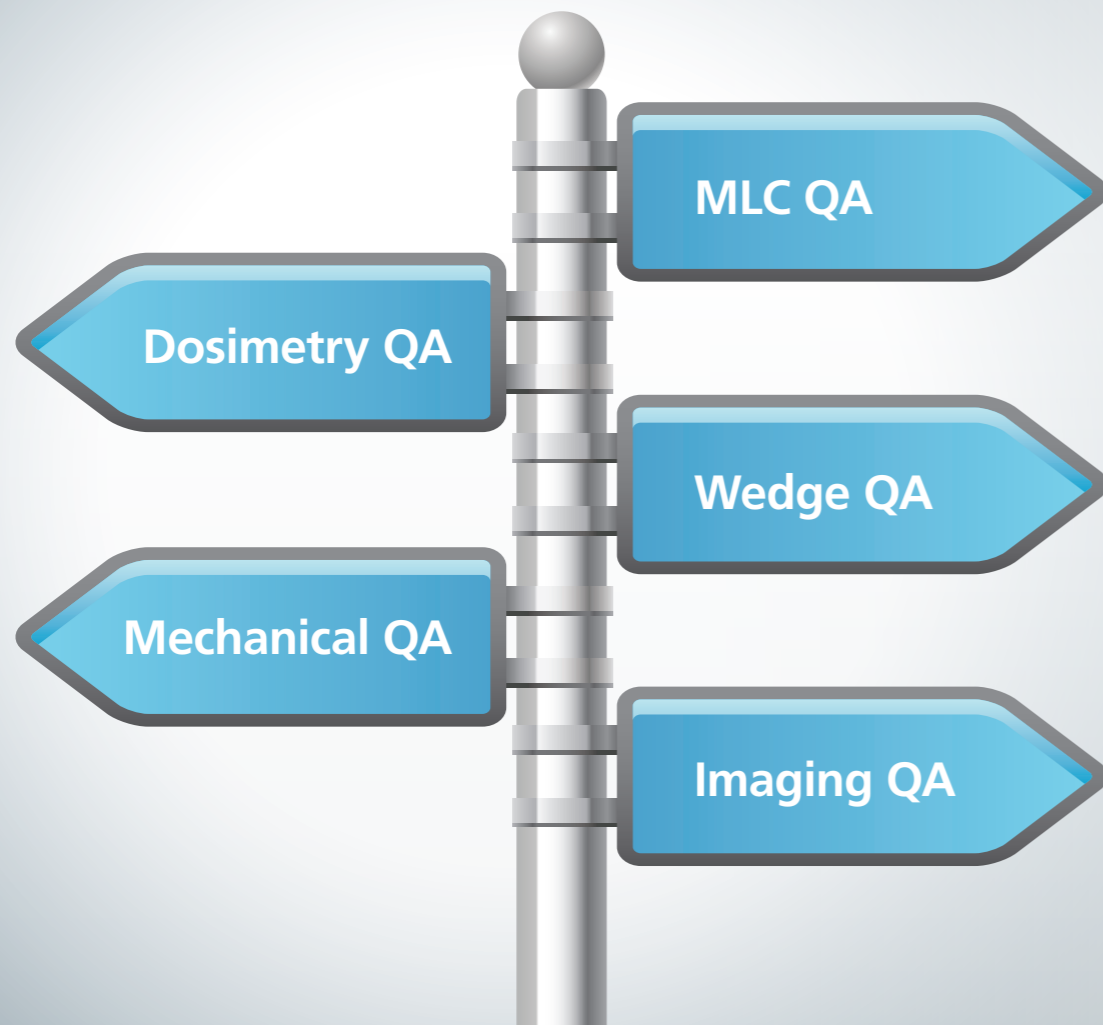


The Right Choice – Any Day, Any Time.



Product Solutions for LINAC QA

Overview

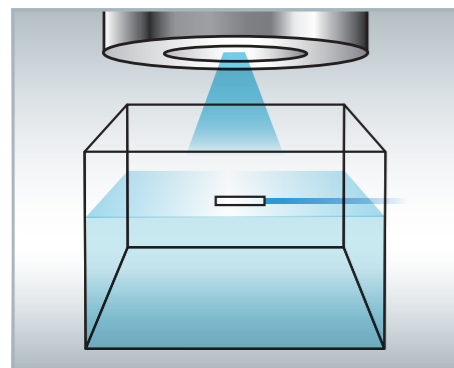


Whether you need a simple test device or a turnkey solution for linear accelerator QA, PTW provides you with the right tools to help you do your job quickly and efficiently.

Day after day, throughout the year.

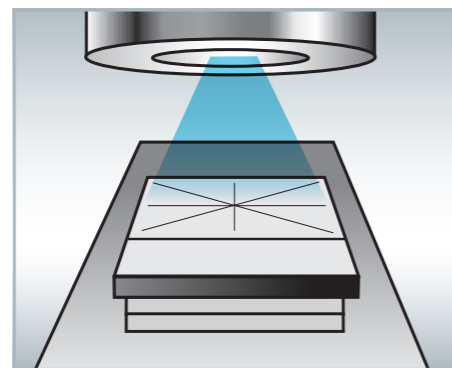
Always the right tool
for the tasks ahead.

