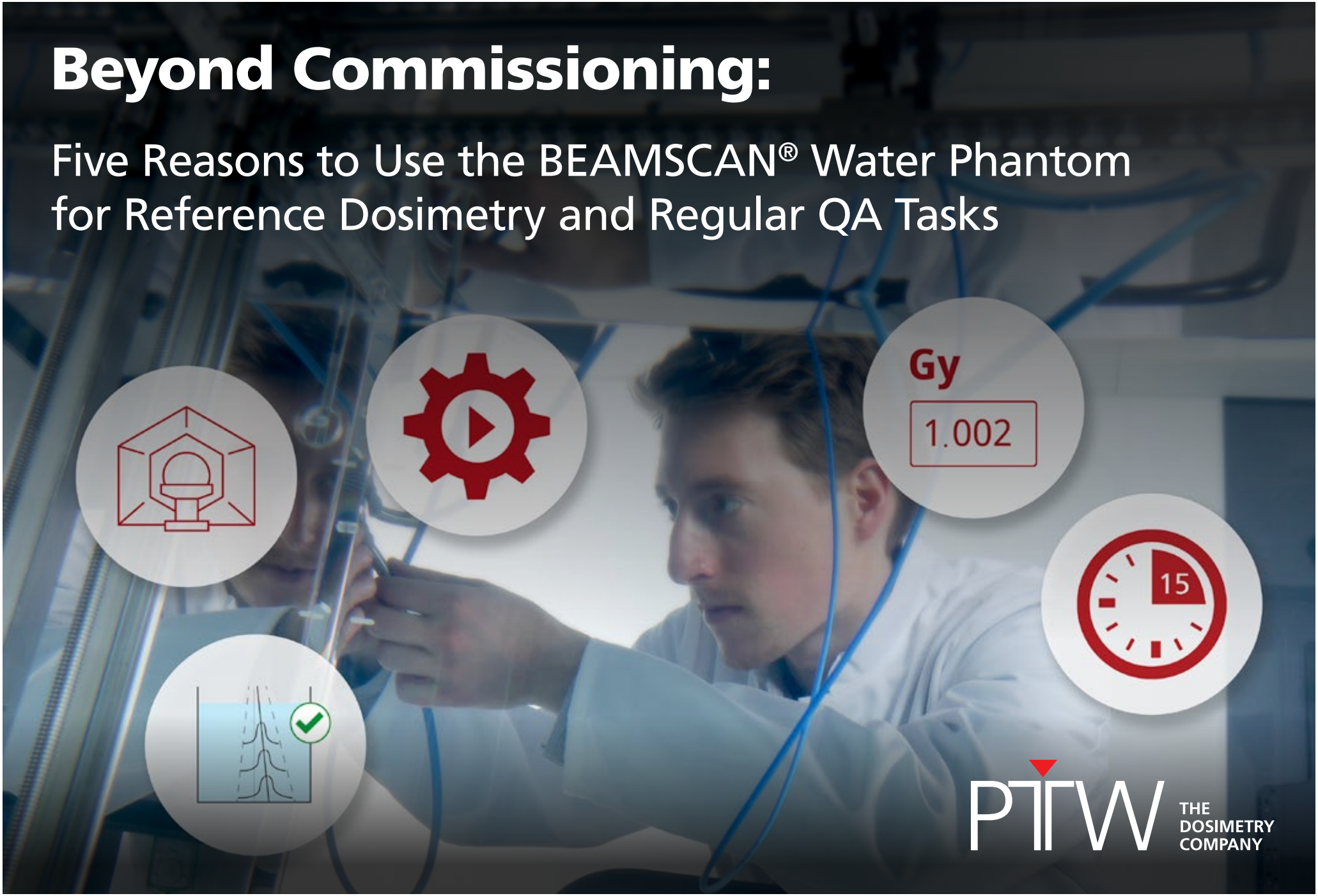
Beyond Commissioning:

Five Reasons to Use the BEAMSCAN® Water Phantom for Reference Dosimetry and Regular QA Tasks



PTW THE DOSIMETRY COMPANY

Operators can install the BEAMSCAN water phantom in less than 15 minutes.

