

# 3D SCANNER™

3D Scanning Comes Full Circle



# BETTER OUTCOMES THROUGH TECHNOLOGY

The 3D SCANNER is different by design, developed from the ground up to provide accurate, reproducible beam data in an era of modern treatment modalities and busy clinical staff.

## The 3D SCANNER Advantage

The 3D SCANNER is a full 3D dosimetry cylindrical water tank with AutoSetup™ capabilities. It improves not only the accuracy of measurement data, but also the setup process, making it less subjective and more reproducible.

### AutoSetup™

- Reproducibly and automatically sets detector position at the water surface; levels and aligns tank
- Total time: < 20 minutes

### No Tank Shifts

- Position tank once
- 650 mm scan range without moving tank
- Position detector in any relevant 3D location
- Consistent detector orientation without repositioning detector, increasing the accuracy of your scans

### Better Data

- Optimal signal to noise ratio for smoother scans without processing
- Eliminate user setup subjectivity with AutoSetup and no tank shifts
- Consistent detector orientation for in-plane, cross-plane, and diagonal scans
- Searchable database for effective data management and sharing
- Raw data is always available even if processing applied
- Every data process layer is saved and accessible



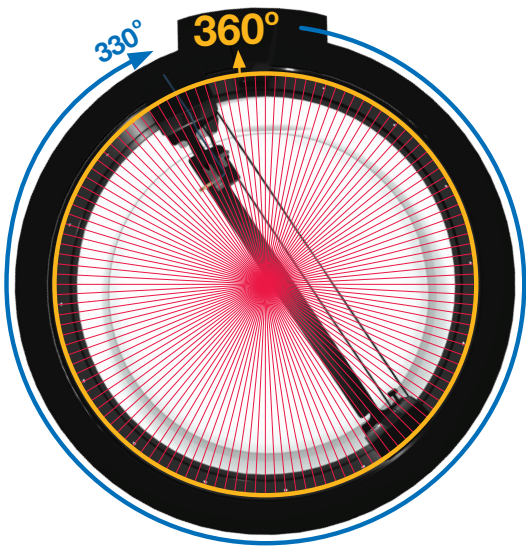
# 360° of Scanning

## Detector Freedom

3D SCANNER offers a diameter drive for consistent detector orientation for in-plane, cross-plane, diagonal, and all other angles throughout the entire 360° circumference. Rotation range of 330° eliminates the need for tank shifts.

The 3D SCANNER system supports off-axis scans with this geometry by combining rotation and diameter movements during the measurement.

- Scanning Range
- Ring Range



360° of scanning with consistent detector orientation results in better data and eliminates the need to change tank setup.

## Consistent Detector Orientation

### Better Results

#### 3D SCANNER

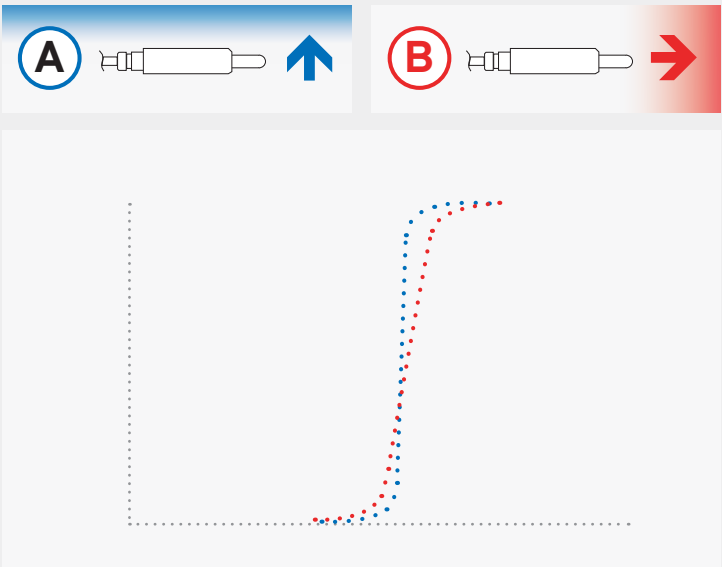
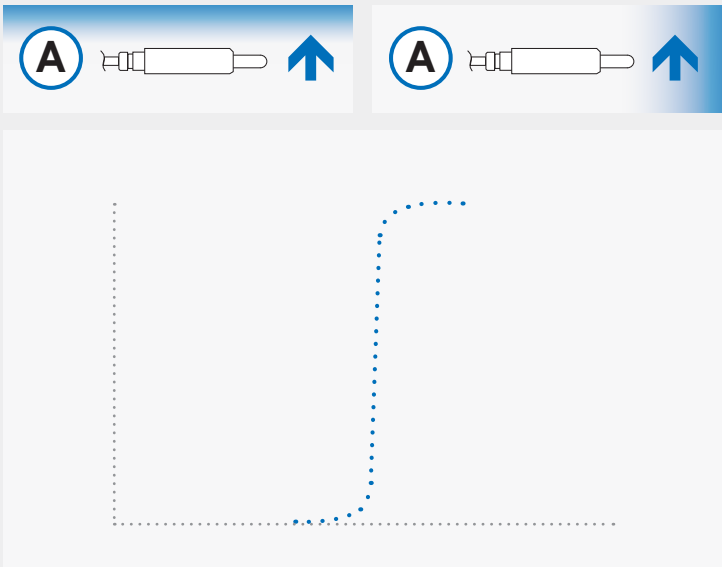
#### Square Tank

