STANDARD IMAGING®

DoseView™

U S E R M A N U A L

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General Precautions

Warnings and Cautions alert users to dangerous conditions that can occur if instructions in the manual are not obeyed. Warnings are conditions that can cause injury to the operator, while Cautions can cause damage to the equipment.

⚠ WARNING: Where applicable, Standard Imaging products are designed to be used with the versions of common radiation delivery devices, treatment planning systems and other common computer software products or systems used in the delivery of ionizing radiation, available at the time the Standard Imaging product is released. Standard Imaging does not assume responsibility, liability and/or warrant against, problems with the use, reliability, safety or effectiveness that arise due to the evolution, updates or changes to these products or systems in the future. It is the responsibility of the customer or user to determine if the Standard Imaging product can be properly used with these products or systems.

⚠ WARNING: Proper use of this device depends on careful reading of all instructions and labels.

⚠ WARNING: An electrical shock hazard of up to ±450 VDC is possible whenever the bias voltage is active. Always set the bias to the 0% or 0 VDC level whenever a device is connected to or disconnected from the electrometer. Do not enable bias on a measurement channel connected to a diode detector.

⚠ WARNING: This equipment is not intended to be used in flammable mixture atmospheres. Do not use with flammable anesthetic mixture with air, with oxygen, or nitrous oxide.

⚠ WARNING: Electric shock hazard. Do not disassemble or remove covers from equipment. Refer servicing to a qualified individual.

⚠ WARNING: Electric shock hazard. Turn the Wireless Pendant off before attempting to change the internal batteries.

⚠ WARNING: Restrain loose clothing or long hair when working near motor and lead screw assemblies.

⚠ WARNING: Do not place your extremities in or near water tank while field detector carriage is in motion.

⚠ WARNING: Do not reach into the water tank when scanning arm is moving.

⚠ WARNING: Use only provided power supplies, which include Protek Power, Model PMP150-14, and are identified in the specifications. The use of any power supply other than the UL/TUV recognized power supplies provided with this unit (Protek PMP150-14 or TRUMPower TMP150-24) and using alternatives other than the UL/CSA recognized or European certified power cord can degrade minimum safety. The power replacements from Standard Imaging Inc. are required for compliance with the requirements of IEC 60601-1.

⚠ WARNING: System is very heavy, especially when filled with water. Handle with care.

⚠ CAUTION: Cybersecurity is a shared responsibility between Standard Imaging and the customer. Secure use of this product is dependent upon the proper utilization of passwords, firewalls, networks, computer platforms, operating systems and data storage.

⚠ CAUTION: When replacing the Wireless Pendant internal batteries, ensure the correct polarity orientation is used.

⚠ CAUTION: Do not over fill water tank or reservoir.

⚠ CAUTION: Always use two or more people to place the DoseView 3D water phantom onto the Lift and Reservoir Cart.

⚠ CAUTION: Do not fill either water tank or reservoir unattended.

⚠ CAUTION: Water reservoir can be filled using either fill port as they are connected internally. Use caution not to overfill reservoir if using both fill ports. Fill capacity is approximately 60 gallons (265 liters).

⚠ CAUTION: Do not clean water tank with abrasive cleansers, isopropyl alcohol or other volatile solvents.

⚠ CAUTION: Do not submerge or scrub the Motion Controller, Electrometer, and Lift and Reservoir Cart in water or solvent to clean.

⚠ CAUTION: When moving the Lift and Reservoir cart, avoid inclined surfaces.

⚠ CAUTION: While in use, place power supplies outside of the Lift and Reservoir Cart storage cavity to prevent overheating.

⚠ CAUTION: Only push the Lift and Reservoir Cart with the cart handles.

⚠ CAUTION: When rotating the water tank upon the Precision Position Platform, ensure the Motion Controller power cable and Precision Position Platform control knobs do not catch on the platform.

⚠ CAUTION: It is recommended to place the pendant on the treatment couch or elsewhere when scanning takes place.

⚠ CAUTION: Use only the provided electrometer with the DoseView 3D. Do not use other manufacturer's electrometers or dosimeters.

⚠ CAUTION: Input voltage on electrometer's triaxial connector should be no greater than +5 V or -5 V.

⚠ CAUTION: Do not drop or mishandle equipment.

⚠ CAUTION: Do not use handles to lift the Lift and Reservoir Cart.

⚠ CAUTION: Do not use aluminum frame on top of the water tank to lift or position the water phantom system.

⚠ CAUTION: Damaged or kinked ionization chamber cables or extension cables should not be used.

⚠ CAUTION: Upon power on, allow for proper warm-up.

⚠ CAUTION: The electrometer should not be connected to a detector which is used in direct contact with a patient.

⚠ CAUTION: Connector end of ionization chamber or diode should not be submerged.

⚠ CAUTION: Do not rotate the water tank while full or when the Lift and Reservoir Cart is at the maximum height position.

⚠ CAUTION: When rotating the water tank, push the base of the tank rather than the top of the tank.

⚠ CAUTION: If this equipment causes interference with other equipment, the user is encouraged to try to correct the interference by the following:

- Increase the separation between equipment
- Connect the power supply cord into a different grounded AC outlet or into a circuit controlled by a different circuit breaker
- Consult Standard Imaging, Inc.

1 QuickStart Guide

1.1 Scan Acquisition

1) Set Up Hardware

Set up and carefully align the DoseView water phantom and scanning arm. For the DV3D, use the three-point leveling system on the scanning arm frame. Verify DV3D leveling by checking chamber alignment with the water surface at the center and corners of the tank.

2) Start Up Software

Define the scan coordinate origin using the “Set origin” button on the tank pendant and ensure the DoseView hardware is connected to the computer. For the DV1D, also ensure connectivity between your SuperMAX or MAX 4000 Plus electrometer and the computer.

Launch the DoseView software by double clicking the DoseView icon.

Select Enter DoseView 3D if you are using a DV3D water phantom and select Enter DoseView 1D if you are using a DV1D water phantom.

3) Define Your Equipment

On the Setup page, ensure that your clinic, machine, detectors that you will use for scanning, and electrometers (DV1D only) are entered in the DoseView software.

4) Create a Scan Queue

On the Setup page, select Scan Queue

Select “Add Queue” and go from top to bottom filling in your scan requirements.

When all requirements are complete, save your scan queue.

5) Prepare Hardware

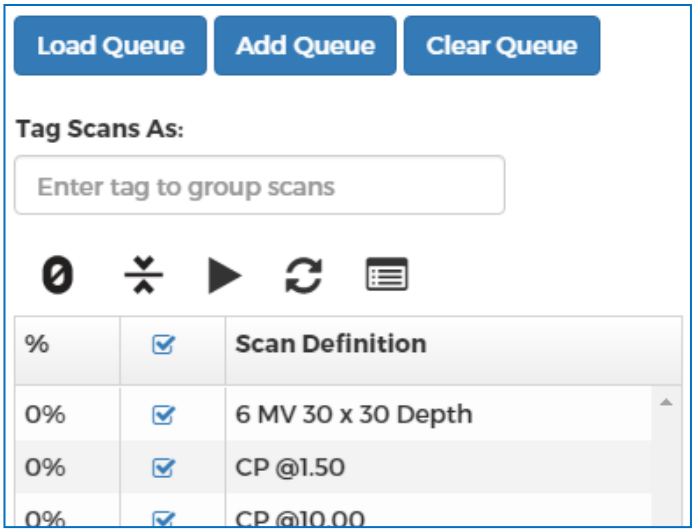
Select Measure to open the Measure page. The Hardware tab will be open by default.

Go from top to bottom through the expander boxes specifying your hardware setup.

6) Run Your Scan Queue

On the Measure page, select Queue

Load your scan queue, zero the electrometer  , normalize the scan  , and start scanning  .



Tags can be used to group scans (e.g., 2018 Annual).

7) Point measurements (DV1D only)

On the measurements page for DV1D, select the Single Point tab.

This interface can be used to perform individual point measurements with the DV1D tank and the SuperMAX or MAX 4000 Plus electrometer.

1.2 Scan Analysis

1) Start Analysis

Select Analyze to open the Analyze Page. Select Load Scans.

The Select Scans dialog will appear.

2) Select Scans

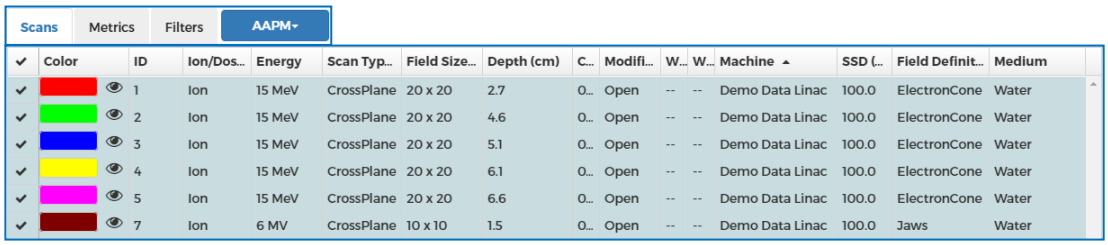
All scans are saved in a database. Progressive search allows you to select your scans easily.

3) Inspect Scan Graph

The scan graph shows selected scans in color, unselected in gray. After filtering, both processed and raw data may be displayed. A toolbar allows you to pan and zoom and identify scan values with your mouse.

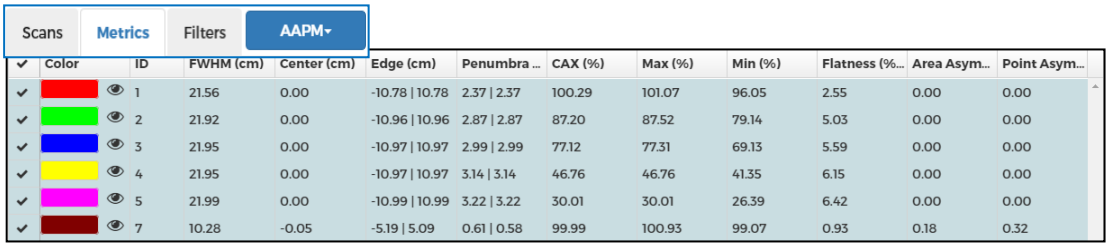
4) Inspect Scan Details

Each selected scan appears in a table with identifying information.



5) Review Scan Metrics

Various standard metrics suites may be chosen (AAPM shown).



Color	ID	FWHM (cm)	Center (cm)	Edge (cm)	Penumbra ...	CAX (%)	Max (%)	Min (%)	Flatness (%...	Area Asym...	Point Asym...
	1	21.56	0.00	-10.78 | 10.78	2.37 | 2.37	100.29	101.07	96.05	2.55	0.00	0.00
	2	21.92	0.00	-10.96 | 10.96	2.87 | 2.87	87.20	87.52	79.14	5.03	0.00	0.00
	3	21.95	0.00	-10.97 | 10.97	2.99 | 2.99	77.12	77.31	69.13	5.59	0.00	0.00
	4	21.95	0.00	-10.97 | 10.97	3.14 | 3.14	46.76	46.76	41.35	6.15	0.00	0.00
	5	21.99	0.00	-10.99 | 10.99	3.22 | 3.22	30.01	30.01	26.39	6.42	0.00	0.00
	7	10.28	-0.05	-5.19 | 5.09	0.61 | 0.58	99.99	100.93	99.07	0.93	0.18	0.32

6) Filter Scans

Scan filtering should be used sparingly because some filters, especially smoothing filters, can affect scan shapes adversely.

Filters allow you to center, normalize, symmetrize and smooth profiles. Depth scans can be shifted, normalized, converted to dose and smoothed.