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. The BEAMSCAN water phantom 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 the BEAMSCAN water phantom in less than 15 minutes.

In addition, the BEAMSCAN water phantom 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 AI-based data processing, the BEAMSCAN water phantom can save much time and effort in the clinical work you do every day.

This eBook presents five reasons to use the BEAMSCAN water phantom 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. One BEAMSCAN water phantom fits all 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 water-equivalent slab phantom because using traditional large water tanks 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, the BEAMSCAN water phantom is ready for measurement in less than 15 minutes. With only one cable to connect, there are no cable runs and no external devices to install. Users simply move the BEAMSCAN water phantom into the treatment room, roughly align and position it to the LINAC, plug in the power cable, then 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, e.g., IAEA TRS-398, AAPM TG-51 or IPEM, a position correction is required. The required shift can be selected and applied remotely using BeamDose software, an optional module that simplifies point dose measurements in a PTW water tank.

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

The BEAMSCAN water phantom 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.

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

In addition, the BEAMSCAN water phantom comes 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, which allows precise detector positioning at any depth, thus eliminating 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.

While BeamDose software is awaiting FDA approval, users in the U.S. can 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 comes with a large, intuitive touchscreen display and a suite of versatile functions, including statistical calculations, making day-to-day operation easy.

Tip:

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

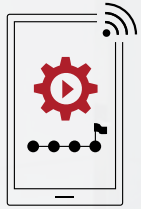
PTW Detector Selector
Check our online selection tool

Educational Webinar "How to choose the best detector for your water phantom"
Watch webinar

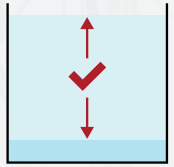
Overview:

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

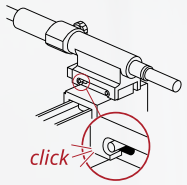
15-Minute Setup



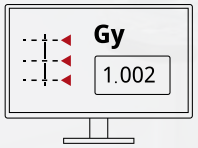
Auto Setup Wizard



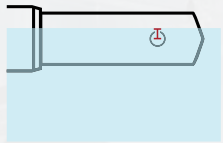
Auto Fill and Full Drain



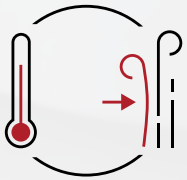
TRUFIX Detector Clip-in



Remote Control and Measurement



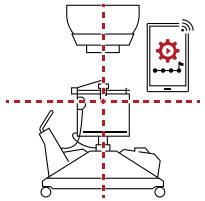
Auto EPOM Positioning



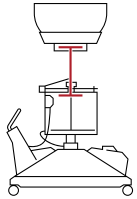
Auto Air Density Correction

Wi-Fi

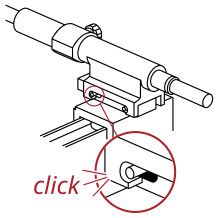
Step by Step:
How to quickly perform reference dose measurements with the BEAMSCAN water phantom



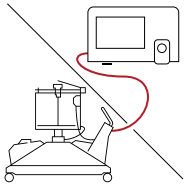
1. Move the BEAMSCAN water phantom into treatment room. Roughly align it to the LINAC using the in-room lasers and plug in power cable. Access the BEAMSCAN Wizard from your smart device (or the included iPod touch®) and start "Reference Run."



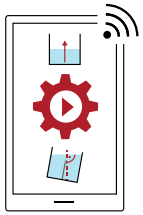
2. Set the source-to-surface distance (SSD) using the click-fix SSD adjustment tool and lift carriage.



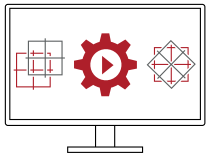
3. Clip in TRUFIX holder with your field detector, e.g., a PTW Farmer® ionization chamber. The TRUFIX system positions your field detector precisely at EPOM. Then slide reference detector into holder and connect the detector cables to socket of lift carriage.



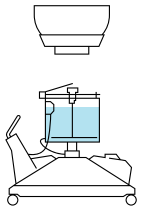
If you use a UNIDOS Tango or Romeo electrometer, follow the same procedure, but connect the cable of your field detector to the electrometer via an extension cable.



