Beyond Commissioning:

Five Reasons to Use BEAMSCAN[®] Water Phantoms for Reference Dosimetry and Regular QA Tasks

Gy

1.002



Introduction

Medical physicists around the world rely on the PTW BEAMSCAN® Water Phantom for linac commissioning because of its fast, automated setup and precise results. BEAMSCAN cuts commissioning and QA time in half, while delivering accurate, high-quality beam data. Because all electronics and cables are built directly into the system, operators can install a BEAMSCAN water phantom in less than 12 minutes. In addition, BEAMSCAN provides value beyond exceptional commissioning capabilities. Its all-in-one design along with wireless operation allow incredibly fast assembly and disassembly times. Thanks to innovative functions such as automatic setup, fast scanning, and Albased data processing, BEAMSCAN water phantoms can save much time and effort in the clinical work you do every day.

This eBook presents five reasons to use BEAMSCAN water phantoms for routine QA tasks in addition to linac commissioning:

- 1. Easy reference dosimetry
- 2. Accurate small-field dosimetry
- **3.** Accurate and easy use for every operator
- 4. BEAMSCAN fits all major linacs
- 5. Advanced automated features prevent errors

1. Easy Reference Dosimetry

Medical physicists usually perform reference dose measurements with a small 1D water phantom or a waterequivalent slab phantom because using traditional large water phantoms takes too much time to set up for weekly or biweekly operations.

However, the BEAMSCAN water phantom is actually easier and faster to use for reference dosimetry than a 1D water phantom because all relevant setup procedures are fully automated. There is no manual water filling, no manual alignment, and no manual positioning of the detector.

As a built-in system, BEAMSCAN is ready for measurement in less than 12 minutes. With only one cable to connect, there are no cable runs and no external devices to install. Users simply move BEAMSCAN into the treatment room, roughly align and position it to the linac, plug in the power cable, set the source-to-surface distance (SSD) and clip in the detector using the TRUFIX® detector positioning system. The patented clip-in TRUFIX system is designed for fast, simple mounting and positioning of the detector both vertically and horizontally in the BEAMSCAN water phantom. The TRUFIX system accurately positions the effective point of measurement (EPOM) of the field detector to the water surface, enabling a quick detector exchange without readjustment of the EPOM. For some protocols, such as IAEA TRS-398, AAPM TG-51, or IPEM, a position correction is required. The necessary shift can be selected and applied remotely using BeamDose software, an optional module that simplifies point dose measurements in a PTW water phantom.

Temperature and pressure, which are required for accurate dose determination, need not be measured manually. BEAMSCAN water phantoms allow for automatic air density correction using the included temperature sensor, which measures the temperature directly in the water phantom, and a built-in atmospheric pressure sensor.

> BEAMSCAN is easier and faster to use for reference dosimetry than a 1D water phantom because there is no manual water filling, no manual alignment, and no manual positioning of the detector.

PTWBEAMSCAN

The BEAMSCAN water phantom can also be easily paired with a UNIDOS reference-class electrometer.



Tip:

Choosing the right detector is key for accurate dose measurements in water. PTW helps you find the best detector for a specific application.



PTW Detector Selector Check our online selection tool

(1)



Educational Webinar "How to choose the best detector for your water phantom" Watch webinar In addition, BEAMSCAN water phantoms come equipped with a highly sensitive built-in dual-channel electrometer, which is compliant with IEC 60731. Detectors and electrometers can be controlled remotely using BeamDose software, allowing precise detector positioning at any depth. This eliminates the need for operators to repeatedly enter the linac treatment room to make necessary depth adjustments.

Users simply move the detector to the desired measurement depth via the software and start measurement from a remote PC or laptop. BeamDose software automatically calculates the dose at the defined measurement position and also enables the export of measurement values to the Track-it QA data management platform for documentation and efficient monitoring.

Users can also easily pair the detector with a UNIDOS® Tango or UNIDOS® Romeo standalone reference-class electrometer, and use the included BEAMSCAN "Detector Positioning" software tool to remotely position the detector in the BEAMSCAN water phantom at the desired measurement positions. Measurements are started via the electrometer, which features a large, intuitive touchscreen display and a suite of versatile functions, including statistical calculations, making day-to-day operation easy.

