4

I. Overview of the diagnostic imaging market
II. Define diagnostic imaging capital asset management
  A. Overview of the ten programs that make up a diagnosticimaging capital asset management system
  B. Getting started
    1. Management audit
    2. Equipment audit
    3. Cost benefit analysis
  C. Key elements of capital asset management
  D. Functions and roles of the department heads

DAY 5

I. Planning and developing a 5-Year capital replacement plan
  A. How to prepare capital replacement plans and budgets
  B. Bid and procurement policies and procedures
  C. Remodeling/new construction
  D. 5-Step process in preparing bid specifications
  E. Analyzing the bidding process
  F. Acceptance testing overview
  G. Process in performing acceptance
    1. installation
    2. warranty
    3. ongoing life cycle
II. Overall Review
III. Final Exam

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RSTI
Radiological Service Training Institute

SERVICING DIAGNOSTIC ULTRASOUND: ACUSON SEQUOIA, HP 5500, AND ATL HDI 5000

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

This course covers the principles of ultrasound with specific focus on the maintenance of the Acuson Sequoia, HP 5500 and ATL HDI 5000.

Objectives

At the completion of this course, participants will be able to:

- Demonstrate an understanding of the physics of sound
- Demonstrate an understanding of basic ultrasound theory
- Identify the characteristics of acoustic waves
- Describe the parts of a basic ultrasound scanner
- Identify signal flow and label system block diagrams
- Understand image quality as it pertains to ultrasound
- Perform QA checks
- Demonstrate the operations of the HP 5500, ATL 5000 and Acuson Sequoia
- Understand theory of operation of the HP 5500, ATL 5000 and Acuson Sequoia
- Perform PM checks on various ultrasound machines
- Perform networking and DICOM setup
- Troubleshoot an ultrasound scanner
- Identify probes and their uses

Course Outline

DAY 1

I. Introduction to ultrasound
  A. Overview of ultrasound in medicine
  B. History
II. Physics of sound
  A. Sound waves
  B. Interactions of sound waves and matter
  C. Wave motion
III. Transducers
  A. Construction
  B. Uses
IV. Modes of operation
  A. 2D-mode
  B. M-mode
  C. Doppler
    1. Color
    2. Spectral
V. Applications
  A. Radiology
  B. Cardiology
  C. Vascular
  D. OB/GYN

DAY 2

I. Basic ultrasound scanner and controls
  A. System block diagram
    1. Beamformer
    2. Transmitter
    3. Receiver
    4. Scan conversion
    5. Output
    6. Power
  B. Basic scanning of the body
  C. Image Quality
    1. Axial resolution
    2. Lateral resolution
    3. Dynamic range

DAY 3

I. Introduction to the HP 5500, ATL 5000 and Acuson Sequoia
  A. Theory of operation
  B. Controls
  C. System architecture

Lab Activities

I. Operation and functional checks

DAY 4

I. Block diagrams
  A. Signal flow
  B. 2 D/M modes
  C. Doppler (spectral)
  D. Doppler (color)

Lab Activities

I. Scanning session

DAY 5

Lab Activities

I. Disassembly, parts location and identification and reassembly

DAY 6

I. Power supplies analysis
  A. Theory
  B. Block diagrams

Lab Activities

I. Power supply checks and test points

DAY 7

I. Diagnostic tools and menus
  A. LEDs and test points
  B. Laptop connections

DAY 8

I. DICOM and Networking
  A. Conformance statement basics
  B. Networking basics
  C. DICOM basics

Lab Activities

I. Perform networking setup and verify operations
II. Perform DICOM setup and verify operations

DAY 9

I. PM procedures
II. QA procedures

Lab Activities

I. Perform a PM on each system
II. Perform a phantom QA for each system

DAY 10

I. Review
II. Final Exam and review

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RSTI
Radiological Service Training Institute

PHILIPS INTEGRIS

Course Length: 2 Weeks
CEUs Awarded: 8

Introduction

The Integris (Integrated Imaging System) is a sophisticated diagnostic imaging system consisting of either a H1000 or H3000 general cardiovascular unit integrated with the Poly C2 positioning system. The Integris consists of four major subsystems that include geometry, image detection, viewing and system coordination. This course is designed to cover the overall system, theory of operation, calibration and troubleshooting.

Objectives:

At the conclusion of the class, student should be able to:

- Describe the Philips Integris V3000 system operation
- Perform block analysis and troubleshooting on subsystem level
- Calibrate system

Prerequisites

RSTI's Phases I-III and Servicing the Philips CP Family of Generators or equivalent experience is required.

Course Outline

DAY 1

I. Introduction
II. System configuration
  A. System overview
  B. Subsystem overview
    a. GECO – Geometry
    b. IDSC – Image detection
    c. VISUB – Viewing
    d. SYSCO – System coordination
III. Integris V/H capabilities

Lab Activities

I. Understanding Philips documentation
II. Review system documentation
III. Subsystem layout
IV. Overall system operation

DAY 2

I. Integris communication
  A. LANs
  B. CANs
  C. SDL 4
  D. Signal bus
II. SYSCO communications
  A. Acquisition coordinator
  B. Peripheral control CPU
  C. Signal bus
  D. Puck interface
  E. Roomervice
  F. Hub board
  G. Acquisition console

Lab Activities

I. SYSCO
  A. Board LED status
  B. Test software controlackage
    a. TCOP basic
    b. TCOP main menu

DAY 3

I. Integris communications (cont.)
  A. Communications overview
  B. SYNCRA NET
  C. CANs
  D. SDL
  E. V24
  F. Roan service bus
  G. GSB
I. System data communication
  A. Overall block diagram
    a. Viewing
    b. X-ray generation
    c. II/TV
    d. Table/stepper
    e. Geometry