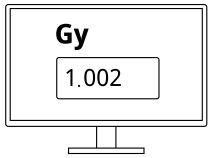
4. Start automatic water filling and tank leveling via BEAMSCAN Wizard.



5. Move into control room and start "Auto Setup" in BEAMSCAN software. Turn on LINAC, then complete the two remaining steps of the auto setup—beam center adjustment and field alignment.



BEAMSCAN water phantom is ready for measurement in less than 15 minutes.



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

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. The BEAMSCAN phantom helps to measure output factors in small fields by automatically positioning the detector in the dosimetric field center using the "Dose Max Search" function.

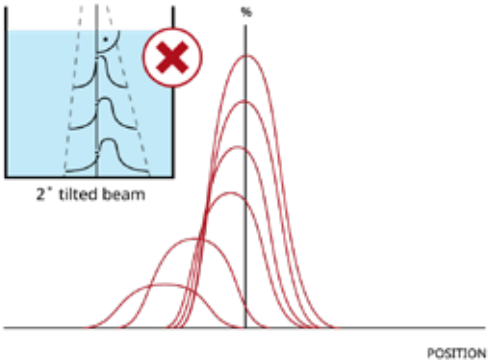


Fig. 1: Before correction

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.

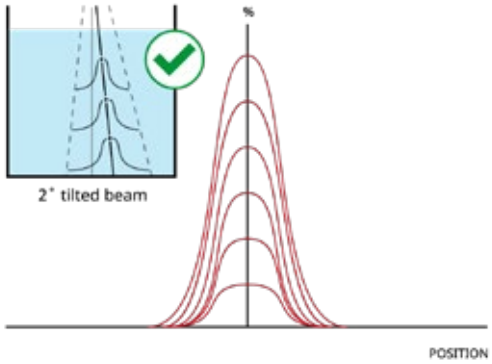


Fig. 2: After correction

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.

The BEAMSCAN water phantom includes high-precision software that identifies and automatically corrects beam inclination.

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 each other in order 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 mm³
Field size:	5 cm² to 40 cm²
Energy range:	100 keV to 50 MV photons
	6 to 25 MeV electrons
	70 to 230 MeV protons

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

Volume:	0.016 cm³
Field size:	2 cm² to 40 cm²
Small fields:	down to 0.8 cm²
Energy range:	^{60}Co to 25 MV photons