LINAC QA Solutions by PTW.



MP3 Water Phantoms

Page 8



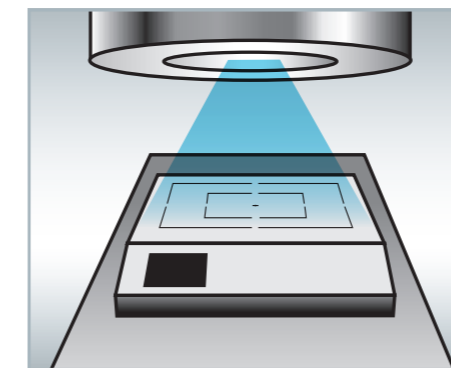
STARCHECK®

Page 6



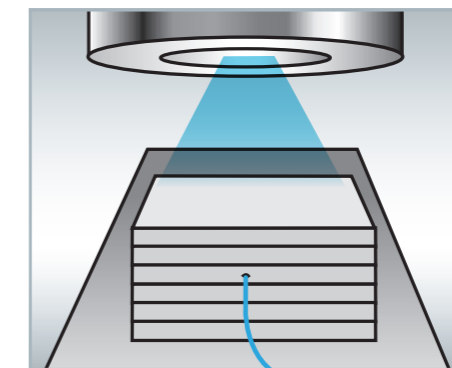
LINAC QA for OCTAVIUS®

Page 4



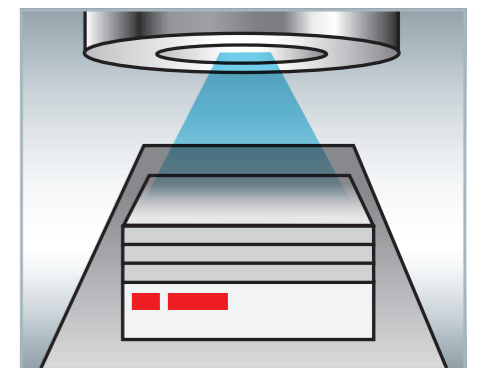
QUICKCHECK *webline*®

Page 4



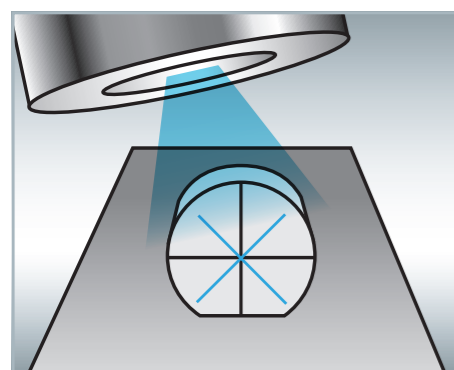
RW3 Slab Phantom

Page 5



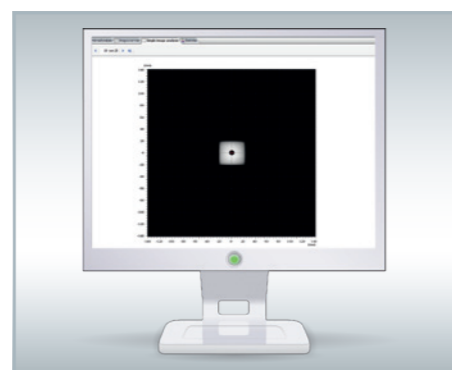
LINACHECK

Page 5



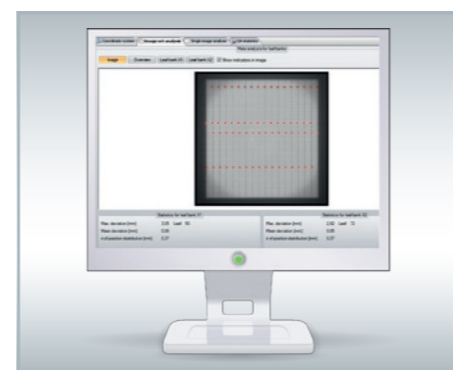
ISOCHECK

Page 10



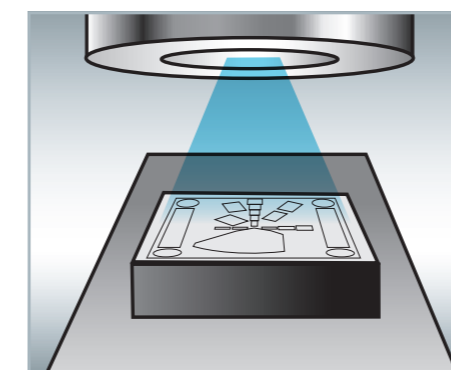
IsoCheck *epid*

Page 10



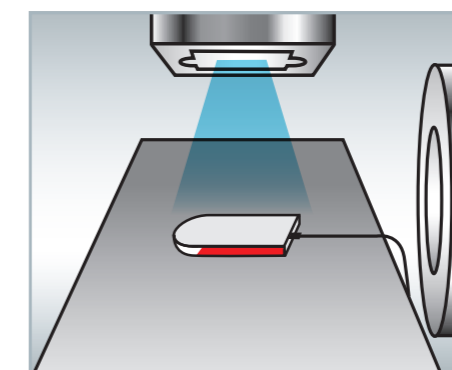
MLCSoft *epid*

Page 11



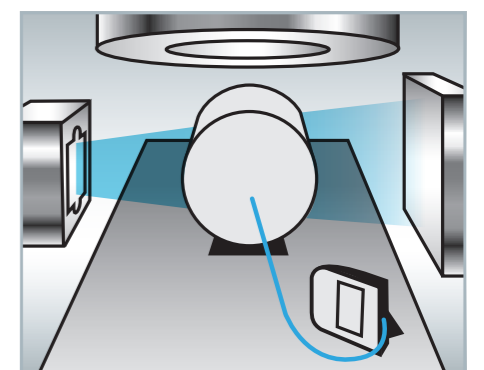
EPID QC Phantom

Page 12



NOMEX® Multimeter

Page 12



NOMEX® Dosemeter

Page 13



LINAC QA Solutions

✓ Dosimetry QA



QUICKCHECK *weblin*®

Portable Constancy Check Device

Key Features

- ▶ Battery-powered, all-in-one device for daily constancy checks of all relevant beam parameters at one go, at any gantry angle
- ▶ Standalone, truly wireless operation
- ▶ Fully automatic measurements with predefined worklists and auto functions
- ▶ 13 Gold Standard ionization chambers
- ▶ For field sizes 10 cm x 10 cm and 20 cm x 20 cm
- ▶ Extended dose rate range (up to 25 Gy/min) for FFF beams (optional)
- ▶ Internal memory for up to 10,000 measurements
- ▶ Trend analysis software

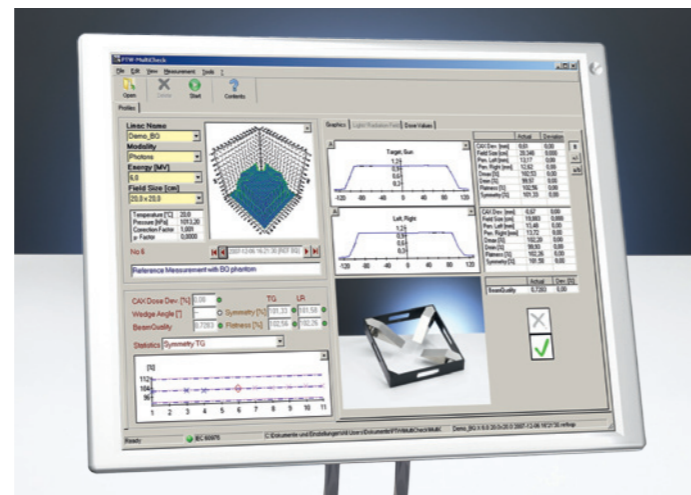
Options

- ▶ FFF Compensators X06 and X10
- ▶ QUICKCHECK *weblin*® Gantry Mount
- ▶ Floor or Wall Mountable Docking Station

QA Procedures

- 1 2 5 6 7