Lab Activities

I. Signal/bus tests
  A. Power on/standby
  B. Prep for fluoro
  C. Fluoro/cont fluoro
  D. RAD

DAY 4

I. System controller (SYSCO)
  A. Introduction & technical data
  B. Installation
  C. System diagram
  D. Programming
  E. Analysis

Lab Activities

I. Inter connections
II. Acquisition console
III. Power on/off unit
IV. Fault finding

DAY 5

I. Geometry coordinator (GECO)
  A. Function
  B. Block analysis
  C. TCOP menu

Lab Activities

I. GECO software
  A. Fault finding
  B. Programming
  C. Adjustments

DAY 6

I. Image detection (IDSC)
  A. Functions
  B. Block analysis
  C. Imaging chain
II. IDSC
  A. Error log
  B. Adjustments
  C. Acquisition

Lab Activities

I. System dose calibration
II. TV adjustments

DAY 7

I. Viewing system
  A. VISUB functions
  B. Block analysis
  C. Error log analysis
II. Options
III. Image processing
IV. TCOP

Lab Activities

I. SSIT test runs
II. Quintessence shell
III. File management
IV. VCCOM

DAY 8

I. Optimus
  A. Functions
  B. Block
  C. Circuit power

Lab Activities

I. Generatoralibration
II. Circuit analysis

DAY 9

I. OMCP – Cont.
  A. Interface
  B. Diagnostics

Lab Activities

I. Troubleshooting
II. Diagnostics

DAY 10

I. Review
II. Final exam
III. Graduation

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RSTI
Radiological Service Training Institute

Servicing the Philips CP Family of Generators: Super CP, Optimus CP, OM 2000

Course Length: 1 weeks
CEUs Awarded: 4

Introduction

The Philips OEM CP Family course includes detailed theory of operation, installation and calibration of Philips CP generators. Systems covered in this course include Philips Super CP, OM 2000 and Optimus CP.

Prerequisites

To attend this course, students must have completed Phase IV or have equivalent experience through on-the-job training. The service professional must also possess a good working knowledge of computer concepts, addressing, and associated support circuits.

Objectives

- Describe circuit operation of Philips CP generator systems
- Perform complete calibration of Philips CP generators
- Troubleshoot Philips systems
- Perform all steps necessary to change X-ray tubes on Philips CP generator

Note: This is a prerequisite for the Philips Integris Cath Lab course and can be taken in conjunction with it as the first week of a 3-week program.

Course Outline

DAY 1

I. Philips CP generators
   A. CP System overview
      1. Block diagrams
      2. Software/firmware
   B. Hardware programming
      1. Tube selection
      2. Image receptor selection
      3. AEC options
   C. Switch settings
   D. System communications

Lab Activities

I. Component identification
II. Signal tracing
III. Software/firmware verification
IV. Hardware programming
   A. Verification
   B. Manipulation
V. Translating CPU buss error codes

DAY 2

I. Philips CP generators (continued)
   A. System logic
   B. software operation
   C. diagnostics
II. kV circuit operation

Lab Activities

I. Software checkout
II. kV calibration
III. Waveform analysis
IV. HV circuit trouble shooting

DAY 3

I. mA circuit operation
   A. Tube adaptation
   B. filament calibration requirements
II. Phototiming
   A. AEC/RAD
   B. AEC/photospot and cine
   C. AEC/digital captures
   D. Brightness stabilization

Lab Activities

I. mA calibration
II. Filament drive calibration
   A. Standby level
   B. Boost
   C. Dose rate controls
III. Waveform analysis
IV. Filament control troubleshooting

DAY 4

I. Rotor controls
   A. YA group
   B. YC extension
   C. YD extension
   D. YG continuous high speed

Lab Activities

I. Rotor control setup
II. Waveform analysis
III. Rotor control troubleshooting
IV. X-ray tube change requirements
   A. Tube prom selections
   B. Rotor connections
   C. Oil cooler
V. Oil cooler maintenance

DAY 5

I. Course review
II. Final exam

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RSTI
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CRES Review

Available upon request

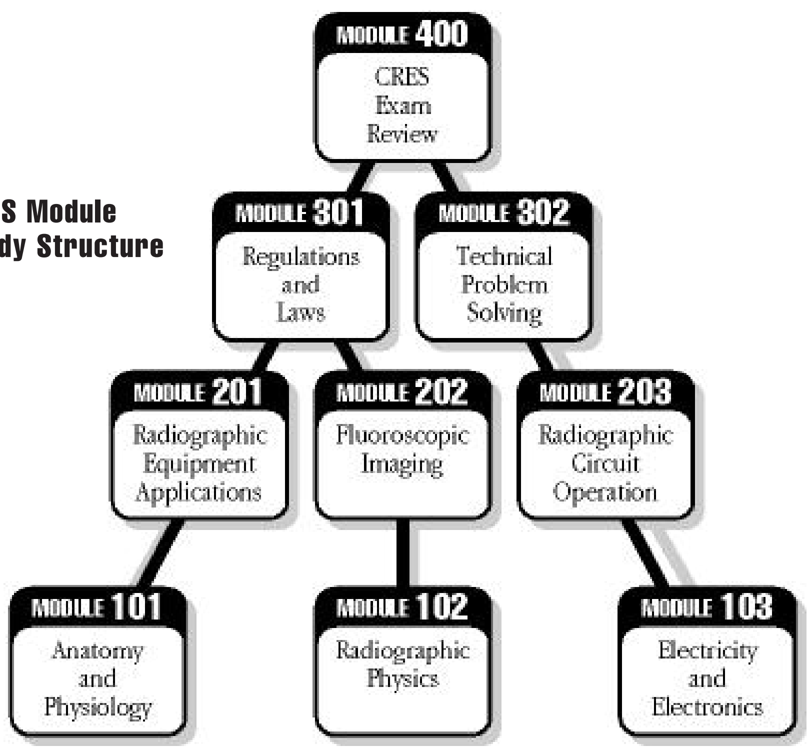
The Certification of Radiological Equipment Specialist (CRES) is formal recognition by the International Certification Commission (ICC) that you have demonstrated theoretical, as well as practical knowledge of the principles of radiological equipment technology. Such recognition results from successful completion of a written examination. To assist you in the preparation for this exam, RSTI has developed a dynamic new training approach that includes a comprehensive review of all subjects covered on the exam.

