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DETECTION
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3D SCANNER™

3D Scanning Comes Full Circle

Do DOSIMETRY

SUN NUCLEAR corporation

Your Most Valuable QA and Dosimetry Tools

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BETTER OUTCOMES THROUGH TECHNOLOGY

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

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The 3D SCANNER Advantage

The geometrical design, setup process, and software have all been developed to improve not only the accuracy of measurement data, but also the water tank 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

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

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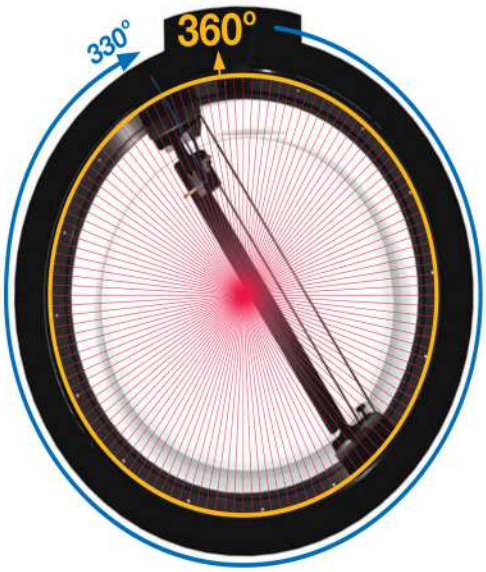
360° of Scanning:

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

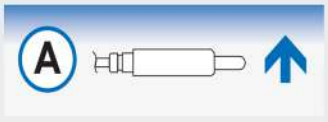
360 degrees of scanning with consistent detector orientation results in better data and eliminates the need to change tank setup.