✓ Dosimetry, Wedge QA



LINAC QA for OCTAVIUS®

LINAC QA Upgrade Package

Key Features

- ▶ Comprehensive package for LINAC QA in combination with an OCTAVIUS detector
- ▶ Routine constancy check of all relevant beam profile parameters, including beam quality and absolute dose, in one single shot using MultiCheck LINAC QA software
- ▶ Real-time measurement and display of beam profiles during gantry rotation with OCTAVIUS 4D phantom*
- ▶ Record and playback function ("Movie" mode) for a quick analysis of the LINAC's startup behavior
- ▶ Profile and trend analysis

Options

- ▶ Universal Gantry Mount
- ▶ Positioning Phantom

QA Procedures

- 1 2 5 6 7 8 9 10 11 15

Detectors supported

- OCTAVIUS® Detector 729 / 729 *xdr*
- OCTAVIUS® Detector 1000 *SRS**
- 2D-ARRAY *seven29*® / *seven29 xdr*

* coming end 2013

✓ Dosimetry QA



All-in-one test device for daily dose monitor checks of a 10 cm x 10 cm field. With built-in sealed plane-parallel ionization chamber, auto functions and internal memory. Battery- or power-operated. Optional LinaSoft software for quick evaluation.

QA Procedures

- 1 2

✓ Dosimetry, MLC, Wedge QA



Water-equivalent RW3 slab phantoms in two different sizes (30 cm x 30 cm, 40 cm x 40 cm) for quality assurance and depth dose measurements in 1 mm increments up to a depth of 30 cm using PTW detectors or film. Consist each of 33 plates in four different thicknesses (1, 2, 5, 10 mm). Field and reference class electrometers, e.g., UNIDOS *weblin*®, optionally available.