The Certified Radiological Equipment Specialist (CRES) Training Program

is an advanced criterion referenced instruction training program specifically designed to review the major subject areas covered on the exam. This segment consists of nine learning modules; each module becomes a self-learning tutorial with its own set of terminal objectives and core learning material. The modules consist of numerous sections that include resource material, programmed instruction, and criterion test items.

- Complete Nine Module Referenced Instruction Self-Study Program
- Includes 15 Sets of Reference Documentation
  - Anatomy/physiology
  - Radiologic physics
  - Electricity/electronics
  - Radiographic equipment Applications
  - Regulations/laws
- Complete set of practice exams and questions

CRES Module Study Structure



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RSTI
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COMPUTED TOMOGRAPHY DEVELOPMENT SERIES

The CT training series is divided into three, two-week courses titled Level I, Level II, and Level III. After completion of the full series, service professionals can expect to perform at least 95% of the CT servicing the first year, including all normal maintenance, PM's, and tube changes.

Level I is designed for the service professional with less than one year of CT servicing experience. Covered in the course are the basic CT concepts of back projection, convolving, algorithms, scan/raw data, X-ray principles, computer fundamentals, array processors, matrix size, etc. Lab exercises place emphasis on proper operation, safety, verification of system performance, troubleshooting to a major subsystem, software backup, and performance of first level PM procedures. Level I may be waived by anyone who is already fully qualified on one CT and is cross training to another.

Level II covers the calibration, trouble-shooting, and detailed theory of operation for the gantry, table, and X-ray systems. The labs comprise approximately 70% of the course including a complete X-ray tube change.

Level III completes the series by covering the detailed calibration and troubleshooting procedures for the data acquisition and computer systems. The emphasis is on image evaluation and artifact troubleshooting using the available diagnostic software.

The CT systems used in the labs include General Electric and Picker units. Also available are a General Electric MPX X-ray control and a Data General S140 computer system for those students specializing on the GE9800, GE9800Q, and Highlight system.

Each course participant will receive a documentation package which includes:

- Class manual
- Lab manual
- Course handouts
- Performance evaluation forms
- Troubleshooting procedures
- Block diagrams

Parts, parts contracts, technical support, and back-up support are available through the RSTI User Network (RUN). Call **(440) 349-4700** for details.

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RSTI
Radiological Service Training Institute

Principles of Servicing Computed Tomography Systems (Level I)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Principles of Servicing Computed Tomography Systems is designed for the new service professional. It teaches all the cognitive skills necessary to understand the CT system and its application to the medical industry.

The program is divided into seven major areas:

- Basic CT principles
- Safety procedures
- System operation
- Verification of system specifications
- Backing up software
- Troubleshooting to major subsystems
- Preventive maintenance

The course contains lecture, demonstration, and hands-on training, which teach participants proper operation, calibration, and preventive maintenance of the CT system. Upon completion of the course, the student will be able to perform first-level service on the computed tomography system.

Prerequisites

Recommended completion of Phase I or a service background and two year associate's degree in electronics or equivalent service experience.

Objectives

At the conclusion of this course, participants will:

- Have a thorough understanding of CT principles and image production
- Follow safety procedures for patients, physicians, and individuals
- Be able to load and back up system and diagnostic software
- Be able to completely operate the CT system including local operation
- Troubleshoot to the major subsystem level
- Perform preventive maintenance

Course Outline

DAY 1

I. Introduction
   A. Overview of CT
      1. What is it
      2. Advantages/disadvantages
      3. Different generations of scanners
      4. Detector differences
II. CT principles
   A. Matrix sizes
   B. CT numbers
   C. Window width and level
   D. Slice thickness
   E. Collimators
   F. Algorithm

Lab Activities

I. Proper power up and power down procedures
II. Location of E-stop/emergency off switches
III. Booting computer into scan software
IV. Measurement of power requirements
V. X-ray tube warm up procedure

DAY 2

I. CT principles (continued)
   A. CT X-ray principles
   B. Sampling rates and number of detectors
   C. Back projection
   D. Attenuation coefficients
   E. Tomographic blurring
   F. Scan parameters
   G. Noise/algorithms
   H. Image manipulation techniques
      1. Standard deviation
      2. Isodensity
      3. Region of interest
      4. Multiviewing of images
II. Simplified block diagram

Lab Activities

I. Introduction to scanning software operation
II. Pilot/scout scans
III. Scanner parameter manipulation
IV. Patient transport operation