7) Useful Filter Sequences

Depth Scans:


Normalize to Dmax


Shift


Dose Convert

Profiles:

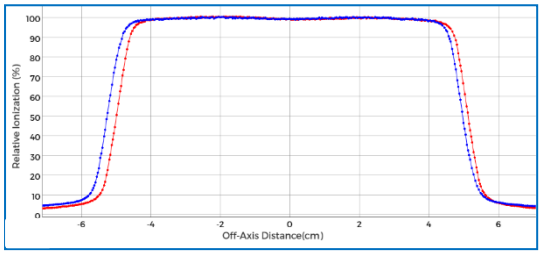

Center

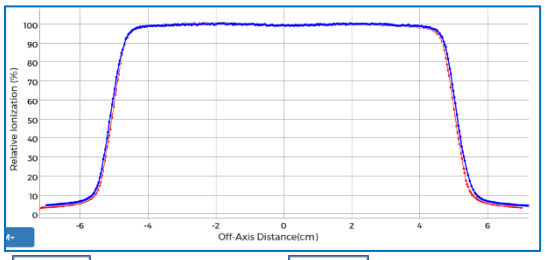

Average Symmetric


Normalize to Central Axis

8) Filtering Example

Unfiltered Profile Scans





 Centered and  Symmetrized Profile Scans

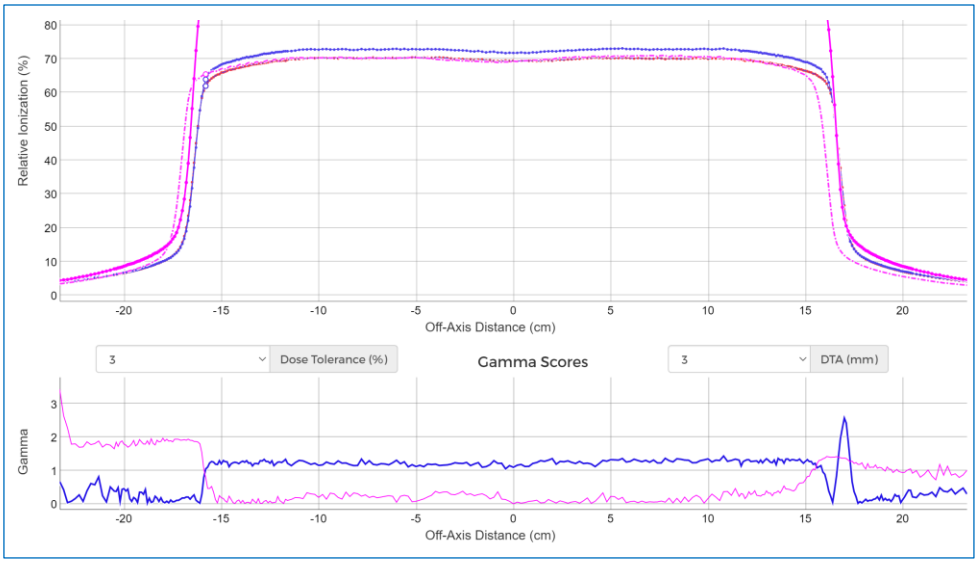
Both graphics and tabular metrics update as filters are applied.

	Color	ID	FWHM (cm)	Center (cm)	Edge (cm)	Penumbra ...	CAX (%)	Max (%)	Min (%)	Flatness (%...	Area Asym...	Point Asym...
✓		81	10.13	0.00	-5.06 | 5.06	0.54 | 0.54	99.20	100.55	98.71	0.92	-0.01	0.00
✓		83	10.24	0.00	-5.12 | 5.12	0.57 | 0.57	99.50	100.45	98.76	0.85	0.00	0.00

9) Scan Comparisons in DoseView

DoseView software provides the user multiple methods of scan comparison including visual overlays and gamma comparisons against the user selected reference scans. These comparisons provide the user insight into Linac output changes over time or variations between matched machines.

- Visual scan comparison viewing of scan results in the plot window.
- Scan comparison of user selected reference scans to selected scans of matching parameters. This includes visual as well as direct metric comparison.
- Gamma comparison in gamma graph to user selected reference scans.
- User-selected dose difference and distance to agreement values.



1.3 Scan Miscellanea

1) Export to TPS and CSV

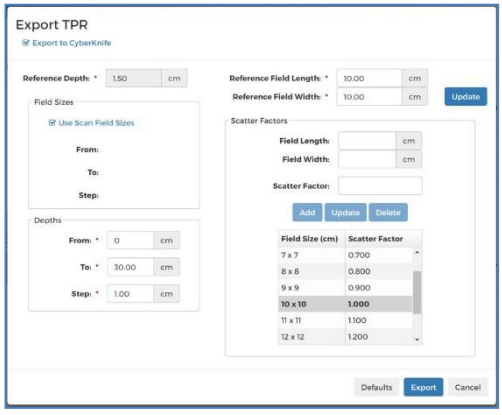
From the Analyze page, select Export

You may export to:
Varian Eclipse
Elekta Monaco
Philips Pinnacle
RaySearch RayPlan

Saved in user-specifiable folder.

2) Export PDD and TPR

From the Analyze page, select Export



Fill in field size and depth steps for tables, reference distances and scatter factors.

Note: CyberKnife Export will default to 1.5cm reference depth.

Saved in user-specifiable folder

3) Produce Reports

From the Analyze page, select [Reports], then click on [Select a report type], selection of two types of report will be presented.

1) CSV Reports

Scans currently loaded in the Analyze page display can be used to create CSV reports. These CSV reports can be easily formatted to your requirements using MS Excel or similar..

Individual reports are created for each combination of machine, modality, analysis type (depth vs. profile) and medium.

Saved in user-specifiable folder.

2) Isodose Curve PDF Reports

The DoseView Software provides the ability to produce PDF reports of Isodose Curves saved in a user-specifiable folder.

4) Create Scan Sets

You can create scan sets - collections of scans that are bound together by common themes (e.g., annual measurements, beam steering episodes, etc.)

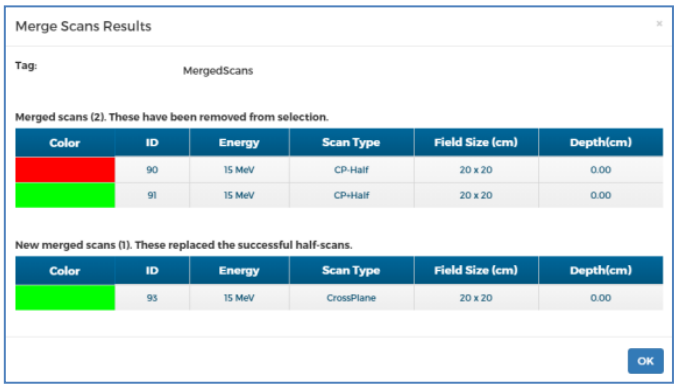
Select Save Scan Set or Scan Sets from the Analysis page bar.
Export PDD and TPR
From the Analyze page, select Export

Fill in field size and depth steps for tables, reference distances and scatter factors.

Saved in user-specifiable folders

5) Merge Half Scans

Profile scans from opposite half sides of the same field can be joined to create a complete scan.



Consider mirroring rather than joining half scans.

6) Use the About Box

Find out how to contact us, what software version you have, and details of the software.

Table of Contents

2 DoseView Software/Computer Requirements

Operating System —	Windows® 10 or 11 Professional, 64-bit (US English)
Runtime Environment —	.NET 4.5.2
Processor —	Dual Core, 1 GHz; Quad Core, 2 GHz Recommended
Memory —	32-bit OS: 2 GB, 4 GB Recommended 64-bit OS: 4 GB, 8 GB Recommended
Hard Drive —	32 GB or greater, 1 GB free space for initial software set up. Typically, 2.5 MB/Year/Linac disk space growth. 25% free space Recommended.
Screen Resolution —	1440 x 900 or greater
Connectivity —	USB 2 port and/or 9-pin serial RS-232 port

Conventions Used in this Manual

Buttons: When a button is described, it is surrounded by [ ] marks.
Example: Press [OK] to proceed.

Menu Paths: When a menu path is described, it is shown with a > between each level.
Example: Navigate to File > Print to print the currently viewed file.

“DoseView 1D” contracts to “DV1D”.

“DoseView 3D Contracts to “DV3D”

3 Overview

This user manual covers the operation and maintenance of the DoseView 3D (REF 92260) and DoseView 1D water phantoms (91800/91810) as well as the *optional* DoseView 3D Lift and Reservoir Cart (REF 72260). This manual also provides guidance for use of the DoseView software.

The DoseView 3D is a 3-axis water phantom system designed to acquire and manage beam data from radiotherapy treatment machines such as linear accelerators and Cobalt60 units. Beam data acquired from the DoseView 3D is typically used for three objectives: acceptance testing, commissioning, and periodic quality assurance. The system is comprised of several components:

- Water Phantom with 3D Controls
    - Acrylic Water Tank (Internal Scanning Dimensions 48 x 48 x 41cm)
    - 3D Motion Controller
    - 3D Wireless Pendant
- Two Channel Electrometer
- Two Exradin A28 Ion Chambers, (Scanning/Reference), 0.125cc
- Detectors Holders and Alignment Accessories
- Web-Based Software for
    - Scan Acquisition
    - Scan Maintenance
    - Scan Analysis
    - Scan Editing and Post-Scan Processing (Filtering)
    - Report Creation
    - Export to Treatment Planning Systems
    - Export of PDD and TPR Tables
- (Optional) DoseView 3D Lift and Reservoir Cart
    - Motorized Lift Mechanism
    - Precision Positioning Platform
    - Motorized Unidirectional Pump

The DoseView 1D is a single axis water phantom system designed to acquire and manage beam data from radiotherapy treatment machines such as linear accelerators and Cobalt-60 units. Beam data acquired from the DoseView 1D is typically used for periodic quality assurance. The system is intended to be used with an independent electrometer. When used with the SuperMAX or MAX 4000 Plus electrometers, the DoseView 1D can be used in conjunction with the DoseView software for automated depth scanning and interactive single point measurements. The system is comprised of several components:

- Water Phantom with 1D Controls
    - Acrylic Water Tank (Internal Scanning Depth 25cm)

    - 1D Motion Controller
    - 1D Pendant
- Detector of choice (not included)
- Detector Holder

4 Definitions

Initialization – Initialization causes the detector to drive to the corner of the phantom nearest the power switch establishing a home position for the motor encoders. Initialization must be performed each time the phantom is powered on. Power cycling clears the home position, the origin and any soft limits that have been set.

Default Origin – After initialization, the detector travels to the default origin, which for the DoseView 3D is at the approximate physical center of the X and Y axes and roughly at the fill point for water along the Z axis.

Hard Limits – Hard limits are those defined during the initialization process. These are the maximum physical limits to which the detector carriage can travel.

Soft Limits – Soft limits allow the user to restrict the movements of the detector carriage so that collisions of the field detector and tank walls can be avoided. Soft limits can be configured using the Wireless Pendant. If a maximum or minimum soft limit is not defined for a given axis, the system will instead respect the hard limit defined during initialization.

Detector – A detector is the measurement instrument used with the DoseView 3D or DoseView 1D. Detector types include cylindrical (chamber), parallel plate (chamber), scintillator, diode, and other.

Profile Axis – For the DoseView 3D, the profile axes are defined in relation to the gantry. Standing facing the gantry, CrossPlane is left-to-right or right-to-left and InPlane is superior to inferior or inferior to superior. Diagonal profile angles are defined such that a 0-degree diagonal is the same as CrossPlane profile and a 90-degree diagonal is the same as an InPlane profile.

Depth Axis – The depth axis is defined as the vertical axis perpendicular to all profiles.

Water Phantom – A water phantom is defined as the complete system associated with the acrylic water tank. For the DoseView 3D this includes the acrylic tank, DoseView 3D Motion Controller, movement arms, detector carriage, DoseView 3D Electrometer and Wireless Pendant. For the DoseView 1D this includes the acrylic tank, DoseView 1D arm, detector carriage, pendant, and SuperMAX or MAX 4000 Plus electrometer.

Motion Controller – The DoseView 3D Motion Controller is the control box which communicates commands to and from the Wireless Pendant, movement arms, DoseView software, and DoseView 3D Electrometer.

Wireless Radio – The wireless radio attaches to the PC via a USB connection and provides communication to and from the PC and DoseView 3D Motion Controller.

Field Detector – The field detector is the moving detector mounted on the detector carriage of the DoseView water phantom.

Reference Detector – the reference detector is a fixed detector mounted on the reference detector holder of the DoseView water phantom.