QA Procedures

- 1 2 3 4 7 12 13 14

QA Procedures

Dosimetry QA

- 1 X-ray output constancy, all energies
- 2 Electron output constancy
- 3 Backup monitor chamber constancy
- 4 Typical dose rate output constancy
- 5 Photon beam profile constancy
- 6 Electron beam profile constancy
- 7 Electron beam energy constancy
- 8 X-ray output constancy vs gantry angle
- 9 Electron output constancy vs gantry angle
- 10 Electron and x-ray off-axis factor constancy vs gantry angle
- 11 Dose rate and symmetry over time (LINAC performance/startup behavior)
- 12 TBI/TSET output calibration

MLC QA

- 13 MLC transmission (average of leaf and interleaf transmission), all energies

Wedge QA

- 14 Wedge factor for all energies
- 15 Check of wedge angle for 60°, full field and spot check for intermediate angle, field size

Multiple applications – one interface: **MEPHYSTO® Navigator**



LINAC QA Solutions

Dosimetry, Mechanical, MLC, Wedge QA



STARCHECK®

High-Resolution Ionization Chamber Arrays for Advanced LINAC QA

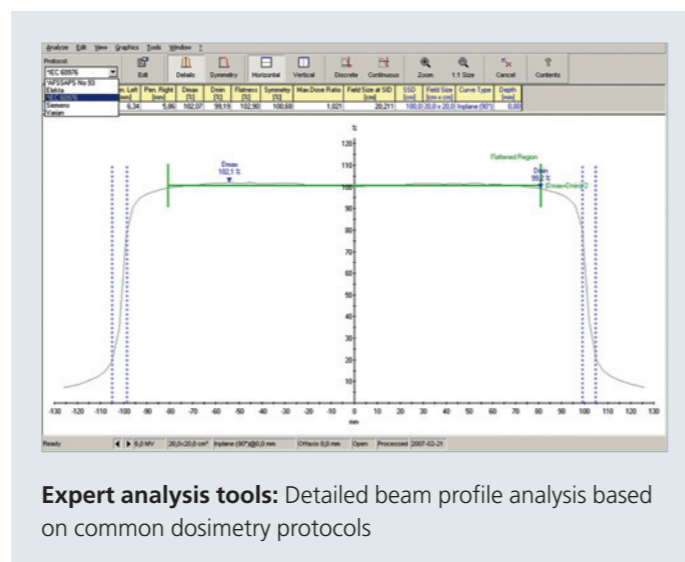
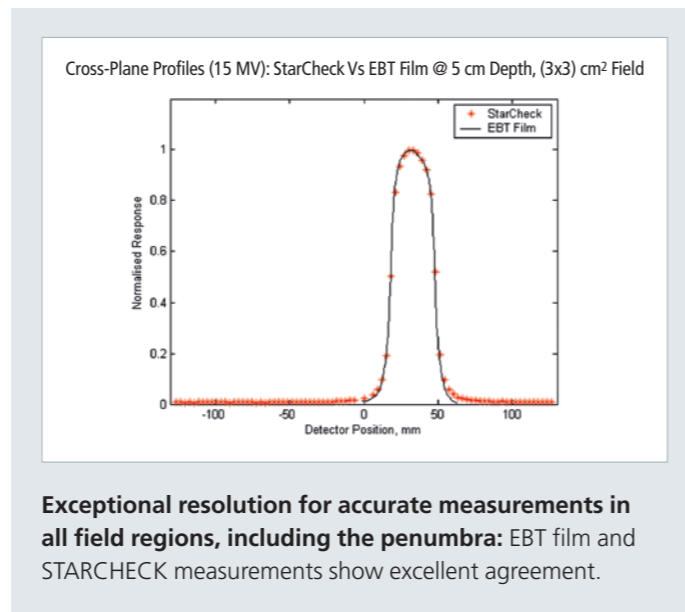
Key Features

- ▶ Comprehensive LINAC QA with one single device
- ▶ Fast, efficient acquisition of in-plane, cross-plane and diagonal beam profiles, including all profile parameters and absolute dose, in one single shot
- ▶ Highest spatial resolution (3 mm) of available arrays
- ▶ Robust Gold Standard ionization chambers
- ▶ Real-time measurement and display of beam profiles during gantry rotation with OCTAVIUS 4D phantom*
- ▶ 40 cm x 40 cm field measurements at clinically relevant 100 cm SSD with STARCHECK *maxi*
- ▶ High chamber voltage for precise measurements at reduced focus distance or of FFF beams
- ▶ Profile and trend analysis with MultiCheck LINAC QA software

