Particle Therapy QA Tools

A Complete Range of Tools for Reference Dosimetry, Machine QA and Patient Plan Verification

PTW THE DOSIMETRY COMPANY

About Particle Therapy

More and more particle therapy centers, especially proton therapy centers, are being established to optimize radiation treatment for cancer patients.

In contrast to photons and electrons, protons or heavier particles exhibit improved accuracy for absorbed dose deposition due to the physical properties of these particles, such as limited scattering and a sharply defined maximum range. The depth of the target volume can easily be matched by means of the spread-out Bragg peak method, varying the energy of the particle beam.

Although most dosimetry tools used in classical radiotherapy centers can also be used in particle therapy centers, there are some specific requirements that are to be addressed. Modern beam scanning systems typically come with gantry systems, and as the beam energy is a very crucial quantity, the requested scanning precision may be higher than in classical radiotherapy.

The main standards dealing with particle therapy QA are IAEA's TRS-398 as well as the AAPM's TG-224 report.

Machine QA

Reference Dosimetry

UNIDOS® Tango - The Smart Reference Class Electrometer

The UNIDOS® Advantage

- Reference class confidence – meets and exceeds IEC 60731, JSMP and IPEM device requirements
- Intelligent Detector Recognition (IDR) for automated detector management and identification
- User profiles for frequent measurement tasks
- Statistical calculations of your measurements immediately available
- Comprehensive detector database with ready-to-use templates
- Auto start/stop with auto reset
- Touchscreen and remote operation via LAN or WiFi

Options

- MP1 1D Water Phantoms
- Stationary Water Phantom (T41023)
- RW3 Slab Phantom (T41023)
- BeamDose 1.3 Software
- Track-it QA Data Management Software

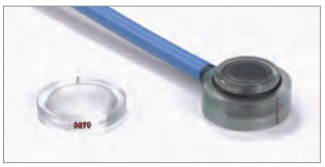
DESIGN AWARD 2021

Radiation Detectors for Reference Dosimetry

PTW Farmer® (30010*, 30013)
Volume: 0.6 cm^3
Field size:
(5 x 5) cm^2 … (40 x 40) cm^2
*non-waterproof

Semiflex 3D Chamber (31021)
Volume: 0.07 cm^3
Field size:
(2.5 x 2.5) cm^2 … (40 x 40) cm^2

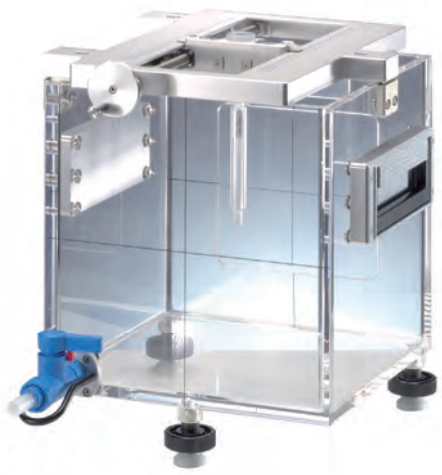
PinPoint 3D® Chamber
(31022)
Volume: 0.016 cm^3
Field size:
(2 x 2) cm^2 … (40 x 40) cm^2



Advanced Markus® Chamber
(34045)
Volume: 0.02 cm^3
Field size:
(3 x 3) cm^2 … (40 x 40) cm^2

Available Phantoms

MP1 1D Water Phantoms (T41019/T41025)
for reference dosimetry and measurement of depth dose curves, motorized or manual



Stationary Water Phantom (T41023)
for reference dosimetry with horizontal beam incidence

RW3 Slab Phantom (T29672)
water-equivalent for therapy dosimetry

Relative Dosimetry

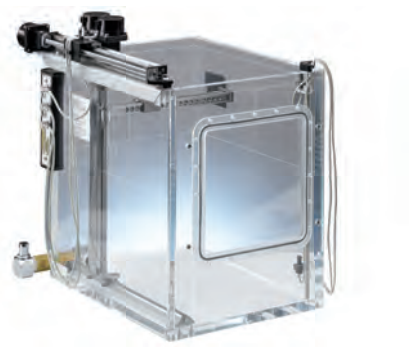
Water Phantoms

MP3-P and MP3-PL

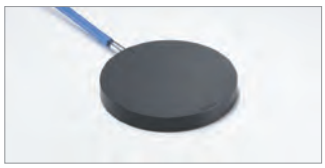
Hi-Tech 3D Water Phantom Solution for Particle Therapy Treatment Machines

