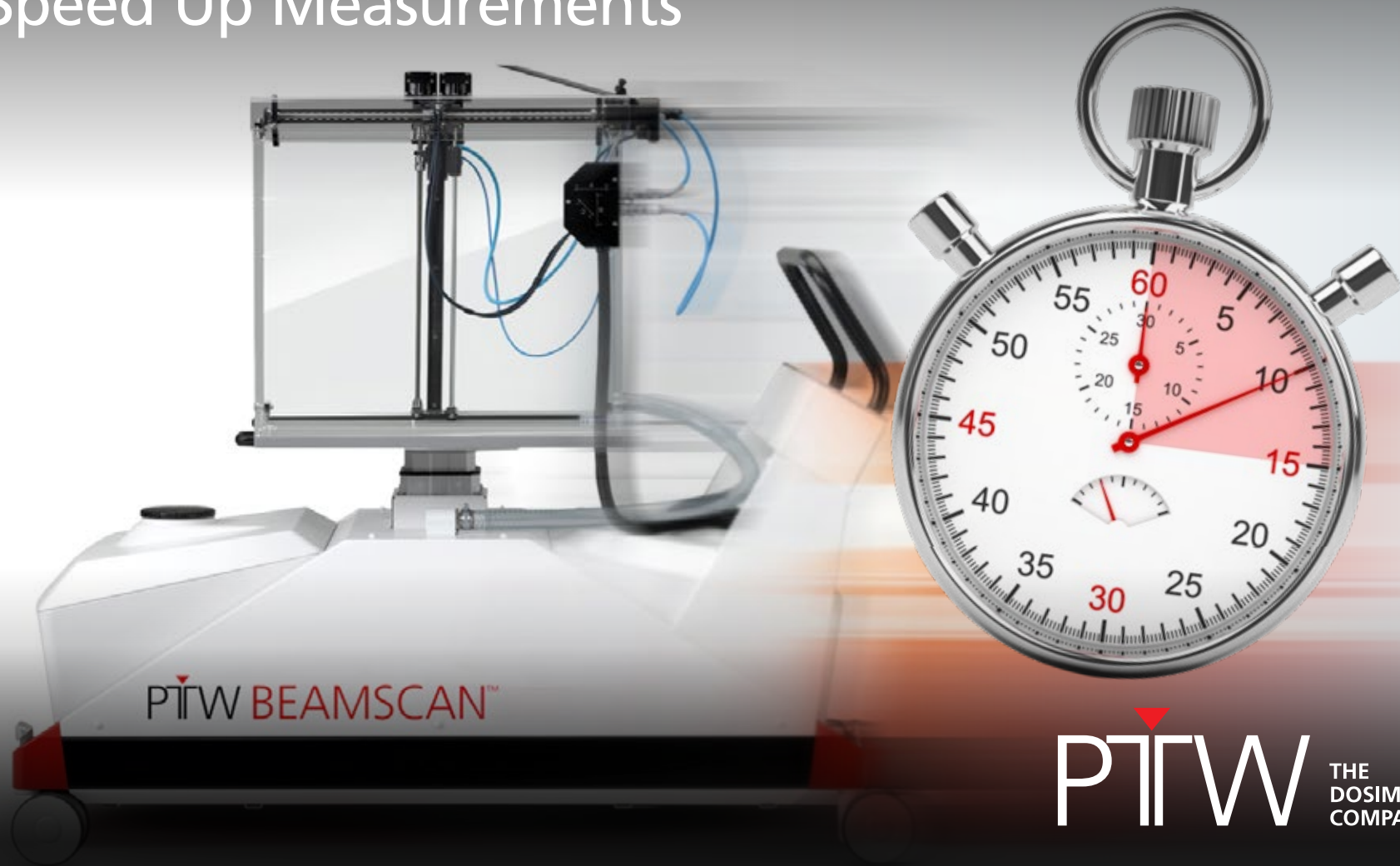


BEAMSCAN® Efficiency:

How to Set Up a BEAMSCAN in Less Than 15 Minutes
and Speed Up Measurements



PTW
THE
DOSIMETRY
COMPANY



Introduction

The BEAMSCAN water phantom is the industry's first fully automated wireless system and is designed to provide medical physicists with unmatched speed and accuracy—from setup and scanning to data analysis.

With all the electronics and cables built directly into the system, the all-in-one BEAMSCAN water phantom is ready for use from the start, requiring only one cable to be connected.

Automated features enable users to set up the system in a few minutes and eliminate back-and-forth trips between the treatment and control rooms. Faster scanning speeds and artificial intelligence (AI) significantly reduce commissioning and QA time without compromising data quality and precision.

Read on for more information on how to quickly set up the BEAMSCAN water phantom and get tips for better and faster results.

Faster setup. Faster scanning. Faster results.