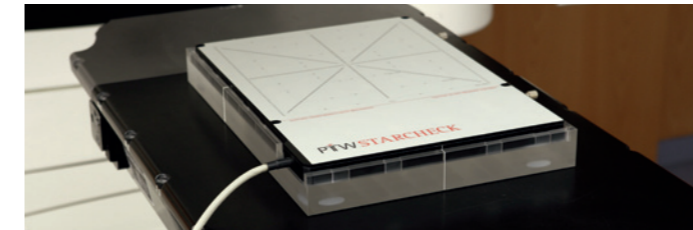
Options

- ▶ BQ-CHECK®
- ▶ FIELDCHECK
- ▶ SC Universal Gantry Mount
- ▶ PMMA or RW3 Build-up Plates

* coming end 2013



Systems



STARCHECK®

527 vented ionization chambers: 108 along each diagonal, 82 on each axis, one at the center, 106 for MLC checks, 40 for field size; field sizes (4 x 4 ... 26 x 26) cm²; dynamic range 0.05 - 80 Gy/min; dimensions 300 mm x 420 mm x 22 mm; weight 5.5 kg

STARCHECK *maxi*®

707 vented ionization chambers: 190 along each diagonal, 140 on G-T axis, 138 on L-R axis, one at the center, 48 for field size; field sizes (4 x 4 ... 40 x 40) cm²; dynamic range 0.05 - 80 (Gy/min); dimensions 465 mm x 740 mm x 30 mm; weight 13 kg

Optional Tools



Dosimetric QA phantom of 30 cm x 30 cm x 4.5 cm in size, with three wedges at the diagonal corners, used for simultaneous measurement of photon (two opposing aluminium wedges) and electron (one copper wedge) beam energy in combination with a STARCHECK system. Optional accessory plate for STARCHECK *maxi*.



Geometric phantom with four movable sliders for filmless light/radiation field QA. Used to verify the light and radiation field coincidence of a 10 cm x 10 cm and 20 cm x 20 cm field with an accuracy of 0.3 mm using a STARCHECK system. Optional accessory plate for STARCHECK *maxi*.

Designed by T. Perik, The Netherlands Cancer Institute NKI-AVL, Amsterdam.

QA Procedures

Dosimetry QA

- 1 X-ray output constancy, all energies
- 2 Electron output constancy
- 3 Photon beam profile constancy
- 4 Electron beam profile constancy
- 5 Electron beam energy constancy*
- 6 X-ray output constancy vs gantry angle
- 7 Electron output constancy vs gantry angle
- 8 Electron and x-ray off-axis factor constancy vs gantry angle
- 9 Dose rate and symmetry over time (LINAC performance/startup behavior)

Mechanical QA

- 10 Light/radiation field coincidence*

MLC QA

- 11 Coincidence of light field and radiation field (all energies)*

Wedge QA

- 12 Check of wedge angle for 60°, full field and spot check for intermediate angle, field size

* optional

Multiple applications – one interface: **MEPHYSTO® Navigator**



LINAC QA Solutions

Dosimetry, MLC, Wedge QA



MP3-M

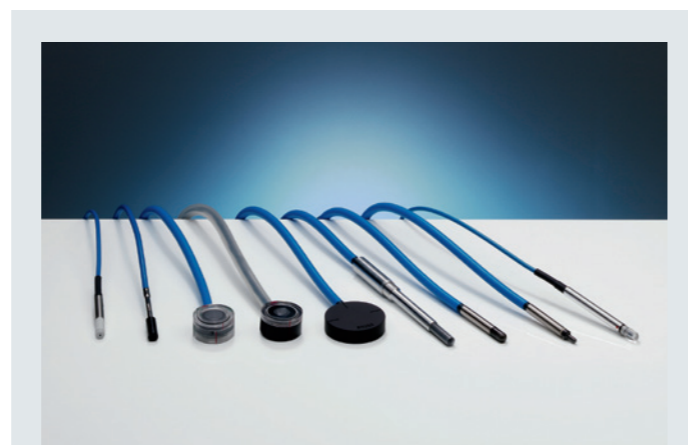
Multi-Purpose 3D Water Scanning System

Key Features

- ▶ Industry-leading, high-precision 3D water scanning system for relative and absolute dosimetry of field sizes up to 40 cm x 40 cm
- ▶ Complete, ready-to-use solution, including robust water tank with 50 cm x 50 cm scanning range, SCANLIFT carriage with built-in water reservoir and IEC 60731 compliant TANDEM electrometer
- ▶ Great choice of Gold Standard radiation detectors
- ▶ Patented TRUFIX system for quick axial and radial detector setup
- ▶ Consistent detector orientation for all scans, including off-axis scans
- ▶ Unique deconvolution algorithm for volume effect correction
- ▶ User-friendly MEPHYSTO mc² software with predefined RTPS task lists for fast operation and multiple measurement and analysis options, e.g., TPR

Options

- ▶ Radiation Therapy Detectors
- ▶ Reference Class Electrometers
- ▶ TPR/TMR Measurement
- ▶ LA48 Linear Ionization Chamber Array
- ▶ MLC QA
- ▶ Film Dosimetry
- ▶ MP1 for TG-51/TRS-398 QA
- ▶ Thin-Entrance Window