DAY 3

I. Computer fundamentals review
   A. CPU/memory/input, output
   B. DMA transfers
   C. Special CT applications
II. CT imaging principles
   A. Filtered back projection
   B. Air calibration–why needed
      1. Pilot/scout scans
      2. Normal scan
   C. Spectrum correction

Lab Activities

I. Scanner parameter manipulation (continued)
II. Technique selection/application

DAY 4

I. System hardware overview–block diagram
   A. Power distribution block diagram
   B. X-ray system block diagram
   C. Gantry block diagram
   D. Patient transport block diagram
   E. Data acquisition block diagram
   F. Computer block diagram

Lab Activities

I. Major component locations
II. Major signal flow
   A. kV/mA
   B. Detector data
   C. Motor feedbacks

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RSTI
Radiological Service Training Institute

Principles of Servicing Computed Tomography Systems (Level I) *continued*

Course Length: 2 weeks
CEUs Awarded: 8

DAY 5

I. Types and uses of phantoms
  A. Spatial resolution
  B. Contrast resolution
  C. Linearity
  D. CT numbers of water equal to zero
  E. Slice thickness
II. Manufacturers' specification

Lab Activities

I. Verification of manufacturers' specification
  A. Linearity
  B. CT number
  C. Spatial/contrast resolution

DAY 6

I. Backing up software
  A. Scan software
  B. Diagnostic software
  C. Images
  D. Raw data
II. Loading software onto a CT system
  A. How to do a "cold" boot
  B. Minimum diagnostics hardware

Lab Activities

I. Make back-up tapes
II. Load software

DAY 7

I. Operate subsystem locally
  A. X-ray subsystem
  B. Gantry subsystem
  C. Computer subsystem
  D. Data acquisition subsystem
II. Introduction to system troubleshooting

Lab Activities

I. Operation of all subsystems locally
II. Location of problems to major subsystems

DAY 8

I. System troubleshooting (continued)
  A. Recognizing and localizing problems
  B. Most common problems to watch for
II. Introduction to P.M.
  A. What constitutes a P.M.
  B. How often should they be performed

Lab Activities

I. System troubleshooting

DAY 9

I. Preventive maintenance
  A. Items to do every week
  B. Items to do every month
  C. Items to do every quarter
  D. Equipment needed to do a P.M.

Lab Activities

I. Perform PM procedures

DAY 10

I. System review
II. Final exam
III. Course evaluation

Advanced Computed Tomography Systems Maintenance (Level II)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Advanced Computed Tomography System Maintenance is a skills development course designed as a continuation of Principles of Servicing Computed Tomography Systems (Level I). Through attending this course, the service professional will become self-confident in working on the gantry, patient transport, and X-ray portions of the CT system.

Prerequisites

To attend this course, the service professional must have good knowledge of CT physics and procedures gained through attendance at the RSTI Principles of Servicing Computed Tomography Systems (Level I) course or equivalent experience.

Objectives

Following attendance at the course, registrants will be able to:

- Calibrate all the hardware associated with the gantry, patient transport, and X-ray portions of the CT system
- Troubleshoot the hardware associated with the gantry, patient transport, and X-ray portions to the circuit/component level
- Troubleshoot the scanning sequence
- Change the X-ray tube and recalibrate

Course Outline

DAY 1

I. Introduction
  A. Gantry block diagram review
  B. Patient transport block diagram
II. Scan sequence
  A. Detailed timing procedure
  B. Steps which can be checked easiest

Lab Activities

I. Scan sequence
  A. Location and measurements
II. Troubleshooting the scan sequence

DAY 2

I. Gantry block diagram review
II. Gantry circuit diagram
  A. Tilt motor
  B. Beam shutter circuitry
  C. Beam filters/collimators
  D. Main gantry drive circuitry

Lab Activities

I. Advanced local operation techniques
II. Introduction to gantry calibration
  A. Gantry speed adjustments
  B. Tilt angle measurement/adjustment
  C. Limit switch adjustment

DAY 3

I. Gantry circuit diagram (continued)
  A. Gantry positioning circuitry
  B. Laser alignment

Lab Activities

I. Calibration (continued)
  A. Gantry positioning
  B. Laser alignment
  C. Limit switches
II. Troubleshooting of gantry
  A. Most common problems
  B. Troubleshooting

DAY 4

I. Patient transport
II. Patient transport circuit diagram
  A. Horizontal positioning and drive
  B. Vertical drive circuitry
  C. Display hardware
III. Calibration of all couch parameters

Lab Activities

I. Patient transport
  A. Calibration/specifications
    1. Troubleshooting
  B. Most common problems
    1. Troubleshooting

DAY 5

I. Patient transport (continued)
  A. Functional checks
  B. Tests/exercises

Lab Activities

I. Table exercise tests
II. Hardware and software checks

DAY 6

I. Changing the X-ray tube
  A. Axial/in-out centering
  B. Lateral/side-to-side centering
  C. kV/mA adjustments

Lab Activities

I. Change X-ray tube
II. X-ray tube adjustments

DAY 7

I. X-ray subsystem
  A. kV control hardware
    1. Primary voltage selection
      a. Compensation for mA
      b. Compensation for line
    2. Secondary regulation
    3. kV measurements
  B. mA control hardware
    1. Filament control
    2. Focal spot selection
    3. Preheats
    4. Filament/real mA feedback

Lab Activities

I. Local and remote mA and kV operation
II. mA calibration
  A. Preheat adjustment
  B. Standby current adjustments
  C. Real mA selection adjustments
III. kV calibration
  A. kV measurement
  B. H.V. primary adjustment
  C. H.V. secondary adjustment