Normalization Point – When normalization is performed, the current detector position is defined as the Normalization Point. When normalization occurs, the measured value at the Normalization Point is treated as 100% for the next scan.

5 Tips for Usage

General Preparation – The user should become familiar with both the hardware and software components in advance of first use. We recommend completing sections 7-10 before setting up in the treatment vault.

Software Set Up – Initial set up of the DoseView software should be completed with administrative privileges for the operating system.

Water - Distilled water is recommended as it will have less of a corrosive effect on your phantom's mechanical parts.

Water – Do not leave water in the reservoir or phantom tanks for a prolonged time, as it may result in algae and bacterial growth. This can be mitigated by adding 12 - 16 oz. of hydrogen peroxide per 30 gallons.

Pendant - Turn off the pendant when not in use to avoid draining its batteries. Batteries should be removed from the pendant during extended storage periods.

Phantom Filling - Fill the DoseView 3D reservoir in advance of scan acquisition to save time and allow the water temperature to equilibrate with the ambient environment. The reservoir holds approximately 227.1 liters (60 gallons).

Phantom Orientation - Orient the DoseView 3D phantom with the motion controller facing the couch. This will result on less water disturbance as the detector travels in the CrossPlane direction.

Phantom Placement – Avoid placing lift cart wheels on the circular floor plate, if possible. A sheet of plywood or particle board can be used to distribute weight.

Phantom Alignment – Avoid using lasers to align the tank as diffraction through the water tank walls can cause laser lines to shift. Instead, we recommend using the crosshairs and optical distance indicator (ODI) for fine setup adjustment after the water tank has been filled.

Phantom Initialization - Press and hold the [INITIALIZE] button on the wireless pendant. When the carriage begins to move after a moment, release the button. *Until this step is performed, the Detector Control movement buttons are not operational.*

Small Field Measurements – Use of an Exradin A4 Spherical detector taped to the gantry head can be used to provide the reference signal for small field measurements [Culberson, 2017, Med Phys. 2017 Jun;44 (6)].

Electron Depth Scans - When measuring electron depth ionization, it is good to have at least 5 centimeters of tail past the theoretical practical range. This will allow better determination of the actual practical range (intersection of photon tail and 60%-25% slope).

Diode Detector - Do not apply a bias to a diode detector.

6 Software Set up

6.1 Software Set up

You must have administrator privileges to set up DoseView Software.

1. Before software set up restart your PC
2. Copy the installer to your desktop
3. Double click on the installer icon
4. Below appears, select [Next >]

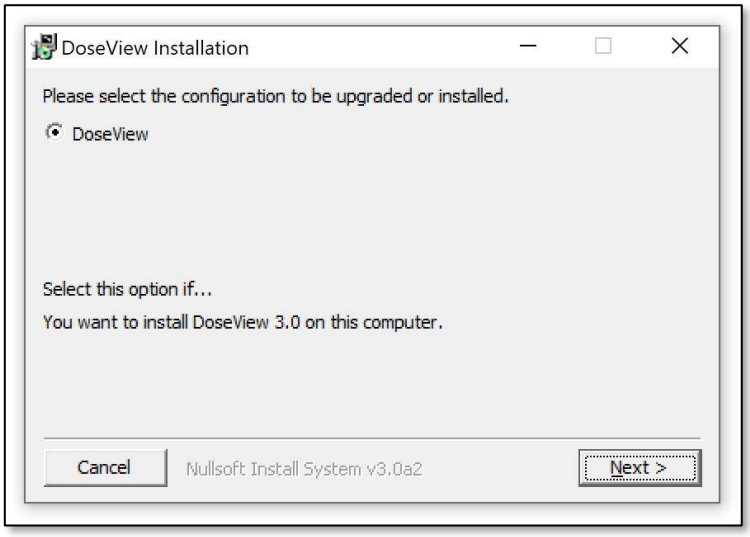


Figure 6-1

5. Below appears, accept the license agreement and select [Next >]

Figure 6-2

6. Below appears, select [Install >]

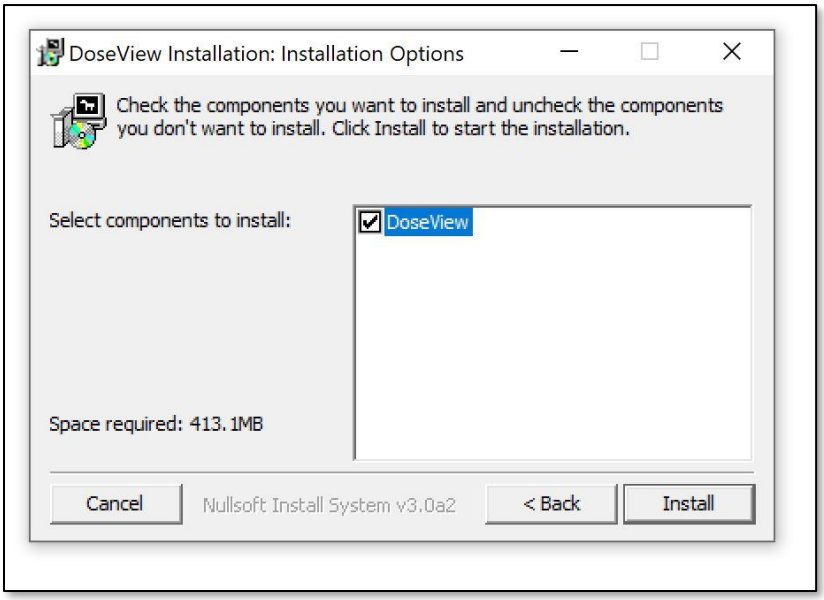


Figure 6-3

7. Below appears, click [Next] when complete.

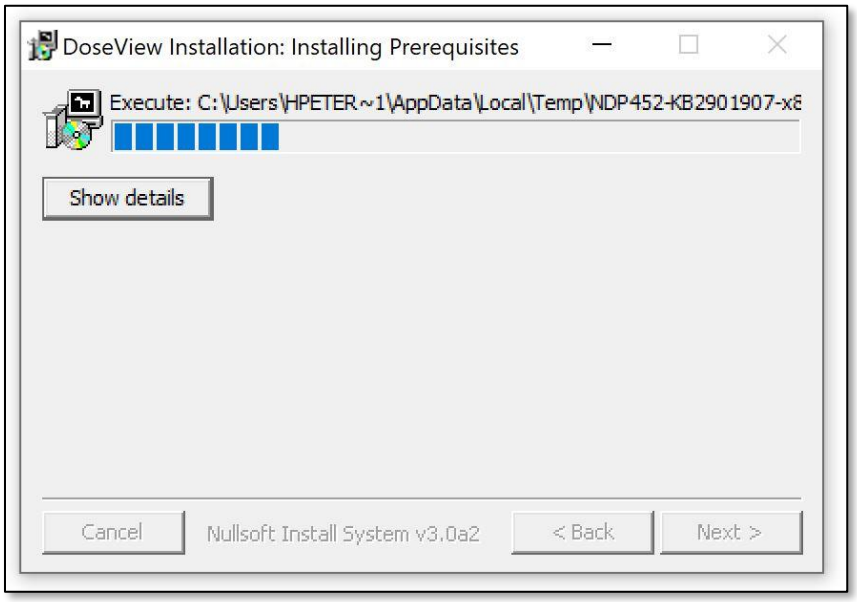


Figure 6-4

8. Below appears, select [Next >]

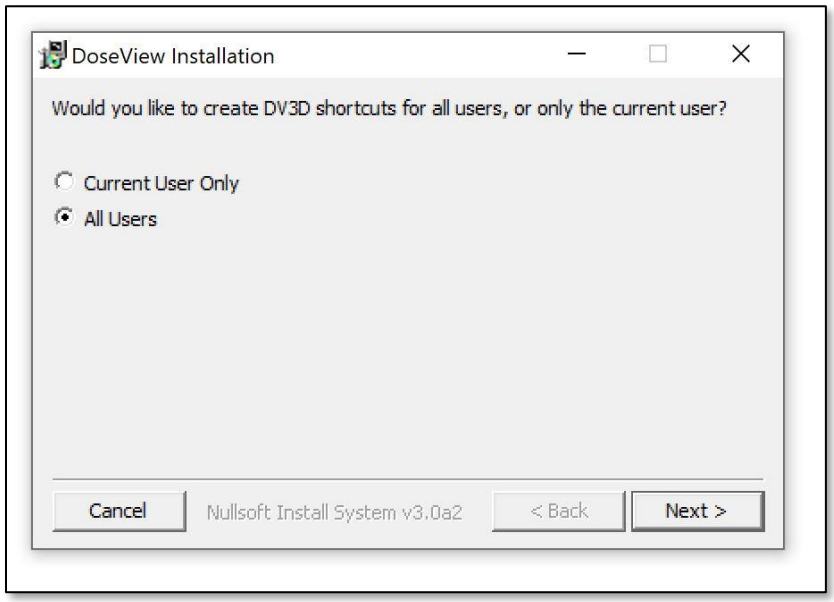


Figure 6-5

9. Below appears, select [Install)]

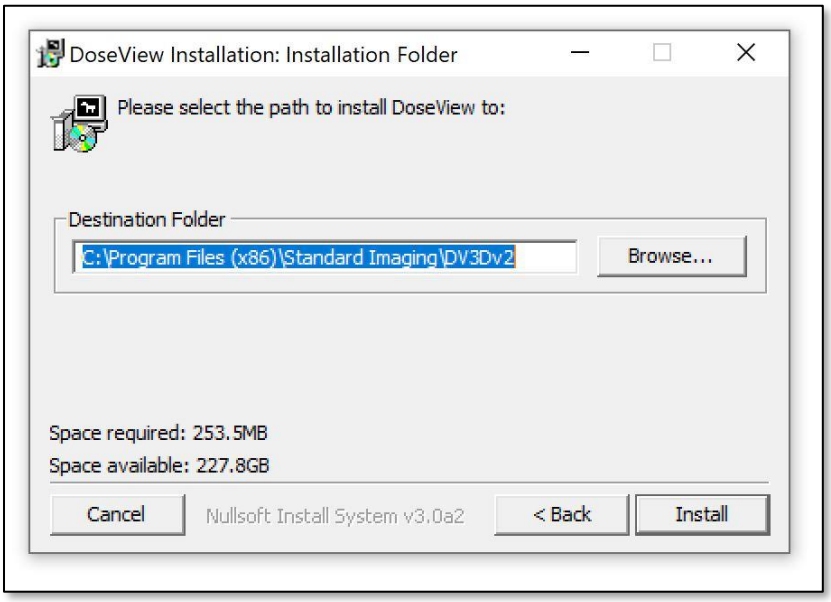


Figure 6-6

10. Below appears

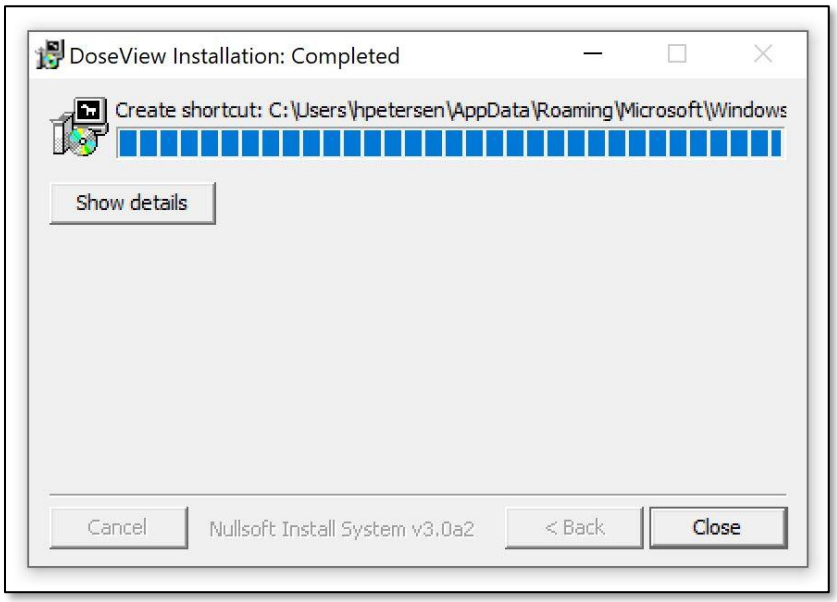


Figure 6-7

11. Below appears, select [Yes]

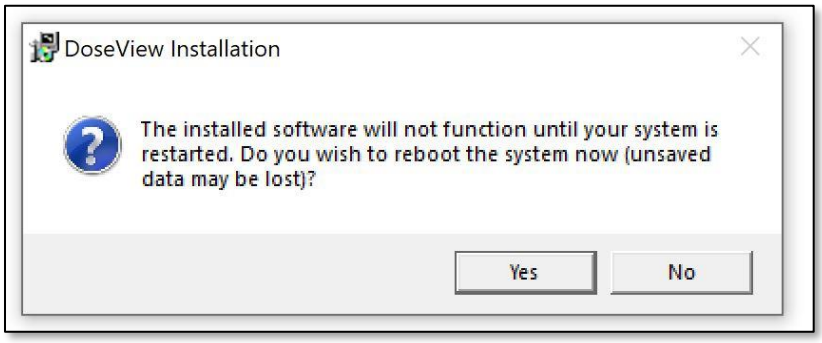


Figure 6-8

12. After system restart, double click the desktop icon…

The splash screen below, should appear…Click on the DoseView 3D icon on the left to start the 3D component of the DoseView Software.