Widest range of application-specific detectors:
Ionization chambers, semiconductor diodes, Diamond detector



MEPHYSTO® Navigator: Intuitive user interface for a quick access to all relevant QA tasks and applications

Application-Specific Solutions



MP3

3D water scanning system with 60 cm x 50 cm x 41 cm scanning range for large field dosimetry

MP3-XS

3D water scanning system with 20 cm x 20 cm x 30 cm scanning range for stereotactic and CyberKnife® applications

MP3-XS IORT

3D water scanning system with 20 cm x 20 cm x 30 cm scanning range for IORT applications

MP3-T

3D water scanning system with 52 cm x 15 cm x 22 cm scanning range for helical TomoTherapy®

MP3-P

3D water scanning system with 35 cm x 38 cm x 25 cm scanning range for particle therapy units

MP2

2D water scanning system with 50 cm x 40 cm x 41 cm scanning range for linear accelerators and Cobalt teletherapy machines

MP1

Remote-controlled 1D water tank with 32 cm x 32 cm x 37 cm scanning range for TG-51 and TRS-398 QA

QA Procedures

Dosimetry QA

- 1 X-ray / electron output constancy
- 2 Backup monitor chamber constancy
- 3 Typical dose rate output constancy
- 4 Photon / electron beam profile constancy
- 5 Electron beam energy constancy
- 6 X-ray / electron flatness change from baseline
- 7 X-ray / electron symmetry change from baseline
- 8 X-ray / electron output calibration (TG-51)
- 9 Spot check of field size dependent output factors for x-rays (two or more field sizes)
- 10 Output factors for electron applicators (spot check of one applicator/energy)
- 11 X-ray beam quality (PDD₁₀ or TMR_{20/10})
- 12 Electron beam quality (R₅₀)
- 13 Physical wedge transmission factor constancy
- 14 X-ray / electron MU linearity (output constancy)
- 15 X-ray output constancy vs dose rate
- 16 PDD or TMR and OAF constancy (OAF = off axis factor)
- 17 Dose rate and symmetry over time (LINAC performance/startup behavior)
- 18 TBI / TSET output calibration

MLC QA

- 19 Leaf position accuracy (IMRT)*
- 20 MLC transmission (average of leaf and interleaf transmission), all energies

Wedge QA

- 21 Wedge factor for all energies
- 22 Check of wedge angle for 60°, full field and spot check for an intermediate angle, field size

* optional

LINAC QA Solutions

Mechanical, MLC QA



ISOCHECK

Film-Based Isocenter Verification

Solid QA phantom of 20 cm diameter to determine the location of the radiation isocenter of a LINAC using **star shot films**.

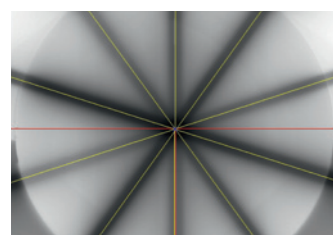
To obtain a star shot image, a film is inserted between the two 50 mm thick plates and exposed at different gantry angles. Size and position of the mechanical isocenter are marked beforehand on the film with the needle marker at the center. IsoCheck software for automated analysis of star shot films optionally available.

Options

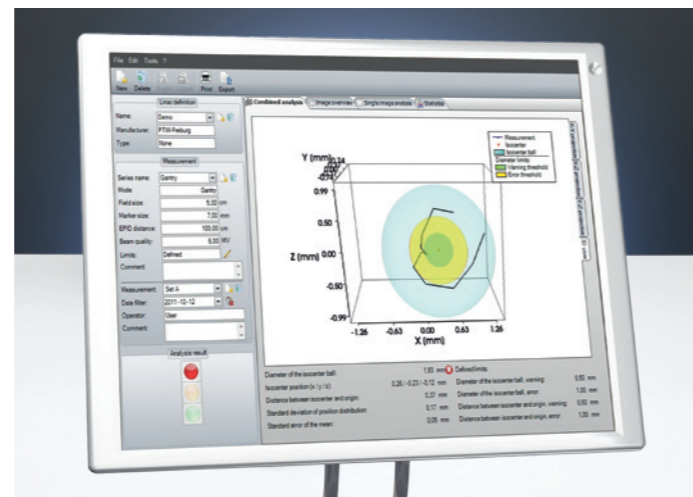
- ▶ IsoCheck Software

QA Procedures

- 2 4 9



▶ Automated star shot film analysis



IsoCheck^{epid}

EPID-Based Isocenter Verification

EPID-based QA software with 3D visualization and statistics tools for a fast, accurate verification of the mechanical and radiation isocenter coincidence of a LINAC using a **Winston-Lutz test**.