microSilicon® Diode
Small silicon diode with excellent spatial resolution

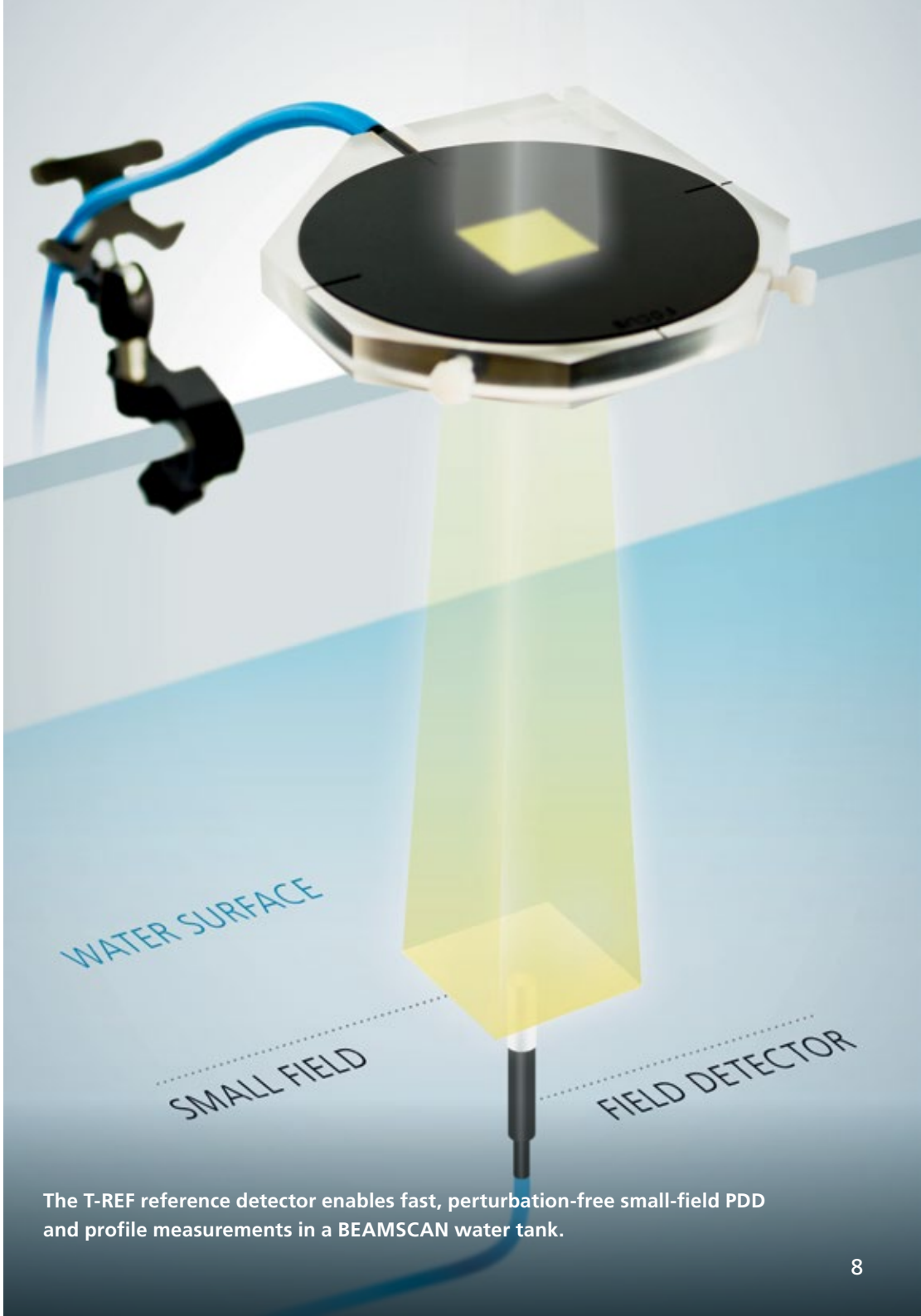
Volume:	0.03 cm³
Field size:	1 cm² to 40 cm² for electrons
	1 cm² to 10 cm² for photons
Energy range:	6 to 25 MeV electrons
	^{60}Co to 25 MV photons

T-REF Chamber
As a thin, plane-parallel transmission chamber with a large diameter, which is easily mounted on the edge of the water tank, 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.

Download now



The T-REF reference detector enables fast, perturbation-free small-field PDD and profile measurements in a BEAMSCAN water tank.