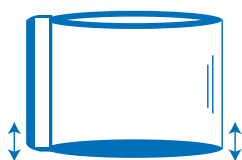
##### Cross-Plane

##### In-Plane

##### Cross-Plane

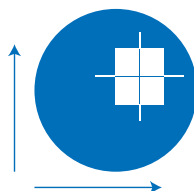
##### In-Plane





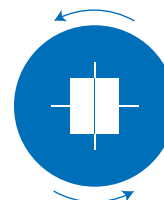
### Auto Level

3D SCANNER water sensor measures water surface relative to the scanning mechanism at three points and automatically adjusts the water tank leveling using two electric motors.



### Auto Center

3D SCANNER measures a 10 x 15 cm beam to determine the center of the beam relative to the center of 3D SCANNER. Two electric motors then align the center of the 3D SCANNER with the beam center.



### Auto Angle Offset

3D SCANNER uses a series of beam measurements to automatically establish in-plane and cross-plane home positions. The ring drive electric motor's zero position is set to the found cross-plane direction.

## Extended Scanning Ranges

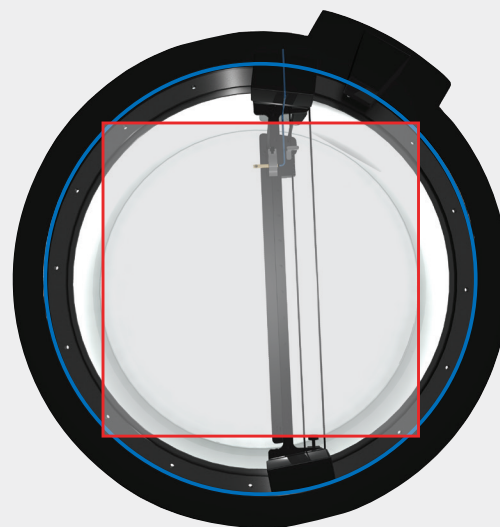
### No Tank Shifts

Square 3D water tanks cannot measure a full 40 x 40 cm field at 30 cm depth and 100 cm SSD unless the user shifts the water tank twice, taking two measurements of two "halves" of the beam at different tank locations. This technique is time intensive and can introduce errors that compromise data quality.

The cylindrical shape of the 3D SCANNER enables the most efficient scanning ranges compared to square water tanks. A 65 cm scan range is possible without a shift of the 3D SCANNER. This allows a 40 x 40 cm measurement at 30 cm depth and 100 cm SSD, without the inconvenience and potential errors involved in shifting the water tank. A 65 cm scan range is achieved with the offset detector holder, whereby two scans are merged and no tank shift is needed.

**Square Tank MAX: 55 cm = Tank shift**

**3D SCANNER MAX: 65 cm = No tank shift**



35% increase in scan range inline/crossline

## Integrated Electronics

The 3D SCANNER design streamlines the connection and packaging of a 3D water tank system with several features:

### Single Cable

3D SCANNER utilizes the same power/data cable that is used for other Sun Nuclear instruments, saving the user from installing another cable in the bunker.