Figure 6-9

If this screen does not appear, there may be an issue with the installed services. Follow the instructions in Checking and Starting Windows Services to resolve the issue (see section 7.2).

6.2 DoseView Admin Utility and License Activation

The latest versions of DoseView software will add a second Icon to your desktop.

Figure 6-10

This Icon <DoseView Admin Utility> will allow you to access the licensing process as well as start and stop the DoseView API in the MS Services function.

Licensing DoseView

DoseView has a licensing requirement where the DoseView 1D or DoseView 3D (which includes the DoseView 1D component) must have an active license in place. The License key will be supplied with the purchase of a DoseView System.

To activate the license to enable you to use the DoseView software/hardware double click the DoseView Admin utility icon.

This will open the DoseView Admin Utility. To activate the license use the <Help> pulldown Menu and select License/Activate License.

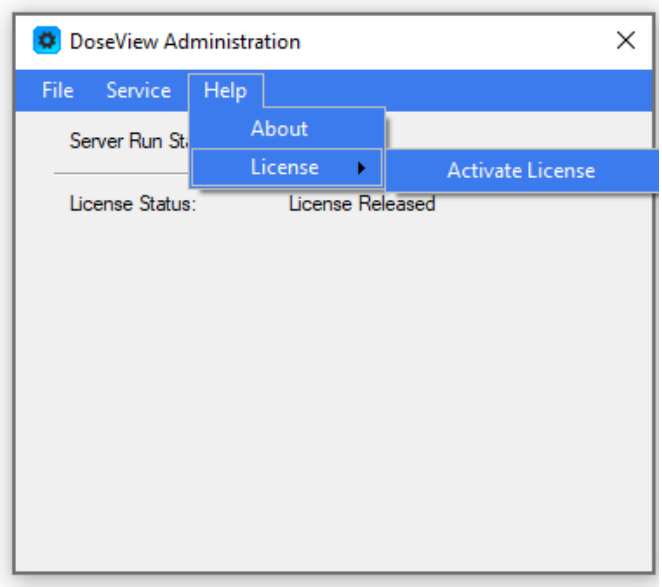


Figure 6-11

An activation window will open, select either Internet Activation (if PC is internet enabled) or Manual Activation. This will open a dialog box according to your selection. To complete the license activation follow the prompts.

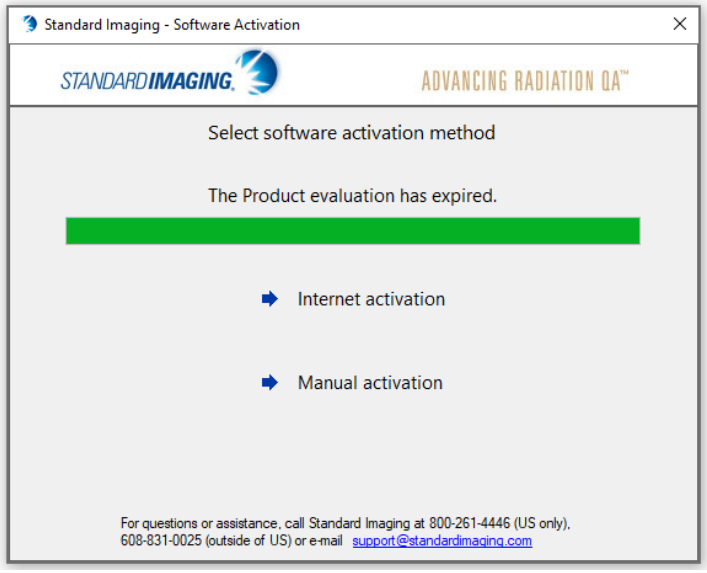


Figure 6-12

Once completed you will be able to enter the DoseView Software from the splash screen.

Additional functionality in the DoseView Admin Utility

In addition to licensing functionality in the DoseView Administration Utility the application provides the ability to start and stop the DoseView API in the Microsoft Services application. This can be used for actions such as allowing the switching out of DoseView Databases.

To access the Services functionality open the DoseView Admin utility. The readout will show the "Server Run State." Typically it will be running. To stop the service click on the Service pull down from the menu bar. This will display the Start/Stop option

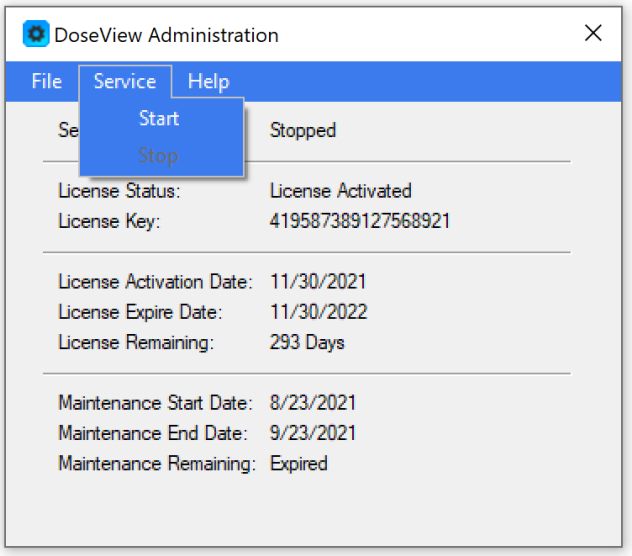


Figure 6-13

6.3 Checking and Starting Services via Windows Services

Execute the steps below if the splash screen does not appear. If you cannot access any of these administrative tools, you may need further user rights on your computer.

1. If DoseView Software appears to be running but with no splash screen, exit from the DoseView Software.
2. Select “Control Panel” from the “Start Menu”, below appears

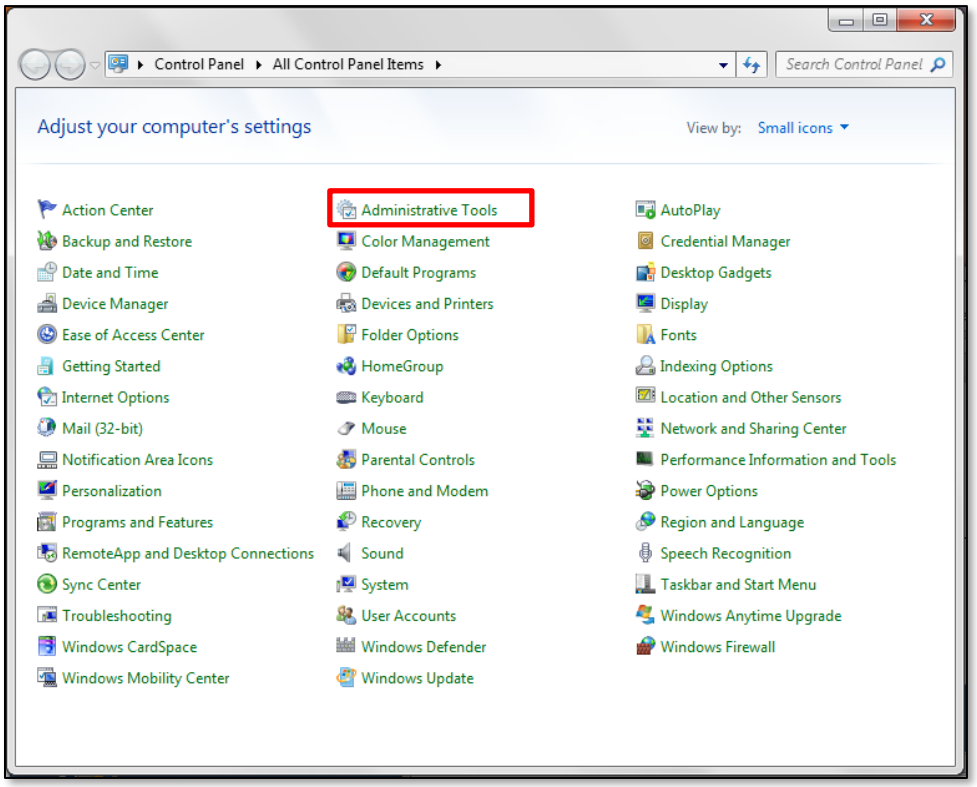


Figure 6-14

3. Select “Administrative Tools”, below appears

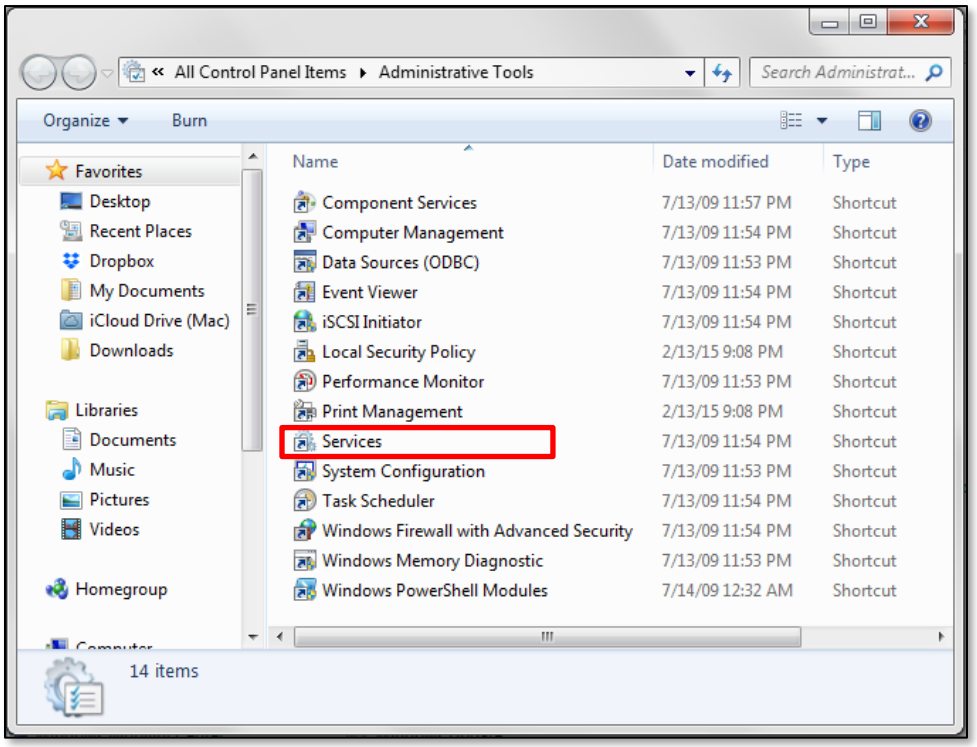


Figure 6-15

4. Select “Services” and locate the service called DV3D API, see figure below. The startup type should say “Automatic” for this service.