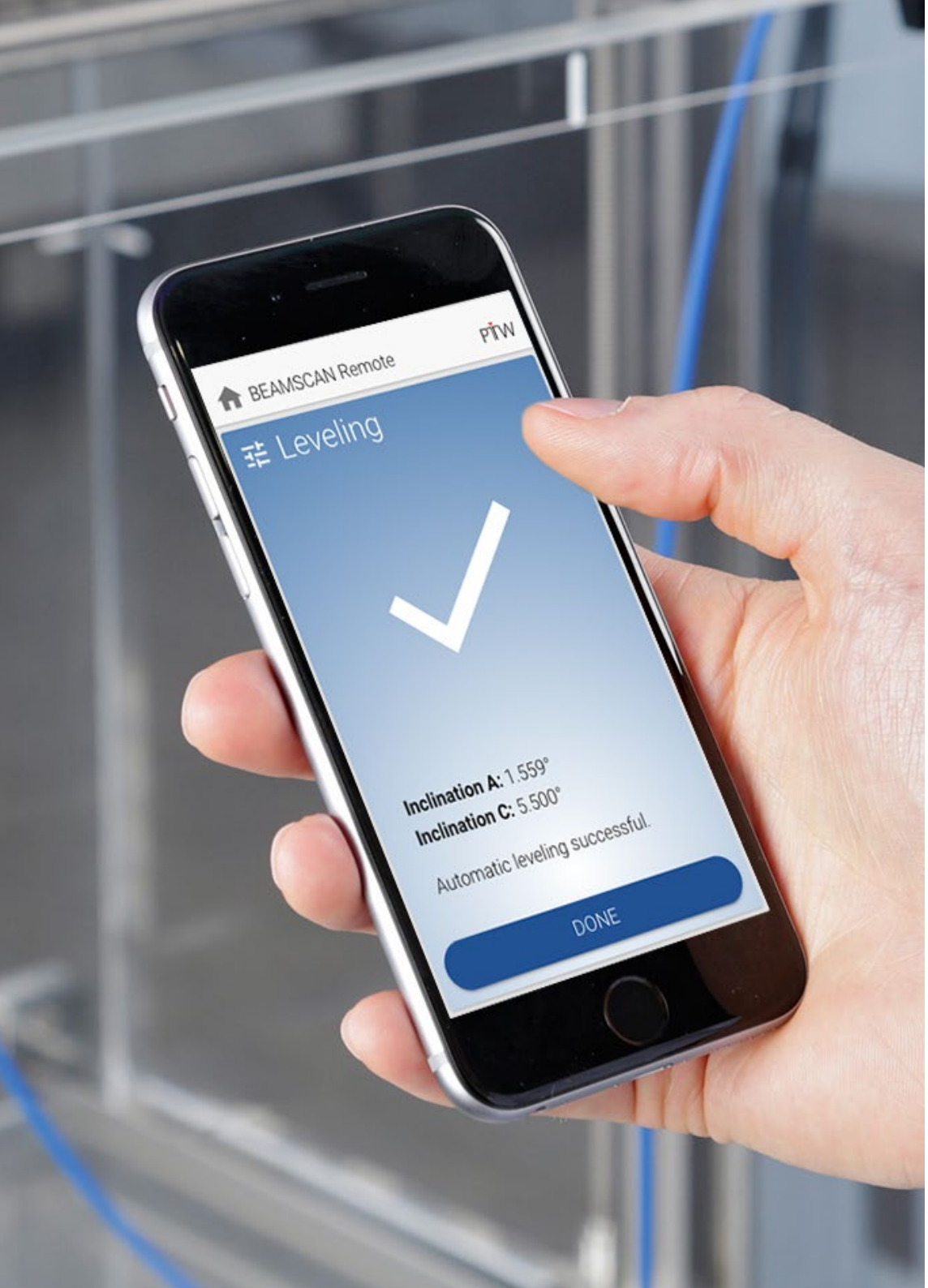
3. Accurate Results & Easy Use for Every Operator

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 water phantom is ideal for multiuser environments. Installation is identical for each operator, which ensures that measurement data is always comparable and reproducible.

No BEAMSCAN water phantom experience is needed, and practically every user can prepare measurements from the start. Operators simply access the built-in BEAMSCAN web server using the included iPod touch or their own mobile device and start the interactive BEAMSCAN Wizard. This automated step-by-step guide enables intuitive, wireless system setup in the treatment room, from reference run to water filling and tank alignment.

“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 tank leveling in just two minutes. TRULEVEL aligns the scanning axes of the water phantom virtually to the water surface without physically moving the tank or scanning arms. Using a three-point measurement and mathematical coordinate transformation, the three scanning axes of the tank 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 tank. Tank leveling is thus fully automated and does not require users to shift the water tank 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 post-processing.

In addition, an automated beam center adjustment and field alignment ensure that the BEAMSCAN coordinate system is perfectly aligned with the coordinate system of the linear accelerator and also exactly leveled to the water surface.

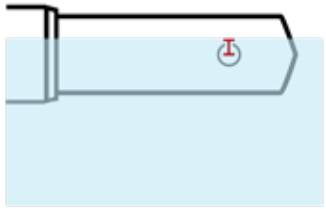
This fully automated setup, along with the simple clip-in TRUFIX system for accurate positioning of any PTW detector at EPOM, makes the BEAMSCAN water phantom an efficient tool for any medical physics team to use.

“A key element in particular is the automatic TRULEVEL™ function, which completes tank leveling in two minutes, without intervention from the user.”