Highlights

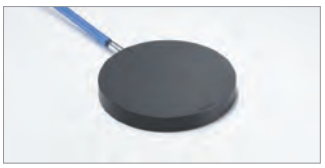
- Versatile, application-specific solution, perfectly adapted to beam commissioning and QA requirements of particle therapy applications
- Appropriately sized, fully automatic 3D water tanks with parallel walls and a thin exchangeable entrance window for precise horizontal beam measurements
- The scanning ranges for the MP3-P and MP3-PL are 380 mm vertically and 350 mm horizontally and 405 mm vertically and 500 mm horizontally, respectively
- Detector positioning accuracy true to 0.1 mm
- State-of-the-art TANDEM XDR dual-channel field class electrometer with extended measurement range also suitable for reference dose measurements
- Full line of accessories, including specially designed water tank, for true one-stop convenience
- Powerful BeamScan software with intuitive Navigator user interface and customizable multiple-queue drag & drop task lists
- Available on a SCANLIFT water reservoir and carriage



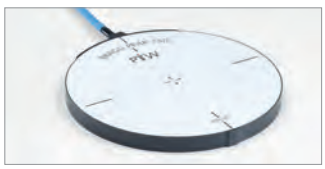
Radiation Detectors for Relative Dosimetry



Bragg Peak Chamber (34070)
Active diameter: 81.5 mm
Field size:
diameter 3 ... 10 mm



Bragg Peak Chamber (34080)
Active diameter: 81.5 mm
Field size:
diameter 3 ... 10 mm



Bragg Peak 150 (34089)
Active diameter: 147 mm
Field size:
diameter 3 ... 10 mm

microDiamond® (60019)
Volume: 0.004 mm^3
Field size:
(1 x 1) cm^2 … (40 x 40) cm^2

PinPoint® 3D Chamber
(31022)
Volume: 0.016 cm^3
Field size:
(2 x 2) cm^2 … (40 x 40) cm^2

Semiflex 3D Chamber (31021)
Volume: 0.07 cm^3
Field size:
(2.5 x 2.5) cm^2 … (40 x 40) cm^2

Array Detectors

OCTAVIUS Detector 1500 XDR and 1600 XDR

- Suitable for patient plan verification and machine QA of proton and heavy ion beams
- Outstanding detector and matrix design:
  - 1405 vented cubic ion chambers, uniformly arranged on a 27 cm x 27 cm matrix (1500 XDR)
  - 1521 vented cubic ion chambers, arranged on a 15 cm x 15 cm matrix (1600 XDR)
- Detector spacing:
  - 7.1 mm center-to-center, diagonals (1500 XDR)
  - 2.5 mm center-to-center central 6.5 cm x 6.5 cm area, 5 mm center-to-center outer 15 cm x 15 cm area (1600 XDR)
- No aging effects by utilizing gold standard ionization chamber technology
- Absolute dose calibration in ^{60}Co beam
- Supported by the measurement and evaluation software programs VeriSoft, MultiCheck and BeamAdjust

The OCTAVIUS Detectors 1500 XDR and 1600 XDR are high resolution ion chamber matrix arrays for patient plan verification and quality control in radiation therapy with protons or heavy ions. Utilizing ion chambers avoids radiation defects, the major drawback of solid-state detectors. The vented plane-parallel ion chambers are 4.4 mm x 4.4 mm x 3 mm (1500 XDR) and 2.5 mm x 2.5 mm x 2 mm (1600 XDR) in size. The square chamber design of the OCTAVIUS Detector 1500 XDR offers 50 % field coverage and the design of the OCTAVIUS Detector 1600 XDR offers unique 100 % field coverage in the central region. Read out cycles of 100 ms provide the basis for real-time analysis of beam profiles.

Pencil Beam Specific Tasks

PQASoft Machine QA Software

Highlights

- Source independent analysis software. Works with TIFF, DICOM and MCC image formats
- Works with PTW's OCTAVIUS Detector 1500 XDR and 1600 XDR array detectors for a powerful, complete solution
- User-defined reference parameters, thresholds and/or tolerances
- Integrated tracking and trending tool
- Automatic PDF format result documentation
- Export capability, integration with PTW Track-it software

PQASoft is a software to check the consistent performance of pencil beam scanning systems in particle therapy. It has been designed for easy e.g. daily checks of beam properties, i.e. beam positioning, spot size and shape, field flatness and energy constancy.