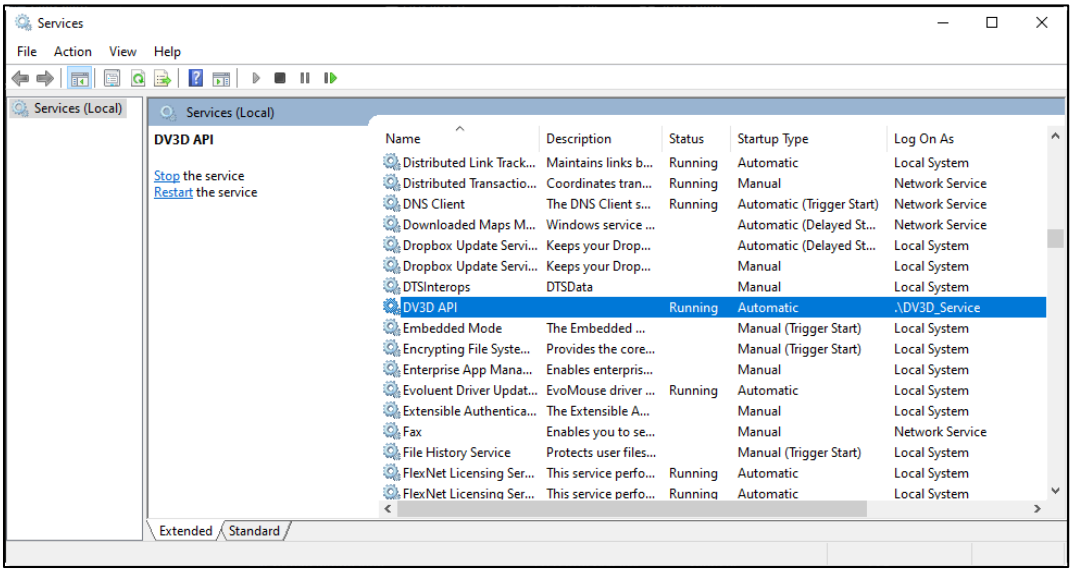


Figure 6-16

5. To set the startup type, right click on “DV3D API” and select properties, From the pull down list set the Startup Type to “Automatic” as shown below.

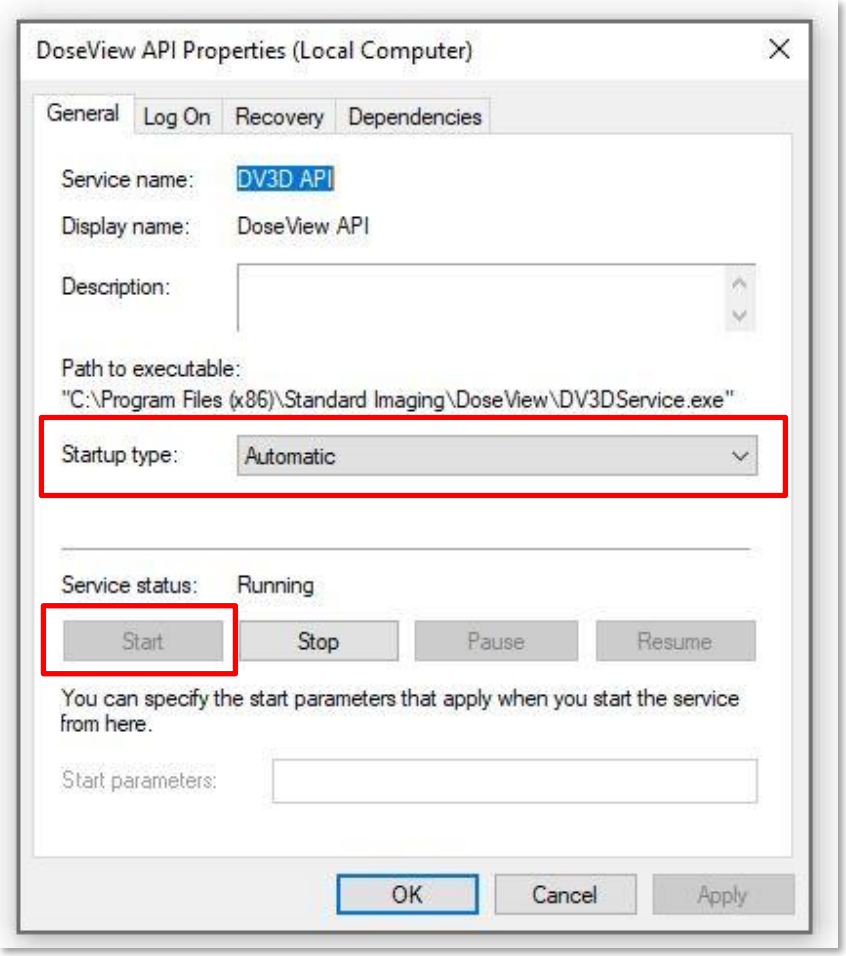


Figure 6-17

6. Make sure that the “Startup type” is “Automatic” and select “Start” and click “OK”.

   Restart DoseView Software.

6.4 Finding DoseView Software Version

If you don't know what version of the DoseView software you currently have, you can find it on the "About" screen under "Application Info". The Contact Us information is shown by default when you select the About page:

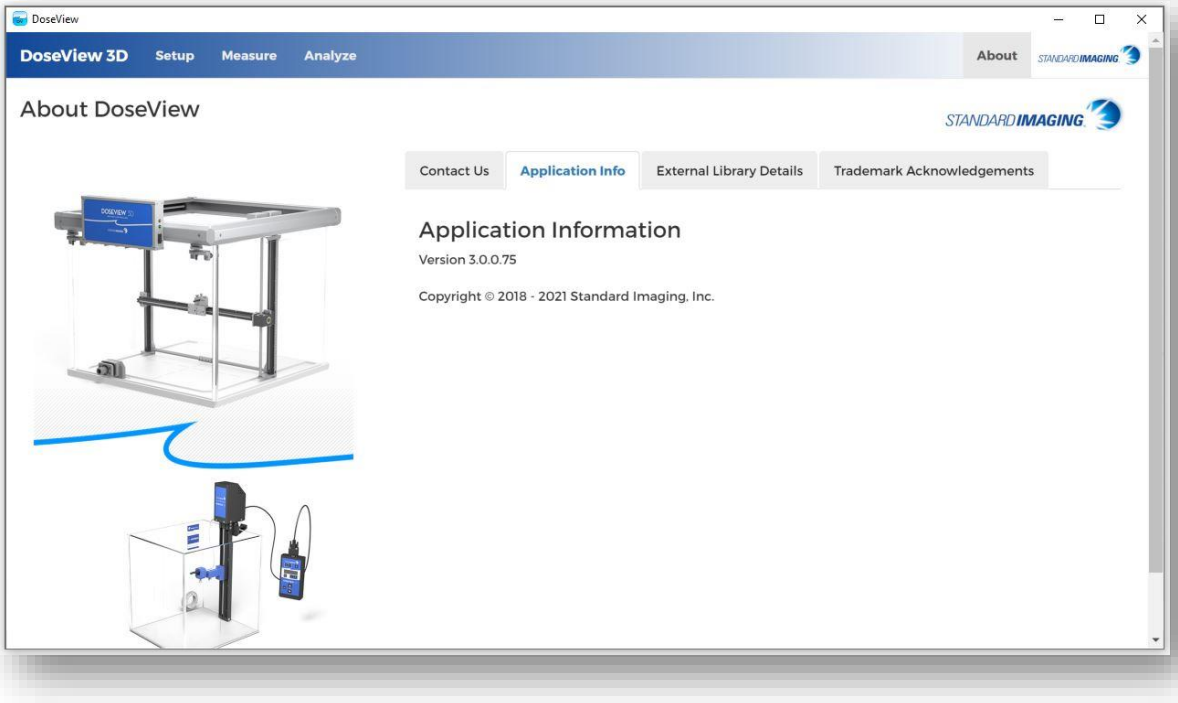


Figure 6-18

6.5 Using the DoseView 3D Firmware Updater

NOTE: the DoseView software Firmware Updater is only for the DoseView 3D Harware there is not included Firmware Updater for the DoseView 1D system.

When the DoseView program is set up, the DoseView 3D Firmware Updater is also installed. If firmware updates are made available, this tool can be used to view the currently installed version number and update the firmware on four main DoseView 3D components: the main controller, motion controller, electrometer and pendant.

Two cases exist for the DoseView 3D:

- If you have purchased a new phantom and are using it for the first time, your firmware is most likely to be up to date.
- If you are updating the DoseView software from a version prior to v2.0, your firmware may not be up to date. Contact Customer Support for firmware updates (support@standardimaging.com).

If your firmware is out of date, DoseView will notify you that you need to update it and will not allow the software to connect to the tank until the firmware is updated.

At this time, DoseView 3D v1.2 should work with both older and newer versions of the firmware; DoseView software v2.0 and higher need the firmware to be updated from v1.2 to v2.0 in order to work.

Getting Started with DoseView 3D

Attach the DoseView 3D phantom directly to the PC via the included RS-232 cable. ***Firmware cannot be updated when communicating to the motion controller in wireless mode.***

Turn the pendant on.

Checking the Current Firmware Versions

Run the DoseView 3D Firmware Updater from the Windows Start Menu or Desktop icon.

If there is a com port error, click the icon in the upper left corner of the firmware updater tool (next to “DoseView 3D Firmware Updater” text), and choose “Select COM Port”. Enter the com port number used with the DoseView 3D system.

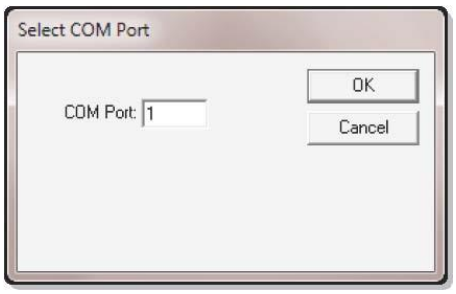


Figure 6-10

Once communication has been established, click the [Get Versions] button on the main program window. Current version numbers will appear next to each system component.

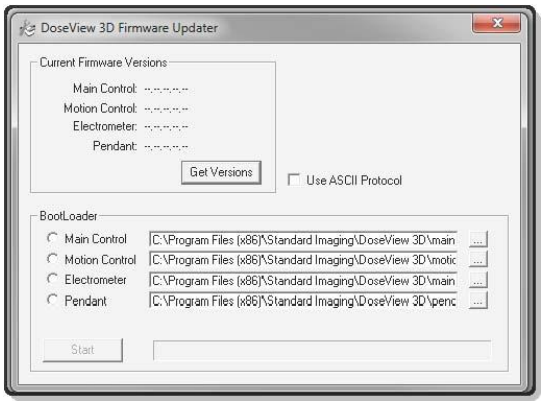


Figure 6-20

Updating to Alternate Firmware Versions

Under the "BootLoader" section, click the [...] button next to each of the four components, and browse for the corresponding firmware .hex file for each component. Firmware .hex files are distributed by Standard Imaging when new firmware versions become available.

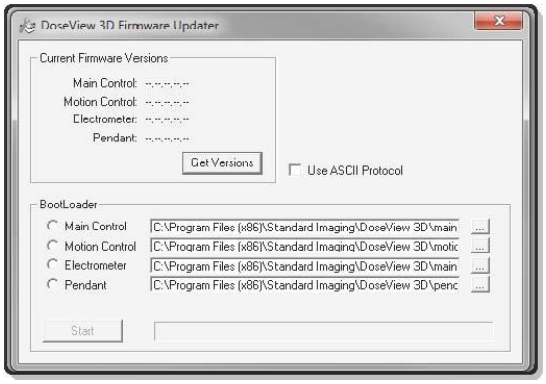


Figure 6-11

To update a component's firmware, click its corresponding radio button and click the [Start] button. The selected components firmware will be updated. If desired, select other components and perform the same procedure.

NOTE: Main control, motion control, and electrometer firmware will update within a few moments, however the pendant firmware can potentially take several minutes as wireless communication is used between the main Control and pendant components. If the pendant update fails, try again until it successfully transfers.

Once the updates are applied, click the [Get Versions] button again to ensure the new versions have been successfully set up.