DAY 8

I. X-ray subsystem (continued)
  A. Timer control hardware
    1. Remote and local control
    2. Time measurement
  B. Rotor controller circuitry
  C. X-ray indicators and faults

Lab Activities

I. Rotor controller calibration
  A. Start-to-run control
II. X-ray subsystem troubleshooting

DAY 9

I. System troubleshooting techniques

Lab Activities

I. System troubleshooting

DAY 10

I. System review
II. Final exam
III. Course evaluation

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RSTI
Radiological Service Training Institute

ADVANCED COMPUTED TOMOGRAPHY IMAGING MAINTENANCE (LEVEL III)

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Advanced Computed Tomography Imaging Maintenance provides a comprehensive approach to servicing the data acquisition and imaging portions of computed tomography with emphasis on system performance and image evaluation. Each subsystem of the imaging chain is analyzed, and methods for optimizing the image are applied. Participants will also learn to run all of the diagnostic programs available.

Prerequisites

For this course, the service professional must have good fundamental knowledge of CT physics and procedures gained through attendance at the RSTI Advanced Computed Tomography System Maintenance course (Level II) or equivalent experience.

Objectives

At the conclusion of this course, participants will be able to:

- Perform all hardware and software calibration procedures of the imaging portion of CT
- Troubleshoot image artifacts
- Use proper test equipment to evaluate system performance
- Run diagnostics

Course Outline

DAY 1

I. Image sequence and data acquisition
  A. Hardware
    1. Detectors
    2. I to F converter
    3. Multiplexing circuitry
    4. Data manipulation
    5. Image reconstruction circuitry
    6. Video graphics generator
    7. Display

Lab Activities

I. Physical layout of acquisition system
II. Interpret scan/raw data

DAY 2

I. Raw data
  A. What is correct raw data
  B. What it should look like
  C. How to access it
  D. Finding bad detectors
  E. Diagnostic programs
II. How to get around bad detectors

Lab Activities

I. Raw data manipulation programs
II. Finding and removing bad detectors

DAY 3

I. Image sequence/data acquisition
  A. Image artifacts
    1. Line and ring artifacts
    2. Troubleshooting techniques
  B. Waveforms of major signals
  C. Data acquisition without X-rays

Lab Activities

I. Artifact creation and interpretation
II. Finding bad channels and detectors

DAY 4

I. Data acquisition troubleshooting
  A. Image processing step separation
  B. Introduction to image artifacts

Lab Activities

I. Raw data acquisition troubleshooting
II. Referencing CT # of water to zero

DAY 5

I. Half value layer optimizing
II. Introduction to data flow within the image processing system

Lab Activities

I. Measurement of HVL
II. Optimizing data acquisition system
III. Software steps prior to BP

DAY 6

I. Computer hardware subsystem
  A. Power supplies
  B. Board layout
  C. Backplane options
  D. Routine computer maintenance

Lab Activities

I. Power supply adjustments
II. Interrupt chain manipulation
III. Minimum hardware

DAY 7

I. Image processing
  A. Image processing hardware overview
    1. Interfacing circuitry
    2. Array processor
    3. Backprojector
  B. Troubleshooting techniques
    1. Restrapping
    2. Voltage measurements
    3. Signals to monitor
    4. Swapping boards
II. Computer tests and diagnostics

Lab Activities

I. Re-addressing of boards
II. Image processing voltage measurements
III. Board swapping techniques
IV. Computer diagnostics

DAY 8

I. Image processing (continued)
  A. Reconstruction diagnostics
    1. AP diagnostics
    2. BP diagnostics
    3. Interface diagnostics
  B. Image artifact correlation
II. Image display control circuitry
  A. Video graphic generators
    1. RAMTEK/DEANZA/GAIDS
  B. Monitors

Lab Activities

I. Run all image reconstruction diagnostics; interpret results
II. Use diagnostics to troubleshoot image artifacts
III. VGG diagnostics
IV. Display control diagnostics and tests

DAY 9

I. System troubleshooting
  A. Image artifact troubleshooting
  B. System error codes

Lab Activities

I. Troubleshooting the entire CT system

DAY 10

I. System review
II. Final exam
III. Course evaluation

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RSTI
Radiological Service Training Institute

Principles of Servicing Magnetic Resonance Imaging Systems

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

Principles of Servicing Magnetic Resonance Imaging Systems is a hands-on course designed for both the technologist actively involved with MRI and those charged with aligning and servicing this equipment. The service professional requires a well-balanced overview of the physics underlying MR image acquisition to help support the MR operator. The class is allowed hands-on operation of a 1.0 Tesla superconducting MRI system with calibration and alignment workshops. This course provides facilities planning to optimize their equipment uptime with proven maintenance strategies.

Prerequisites

To attend this course an understanding of basic electronics is recommended.