How to Set Up the BEAMSCAN Water Phantom in 15 Minutes or Less

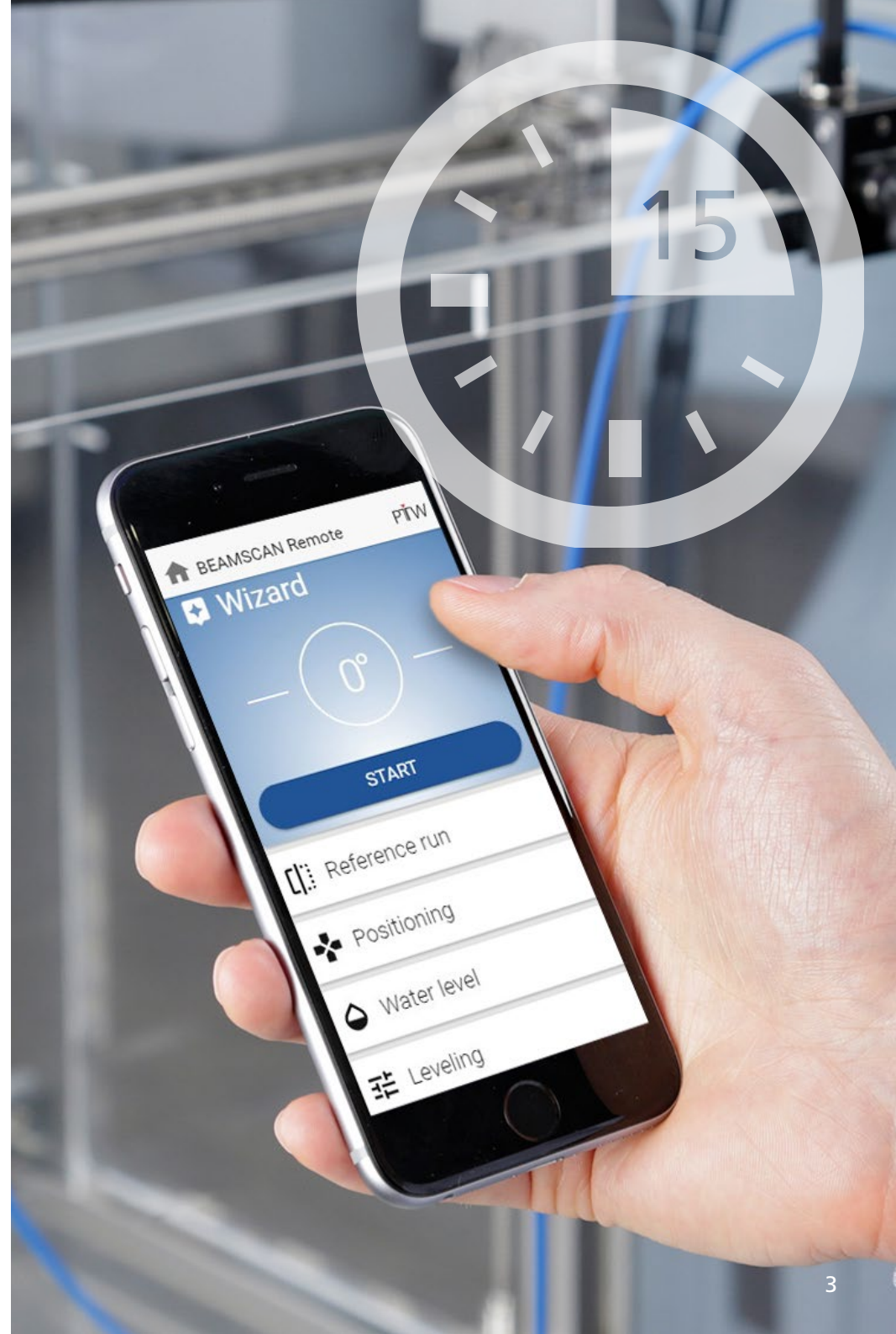
Unlike less automated 3D water phantoms that require a lengthy setup process, practically every user, even those with less experience, can set up the BEAMSCAN water phantom for measurement in less than 15 minutes.

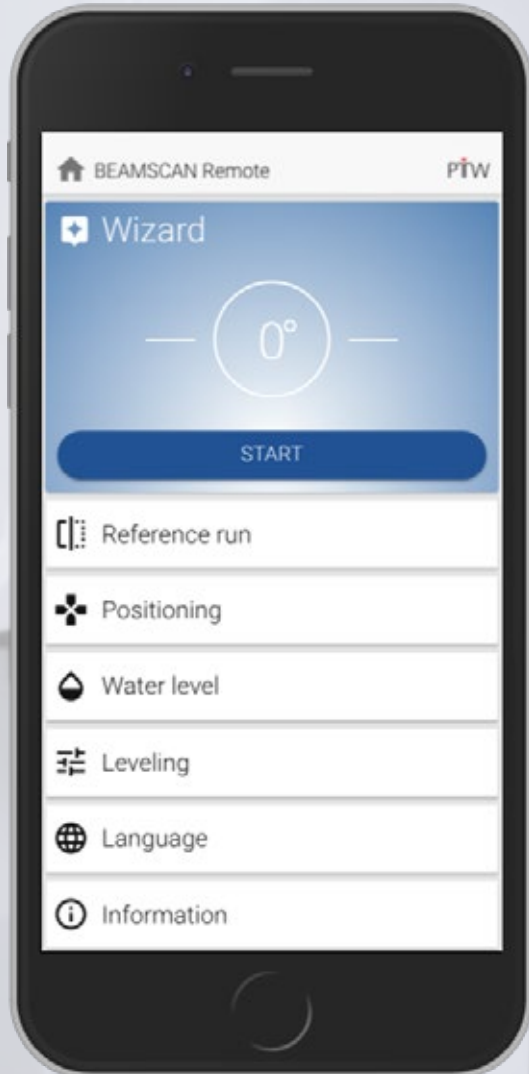
With all the electronics and cables built directly into the system, the all-in-one BEAMSCAN water phantom installs in no time. Preparing it for operation is fast and easy. Just wheel it into the treatment room, lock the wheels, plug in the power cable and roughly line it up with the LINAC using the in-room lasers.