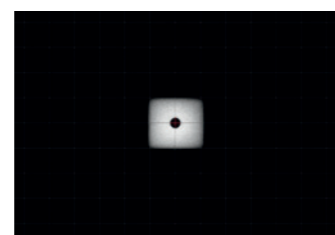
To obtain images for analysis, the optional radiopaque ISOBALL is placed at the mechanical isocenter of the LINAC and irradiated. The EPID images acquired are analyzed based on predefined tolerance levels. Single and multiple image analysis selectable.

Options

- ▶ ISOBALL Isocenter Marker

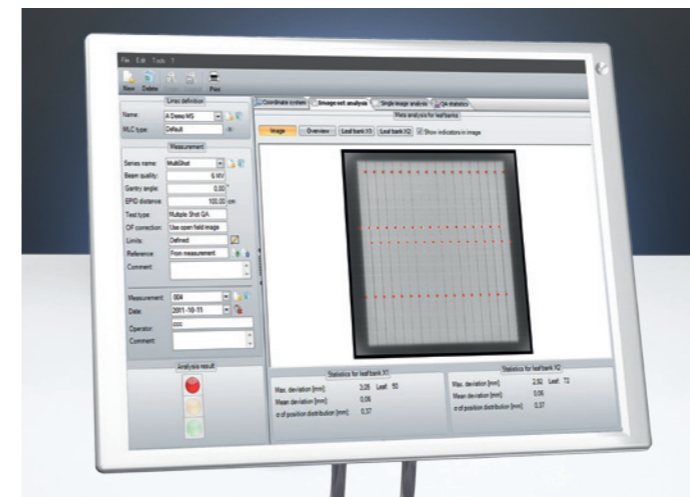
QA Procedures

- 1 2 3 4 9



▶ Single and multiple EPID image analysis

MLC QA



MLCSoft^{epid}

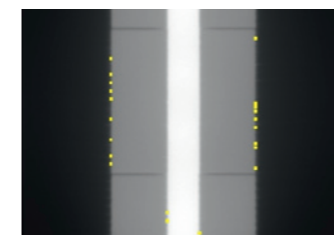
EPID-Based MLC QA

EPID-based MLC QA software with statistics tool which makes it possible to determine MLC leaf positioning accuracy accurately using a **"picket fence"** or other **MLC strip test** patterns.

For analysis, the leaf positions on a series of individually acquired EPID images are compared against a reference set of EPID images previously acquired. The highly precise Multiple Shot QA method permits detecting MLC position errors with an accuracy of fewer than 0.4 mm. Suitable for all common MLCs with more than one leaf width.

QA Procedures

- 5 6 7 8



▶ Two shot mode for daily QA

QA Procedures

Mechanical QA

- 1 Collimator rotation isocenter
- 2 Gantry rotation isocenter
- 3 Couch rotation isocenter
- 4 Coincidence of radiation and mechanical isocenter

MLC QA

- 5 Qualitative test (i.e., matched segments, "picket fence")
- 6 Setting vs radiation field for two patterns (non-IMRT)
- 7 Leaf position accuracy (IMRT)
- 8 Leaf position repeatability
- 9 MLC spoke shot

Multiple applications – one interface: **MEPHYSTO® Navigator**



Imaging QA Solutions

✓ MV (EPID) Imaging QA



EPID QC Phantom

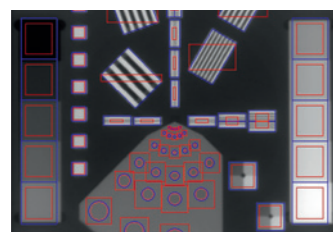
Turnkey Solution for Portal Imaging QA

Key Features

- ▶ Multiple test patterns provided in one single phantom
- ▶ Simultaneous check of all image quality parameters in one exposure: signal-to-noise ratio, low-contrast resolution, spatial resolution (MTF), linearity, geometric distortion
- ▶ High-resolution line pair patterns (0.125 to 3.33 lp/mm), arranged in diagonal, horizontal and vertical direction, for accurate MTF determination
- ▶ Focal spot geometry for best spatial resolution
- ▶ Automated image registration and analysis with baseline comparison and trending using optional epidSoft software
- ▶ Suitable for any EPID and imager

QA Procedures

1 2 3 4



▶ Automated or manual image registration

Optional epidSoft software with automated image registration and evaluation

Designed by Schmidt, Decker, Winkes, Rittler, Kretner and Herbig, Westfalzklinikum Kaiserslautern, Germany

✓ kV Imaging QA



NOMEX® Multimeter

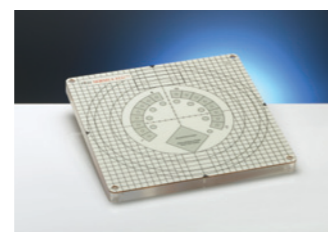
Turnkey Solution for Absolute Dosimetry and Quality Control in Diagnostic Imaging