Course Outline

- I. Introduction
  - A. History of MRI
  - B. Capabilities
    - 1. Present
    - 2. Future - Functional MRI, real time imaging, etc.
- II. MRI System Block Diagram
  - A. Radio frequency system
  - B. Magnet system
  - C. Gradient System
  - D. Computer System
- III. Safety considerations for MRI
  - A. Patient contra-indications
  - B. Safety issues for the technician
    - 1. Maximum static field strength
    - 2. Maximum gradient field strength
    - 3. SAR RF deposition levels for the head and body
    - 4. Cryogen handling techniques
  - C. Emergency magnet rundown unit
    - 1. Magnet quench
    - 2. Oxygen monitoring system
  - D. Dangers of projectiles around the magnet
  - E. Personal property management around the magnetic field

Lab Activities

- I. Tour of the MRI Suite
  - A. Overview of the system hardware
  - B. Establishment of the 5 Gauss boundary
  - C. Demonstration of MRI test scan

DAY 2

- I. MRI Physics
  - A. Properties of precessing nuclei in a magnetic field
  - B. Larmor frequency
  - C. Magnetic field strength measurement units
  - D. Resonance and excitation selection
  - E. Glossary of MRI terms
- II. MRI parameters
  - A. Fundamental concepts in MRI
  - B. Introduction to T1
  - C. Measurement of magnetization and the T1 relaxation curve
  - D. Echoes and introduction to T2
  - E. Combined effects of T1 and T2 relaxation
  - F. The chemical shift

Lab Activities

- I. Component location and identification
- II. Operation for system start-up and shutdown
- III. Entering scan parameters at operator's console

DAY 3

- I. The imaging process
  - A. Slice excitation
  - B. Slice selection
    - 1. Transverse, sagittal, coronal
    - 2. Factors affecting slice width
    - 3. Phase shifts across the slice
  - C. Spatial encoding the magnetic field
  - D. Introduction to gradients
- II. MRI imaging methods
  - A. Single point
  - B. Sensitive line technique
  - C. Planar
    - 1. Back projection
    - 2. Two dimensional Fourier transformation
    - 3. 2D-FT imaging with varying phase encoding steps
  - D. Multi-slice imaging
- III. MRI image reconstruction and image grey scale
  - A. Fourier transformation and "K" space
  - B. Readout gradient, preparation gradient, and image resolution
  - C. Contrast
  - D. Number of acquisitions and scan time
  - E. Averaging and reduced (smart averaging) acquisition strategies

Lab Activities

- I. System operation–taking a scan
- II. Measurements of scan parameters
  - A. S/N ratio
  - B. Phantom dimensions
  - C. Flood field uniformity
  - D. Slice thickness measurements

DAY 4

- I. MRI scan sequences
  - A. Spin-echo pulse sequences
    - 1. Multi-echo pulse sequences
    - 2. Phase correcting the spin echo sequence
    - 3. Image contrast
  - B. Inversion recovery
    - 1. Fat suppression
    - 2. Image contrast (T1/T2 weighted)
  - C. Proton density (Rho) sequences
  - D. How to quantify the degree of T1, T2, and proton density weighting

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Principles of Servicing Magnetic Resonance Imaging Systems (continued)

Course Length: 2 weeks
CEUs Awarded: 8

- A. Mathematical tools
- B. Tissue time constants and image contrast
- D. Saturation recovery scan techniques
- E. Reduced-flip-angle SE imaging

II. Introduction to fast imaging techniques
- A. Partial flip angles and shortened TR
- B. Gradient reversal echoes
- C. 3D imaging techniques
- F. Technical aspects
  1. Shielded gradients
  2. Signal-to-noise ratios
  3. Synthesizing data processes

Lab Activities

I. Oscilloscope waveform lab–observing the FID

II. Waveform lab
- A. Gradient waveforms of the spin echo sequence
- B. T2* waveforms and X, Y, Z offsets
- D. Shimming
  1. Iron
  2. Electrical

III. Systems operations for scanning in the three imaging planes

IV. Drawing the gradient waveforms for phase compensation

DAY 5

I. Magnets
- A. Resistive, superconducting, and permanent types
- B. Cryogen transfers and boil-off calculations.
- C. Field plots and homogeneity calculation
- D. Shimming
  1. Iron
  2. Electrical
- E. Eddy Current compensation
- F. Ramping a superconductive magnet to field

Lab Activities

I. Magnet filling

II. Clearing ice blocks lab

III. Emergency run down unit test

IV. Weekly review

DAY 6

I. Quiz and review

II. Gradient system
- A. Gradient coil theory
- B. Gradient circuitry theory

Lab Activities

I. Centering the gradient coil

II. Troubleshooting the gradient system

III. Shimming with the gradients

IV. Eddy current compensation adjustment lab

DAY 7

I. Radio frequency system
- A. Transmitter section
  1. Modulation and bandwidth
  2. Gain, dB, dBm
  3. Transmission lines and SWR measurements
  4. Impedance matching

II. Calibration
- A. Transmitter section
  1. Modulation
  2. Gain
  3. SAR

Lab Activities

I. RF transmitter lab

II. Tuning and matching the body coil

III. Low level RF input checks

IV. High level RF output checks

DAY 8

I. RF receiver section
- A. Demodulation
- B. Quadrature phase detection theory
- C. Gain balance, real and imaginary
- D. Preamp gain measurements
  1. SNR
  2. Nyquist noise theory

Lab Activities

I. Tuning and matching the coils
- A. QD head
- B. Body
- C. Surface
- D. Extremity

II. Measuring the Q and SNR of the coils

DAY 9

I. Special servicing problems of MRI systems
- A. Site requirements
- B. Special test equipment
- C. Installation of MRI equipment

II. Troubleshooting by system blocks

Lab Activities

I. RF spectrometer lab
- A. RF shielding measurements
- B. Quadrature coil checks
- C. RF traps checks

II. Troubleshooting lab
- A. Image artifacts
  1. Line and point-mirrored ghosts
  2. Discretes
  3. Zippers, popcorn, etc.
- B. QA evaluation

DAY 10

I. Raw data analysis

II. Course review

III. Final written exam

IV. Final course evaluation

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MULTI-PRODUCT C-ARM TRAINING OEC 9600/9800

Course Length: 2 weeks
CEUs Awarded: 8

Introduction

This course is designed to provide the advanced service professional with the skills and knowledge to maintain the OEC 9600 and OEC 9800 at the highest state of readiness. All adjustments will be discussed to establish optimum performance criteria. Theory and hands on sessions will develop the skills necessary to troubleshoot system failures and restore it to operation.