Machine QA Solutions from DE.TEC.TOR

The company DE.TEC.TOR - Devices & Technologies Torino has specialized in the design and manufacturing of high-quality devices for precise monitoring and verification of therapeutic particle beams. Their portfolio comprises a variety of dedicated tools for fast, reliable and ultra-precise QA measurements – from quick verifications of Bragg peaks and spread-out Bragg peaks (SOBP) during weekly and monthly quality assurance to beam characterization tests to spot characterization, as well as machine QA.

QUBENEXT is an MLIC-detector for the measurement of depth dose curves to get the full QA characterization of your beam. The base version contains 4 modules allowing a measuring depth of 77 mm WET (2.4 mm physical resolution). The sensitive area is 127 mm x 127 mm. Additional modules for a WET of about 300 mm max and an xy-detector-add-on are available.

AQURACY is a detector for spot characterization and measures radiation characteristics in a single beam shot. The data comes from a 50 mm diameter scintillating screen and CCD camera. The resolution is 10 µm.

QEYE is a multi-layer detector for range and modulation verification in ocular tumor therapy. It is a device to measure depth dose curves to a depth of 60 mm WET. The resolution is 120 µm resolution and the diameter of the sensitive area is 80 mm.

NEXTQ is an all-in-one, accurate device to speed up QA procedures by measuring beam characteristics (intensity and lateral profiles) in a single beam shot. It consists of x and y strip ionization chambers with a physical resolution of 1 mm, and an integrating chamber. The sensitive area is 127 mm x 127 mm.

QPLUS is a detector to measure radiation characteristics in a single beam shot. It consists of a dots array to identify the beam center by measuring the particle flux and can replace the use of Gafchromic films for 2D spot characterization. The sensitive area is 38 mm x 38 mm with a dot pitch of 0.6 mm.

PINQ is a detector for large area spot scanning measurements. It has a sensitive area of 320 mm x 420 mm and a physical resolution of 2.5 mm. It has an additional unsegmented electrode to do integral measurements.

FLASHQ is a new ground-breaking device for Flash proton therapy, designed to measure beam characteristics (intensity and lateral profiles) during ultra-high dose rate machine QA. The physical resolution is 1 mm and the sensitive area is 128 mm x 128 mm.

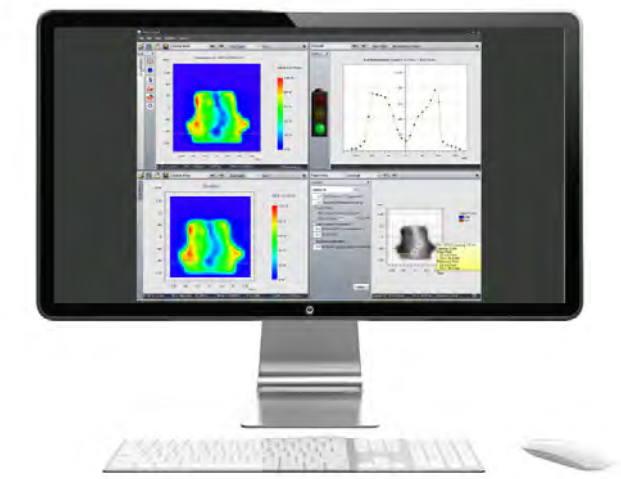
FLASHDOSE is a large field detector for conventional and Flash proton therapy. It is designed to measure beam characteristics during machine QA. The physical resolution is 3 mm and the sensitive area is 330 mm x 330 mm.

Patient Specific QA

VeriSoft - Patient Plan Verification Software

Highlights

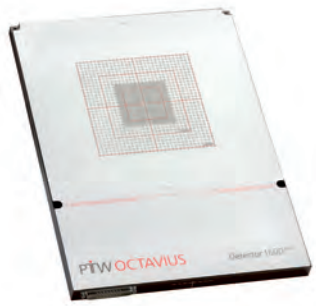
- Patient plan verification software with advanced tools for measurement, dose comparison and evaluation
- Supports the use of all available PTW OCTAVIUS detectors necessary to verify treatment plans, including OCTAVIUS Detector 1500 XDR and OCTAVIUS Detector 1600 XDR
- Provides powerful 3D dose distribution comparison and evaluation tools to compare a treatment plan with a pre-treatment phantom measurement



VeriSoft is a patient plan verification software with advanced tools for measurement, dose comparison and evaluation.
In addition to all standard comparison tools, VeriSoft gives you a full range of advanced tools for the comparison in axial, sagittal and coronal planes.