Setup and alignment are fully automated. To start the Auto Setup process, simply access the interactive BEAMSCAN Wizard from the included iPod® touch or any other smart device, e.g., your own smartphone or tablet. It guides you step by step through the system preparation in the treatment room, and performs a reference run, zero positioning, water filling and virtual tank leveling automatically.

After the reference run, set the source-to-surface distance (SSD) using the “click-fix” SSD adjustment tool. Simply click the SSD adjustment tool onto the base plate of the patented TRUFIX® detector mounting system installed on the scanning arm, then project the SSD, and set it to the desired position using the lift carriage.

“A key element is the interactive BEAMSCAN Wizard, an automated step-by-step guide, accessible from any smart device, which enables intuitive, wireless system setup in the treatment room.”





BEAMSCAN Wizard

The wireless Auto Setup requires no tools and no tank shifts or adjustments.



Reference Run

Automatically detects mechanical limits of the scanning mechanism



Water Level

Fills the tank to water sensor position in less than six minutes and drains it completely after scanning



Positioning

Allows adjustment of the automatically calculated zero point



Leveling

Virtually aligns scanning axes to the water surface in less than two minutes



The TRUFIX system enables you to quickly change detectors without the time-consuming readjustment of the effective point of measurement.

Next, mount the field and reference detectors. Clip in the TRUFIX holder with your field or scanning detector, e.g., a Semiflex® 3D ionization chamber. The TRUFIX detector mounting system accurately positions the effective point of measurement (EPOM) of the field detector to the water surface, ensuring that it is always in the correct position for scanning. It also enables you to quickly change detectors without the time-consuming readjustment of the EPOM. After mounting the field detector, slide the reference detector into its holder and connect the detector cables to the sockets of the lift carriage.

Proceed with auto filling. The high-efficiency water pump fills the tank exactly to water sensor position in up to six minutes.

Now align the water tank using the patented automatic TRULEVEL™ function which completes tank leveling in only two minutes—without moving the tank or scanning arms. Eliminating any physical interaction reduces errors, provides the most accurate, reproducible results and avoids time-consuming mechanical corrections or post-processing.

Depending on your routine, you can also install the detectors after water filling and tank leveling as shown in the illustrated workflow at the end of this eBook.

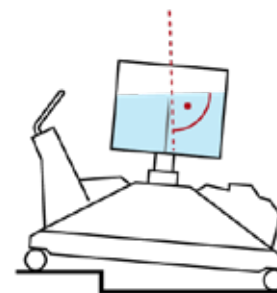


Fig. 1: Virtual Tank Leveling

BEAMSCAN is the only water phantom to offer a fully automatic tank filling and tank alignment. 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.

Next, complete the Auto Setup in the control room. Start the BEAMSCAN software and select the "Auto Setup" function, which guides you through the remaining setup steps that require radiation—beam center adjustment and auto field alignment. Both functions ensure that the coordinate system of the BEAMSCAN water phantom is fully aligned with the coordinate system of the

linear accelerator and exactly leveled to the water surface.

Thanks to all the advanced automated features of the BEAMSCAN water phantom, you are ready to start scanning and conducting commissioning and QA measurements in less than 15 minutes.

"BEAMSCAN automates the setup process by eliminating human intervention as much as possible. It saves valuable LINAC time and ensures highly accurate beam data right from the first scan every time it is used."

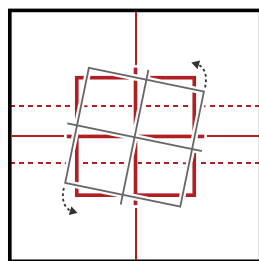
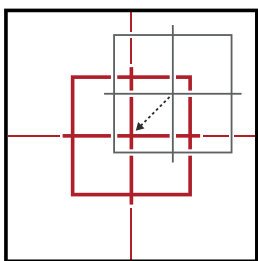