Prerequisites

To attend this course, the service professional must have good fundamental knowledge and understanding of the principles gained through attendance at our Phase I, Phase II, and Phase III X-ray courses or equivalent field experience.

Objectives

At the completion of this course participants will be able to:

- Operate the OEC 9600 and OEC 9800
- Identify all systems, subsystems and components of the OEC 9600 and OEC 9800
- Verify power supplies for accuracy and function
- Service and calibrate system batteries and charger circuits
- Utilize all communication interfaces to calibrate and evaluate the systems
- Evaluate the performance of the X-ray generator, imaging and workstation sections of each system
- Calibrate and adjust all components of the X-ray generator, imaging chain and workstation
- Utilize all diagnostic indicators to troubleshoot system failures
- Restore the system to proper functional state following a system failure
- Evaluate and repair mechanical systems
- Load system software

Course Outline

DAY 1

I. Introduction
  A. Course Objectives
  B. System
    1. Major components
    2. Configurations
    3. Documentation
II. System operation
  A. C-arm controls
    1. X-ray subsystem
    2. I.I., collimator and CCD camera controls
    3. Mechanical systems
  B. Workstation controls
III. Physical layout and component identification

Lab Activities

I. System operation
  A. Fluoroscopic modes
    1. Low dose
    2. High dose
    3. Boost
  B. Radiographic mode
  C. Patient data input
  D. Recall stored images
  E. Collimator controls
  F. TV/ II controls
II. Physical layout and component ID
  A. Covers and panels
  B. Power supplies
  C. Circuit boards
  D. Battery removal
  E. X-Ray tube removal and installation
  F. I.I. removal and replacement
  G. Mechanical systems

DAY 2

I. AC Power Distribution
II. DC Power Distribution
III. Batteries and charger

Lab Activities

I. Power supply verifications
II. Battery charger calibration
III. Battery charger test points and waveforms

DAY 3

I. System communications
II. Interlocks
III. Calibration software interface
  A. Level 2 software
  B. Using RUT and RUS

Lab Activities

I. Verify ARCNET communication
II. Initialize calibration modes for 9600
III. RUT or RUS communication
  A.Calibration screens
  B. Logging
  C.Calibration process
IV. Connect external system monitors
V. Connect external keyboard

DAY 4

I. X-ray generator
  A. Stator power and control
  B. Pre-charge
  C. X-ray On, X-ray Disable
  D. High voltage control
  E. Filament/ mA control

Lab Activities

I. Verify stator operation
II. Pre-charge test
III. Verify x-ray enable signals

DAY 5

Lab Activities

I. Calibrate x-ray generator
II. High voltage test points and waveforms
III. Filament/mA control test points and waveforms
IV. Max "R" adjustment

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MULTI-PRODUCT C-ARM TRAINING
OEC 9600/9800 *CONTINUED*

Course Length: 2 weeks
CEUs Awarded: 8

DAY 6

I. Imaging system components
  A. X-ray tube
    1. Central ray adjustment
    2. Filtration
  B. Image/Fluoro Functions Control PCB's
    1. Collimator control
      a. Collimator iris size and center
      b. Semi-transparent leafs
        i. Width
        ii.Rotation
    2. Image intensifier
      a. Size control
      b. Focusing
    3. Camera
      a. Centering
      b. Focus
      c. TV camera iris
    4. Thermoelectric cooling

Lab Activities

I.HVL measurement
II.Central ray adjustment
III.Collimator centering
IV.Collimator size tracking calibration
V.Verify and adjust II viewed field
VI.I.I. focus adjustment

DAY 7

I. Dose/ brightness control
  A. Video path
  B. Brightness control processing
  C. Iris adjustment

Lab Activities

I. TV camera focus
II. TV camera center adjustment
III. TV camera rotation adjustment
IV. TEC verification and adjustment
V. TV camera iris adjustment

DAY 8

I. Image display
  A. Image Processor
    1. Image manipulation
      a. Window/Level
      b. Subtraction
    2. Noise suppression
      a. Motion Artifact Suppression
  B. Video distribution board
    1. Video input
    2. High resolution video output
    3. Standard resolution video output
  C. Monitors
  D. Touch screen
II. Image storage
  A. Single disk
  B. 2/4 disk cine
III. Mechanical systems
  A. Flip flop
  B. Orbital motion
  C. Wig wag motion
  D. Horizontal cross arm motion
  E. L-Arm
  F. Vertical lift
  G. Steering and breaking

Lab Activities

I. Monitor adjustments
II. Image centering
III. Enable/disable MAS
IV. Capture and evaluate subtraction images
V. Vertical lift drive tests
VI. Wig wag adjustment
VII. Mechanical evaluation

DAY 9

I. Diagnostics
  A. Error messages
  B. LED displays
  C. Bar graphs
  D. Seven segment displays
  E. VGA monitor "debug" screens
  F. Status monitor
  G. Status/Error logs
II. System software installation

Lab Activities

I. Evaluate for diagnosis
  A. LED functions
  B. Bar graphs
  C. Seven segment displays
II. Use "debug" monitor verify system operation
III. View status logs
IV. View error logs
V. Reload system software
VI. System troubleshooting

DAY 10

I. System review
II. Course Evaluation

NOTE: Due to copyright issues, students are required to purchase and bring to class a copy of OEC's Service Documentation CD, P/N 00-88027-08. To order this CD, Please call (800)874-7378.