### Connections

All 3D SCANNER accessories plug directly into the 3D SCANNER eliminating the need for external junction boxes.

### Electronics

The electronics housing attaches to the 3D SCANNER and contains the following:

- Electrometer Unit – A dual channel electrometer collects all field and reference data for the 3D SCANNER. The electrometer is guarded against extra cameral volume and provides exceptional specifications for low noise scan data that requires minimal processing
- Control Unit – 3D SCANNER control electronics for motors and other hardware

### Integrated Electrometer

- Dual measurement channels
- Mounts directly to tank

### Ring Drive

- Precise positioning of the diameter drive to any orientation in the profile plane

### Detector Holders

- Field and reference holders are included

### Vertical Drive

- Precise positioning of the diameter drive to the desired depth in the water tank
- Lead screw design

### Diameter Drive

- Consistent detector orientation through the penumbra regardless of scan axis
- 650 mm scanning range
- Tension belt design

### WaterProof PROFILER™ & TPR Ports

- Input for available integrated Water-proof PROFILER
- Input for available integrated 3D TPR™ kit

### Water Tank

- Cylindrical PMMA acrylic design resists deformation
- Smaller than square tanks (~20% less water)

### Integrated Motor Controller

- Paired with electrometer
- Mounts directly to tank

### MiniLift Modes

- Transport - fits through standard size doorways
- Storage - requires less space for easy storage
- Measurement - straddles the linac couch ring for stability



## Intuitive Software Saves Time

3D SCANNER operates using SNC Dosimetry™ scanning software.

SNC Dosimetry is a modern software application designed to offer both familiar concepts from existing water tank conventions, as well as new tools that were not previously available with a 3D water tank system.



### 1. Queues

Pre-configured and custom queues organize and execute groups of scans. Queue results and analysis are displayed instantly and saved to a project.

### 2. Database

All scans are indexed in a searchable database. Scan data can then be shared among users as needed.

### 3. Electrometer Mode

Collect point measurements through on-demand or automatic charge integration.

### 4. Layers

Unprocessed data and processing history is preserved and can be recalled as needed.

### 5. Analysis

Selected scans provide on-screen analysis, including Batch Scan Comparison with quantitative analysis.

### 6. Projects

Measurements may be organized in multi-level projects for customizable organization. Examples of projects include: annual QA and commissioning.

### 7. Graphs

Scanned data is displayed graphically.

### 8. Processing Layers

Each processing function is treated as a unique layer of the scan data. The processing layers do not overwrite the original scan data, so users may revert to earlier unprocessed data at any time.



## Accessories

### 3D SCANNER accessories



#### 3D MiniLift™

- Straddles the linac couch ring for stability
- Easily stored; requires less space
- Fits through standard size doorways
- Breaks down easily for transport



#### 3D Reservoir™

- Time to fill 3D Scanner: <7 minutes
- Time to empty 3D Scanner: <5 minutes
- Capacity of 187 liters



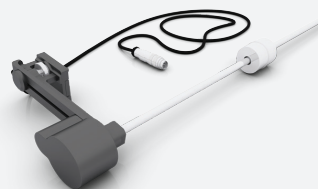
#### WaterProof PROFILER™

- 50.4 cm scan area with 127 SunPoint® Diode Detectors
- Quick connect to 3D SCANNER; no tools required
- Detector size 0.8 x 0.8 mm with 4 mm detector spacing



#### EDGE Detector™

- Accurate penumbra characterization for all fields
- Ideal for steep dose gradients and small fields
- On Accuray® Recommended QA Equipment list
- 842 times smaller in volume than micro ion chambers
- 100 times more signal than micro ion chambers
- No dose volume averaging
- Accuracy for critical penumbra measurements
- Works with all common water phantoms



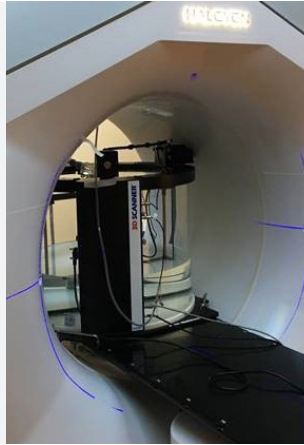
#### 3D TPR™

- Less than 5 minutes to install – no tools required
- Works with 3D Reservoir for fast drainfill time
- 20 cm TPR drain measurement: 2.5 minutes
- 20 cm TPR fill measurement: 3.5 minutes
- Supports Varian, Elekta, Siemens and CyberKnife® systems