Fig. 2: Beam Center Adjustment

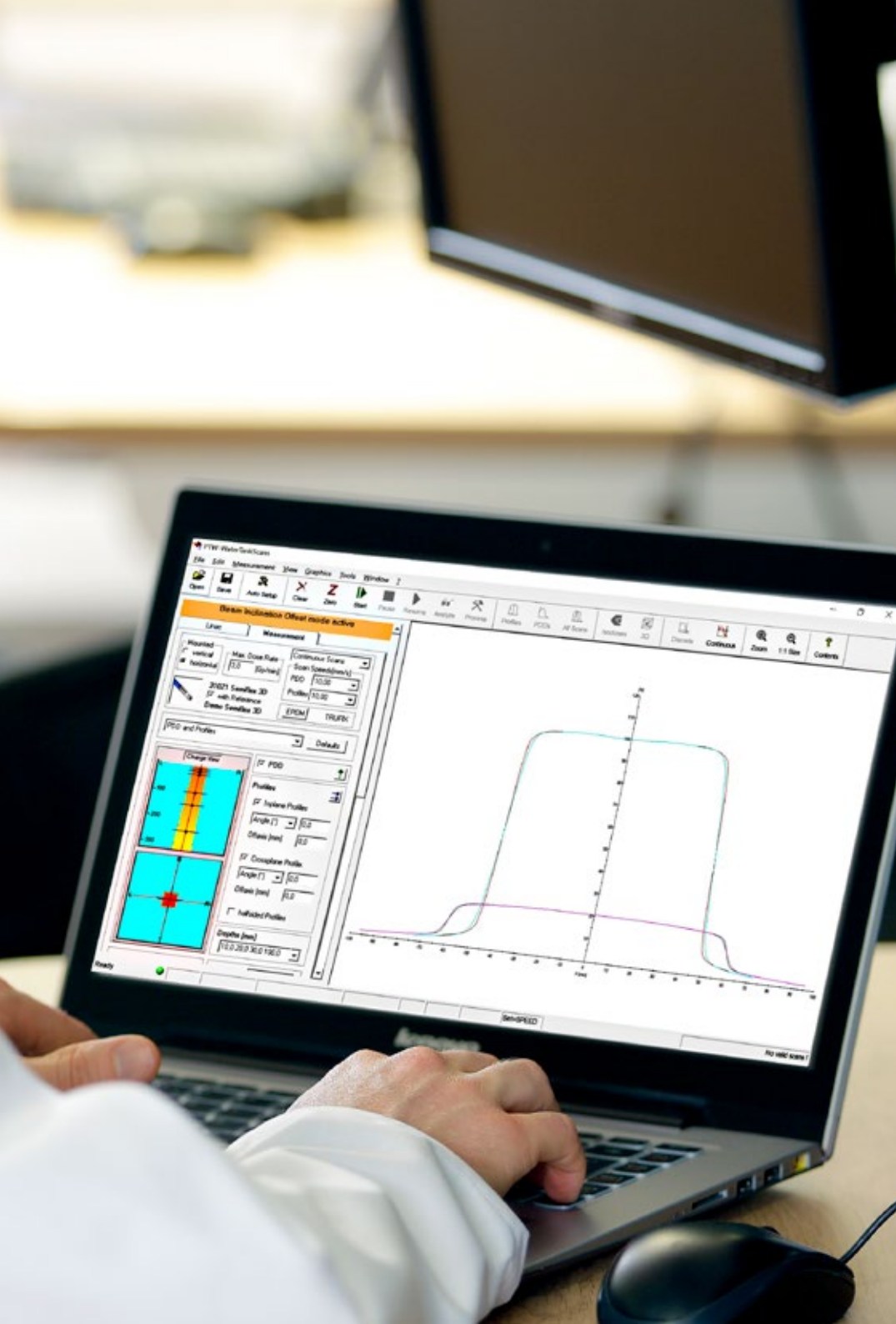
The "Beam Center Adjustment" function detects and automatically corrects for CAX shift between the coordinate systems of the water phantom and the LINAC. To calculate the offset from the central axis, it determines the center of a defined field size by measuring an in-plane and a cross-plane profile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

Fig. 3: 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.



BEAMSCAN Auto Setup: Saves time. Prevents errors.



Seven Tips for Getting Better, Faster Results

Tip #1 Use the BEAMSCAN water phantom for fast and highly accurate small-field dosimetry

To prepare for small-field dosimetry, the BEAMSCAN software can easily identify and correct beam inclination caused by imprecise gantry angles or gantry sag of the linear accelerator. Gantry sag is a common source of mechanical distortion, which leads to imprecise PDD and profile measurements. To automatically correct beam inclination, select the measurement task "Beam Inclination," check the result for plausibility, then choose "Set Beam Inclination." The BEAMSCAN software will automatically correct beam inclination for all subsequent measurements.

During output factor measurements, a precise positioning of the detector in the dosimetric field center is essential. For example, positioning uncertainties of the yaws can lead to field size deviations and to an offset of the field center, resulting in imprecise output factor measurements. The BEAMSCAN water phantom helps to measure output factors in small radiation fields by

automatically positioning the detector in the dosimetric field center (dose maximum). Thanks to the "Search Dose Maximum" function in the BEAMSCAN software, which is activated once, the field size and the offset to the zero point are automatically determined and applied for each output factor field size. If necessary, operators can perform several measurements for each field size. The average and the standard deviation will be automatically calculated. The average value can then be transferred to the output factor table and easily formatted as required by your treatment planning system (TPS).

"BEAMSCAN is the only water phantom that identifies and automatically corrects beam inclination, ensuring the most accurate measurements for small radiation fields."

Tip #2 Use task lists to accelerate beam data collection

The “Task Lists” feature automates beam data collection, saving users valuable LINAC time.

A task list is a set of measurement tasks that are automatically processed. All tasks with the same LINAC parameters can be grouped into queues. The BEAMSCAN software already comes with ready-to-use task lists for the commissioning of all major treatment planning systems (TPS). In addition, you can also easily create your own task lists to streamline repetitive or regular QA tasks (e.g., monthly or annual QA) by customizing an existing task list with a simple drag and drop. Choose from multiple measurement programs to set up the task list you need, e.g., PDDs and profiles at various depths and for different field sizes, TPR measurements, output factor measurements.

Working with task lists is simple. Once the run process has been started, each queue will be executed automatically. After each queue, the BEAMSCAN software will tell you which LINAC parameters (e.g., field size, energy, gantry angle, collimator angle) have to be modified. Upon confirmation, the next queue will start and run automatically until all measurement queues and tasks of your chosen task list have been completed.