Tip:

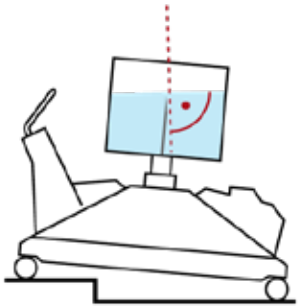
What is the BEAMSCAN Auto Setup? How does it work?
Watch video

Overview:
Four automated features for everyday and everyone’s use



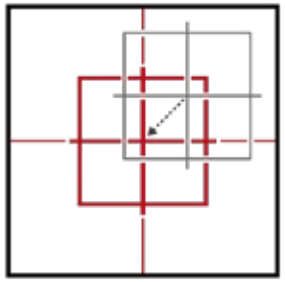
1. Auto EPOM Positioning

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 required shift can be selected and applied remotely using BEAMSCAN software.



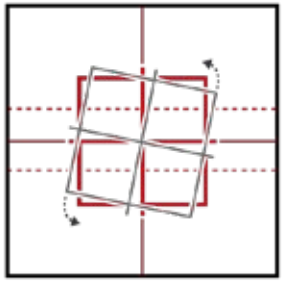
2. Virtual Tank Leveling

The BEAMSCAN water phantom uses a highly precise mathematical algorithm for tank leveling. Tank 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.



3. Beam Center Adjustment

For correct measurements, the water tank 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.



4. Auto Field Alignment

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. One BEAMSCAN Water Phantom Fits All LINACs

With the BEAMSCAN water phantom, clinics need only one water phantom for their linear accelerators. The BEAMSCAN water phantom can be used with all major LINAC types—Varian, Elekta or CyberKnife®—without any restrictions.

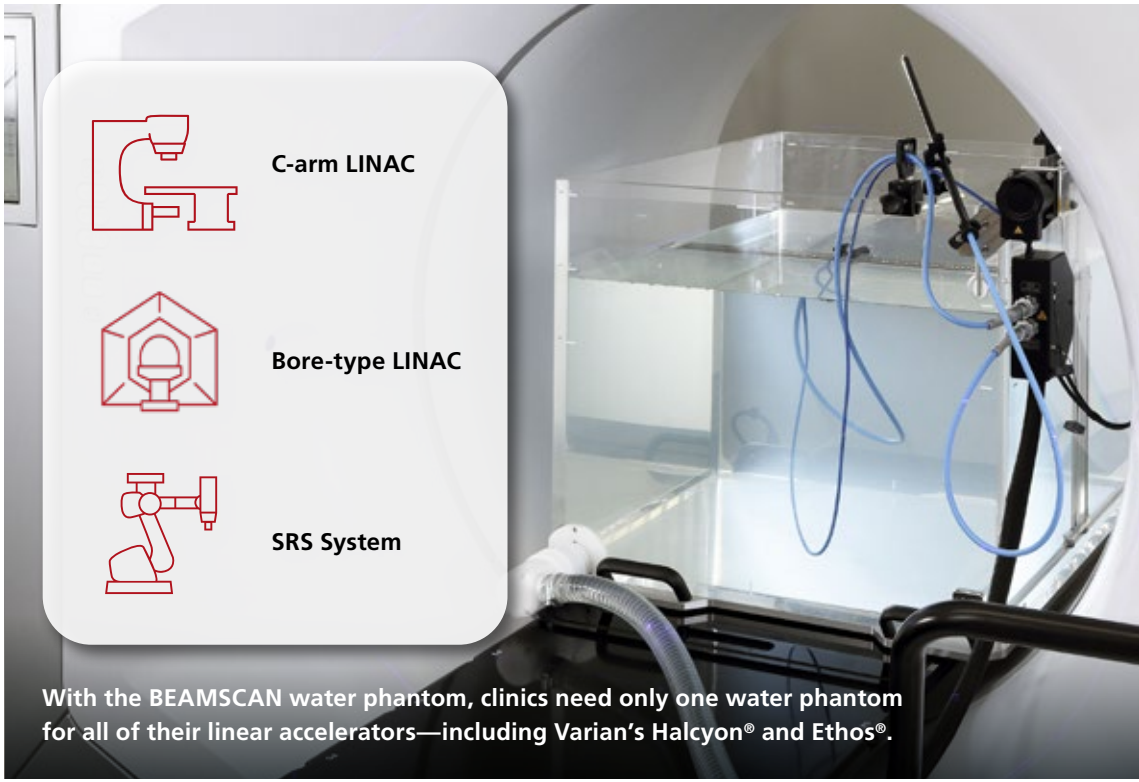
Using the BEAMSCAN water phantom with Varian's Halcyon® or Ethos® LINAC requires only a simple hardware add-on upon installation. A unique feature of the Halcyon and Ethos accelerators is a ring-mounted gantry, which differs from conventional C-arm accelerators on the market. This design presents special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