## Halcyon™ Kit with SNC Dosimetry™ v3.6

- Couch Positioning Plate
  - Index to Halcyon couch provides alignment to coordinate system
  - AutoSetup™ Routine
- SNC Dosimetry™ v3.6
  - Halcyon-specific scan support



## Reference Detector™

- Patented out-of-field reference detector for use in water tank scanning of photon energies
- Eliminates scanning chamber interference in small SRS fields
- Use with any field size
- No need to move location for different field sizes



## Sun Nuclear Ion Chambers



### SNC125c™

- Enhanced penumbra without loss of signal strength
- Optimized to work with 3D Scanner
- Sensitivity of a 0.125cm<sup>3</sup> penumbra closer to a micro-chamber



### SNC600c™

- Classic Farmer chamber design
- Compatible with most existing slab phantoms and detector holders
- Improved accuracy through consistent orientation used by calibration laboratory



### SNC350p™

- Reference, field and scanning dosimetry of electron beams
- Conforms to design principles stated by Dr. M. Roos
- Well-guarded to reduce perturbation effects

## Common Features

- Water-proof and fully guarded
- Meet IEC 60731 standards for reference class dosimeters
- Satisfies recommendations of dosimetry protocols (e.g., AAPM TG-51 and IAEA TRS-398)
- White chamber body allows easy visualization during setup and relative to cross hairs and lasers
- Vented to provide air-density correction and eliminate need for radioactive stability check device



## FAQ

### Why is the 3D SCANNER cylindrical?

1. Consistent detector orientation. The scanning detector is always in the ideal orientation (narrowest dimension perpendicular to the field edge), for crossline, inline and diagonal profiles. This eliminates effects of inconsistent detector orientation such as variable dose volume averaging, and delivers the sharpest possible penumbra.
2. More stable water surface. In a cylindrical tank the scanning detector always travels parallel to the scan rail, whereas in square tanks the entire rail travels to acquire inline profiles, and both rails travel for diagonal profiles, creating more ripples in the water. A cylindrical tank's curved walls also help to reduce and cancel ripples.
3. Fast fill and drain time. Faster fill and drain time are achieved due to a smaller tank volume (~20% less water), an important advantage for TPR measurements. Fill/drain time is 3.5/2.5 minutes respectively.
4. No tank shifts. The maximum scan range on any axis of 65 cm should require no tank shifts. A tank shift requires a change to the setup, compromising the stability of the original scanning setup.
5. Scanning volume. Due to the cylindrical shape, ring drive, and scan rail, nearly the entire volume of a cylindrical tank is useful for scanning.

### My beam is shaped square, should my water tank also be shaped square?

No. The raw beam generated by the linear accelerator is actually not square in geometry, and is shaped by a round flattening filter, and trimmed by primary and secondary collimators. A cylindrical tank more closely matches the actual beam geometry than a square tank.

### Can I bypass AutoSetup and setup manually?

Yes. There are two ways: 1) The user can individually command portions of AutoSetup. 2) The user can manually adjust any setup parameter (except hysteresis) via pendant or software.

### AutoSetup aligns the 3D SCANNER to beam CAX automatically; however if the beam is slightly off or skewed will the automatic CAX setup be incorrect?

No. Not even if there is an asymmetric field or if symmetry is wrong. During the "Adjust the ring center's position to the central axis" step, the Linac collimator is rotated by 180 degrees in order to eliminate any asymmetries from the centering process.

### What is the maximum scan field size of the 3D SCANNER?

Without tank shifts, the 3D SCANNER can scan up to 65 cm with the included offset detector holder, or 50 cm without the offset detector holder. The 3D SCANNER can scan a full 40 x 40 cm field, with 5 cm tails at 100 cm SSD and at a depth of 30 cm with the offset detector holder. For a diagonal scan of a 40 x 40 cm field at 30 cm depth, an 80 cm SSD is used.

### Do I have to adjust the gain setting each time I start a new scan?

The 3D SCANNER electrometer has a very large dynamic range so the gain does not need to be reset between scans when using the same detector. This includes high dose rate FFF beams.