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Course Length: 1 Week
CEUs Awarded: 4

MULTI-VENDOR DRY LASER PRINTERS: AGFA, FUJI, KODAK, KONICA

Introduction

Medical Laser Imagers have become a staple in many medical imaging departments since their introduction in 1984. With the increased use of CR and DR added to the already high output of MRI, CT and Ultrasound departments the use of dry lasers and the demands placed on these units is increasing. The trained service professional will be taught the skills necessary for mechanical, electromechanical and electronic maintenance of laser imagers.

Prerequisites

To attend this course, the service professional should have a good understanding of basic electronic principles, a high mechanical aptitude and be computer literate. An understanding of DICOM connectivity is a plus.

Objectives

At the conclusion of this course participants will be able to:

- Evaluate overall system performance
- Troubleshoot mechanical and electronic problems on all components of the units
- Perform complete and thorough preventative maintenance procedures on the units
- Follow system detail block diagrams

Course Outline

DAY 1

I. Overview
  A. Overview and history of dry medical laser imagers
  B. Safety issues
  C. Using documentation
  D. Unit operation
  E. Service access
    1. Component location
    2. Component ID
    3. Theory of operation

DAY 2

I. System breakdown
  A. Review
  B. Mechanical systems
    1. Transport
    2. Pneumatics
    3. Robotics
    4. Lasers
  C. Power distribution
  D. System electronics
    1. PCB identification and function
  E. Connectivity options

DAY 3

I. Diagnostics and preventative Maintenance
  A. Review and troubleshooting
    1. Service software
    2. Diagnostics
    3. Configurationa and adjustments
    4. Parts removal and replacement
  B. Preventative maintenance procedures

DAY 4

I. DICOM fundamentals
  A. Introduction
  B. Products
  C. Installation

DAY 5

I. Modality Interface
  A. Modality configuration
  B. Print link installations
  C. Course review and q & a

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Hands-On Training Course

Course Length: 1 Week
CEUs Awarded: 4

KODAK CR800/CR900 CR SYSTEMS

Introduction

Computed Radiography using imaging plates to replace conventional x-ray film cassettes is the best intermediate step towards the filmless imaging department. Because it is well suited for small and large facilities the service professional will obtain an understanding of the Kodak CR800/CR900 systems and their service requirements.

Prerequisites

To attend this course, the service professional should have a good understanding of basic electronic principles, a high mechanical aptitude and be computer literate, and have attended Phase I.

Objectives

At the conclusion of this course participants will be able to:

- Understand system theory and design
- Evaluate overall system performance
- Troubleshoot mechanical and electronic problems on all components of the units
- Perform complete and thorough preventative maintenance procedures on the units
- Determine system performance and optimal image quality

Course Outline

DAY 1

I. CR Theory
  A. Understanding CR
    1. Film-screen capture
    2. Computed radiography
    3. Direct radiography
II. Documentation
  A. Operators manual
  B. Service manual
III. CR Systems
  A. Kodak CR800/900 comparison
  B. What is does
  C. How it works
    1. Creating the latent image
      a. IP's
        1. Powder phosphor
        2. Needle phosphor
        3. Cassettes
          a. General Purpose
          b. High Resolution
    2. Scanning the image
      a. Lasers
        1. Laser safety
        2. Flying spot scanning
        3. Scan head scanning
      b. Optics
      c. Capturing charge
      d. A/D
      e. DICOM file creation
        1. RAW data
        2. LUT's
        3. Patient demographics
    3. Image Erasure
      a. Erasure lamp assembly
      b. Manual/Scan sequence erasure

DAY 2

I. Major subsystems/component ID
  A. Cassette transport table
  B. Touch-screen monitor
  C. Upper control mechanism
  D. Cassette handling and air system
    1. Cassette handling
    2. Cassette opening
  E. Slow scan
  F. Laser/Optical assembly
    1. Laser assembly
    2. Galvanometer assembly
    3. F-Theta lens assembly
  G. PC
  H. UPS
  I. Boards
  J. ROP (Remote Operators Panel)
II. Specifications
III. Covers & Panels
  A. Remove and replace

DAY 3

I. Operation
  A. Reading images
  B. Entering patient demographics
    1. ROP
    2. Barcode
    3. Touch-screen monitor
    4. Modality worklist
II. Installation
  A. Unpacking/Setup
  B. Inner/Outer frame
  C. Power
  D. Network
    1. Input/Output devices
  E. ROP
  F. Barcode scanner
  G. Options
  H. Backup

DAY 4

I. Connectivity
  A. Network overview
  B. TCP/IP overview
  C. DICOM overview
  D. Network configuration
  E. Local image storage
  F. Output devices
  G. Worklist configuration
II. System Software
  A. Workflow
  B. Diagnostics
III. Power Distribution
  A. Schematics

DAY 5

I. Maintenance
  A. Upgrading software
  B. Calibration
  C. QC
  D. PM
    1. Maintaining IP's
    2. Image quality evaluation

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RSTI
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The Radiological Service Training Institute (RSTI) is a private, coeducational school in Solon, OH. The school was founded in 1985 to provide advanced diagnostic imaging service engineering, parts, and capital asset management programs in X-Ray, Nuclear Medicine, Computed Tomography (CT), Diagnostic Ultrasound, Magnetic Resonance Imaging (MRI), and Radiation Therapy (RT).

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