Array Detectors

For details on the array detectors, see page 5



Accessory

Holder (T40065)
This holder allows the positioning of the OCTAVIUS array detectors with a variable number of RW3 buildup plates so that patient verification measurements can be done for gantry angles 0°, 90°, 180° or 270° at depths adjustable in 1 mm steps. The RW3 phantom (T29762) is required.

Patient Positioning and End-to-End Testing

RUBY Phantom

Perform integrated tests of the entire treatment chain from imaging to treatment planning and verification with one basic phantom. Add and expand QA capabilities when needed. As the new modular phantom platform for radiotherapy QA, RUBY comes with a variety of exchangeable, application-specific inserts that satisfy all test requirements in a modern treatment facility.

PTW Products for TG224 QA Procedures

Daily QA **Dosimetry**	MP3-P/PL	PQASoft	OCTAVIUS Array Detectors	Ionization chamber with e.g. solid or water phantom	RUBY	QUBENEXT	NEXTQ/PINQ	AQURACY	QEYE	QPLUS
Output constancy	x		x	x	x	x	x			
Depth verification	x					x			x	
Distal	(x)					x			x	
Proximal	(x)					x			x	
SOBP width (DS/PS/US)	(x)					x			x	
Spot position		x	x			(x)	x	x		x
Mechanical										
Couch translation motion			x		x					
Lasers position accuracy			x		x					
Imaging										
X-ray vs Laser isocenter					x					
Optional										
Field width	x		x			(x)	x			
Proximal depth verifcation	(x)					x			x	
SOBP width	(x)					x			x	
Field symmetry	x	x	x				x			
Field flatness	x	x	x				x			
Dose rate	x		x	x						

Only TG-224 items that are covered are mentioned.

Monthly QA

Dosimetry	MP3-P/PL	PQASoft	OCTAVIUS Array Detectors	Ionization chamber with e.g. solid or water phantom	RUBY	QUBENEXT	NEXTQ/PINQ	AQURACY	QEYE	QPLUS
Output constancy	x		x	x	x	x	x			
Field symmetry	x	x	x				x			
Field flatness	x	x	x				x			
Range	(x)					x			x	
Spot size		x	x			x	x	x	x	x
Mechanical										
Couch translational accuracy			x		x					
Couch rotational accuracy					x					

Annual QA

Dosimetry	MP3-P/PL	PQASoft	OCTAVIUS Array Detectors	Ionization chamber with e.g. solid or water phantom	RUBY	QUBENEXT	NEXTQ/PINQ	AQURACY	QEYE	QPLUS
Standard output calibration	x			x		x				
Range verification	x					x			x	
SOBP width (DS/PS/US)	(x)					x			x	
Depth doses verification	x					x			x	
Lateral profile penumbra	x		x			(x)	x	x		x
Range uniformity	x					x			x	
Field symmetry	x	x	x			(x)	x			
Field flatness	x	x	x			(x)	x			
Spot position		x	x			(x)	x	x		x
Spot size		x	x			(x)	x	x		x
Uniformity of spot shapes		x	x			(x)	x	x		x
Monitor chambers:										
Linearity	x			x		x	x			
Reproducibility	x			x		x	x			
Verification of daily QA Eq.	x									
Cross calibration of field chambers	x			x		x	x			

Only TG-224 items that are covered are mentioned.

Dosimetry Pioneers since 1922.

PTW is a global market leader for dosimetry and quality control solutions in radiation medicine, serving the needs of medical radiation experts in more than 160 countries worldwide. Starting with the famous Hammer dosemeter in 1922, the German manufacturer is the pioneer in medical radiation measurement, known for its unparalleled quality and precision.

For PTW, making medical radiation safer is both a passion and lifetime commitment. The family-run high-tech company operates the oldest and largest accredited calibration laboratory in the field of ionizing radiation and established THE DOSIMETRY SCHOOL to globally promote the exchange of knowledge in clinical dosimetry.

For more information on our products visit ptwdosimetry.com or contact your local PTW representative: ptwdosimetry.com/en/contact-us/local-contact

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