### Do I have to purchase TPS export modules?

No. All available TPS export modules are included in the 3D SCANNER's SNC Dosimetry software. This can be a significant cost savings.

### How is 3D SCANNER different from other systems regarding processing?

Each scan that has had processing retains a list of the processing layers, along with a time stamp of when the scan processing layer was added. Due to the 3D SCANNER's database, raw data is saved, and each scan can always be returned to a previous layer of processing, or returned to its raw state. One may also see processing changes already implemented by selecting individual prior layers without reverting the processed scan.

### Can I make off axis scan measurements?

Yes. This is most often requested for Pinnacle<sup>3</sup> and measuring intra-leaf leakage. 3D SCANNER combines the Ring and Diameter Drive movements simultaneously to acquire off axis scan measurements.

### How can I share data between colleagues and PCs?

SNC Dosimetry software has a "Save" function that will create files as .xml, .txt, or TPS-compatible .ascii format, which allows sharing of data as with any other system that does not have a database. One may also create a database backup and send that to a colleague. The colleague can then open it as a new database on their system. The software can support multiple databases.

### Why is a Halcyon kit required for data collection with 3D SCANNER?

The unique Couch Positioning Plate protects the treatment couch and indexes the 3D SCANNER to the optimal orientation and set up coordinates.

## Features and Specifications

### Scanning

Vertical (mm):	400.0
Diameter (mm):	650.0
Ring (degrees):	330.0
Motors:	Encoded stepper/servo
Scanning modes:	Continuous and step
Scanning Speed Range (mm/sec):	Variable up to 16
Scanning Accuracy (mm):	0.1

### Water Tank

Thickness Wall / Bottom (mm):	13 / 19
Height (mm):	673
Width (mm):	875
Diameter Inner (mm):	676
Water Capacity (L):	166
Weight Empty / Full (kg):	44 / 210

### Software

Tank Centering:	Automatic
Leveling:	Automatic
Surface Detection:	Automatic
TPS Export:	Included

### TPR/TMR Measurement

Drain Rate (cm/min):	~ 13
TPR Measurement Fill/Drain (min):	~ 3.5/2.5

### Electrometer

Warm up Time (min):	< 1.0
Charge:	10pC to no upper limit
Current:	10pA - 7.5nA
Leakage (pA):	< 0.001
Collection Interval (ms):	50
Voltage (V):	Adjustable, -400 to +400
Non-linearity:	± 0.1%
Repeatability:	+/- 0.25%
A/D Converter:	16 bit
Linac Pulse Count:	Included with threshold detection

### Computer Hardware/Software Requirements

CPU:	2.4GHz; 2 cores
RAM:	4GB
Hard Drive Space:	4GB
Operating System:	Windows 7 and 10 (Professional); check with representative for SQL Server or SQL Server Express requirements
USB Version:	2.0
Video Card Memory:	64MB

### 3D MiniLift

Vertical Height Min. (mm):	570.0
Vertical Height Max (mm):	950.0
Vertical Stability (mm):	1.0
Configuration Dimensions L/W/H (mm)	
Measurement:	1230.0 x 1130.0 x 584.0
Storage:	940.0 x 630.0 x 584.0
Transport:	1520.0 x 720.0 x 584.0
Disassembled Dimensions L/W/H (mm)	
Automatic Leveling Platform:	612.0 x 612.0 x 128.0
Lift:	305.0 x 406.0 x 508.0
Frame:	940.0 x 592.0 x 305.0
Total weight (kg):	87.7 (Does not include leveling platform)
Individual Component Weight (kg):	Frame assembly: 45.7 Actuator assembly: 38.2 Handle: 3.8 Leveling Platform: 23.0

### 3D Reservoir

Max Fill / Drain Speed (min):	7 / 5
Dimensions L/W/H (cm):	114.2 x 65.0 x 90.0
Weight (Full / Empty, kg):	228.0 / 39.0
Capacity (L):	187.0
Fill and Empty Rate (L/min):	22.0
Ground Clearance (mm):	130.0

### Compatibility

FFF:	Yes
Stereotactic:	Yes
Applicable TPS Systems:	Yes
Halcyon:	Yes with Kit



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