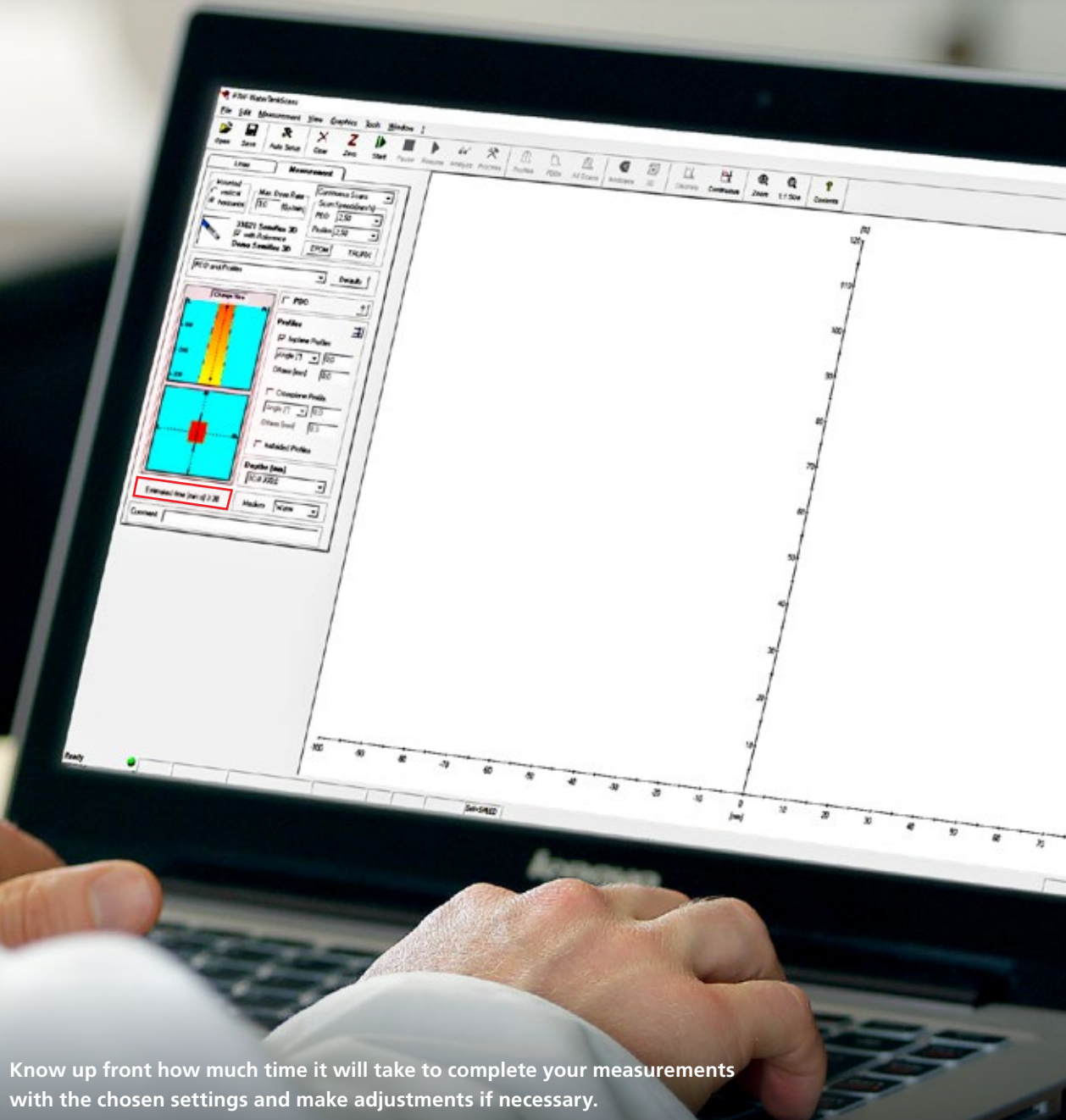
BEAMSCAN software automates beam data acquisition with ready-to-use, easy-to-customize task lists for all major treatment planning systems.

Tip #3 Run the scan time predictor to better manage your measurement schedule

The “Scan Time Predictor” shows you the time it will take to conduct a specific measurement. This function is particularly useful for monthly QA or when you need to carry out measurements following LINAC maintenance and the LINAC must return to service quickly.

The predictor enables the medical physicist to determine which data and data quality are most important to collect given the allotted timeframe.

For example, obtaining high-quality data achieved by longer measurement time could be saved for commissioning or long-term planning sessions. However, when measurements are needed to quickly confirm that the LINAC is in good working condition, you can use the “Scan Time Predictor” to decide whether to reduce the resolution or increase the scanning speed in order to achieve the necessary results in half the time.