7 DoseView 1D Hardware Setup and Operation

7.1 Preparing the Scanning Arm

Attach the AC power cable to the rear of the arm and plug the unit into a wall outlet. The two LEDs on the scanning arm indicate the following:

Amber: Power indicator
Green: Indicates successful self-test

Attach the hand pendant directly to the serial cable attached to the scanning arm. The display will illuminate and initially show firmware versions for the arm "robot" and pendant.

Next, "Not Initialized" will be displayed.

CAUTION: Before initializing, ensure no obstructions will impede the detector carriage.

To initialize, press and briefly hold the [INITIALIZE] button on the pendant until the detector carriage begins to move. The carriage will move to the top limit of the arm travel and stop. The arm carriage is now free to set to origin.

The origin can be set at this time with the hand pendant (see also Section 7-6).

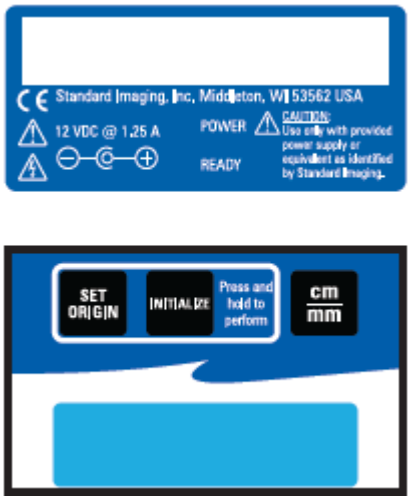


Figure 7-1:
DoseView 1D Scanning Arm rear status, hand pendant setup controls, and display

7.2 Aligning the Water Tank

1. Place the 1D tank on the treatment couch.
2. Loosely mount the scanning arm on the side of the water tank that does not have a black alignment line.
3. Orient the tank with the scanning arm to the foot of the couch.
4. Use the three vertical tank alignment lines to align the tank to isocenter using the treatment room lasers.
5. Using a spirit or digital level, adjust the **white screw (1, below)** on the left-hand side of the hinge rail until the scanning arm is level in the cross-plane direction.
6. Slide the scanning arm left or right until the sagittal light field or laser line matches the white line on the detector bracket. See Figure 8-2.
7. Tighten the **black clamp (2, below)** on the hinge rail until the scanning arm is securely attached to the tank.

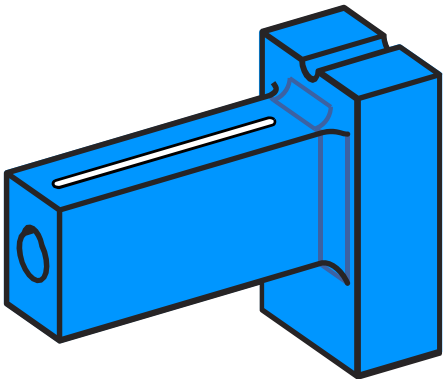


Figure 7-2:
Detector mount white alignment line

8. Using a spirit or digital level, adjust the **metal leveling** thumbscrew **(3, below)** until the scanning arm is level in the in-plane direction.

The 1D Scanning Arm should now be level. Check the leveling with your spirit or digital level.

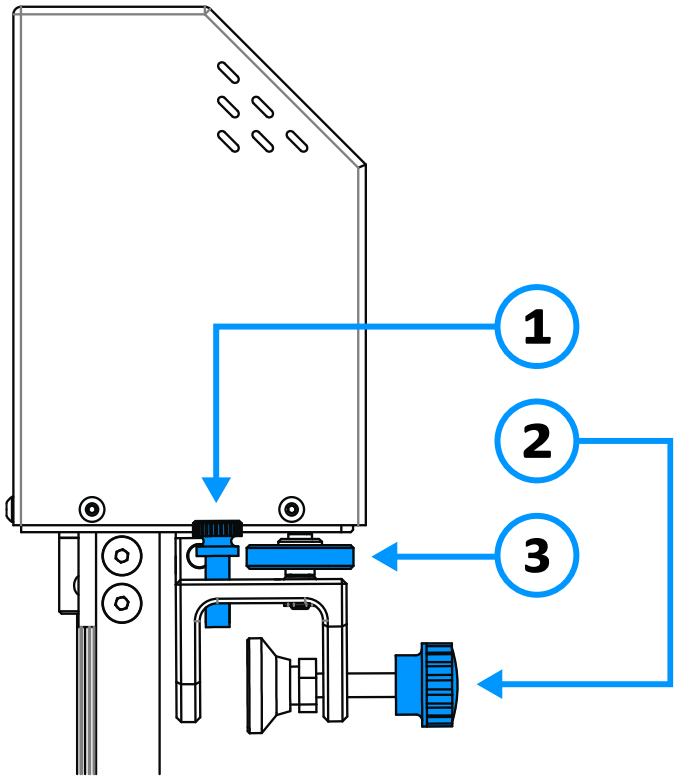


Figure 7-3:

Alignment Adjustment Points

7.3 Attaching a Detector

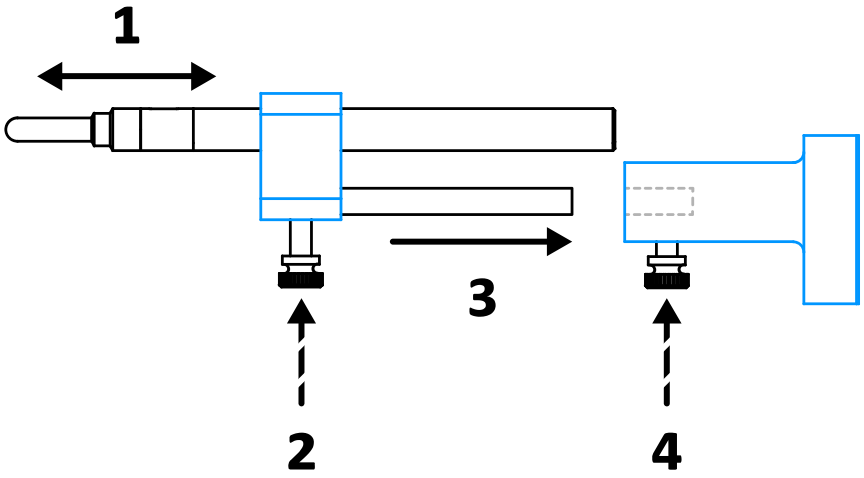


Figure 7-4:

Attaching an ionization chamber

To attach a detector to the scanning arm, follow the instructions below and refer to Figure 7-4 above.

1. Select the desired detector and insert it into the hole in the blue detector bracket separated from the scanning arm.
2. Tighten the white thumb screw to secure the chamber into place.
3. Insert the black rod of the detector/mount assembly into the scanning arm's blue bracket. Match the white alignment lines of both blue detector bracket pieces as shown in Figure 7-5. Align the detector with the light field adjusting the position from step 1 if necessary.
4. Tighten the white thumb screw to secure the assembly into place.

Any thimble ion chamber should fit into the detector bracket holder, and most parallel plate chambers (which have a rigid stem) can be used with this detector bracket holder.

For parallel plate chambers, simply insert the connector first into the holder, feed the cable through, and then tighten down the white thumbscrew when the chamber's stem is in position.

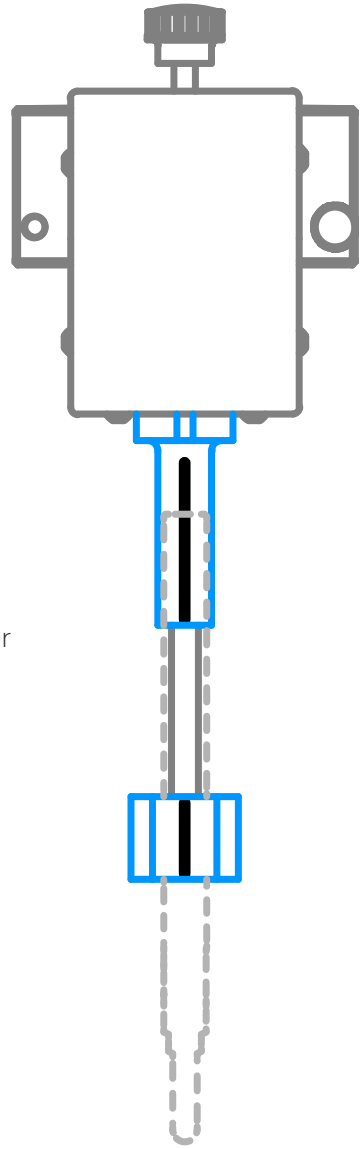


Figure 7-5:
Detector mount alignment lines
(ion chamber shown as dotted line to show alignment)

Figure 7-6:

Fully mounted detector

7.4 Attaching the Reference Detector Positioning Kit

DoseView 1D has a Reference Detector Positioning Kit that contains the following:

- Base for detector attachment to tank
- Long carbon fiber tube
- Reference detector holder
- Tube/base post combination fastener

To attach the Reference Detector Positioning Kit

1. Loosen the combination fastener and insert the tube into it.

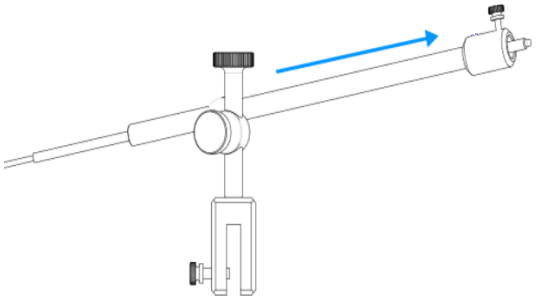


Figure 7-7:
Reference Detector with one tube section

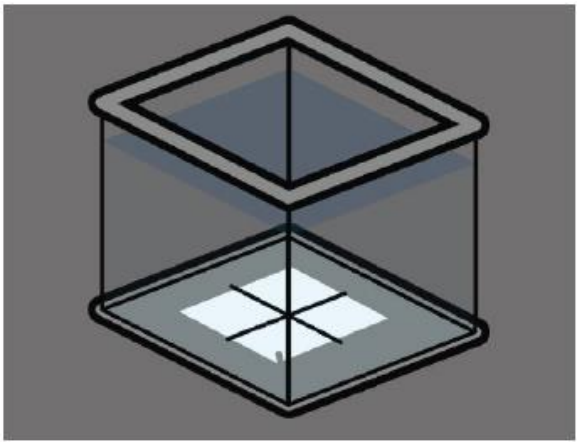


Figure 7-8:
Reference Detector position

2. If the diameter is sufficient for the detector used (less than or equal to 8 mm such as the Exradin A28 Ion Chamber), slide the detector into the tube and if desired, attach the reference detector holder onto the tube assembly. If used, tighten the white thumbscrew to fix the reference detector in place. For larger detectors a small piece of tape can be used to secure the detector in place.
3. Position the reference detector such that the detector's shadow can be partially seen in the field area. The corner is an ideal spot as it prevents the reference detector from obstructing the measurement path of the sample detector.
   Place the included build-up cap on the reference detector.

7.5 Filling the Water Tank

The Standard Imaging DoseView 1D scanning arm has 28 cm of end-to-end travel distance.

The arm is intended to be used at a maximum of 25.0 cm depth, with added space at the top to match the chamber depth to the water surface and provide adequate spacing at the full depth of 25.0 cm. The tank label shown in Figure 8-9 shows the two minimum fill lines. If only 20.0 cm of depth travel is desired, simply fill water to at least the 20.0 cm fill line, and likewise for the 25.0 cm fill line.

CAUTION: Do not use the draining tube for filling the tank, as the components are not rated for high pressure throughput.

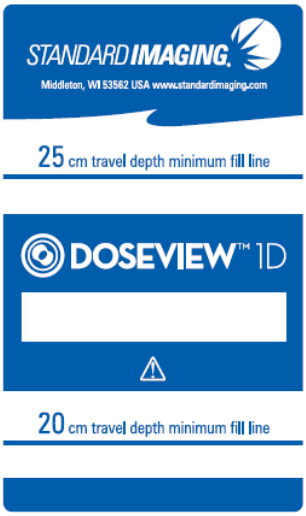


Figure 7-9:
DoseView 1D tank minimum fill label

7.6 Setting the Origin

Use the hand pendant (see Section 8.9) to position the detector carriage at the desired origin position. To confirm the position, press and briefly hold the [SET ORIGIN] button. The display will show the current position as 0.