However, with the BEAMSCAN phantom, you can disconnect the water tank and place it on the treatment couch. Operators simply lift the BEAMSCAN water tank to the same height as the treatment couch, unlock the Halcyon base plate, slide the tank 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 that it compensates for couch pitch and tilt caused by the phantom weight when you move the couch inside the bore. Using the BEAMSCAN TRULEVEL auto-leveling function eliminates the need to adjust the phantom manually by reaching into the bore or using additional tools.

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

Current BEAMSCAN phantom 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 phantom users can buy the Halcyon option directly.



With the BEAMSCAN water phantom, clinics need only one water phantom for all of 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 white paper

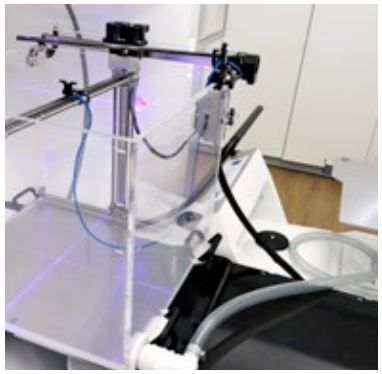
BEAMSCAN Water Phantom:
Equally efficient for Halcyon® and Ethos® LINACs

“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

1. Install

Lift the BEAMSCAN water tank to the same height as the treatment couch, unlock Halcyon LINAC base plate, slide tank onto couch, turn it by 180°, then connect the extended water hose.

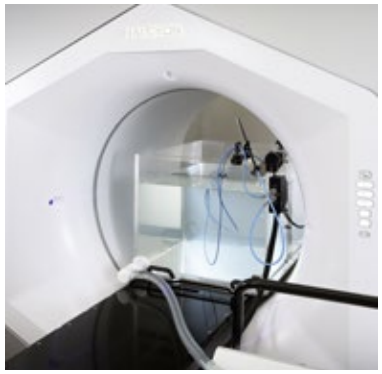


2. Align

Align the BEAMSCAN water tank to the lasers, mount detectors, then move tank into LINAC bore.

3. Run Wireless Auto Setup

Start BEAMSCAN Auto Setup from your mobile device or the included iPod. It will perform all setup tasks from water filling to tank leveling inside the bore fully automatically, without any manual interventions.



4. Ready to Scan

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 to accurate LINAC performance. The BEAMSCAN water phantom includes a host of advanced automated features that reduce errors and deliver accurate functionality for every application.

The BEAMSCAN wireless auto setup via the included iPod touch or any mobile device performs a reference run, zero positioning, water filling and virtual tank leveling automatically, thereby reducing the risk of setup and positioning errors caused by human intervention. It also helps to eliminate intra- and inter-user variability. In addition, automatic beam centering and field alignment eliminate the reliance on manual calculations and corrections.