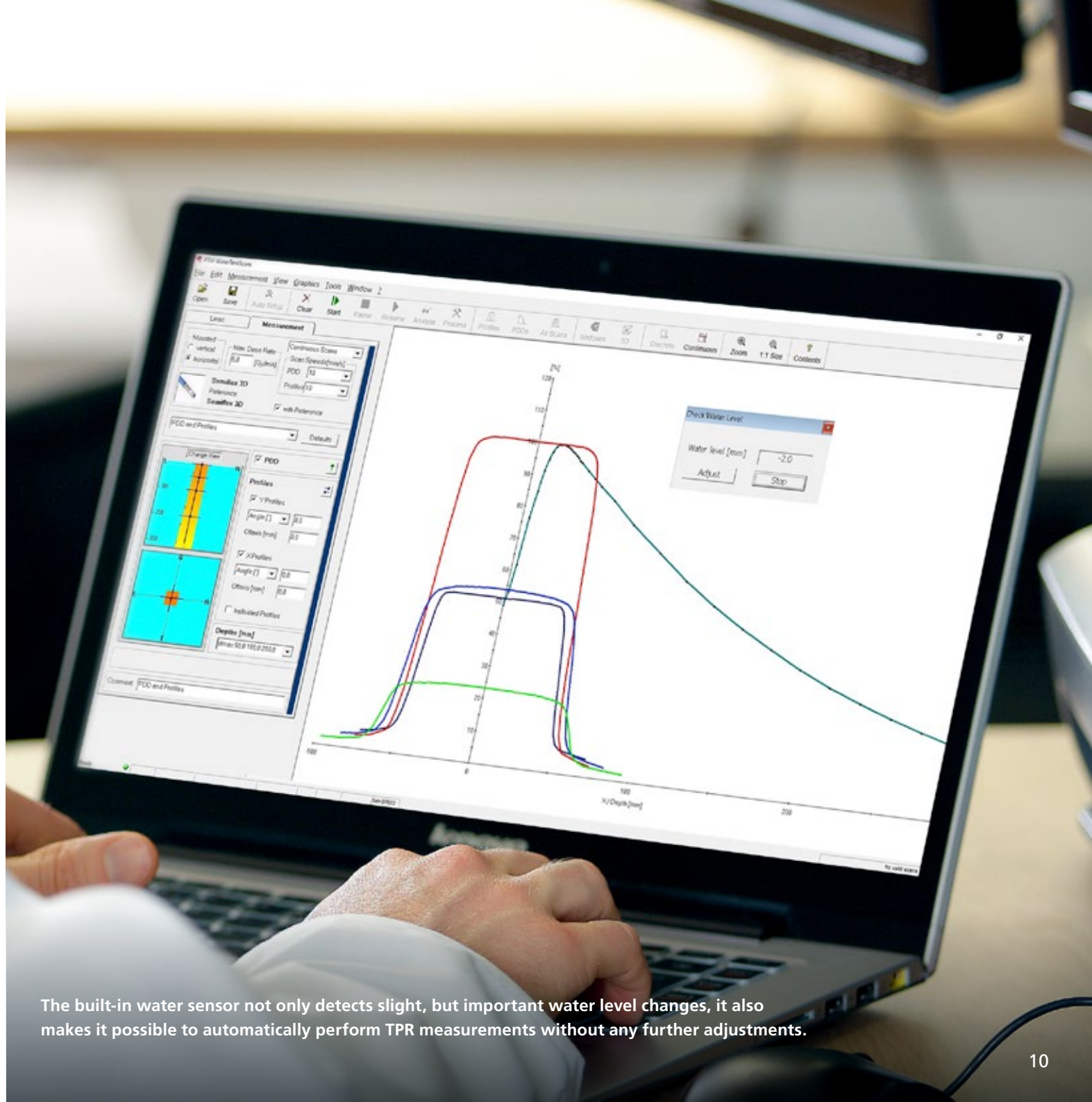
Know up front how much time it will take to complete your measurements with the chosen settings and make adjustments if necessary.

Tip #4 Check the water level for efficient evaporation control

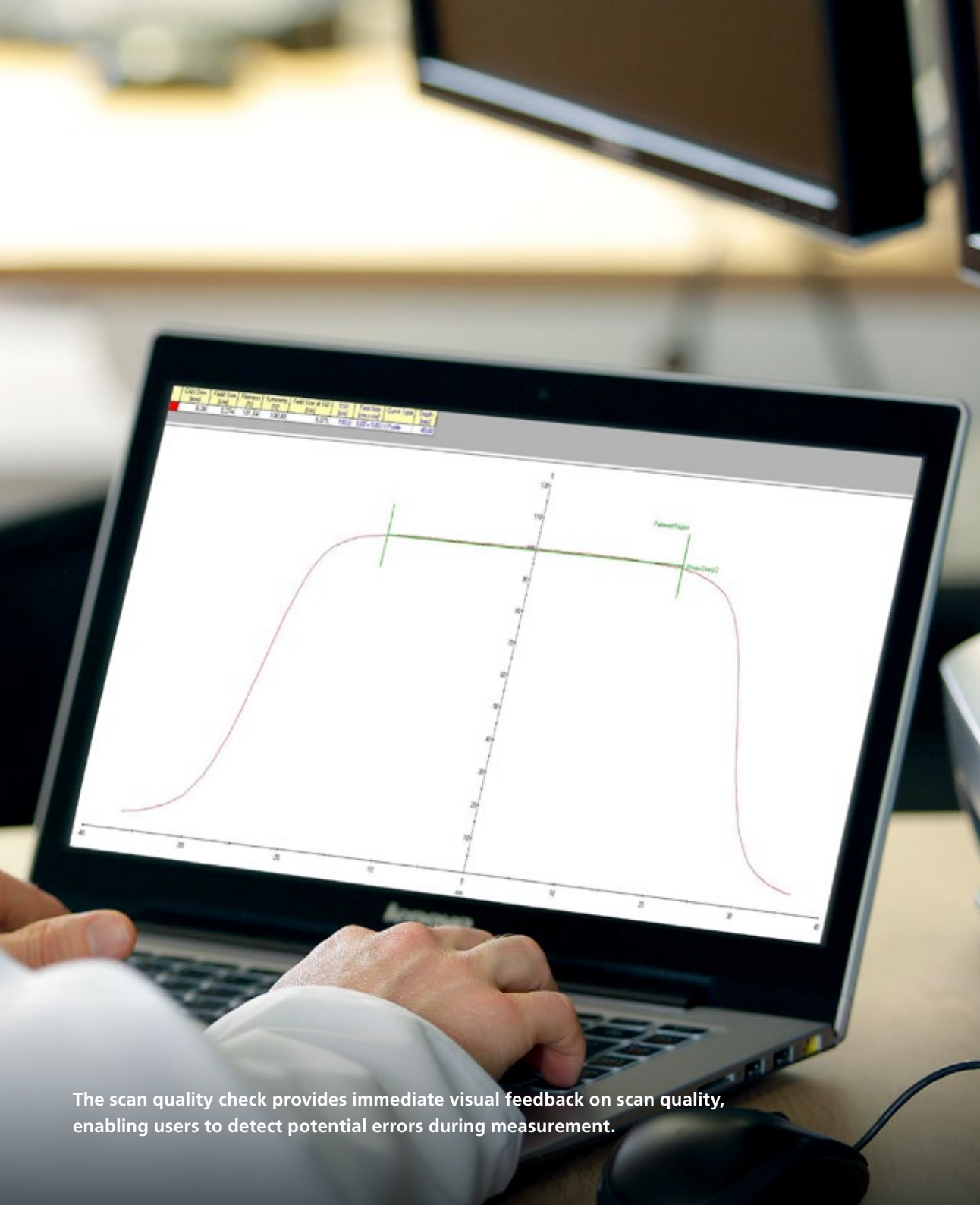
Evaporation is common, particularly during long periods of measurements. The BEAMSCAN water phantom is equipped with a water sensor, providing integrated water level control and water level measurement reminders, so the medical physicist knows when to check for evaporation that can lead to inaccurate results. Using a water sensor improves accuracy because a visual check of the water level can overlook slight, but important water level changes.