Figure 7-10:
Setting the origin

NOTE: The carriage can be driven into either rail end without risk. However, for maximum longevity of the scanning arm, this should be avoided other than during initialization. Also, if a rail end is hit at fast speed, the carriage must be moved away from the end at fast speed. If the end is hit at slow speed, either speed will move the carriage away from the rail end.

7.7 Operating the Scanning Arm from Outside of the Treatment Vault

Disconnect the hand pendant from the scanning arm and in its place, attach the provided 9-pin serial extension cable. Run this cable outside of the treatment vault and re-connect the hand pendant. See Figure 7-11. The pendant will re-power on, display the current detector position and be ready for positioning the detector in the desired measurement location(s).

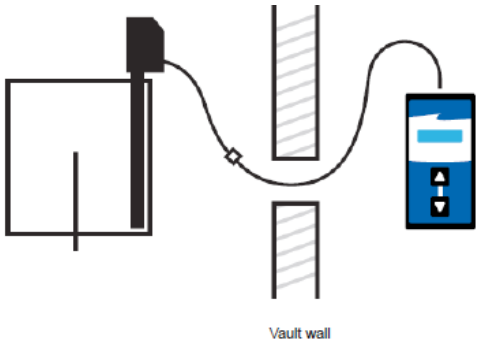


Figure 7-11:
Hand pendant connection

7.8 Draining the Water Tank

Attach the included draining tube to the valve located at the bottom of the water tank. The water will drain automatically. Press the round button on the valve to release the draining tube. See Figure 7-12.

NOTE: Water should be drained after each use to maximize the longevity and performance of the scanning arm and water tank.

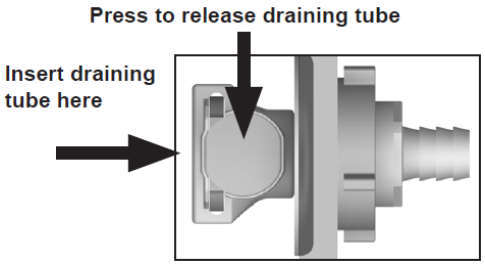


Figure 7-12:
Water tank drain valve

7.9 Using the Hand Pendant

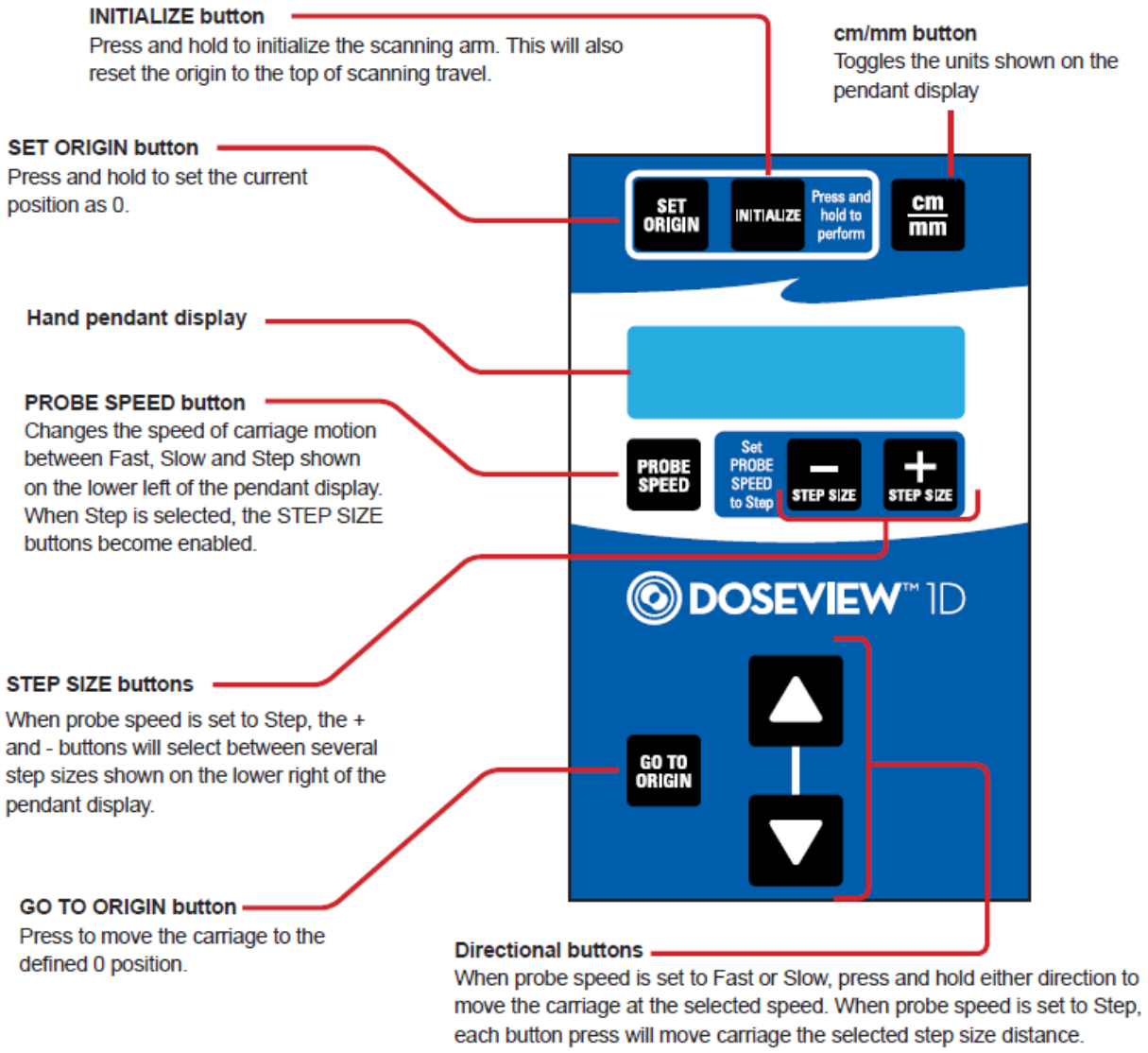


Figure 7-13: Hand Pendant

7.10 Connecting the DoseView 1D scanning arm and electrometer to a PC for 1D Scanning with the DoseView Software

The DV1D component of the DoseView Software records electrometer data for point measurements and facilitates depth-dose curve acquisition.

The general DV1D software process:

1. Set up and align DV1D water phantom as noted above in sections 8.1 – 8.7.
2. With power connected to the 1D arm, initialize, and set the origin using the pendent. Indicator Lights should show:
   Amber: Power is connected.
   Green: Indicates unit microprocessor is operational and ready.
3. With the Electrometer powered on, warmed up, and zeroed, connect DV1D scanning arm and electrometer to your computer directly via the included serial cables and/or included serial to USB adapters.
4. Start DoseView software and select [Enter DoseView 1D].

DoseView 1D Scanning Arm

Compatibility

Note that the DoseView software for 1D scanning with the DoseView 1D water phantom is only compatible with the DV1D scanning arm. Older 1D Water Scanning Systems may be compatible if they have been upgraded. Please contact Standard Imaging for purchasing or updating options for the DV1D scanning arm.

Initialize

The scanning arm must be initialized before it can be used with the software. To do this, attach the AC power cable to the rear of the scanning arm and plug the unit into a wall outlet. The two LEDs on the scanning arm indicate the following:

Amber: Power is connected.
Green: Indicates unit microprocessor is operational and ready.

Attach the hand pendant directly to the serial cable attached to the scanning arm. The display will illuminate and initially show firmware versions for the arm “robot” and pendent. Next, “Not Initialized” will be displayed.

To initialize, press and briefly hold [Initialize] on the pendant until the detector carriage begins to move. The carriage will move to the top limit of arm travel and stop. The arm carriage is now ready to begin measurements.

Detach the pendant. Attach the DV1D scanning arm to the computer using the serial cable and USB to Serial Adapter (if necessary) provided with the DV1D scanning arm.

Electrometer

Compatibility

The DV1D component of the DoseView software is only compatible with the following electrometers:

- SuperMAX, with software version 2.0 or higher
- MAX 4000 or Max 4000 Plus with firmware version 7.0 and higher. This includes Max4000(PLUS) electrometers with serial numbers beginning with the letter "F" Users with serial numbers beginning with "E" or previous should contact support@standardimaging.com to check compatibility and confirm if updated firmware options are available..

Connecting

Power on and connect your electrometer to the computer with a nine-pin serial cable using either an RS-232 protocol or a serial cable with a USB adapter. Please note that if the electrometer is currently in a warm-up or 'preferences' screen, it will not connect properly to the DV1D software.

NOTE: When using a SuperMAX electrometer, one of the following screens must be displayed in order to communicate properly with the DoseView 1D software:

- Channel 1
- Channel 2
- Channels 1 & 2

NOTE: Use only the adapter supplied with the electrometer.

8 DoseView 3D Hardware Setup

8.1 Power Supply and Cable Connection

Included with the DoseView 3D and the DoseView 3D Lift and Reservoir Cart are identical power supplies. Both power supplies are attached to the cart with a pass-through power cable extending up to the Motion Controller to provide power to the water phantom.

Figure 8-1

1. On the end of the cart with the taller handle, locate the large sliding door and open it, revealing a storage compartment with two power connectors.
2. Connect a power supply to each port. Since both supplies are the same, it does not matter which port is used with which power supply.
3. Connect the provided wall outlet power cord to each power supply.

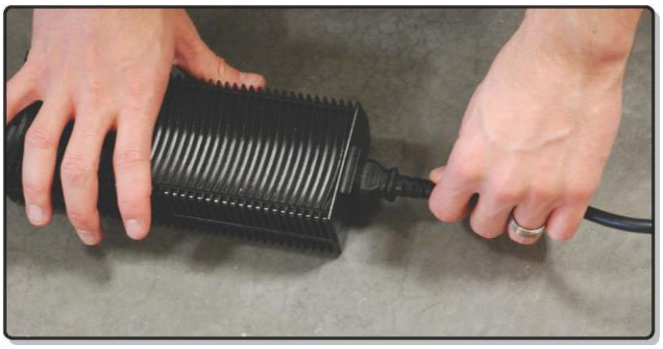


Figure 8-2

4. From the top of the cart, extend the power extension cable to the Motion Controller connector port, allowing for adequate slack for when the phantom is rotated. To prevent the rubber grommet from coming loose when pulling the extension cable, hold it down with one hand while pulling the cable with the other.

Figure 8-3

Figure 8-4

Figure 8-5

5. Connect the cable to the Motion Controller aligning the notch and the pins.

8.2 Connecting the Triaxial Junction Cable

Included with the DoseView 3D is a 1-meter triaxial junction cable which allows for snag-resistant use of the field detector within the water phantom. Connect one end to the DoseView 3D Electrometer “Sample Probe” connector and the other end to the triaxial junction point on the opposite side of the phantom.

Figure 8-6

8.3 Setting up the Reference Detector Holder

The DoseView 3D includes a Reference Detector Positioning Kit containing the following:

- Base post
- Long carbon fiber tube
- Reference detector holder
- Tube/base post combination fastener

The exact combination of components used will vary depending on the field size being measured; however, the base post and combination fastener must be mounted in any case. On the top of the frame assembly, there are two threaded holes which support the base post. These can be chosen based on the desired detector position. The combination fastener will need to be slid onto the base post before mounting the post onto the frame.

Figure 8-7

8.4 Connecting the Reservoir to the Water Tank

When using the DoseView 3D Lift and Reservoir Cart, the water tube must be connected to the DoseView 3D water tank to perform filling and draining operations using the following steps:

1. Using a slot-head screwdriver, loosen and press a tube clamp over the end of the tube extending from the cart.
2. Press the tube from the cart onto the connection port on the water tank. The end of the tube should be nearly flush with the connection assembly.