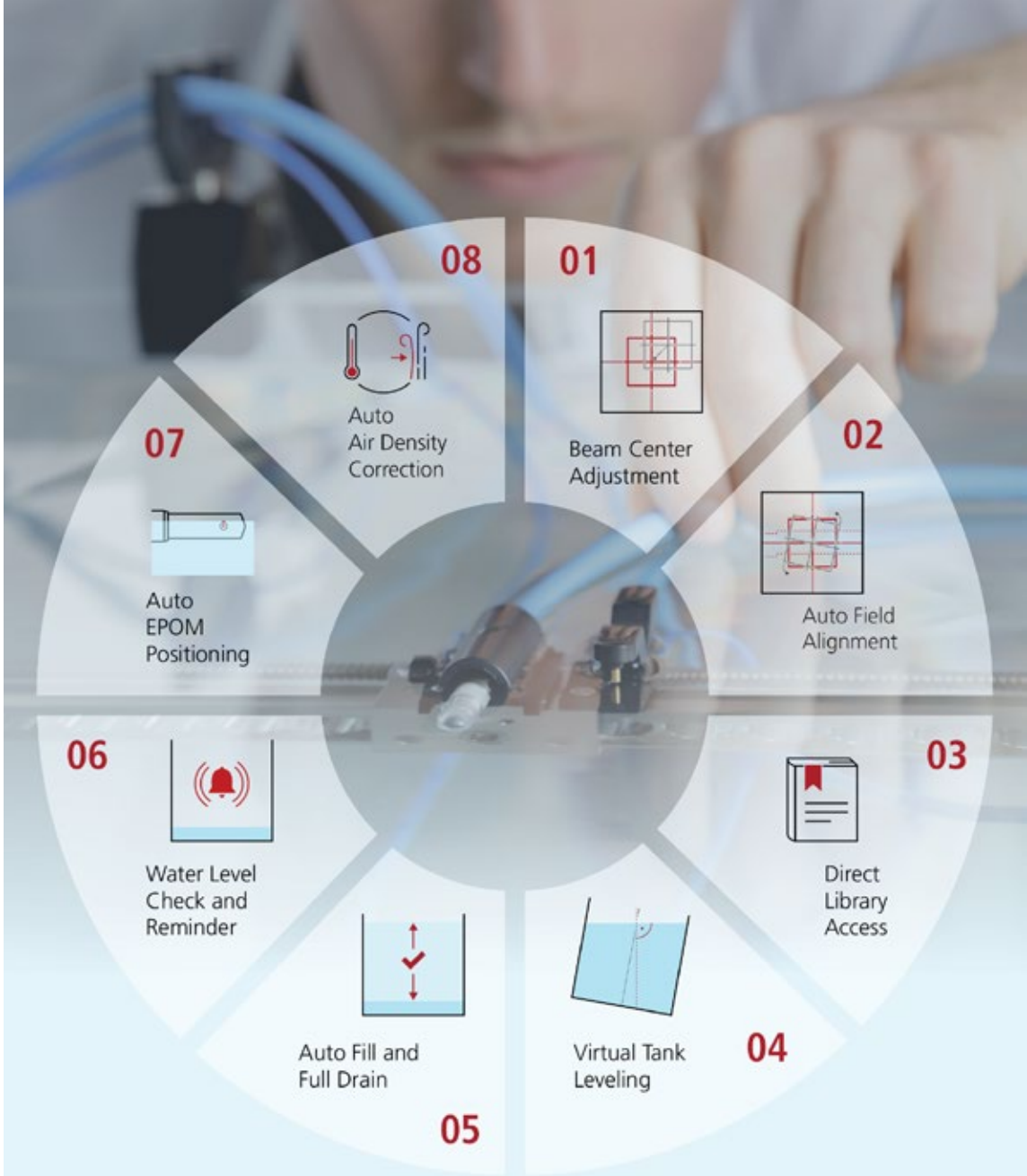
A water sensor controls the filling pump, so the water level is always correct, every time for every user. Evaporation is common particularly with commissioning measurements. The system also has a water level measurement reminder, so users know when to check for evaporation that can affect performance accuracy.

The inclined bottom of the BEAMSCAN tank ensures that the tank is completely drained after scanning to prevent deposits or rust on the scanning mechanism or algae growth in the water tank.

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, which are required for accurate dose determination, need not be measured and entered manually. The BEAMSCAN water phantom is equipped with a temperature and atmospheric pressure sensor, which allows for automatic air density correction, saving time and removing an additional source of error.



The BEAMSCAN water phantom includes a host of advanced automated features that reduce errors and deliver accurate functionality for every application.

Conclusion

The BEAMSCAN water phantom offers the same high accuracy and efficiency to reference dosimetry and regular QA tasks that it does to standard LINAC and especially small-field commissioning. This enables fast, easy, precise operation that medical physicists use every day with confidence.

To learn more about the BEAMSCAN water scanning system visit **www.PTWBEAMSCAN.com.**

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