To check the water level and refill the evaporated water without entering the treatment room, simply activate the water level check in the BEAMSCAN software. Thanks to the water sensor, the water pump delivers the right amount of water every time, without the risk of overflowing.

The built-in water sensor also helps users to easily and efficiently perform tissue-phantom ratio (TPR) measurements which are conducted at different water levels. Unlike other water phantoms, no further adjustments of the BEAMSCAN water phantom are needed to collect TPR data.



The built-in water sensor not only detects slight, but important water level changes, it also makes it possible to automatically perform TPR measurements without any further adjustments.



The scan quality check provides immediate visual feedback on scan quality, enabling users to detect potential errors during measurement.

Tip #5 Perform a quick scan quality check to spot errors in time

Errors in phantom positioning or wrong settings can reduce the quality of the beam data collected and lead to extra work, particularly if these errors are detected late in the process.

The online (or automatic) data analysis feature of the BEAMSCAN software provides users with immediate visual feedback on scan quality, helping them detect potential errors during measurement by comparing the current measurement against a reference measurement.

Receiving result parameters after each scan enables the medical physicist to make necessary corrections immediately rather than wait until the entire scanning process is complete. Operators save time, and the LINAC is back to use more quickly.

Tip #6 Activate BEAMSCAN AI to save measurement time and improve quality

The BEAMSCAN water phantom is the first water phantom which uses artificial intelligence (AI) to improve scan quality and, at the same time, significantly speed up profile and PDD measurements performed with Semiflex 3D and microDiamond® detectors.

Why use AI

The Semiflex 3D ionization chamber is the most commonly used scanning detector and comes included with the all-in-one BEAMSCAN water phantom. With its true 3D geometry, which provides uniform response in any direction, the Semiflex 3D ionization chamber is the ideal solution for relative dose measurements in water. It allows for fast scanning and produces minimum signal noise. Due to its larger volume, however, the Semiflex 3D delivers less accurate results in the penumbra region unlike dedicated small-field detectors. This makes the Semiflex 3D ionization chamber unsuitable for small-field measurements.

The microDiamond detector is the gold standard detector for small-field dosimetry, delivering the most accurate results down to the smallest field size of 0.4 cm as defined by IAEA TRS-483. However, since the detector is

noisy, users need to reduce the scanning speed in order to obtain highly accurate scan data, resulting in much longer measurement times.

AI functions increase efficiency of beam data collection

BEAMSCAN AI combines the strengths and, at the same time, compensates for the weaknesses of both detectors without compromising data accuracy. The AI-based “Deconvolve” function enables distortion-free beam profiles for all field sizes from 2.5 cm to 40 cm at five times faster scanning speeds. It corrects the volume effect in the penumbra region of beam profiles measured with the Semiflex 3D chamber in a one-click operation, achieving an accuracy comparable to that of microDiamond detector measurements.

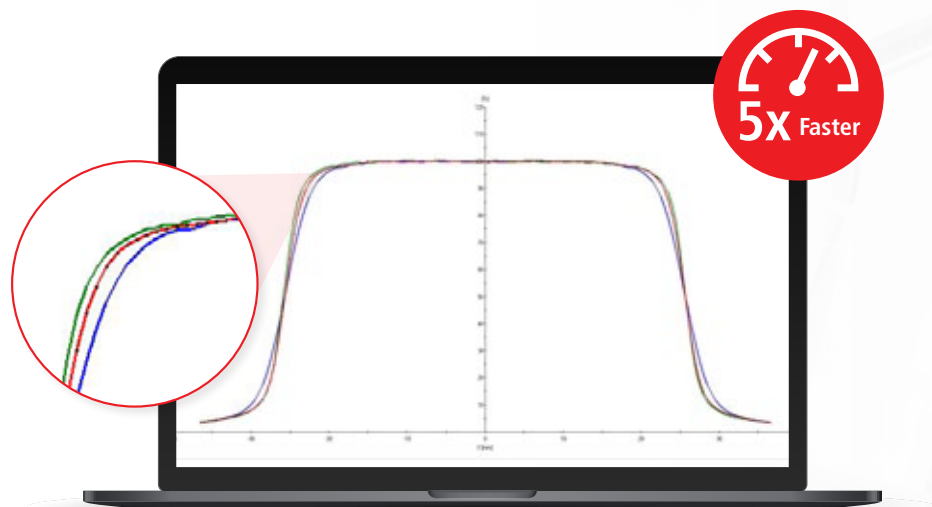
The AI “Denoise” function improves the scan quality of the microDiamond detector profile and PDD measurements, which can be performed up to three times faster thanks to AI-based noise reduction.