Overview:

Eight features which also make BEAMSCAN water phantoms a perfect choice for reference dosimetry and routine QA



Step by Step:

How to quickly perform reference dose measurements with the BEAMSCAN water phantom



If you use a UNIDOS Tango or Romeo electrometer, follow the same procedure, but connect the cable of your field detector to the electrometer via an extension cable.



Move the BEAMSCAN water phantom into the treatment room. Roughly align it to the linac using the in-room lasers and plug in the power cable. Access the BEAMSCAN Wizard from your smart device and start "Reference Run."



Set the source-to-surface distance (SSD) using the click-fix SSD adjustment tool and the lift.



3.

Clip in the TRUFIX holder with your field detector, e.g., a PTW Farmer[®] ionization chamber. The TRUFIX system positions your field detector precisely at EPOM. Then slide the reference detector into the holder and connect the detector cables to the socket of the water phantom.



Start automatic water filling and leveling via BEAMSCAN Wizard.

Move into the control room and start "Auto Setup" in the BEAMSCAN software. Turn on the linac, then complete the two remaining steps of the auto setup–CAX and rotational correction.

BEAMSCAN is ready for measurement in less than 12 minutes.



Start the BeamDose software module, select the detector and electrometer to be used, move the detector to the desired measurement position, then start measurement. The result will be displayed immediately in the BeamDose software.



2. Accurate Small-Field Dosimetry

In small-field dosimetry, the gantry angle of the linear accelerator can be imprecise because of gantry sag, causing deviations in profiles and percentage depth dose curves (PDD). This deviation leads to beam inclination, which can be identified and automatically corrected when using the integrated beam inclination correction function as shown in the figures below.



Fig. 1: Before correction

Imprecise gantry angles or gantry sag of the linear accelerator can lead to deviations in PDD and profiles, particularly of small fields. The above figure shows the shift of the detector from the beam center before "Beam Inclination Correction" is applied, resulting in inaccurate profile and PDD measurements. In addition, positioning uncertainties caused by the collimator (e.g., yaws) can lead to slight shifts of the field center, resulting in imprecise output factor measurements, especially in small fields. BEAMSCAN helps to measure output factors in small fields by automatically positioning the detector in the dosimetric field center using the "Dose Max Search" function.

2° tilted beam

POSITION

Fig. 2: After correction

POSITION

The "Beam Inclination Correction" detects the inclination of the beam and measures PDD and profiles along the tilted beam. The beam inclination angles are calculated from in-plane and cross-plane profile measurements performed at two different depths and can be automatically applied to all subsequent measurements.



PTW also offers the largest diversity of dedicated small-field detectors in the industry, including the widely used microDiamond[®], microSilicon[®] and PinPoint[®] 3D, allowing users to choose the most suitable detector for specific measurement tasks. All components – from phantom and electrometer to detectors, holders and connectors – are precisely matched to achieve the maximum accuracy required for small-field dosimetry.

microDiamond® Detector

Gold standard diamond detector for small-field dosimetry in radiation therapy

Volume:0.004 mm³Field size:5 cm² to 40 cm²Energy range:100 keV to 50 MV photons6 to 25 MeV electrons70 to 230 MeV protons

PinPoint[®] 3D Chamber

Ultra-small cylindrical ionization chamber with high spatial resolution and true 3D characteristics

Volume:0.016 cm³Field size:2 cm² to 40 cm²Small fields:down to 0.8 cm²Energy range:60Co to 25 MV photons

microSilicon® Diode

Small silicon diode with excellent spatial resolution

Volume: 0.03 cm³ Field size: 1 cm² to 40 cm² for electrons 1 cm² to 10 cm² for photons Energy range: 6 to 25 MeV electrons ⁶⁰Co to 25 MV photons

T-REF Chamber

As a thin, plane-parallel transmission chamber with a large diameter, which is easily mounted on the edge of the water phantom, the T-REF chamber is the perfect reference detector for fast small-field PDD and profile measurements in a water phantom. It eliminates perturbation effects and requires no repositioning, saving users multiple trips into the treatment room.

Tip:

Is a diode the best choice for small-field dosimetry? Which criteria are important to get accurate and reliable measurement results? Get answers to this and other questions in the recent edition of our Application Guide for Small-Field Dosimetry.