Consistent Detector Orientation

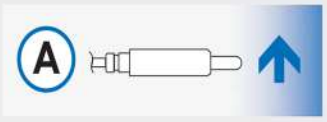
Better Results

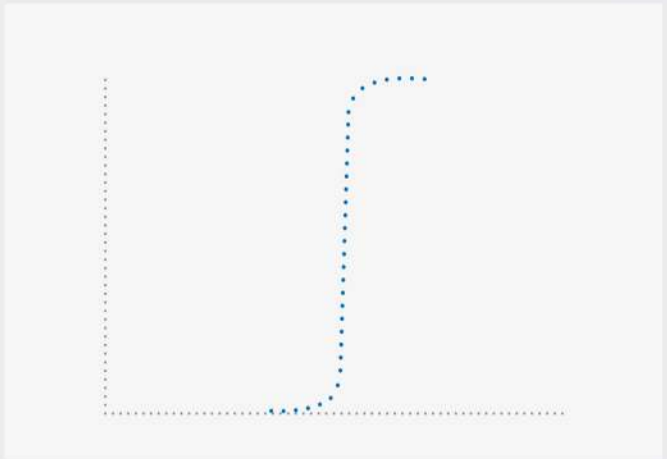
3D SCANNER

Cross-Plane



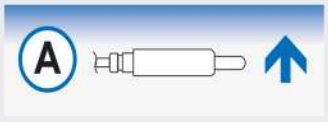
In-Plane



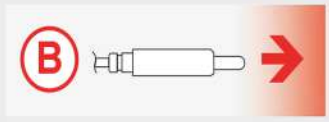


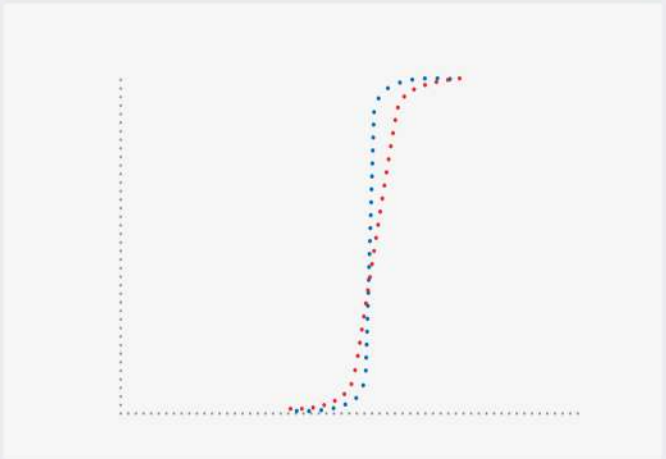
Square Tank

Cross-Plane



In-Plane





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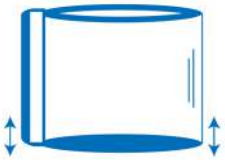
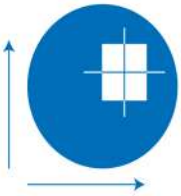
AutoSetup™

Less Subjective, Saves Time



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

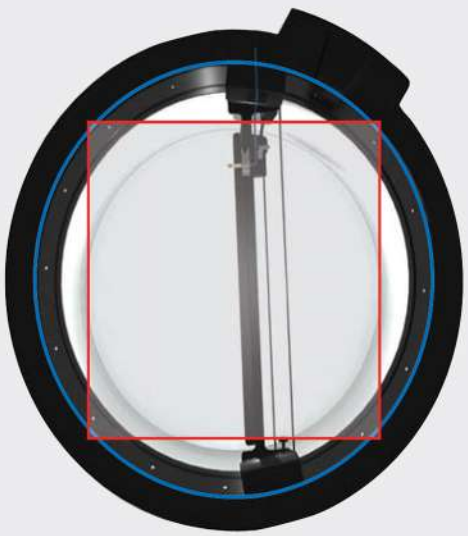
Square 3D water tanks cannot measure a full 40 x 40 cm field at 30 cm depth and 100 cm SSD unless the user shifts the water tank twice, taking two measurements of two "halves" of the beam at different tank locations. This technique is time intensive and can introduce errors that compromise data quality.

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

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Integated 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

Water-proof 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

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Do
DOSIMETRY

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
Queues organize and execute groups of scans. Queue results and analysis are displayed instantly for saving to a project.

2. Database
All data is indexed in a searchable database. Scanned data can then be shared among users as needed.

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

4. Analysis
Selected scans provide on-screen analysis.

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

6. Graphs
Scanned data is displayed graphically.

7. 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.

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Accessories

3D SCANNER accessories

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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

Water-proof **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

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SNC**125c**™

- Reference, Field, Scanning dosimetry of electron and photon beams
- IMRT/VMAT Quality Assurance
- Enhanced penumbra without loss of signal strength
- Water-proof and fully guarded
- Vented to provide air-density correction and eliminate the need for radioactive stability check device
- White chamber body gives a clear line of sight to the crosshairs and lasers during set up and set up verification

SNC**600c**™

- Reference class ionization chamber (IEC 60731)
  - Highest performance and stability level
  - Satisfies recommendations of dosimetry protocols (e.g. AAPM's TG-51 and IAEA's TRS-398)
- Follows classic Farmer chamber design
  - Compatible with most existing slab phantoms and detector holders
- Fully guarded, vented, and water-proof
  - Quick setup with no required wait time before measuring
- White thimble
  - For improved setup and accuracy
  - Crosshairs and lasers easily discerned on thimble
- Rotational orientation mark
- Improved accuracy through consistent orientation that calibration laboratory uses

SNC**350p**™

- Reference, field, and scanning dosimetry of electron beams
- TDD/TPS Commissioning and QA
- Conforms to the design principles as stated by Dr. M. Roos
- Meets AAPM TG-51 and IAEA TRS-398 requirements for low-energy beams
- Reference dosimeter can be used to cross calibrate field dosimeters
- Meets highest standards of performance (IEC 60731)
- Well-guarded to reduce in-scattering perturbation effects
- Vented to provide air-density correction and eliminate need for radioactive stability check device
- White chamber body allows easy visualization of the setup relative to the crosshairs and lasers

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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^3 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 .asci 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.

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Features and Specifications

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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):	~ 3.5/1.5

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:	3GB
Operating System:	Windows XP and 7
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

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