“BEAMSCAN AI corrects penumbra distortion and noise in profile and PDD measurements, allowing users to obtain significantly better data in significantly less time.”



AI-based data processing saves BEAMSCAN users valuable time during commissioning and quality assurance measurements.

BEAMSCAN AI: Delivering Accurate Scans Much Faster



- microDiamond detector measurement
- Semiflex 3D ionization chamber measurement before AI-based correction
- AI-processed Semiflex 3D ionization chamber measurement

**Fig. 4: AI-Based "Deconvolve" Function:
Gold standard accuracy at up to 5x faster scanning speeds**

Beam profiles of a 5 cm x 5 cm radiation field measured with Semiflex 3D ionization chamber at 10 mm/s scan speed before and after AI-based correction compared to a microDiamond detector measurement at 2 mm/s scan speed. AI "Deconvolve" converts your Semiflex 3D chamber measurement into microDiamond detector quality at 5x faster scanning speeds compared to a microDiamond detector measurement.



- microDiamond detector measurement before AI-based correction
- AI-processed microDiamond detector measurement

**Fig. 5: AI-Based "Denoise" Function:
Accurate scans at up to 3x faster scanning speeds**

Beam profile and PDD measured with microDiamond detector at 20 mm/s scan speed before and after applying AI-based noise reduction. A higher scanning speed can impact the quality of profile and PDD measurements. AI "Denoise" compensates for signal noise in microDiamond detector measurements, allowing you to speed up measurements significantly.

Tip: Learn more about the AI algorithm used in BEAMSCAN 4.5 software and the clinical benefits of using AI-based scan data analysis.



[Read peer-reviewed publication](#)



[Watch webinar](#)

Tip #7 Compare multiple scans in seconds to increase efficiency

Analyzing beam data to monitor LINAC performance is a crucial but laborious task. Large data sets have to be scrutinized for errors or inconsistencies by comparing them against reference data, e.g., Golden Beam Data provided by the LINAC manufacturer or collected during initial commissioning.

BEAMSCAN software allows you to quickly compare multiple profiles and PDDs against reference scans, making it much easier for you to spot critical deviations faster.

Simply select the measured and reference scans you want to compare, then choose the comparison mode. Scans can be compared using 1D Gamma comparison or percentage deviation based on preset quality criteria. Results are instantly available and displayed in concise graphical and table formats on one screen. An easy-to-interpret “traffic light” results summary allows you to see, at one glance, whether all scanned profiles and PDDs meet the individual quality standard of your department or if some scans failed and require further action.

Save your results in a PDF for documentation and efficient performance monitoring.

From System Setup to Beam Data Analysis:

How BEAMSCAN Speeds Up LINAC Commissioning and Regular QA



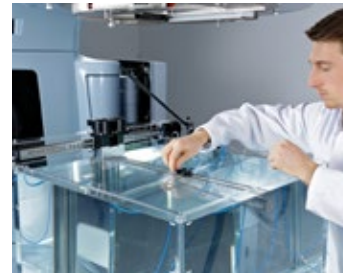
1. Move the system into the treatment room, and lock the wheels. Plug in the power cable, and roughly align the BEAMSCAN water phantom to the LINAC using the in-room lasers.



4. Proceed with auto setup. Start automatic water filling and tank leveling via BEAMSCAN Wizard.



2. Access BEAMSCAN Wizard from your smart device (or the included iPod touch®), and start "Reference Run."



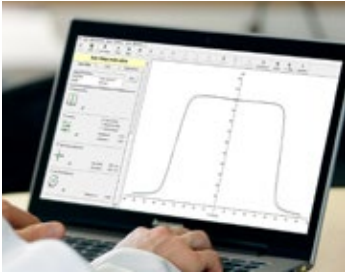
5. Clip in the TRUFIX holder with your field or scanning detector, e.g., a Semiflex 3D ionization chamber. The TRUFIX system positions your field detector precisely at EPOM.



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



6. Slide reference detector into holder, and connect detector cables to socket of lift carriage.



- 7.** Move into the control room and start “Auto Setup” in the BEAMSCAN software. Turn on the LINAC, then complete the two remaining auto setup steps that require radiation—beam center adjustment and auto field alignment.



- 8.** System is now ready to scan.
Tip: *If you are planning long measurements, activate the water level check in the BEAMSCAN software.*



- 9.** Select and run automated task list.
Tip: *To save measurement time without quality loss, choose faster scanning speeds and apply AI-based correction after scanning.*



- 10.** Compare and analyze your beam data using the advanced analysis and processing tools of the BEAMSCAN software.

Tip: *Use the 1D Gamma comparison for data analysis. It also provides an easy-to-interpret “traffic light” results summary to quickly identify curves that do not meet your quality criteria.*



- 11.** Format your analyzed beam data for easy import into your treatment planning system (TPS) and/or export it to Track-it for trending and reporting.

From setup to scan in less than 15 minutes:

Watch this video to learn more about the setup process.



[Watch video](#)



Conclusion

Medical physicists around the world rely on the BEAMSCAN water phantom for fast, easy operation and advanced AI-based features to quickly obtain accurate results.

Visit **www.PTWBEAMSCAN.com** to discover more ways the BEAMSCAN water scanning system can solve your dosimetry challenges.