 WATER SURFACE

 WATER SURFACE

 WATER SURFACE

 MALTER

 MALTER

 FELD DETECTOR

3. Accurate Results & Easy Use for Every Operator

The manual setup of a traditional water phantom by several users can lead to an inter- and intra-user variability in the process. This can result in measurements that are not precise or reproducible.

Because of its advanced automated features and functionalities, the BEAMSCAN is ideal for multiuser environments. Installation is identical for each operator, which ensures that measurement data is always comparable and reproducible.

No BEAMSCAN experience is needed, and practically every user can prepare measurements from the start. Operators simply access the built-in BEAMSCAN web server using any mobile device, e.g., a tablet or smartphone, and start the interactive BEAMSCAN Wizard. This automated stepby-step guide enables intuitive, wireless phantom setup in the treatment room, from reference run to water filling and leveling.

"The interactive BEAMSCAN Auto Setup Wizard can be accessed from any mobile device, even your smartphone."





A key element of the BEAMSCAN Auto Setup is the patented automatic TRULEVEL[™] function, which completes leveling in just two minutes. TRULEVEL aligns the scanning axes of the water phantom virtually to the water surface without physically moving the phantom or scanning arms. Using a three-point measurement and mathematical coordinate transformation, the three scanning axes of the phantom are aligned exactly perpendicular and parallel to the water surface.

They are controlled via the firmware of the BEAMSCAN system, which transfers movements of the virtual coordinate system to the scanning axes of the water phantom. Leveling is thus fully automated eliminating the need for users to shift the water phantom or the scanning mechanism mechanically or electromechanically, e.g., by using a leveling platform. By removing any physical interaction, the TRULEVEL function reduces common error sources, ensures accurate, reproducible results independent from the operator, and eliminates time-consuming corrections or postprocessing.

In addition, automated CAX and rotational corrections ensure that the BEAMSCAN coordinate system is perfectly aligned with the coordinate system of the linear accelerator and precisely leveled to the water surface.

This fully automated setup, along with the simple clip-in TRUFIX system for accurate positioning of any PTW detector at EPOM, makes BEAMSCAN an efficient tool for any medical physics team to use.

"A key element in particular is the automatic TRULEVEL[™] function, which completes leveling in two minutes, without intervention from the user."

Tip:



What is the BEAMSCAN Auto Setup? How does it work? Watch video

Overview:

Four automated features for everyday and everyone's use











The clip-in TRUFIX detector mounting system positions the effective point of measurement (EPOM) of the field detector exactly to the water surface, ensuring that the detector is always in the correct position for scanning. By default, it uses the EPOM definition of DIN 6800-2 (half of the radius above the chamber axis). For some protocols, e.g., IAEA TRS-398, AAPM TG-51 or IPEM, a position correction is required. The necessary shift can be selected and applied remotely using BEAMSCAN software.



BEAMSCAN water phantoms use a highly precise mathematical algorithm for leveling. Leveling is fully automated without human involvement or intervention and completed in two minutes. The patented TRULEVEL function measures the water surface at three points and calculates a virtual coordinate system by means of a coordinate transformation. Movements in the virtual coordinate system are transferred to the scanning axes of the water phantom via the system's firmware.



For correct measurements, the water phantom needs to be properly aligned to the coordinate system of the linac. The "Beam Center Adjustment" function detects and automatically corrects for CAX shift between the coordinate systems of the water phantom and the linac. To calculate the offset from the central axis, it determines the center of a defined field size by measuring an in-plane and a cross-plane profile at a defined measuring depth.



The "Auto Field Alignment" function automatically detects and corrects rotation between the coordinate systems of the water phantom and the linac by calculating the rotation angle. To calculate the rotation angle, it measures two off-axis profiles at a defined measuring depth.

4. BEAMSCAN Fits All Major Linacs

BEAMSCAN water phantoms can be used with all major linac types – Varian, Elekta or CyberKnife[®] – without any restrictions.

Using BEAMSCAN with Varian's Halcyon® or Ethos® linac requires only a simple hardware add-on upon installation. A unique feature of the Halcyon and Ethos accelerators is a ring-mounted gantry, which differs from conventional C-arm accelerators on the market. This design presents special challenges for beam commissioning and QA measurements because it is not possible to retract the couch and move the entire water phantom directly into the radiation field.