Key Features

- ▶ PC-based dose measurement system for comprehensive kV x-ray dosimetry
- ▶ Small, lightweight, with built-in detectors for easy setup and fast operation
- ▶ All relevant beam parameters captured in one single exposure: dose/kV units, irradiation time, HVL, TF, waveforms
- ▶ Simultaneous assessment of image quality using optional NORMI RAD/FLU test object
- ▶ Autoranging for dose, kV and total filtration
- ▶ Statistical analysis

QA Procedures

5 6 7 8 9 10 11



▶ Simultaneous assessment of image quality

NOMEX Multimeter and NORMI RAD/FLU Set PMMA for simultaneous assessment of dose and image quality in one exposure

✓ Cone-Beam CT QA



NOMEX® Dosemeter

High-Precision Dosimeter for CBCT Dosimetry

Key Features

- ▶ Handheld, battery-operated dose measurement system for use in multiple x-ray modalities
- ▶ All relevant beam parameters captured in one single exposure, including dose length product (DLP)
- ▶ Large display with easy touch screen operation
- ▶ Dedicated CT chambers and phantoms for CBCT dosimetry (optional)
- ▶ Interface for connection of NOMEX Multimeter, external PTW ionization chambers or semiconductor detectors
- ▶ Statistical analysis

QA Procedures

12



▶ Additional dosimetric tools for CBCT dose measurement

Pencil-type CT chambers (10 cm, 30 cm long) and dedicated phantoms (body 32 cm Ø, head 16 cm Ø, combined) for CBCT dose measurement (and CTDI determination where applicable)

QA Procedures

MV (EPID) Imaging QA

- 1 Imaging and treatment coordinate coincidence
- 2 Spatial resolution (high-contrast resolution)
- 3 Contrast (low-contrast resolution)
- 4 Noise

kV Imaging QA

- 5 Imaging and treatment coordinate coincidence*
- 6 Scaling*
- 7 Spatial resolution*
- 8 Contrast*
- 9 Uniformity and noise*
- 10 Beam quality / energy
- 11 Imaging dose

Cone-Beam CT (kV/MV) QA

- 12 Imaging dose

* optional

Multiple applications – one interface: **MEPHYSTO® Navigator**



Quick Overview

LINAC QA

Choosing the right tool for your task

		MP3 Water Phantom	STARCHECK	LINAC QA for OCTAVIUS	QUICKCHECK ^{webline}	LINACCHECK	RW3 Slab Phantom	ISO-CHECK	IsoCheck ^{epid}	MLCSoft ^{epid}	EPID QC Phantom	NOMEX Multimeter	NOMEX Dosimeter
Dosimetry QA	X-ray output constancy (all energies)	•	•	•	•	•							
	Electron output constancy	•	•	•	•	•							
	Backup monitor chamber constancy	•											
	Typical dose rate output constancy	•											
	Photon beam profile constancy	•	•	•	•								
	Electron beam profile constancy	•	•	•	•								
	Electron beam energy constancy	•	▲	•	•								
	X-ray flatness change from baseline	•											
	X-ray symmetry change from baseline	•											
	Electron flatness change from baseline	•											
	Electron symmetry change from baseline	•											
	X-ray output calibration (TG-51)	•											
	Electron output calibration (TG-51)	•											
	Spot check of field-size dependent output factors for x-rays	•											
	Output factors for electron applicators	•											
	X-ray beam quality (PDD ₁₀ or TMR _{20/10})	•											
	Electron beam quality (R ₅₀)	•											
	Physical wedge transmission factor constancy	•											
	X-ray MU linearity (output constancy)	•											
	Electron MU linearity (output constancy)	•											
	X-ray output constancy vs dose rate	•											
	X-ray output constancy vs gantry angle			•	•								
	Electron output constancy vs gantry angle			•	•								
Electron and x-ray OAF constancy vs gantry angle			•	•									
PDD or TMR and OAF constancy	•												
TBI/TSET output calibration	•												
Mechanical QA	Light/radiation field coincidence		▲										
	Collimator rotation isocenter												
	Gantry rotation isocenter						•	•					
	Couch rotation isocenter												
MLC QA	Coincidence of radiation and mechanical isocenter						•	•					
	Qualitative test (e.g. "picket fence")									•			
	Setting vs radiation field for two patterns (non-IMRT)										•		
	Leaf position accuracy (IMRT)	▲									•		
	MLC transmission, all energies	•					•						
	Leaf position repeatability											•	
Wedge QA	MLC spoke shot						•	•					
	Coincidence of light field and radiation field (all energies)		▲										
	Wedge factor for all energies	•											
MV Imaging (EPID)	Check of wedge angle for 60°, full field and spot check for an intermediate angle, field size	•	•	•									
	Imaging and treatment coordinate coincidence										•		
kV Imaging	Spatial resolution										•		
	Contrast										•		
	Noise										•		
	Imaging and treatment coordinate coincidence											▲	
CBCT Imaging	Scaling											▲	
	Spatial resolution											▲	
	Contrast											▲	
	Uniformity and noise											▲	
	Beam quality/energy											•	
	Imaging dose											•	
CBCT Imaging	Imaging dose											•	

• supported ▲ optional

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