However, with BEAMSCAN, you can disconnect the water phantom and place it on the couch. Operators simply lift the water phantom to the same height as the couch, unlock the Halcyon base plate, slide the phantom onto the couch, turn it by 180°, then connect the water hose. An equally important feature of the BEAMSCAN phantom, which makes it suitable for use with ring-mounted gantries, is its ability to compensate for couch pitch and tilt caused by the phantom's weight when moving the couch inside the bore. With its patented TRULEVEL function, BEAMSCAN is the only system capable of leveling the phantom on the couch without requiring additional tools or physical intervention from the user.

Thanks to its simple handling and automated features, BEAMSCAN can be used with ease and efficiency on the Halcyon linac, taking less than 20 minutes for a complete setup.

Current BEAMSCAN users can easily upgrade to the Halcyon option with a specially designed component package from PTW that is fast and easy to install. New BEAMSCAN users can buy the Halcyon option directly.



With the BEAMSCAN water phantom, clinics need only one water phantom for their linear accelerators – including Varian's Halcyon® and Ethos®.

Tip:

How can you set up BEAMSCAN for measurement in a ring-mounted gantry?



Watch video

Listen to podcast



Download case study

BEAMSCAN Water Phantoms: Equally efficient for Halcyon[®] and Ethos[®] Linacs

"The Auto Level function is a massive time saver with the Halcyon LINAC. All initial scanning was completed with ease, and the results spoke for themselves. From setup to results, the BEAMSCAN system performed well. We are very happy with our decision and would make the same decision if faced with a similar situation." Jonathan Haynes, BUSAMED Hillcrest Oncology Centre, South Africa





Lift the BEAMSCAN water phantom to the same height as the couch. Unlock the Halcyon linac base plate, slide the phantom onto the couch, turn it by 180°, then connect the water hose.



Align

Align the BEAMSCAN water phantom to the lasers, mount the detectors, then move the phantom into the linac bore. Start the BEAMSCAN Auto Setup from your mobile device. It will perform all setup tasks from water filling to leveling inside the bore fully automatically,

without any manual interventions.

Run Wireless

Auto Setup





Complete the remaining steps which require radiation from the control room – no further corrections needed.

5. Advanced Automated Features Prevent Errors

Preventing dosimetry errors is vital for accurate linac performance. BEAMSCAN water phantoms include a host of advanced automated features that reduce errors and deliver accurate functionality for every application.

The BEAMSCAN wireless auto setup via any mobile device performs a reference run, zero positioning, water filling and virtual leveling automatically, thereby reducing the risk of setup and positioning errors caused by human intervention. It also helps to eliminate intra- and interuser variability. In addition, automatic CAX and rotational corrections eliminate the need for manual calculations and adjustments.

A water sensor controls the filling pump, so the water level is always correct, every time for every user. Evaporation is common particularly with commissioning measurements. BEAMSCAN also has a water level measurement reminder, so users know when to check for evaporation that can affect performance accuracy. The inclined bottom of the BEAMSCAN ensures that the phantom is completely drained after scanning to prevent deposits or rust on the scanning mechanism or algae growth in the water phantom.

The clip-in TRUFIX detector holder positions any PTW detector exactly at the effective point of measurement (EPOM), requiring no further adjustment. Detectors can also be quickly exchanged without having to readjust the EPOM.

Detector and treatment machine libraries give users immediate access to specific operation details, such as calibration factors and bias for their detector, for all brands of equipment. Default settings can thus be easily changed when needed – eliminating the need to search different locations.

Temperature and pressure, essential for accurate dose determination, no longer need to be measured and entered manually. BEAMSCAN is equipped with temperature and atmospheric pressure sensors, enabling automatic air density correction, which saves time and eliminates an additional source of error.



BEAMSCAN water phantoms include a host of advanced automated features that reduce errors and deliver accurate functionality for every application.



Conclusion

BEAMSCAN provides the same high accuracy and efficiency for reference dosimetry and regular QA tasks as it does for standard linac and especially small-field commissioning. This ensures fast, easy and precise operation, which medical physicists use with confidence every day.

To learn more about BEAMSCAN water phantoms visit **www.PTWBEAMSCAN.com.**



©PTW 10/2024. All rights reserved. Due to continuous innovation, product specifications are subject to change without prior notice. All trademarks mentioned in this document are the trademarks of their respective owners.