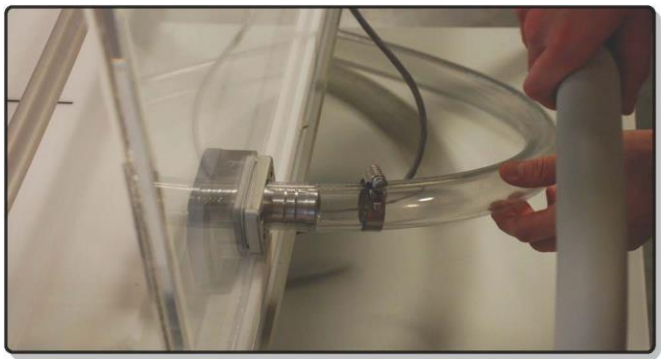


Figure 8-8

3. Tighten the clamp when it is approximately halfway along the water tank connection port to seal the tube in place.

Figure 8-9

8.5 Filling the Water Reservoir

1. Unscrew the two black reservoir lids. One is used to fill, while the other is used to verify the water level of the second tank.

With a hose, bottle or other method, pour water into the reservoir via either fill port. Both reservoir tanks are inter-connected thus the second reservoir will fill at a slower rate than the reservoir being actively filled, so attention must be given to prevent overfilling and to ensure both reservoirs are full (each individual reservoir tank has a capacity of approximately 110 Liters (29 gallons) the lift/reservoir cart has a total capacity of approximately 220 liters (58 gallons)).

Maximizing the amount of water in the two reservoirs will allow for the greatest scanning depth when water is transferred to the water phantom. To prevent overfilling, there is an internal float switch and the automatic fill process will stop prior to the water level reaching the designated fill line on the water tank. Use the manual fill button to adjust the water level after the automatic fill process has stopped.

CAUTION: When using the manual fill buttons, care should be taken while monitoring the water level to prevent an overflow condition.

8.1 Connecting the Communication Cables and Wireless Radio

To wirelessly communicate with the DoseView 3D via a computer interface, the included 35m USB 2.0 Active Extension Cable must be routed from the control console into the treatment vault where the DoseView 3D will be used. This cable can be run via the raceway, conduit, or maze.

1. Run the included USB 2.0 Active Extension Cable from the host PC into the treatment vault via the raceway, conduit, or maze. Connect the included power supply to this USB Cable.
2. Connect the green DIGI XSTICK Xbee USB Radio Module (figure 9-10) to the interior vault side of the USB cable.

Figure 8-10

3. In most cases, USB to serial communication requires set up of driver software, so it is recommended to have these drivers set up on the PC in advance of scanning. Furthermore, as the DoseView software communicates on communication ports 1-8 only, verify the adapter has been configured for a supported port number. Consult the operating system documentation for additional information.
4. Connect the USB cable to the PC.

If it is not desired to use wireless radio communication to the PC there are two options run the included 33m RS232 cable instead of the USB 2.0 active extension cable. The serial cable can be connected directly to the DoseView 3D Motion Controller as shown (figure 9-11) and to the PC via an RS232 port or with the included RS232 to USB adapter.

Figure 8-11

8.2 Inserting Batteries in the Wireless Pendant

Use a phillips head screwdriver to remove the battery door on the back of the wireless pendant and insert four AA batteries in the orientation shown on the rear label of the pendant. Using the power switch located on the right edge of the pendant, turn on the wireless pendant, verifying operation.

8.3 Setup and use with the Varian Halcyon™ Radiation Therapy system only

NOTE: This section is used for setup of the DoseView 3D System to the Varian Halcyon only. It assumes that you are already familiar with proper operation of the DoseView 3D system and have completed setup steps through Section 9.7 preceding, as appropriate.

Due to the unique enclosed gantry of the Varian Halcyon, a slightly modified workflow should be followed to ensure proper system setup of the DoseView 3D.

The end goal of the following suggested setup and workflow is:

- Scanning detector (Exradin A28) positioned and zeroed at Halcyon system iso center
- DoseView 3D scanner arms orthogonal to the water surface
- Water tank filled with exactly 10 cm of water above isocenter (at 90 cm SSD)

Alignment Procedure

1. Raise the Varian Halcyon treatment couch to a height of **74.0 cm** above the floor.

2. Place the Varian Service Plate on top of the treatment couch to protect it from scratches, positioning about even with the upper end of the couch as shown in the left photo in Figure 8-12 below.

3. If the DoseView 3D Water Tank is already residing on top of the DoseView 3D Lift and Reservoir Cart, position them beside the patient couch, with the Motion Controller Box facing the foot of the couch. If needed, raise the Lift to the same height as the treatment couch to assist in the transfer of the empty Water Tank to the couch, positioning it about 15 cm from the head of the couch as shown in the left photo in Figure 8-12 below.

   The Lift and Reservoir Cart is only used to transfer water from its reservoir to fill the Water Tank and is not shown in the images below. A longer water hose may be used to make the link easier. Alternate filling methods, if available or more convenient, may be used.

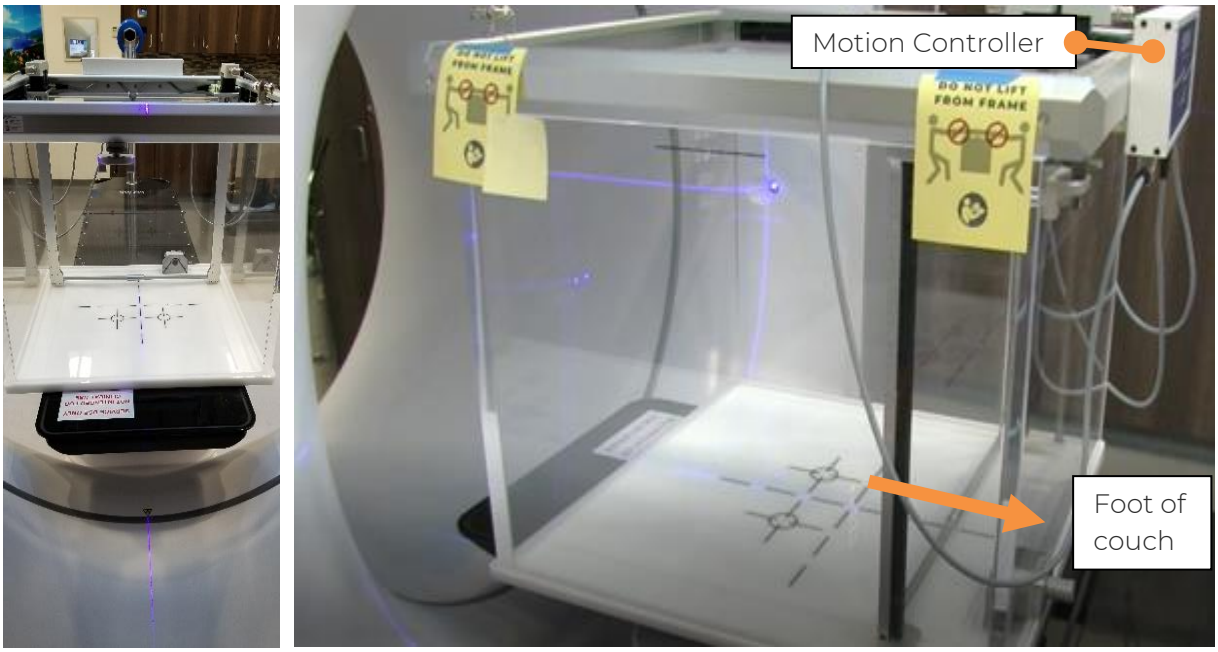
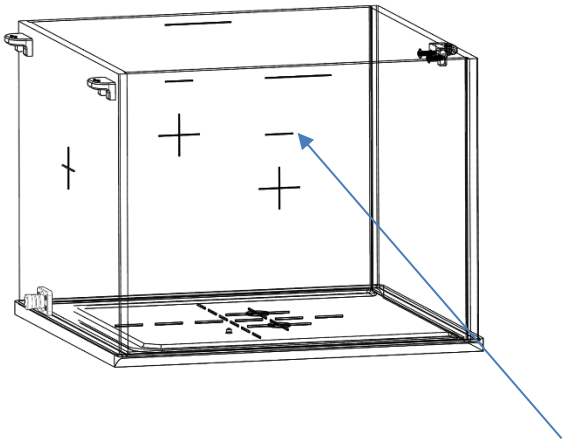


Figure 8-12: DV3D placed and oriented properly on the Halcyon Treatment couch before initial alignment at virtual isocenter.

4. Alignment lines etched on the bottom of the DoseView 3D Water Tank are effective for precise orientation to the Halcyon system. The latest generation of water Phantom has a fill line specific to the Halcyon couch weight limitations as seen in the image immediately below, If using an older version of the phantom with only a full fill line, the user should add a mark to identify the desired water fill level on the Water Tank, if not already present:

IF NEEDED → Use a ruler to mark a line indicating water fill level for the Halcyon system, which should be exactly **12.0 cm below** the existing black etched line on both sides of the tank. See Figure 8-13 below:



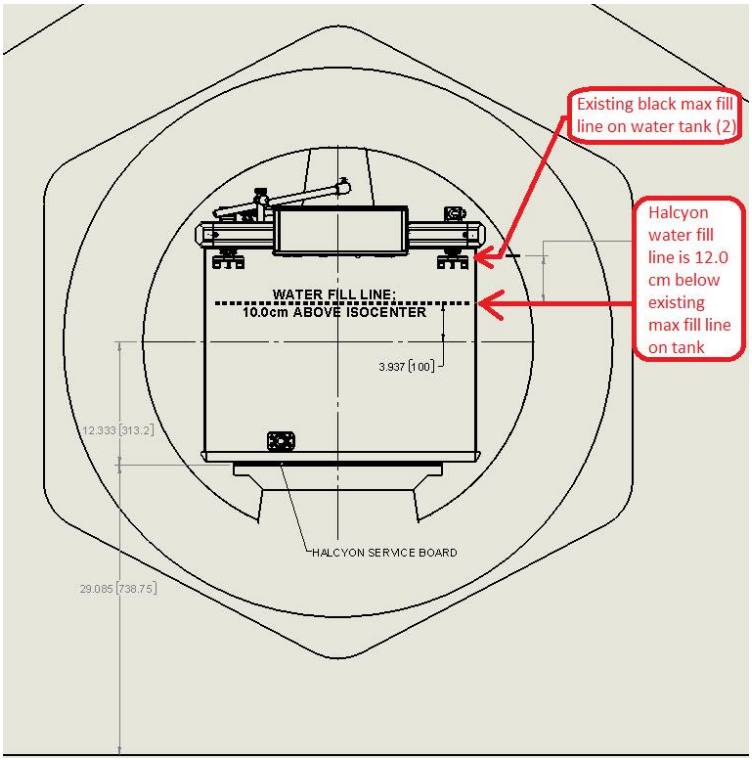
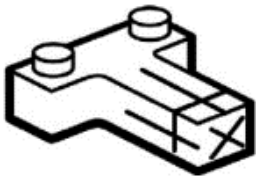


Figure 8-13: The Halcyon Water fill line is 12.0 cm below the existing water fill line on the Water Tank. This can be marked with tape or marker if not already present.

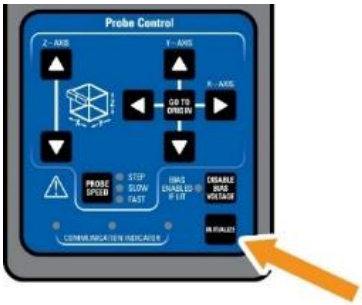
5. Mount the Origin Crosshair Alignment Jig onto the scan arm, and power on the Motion Controller by attaching the power supply and using the power ON switch located on the

right side of the Motion Controller. Verify power is present by confirming the green LED near the switch is lit. Additional system assembly can take place at this time as well since the system is still accessible outside the Halcyon bore. This includes the electrometer and triaxial cables, see also section 9 of this manual.



Init

6. Press and hold the [INITIALIZE] button on the Wireless Pendant to initialize the DV3D System. When the carriage begins to move after a moment, release the button. Until this step is performed, the Detector Control movement buttons are not operational.



7. The scan arms will move to a default location after some initial movements, and you should verify the X- and Y-axes are aligned vertically over the top of the middle crosshairs etched into the bottom of the tank. See Figure 8-14 below. This location will be automatically set to (X, Y, Z) = 0,0,0 mm following initialization. Note that the Z-axis location will be adjusted in the following steps once the water height is determined

   CAUTION: *Ensure any detectors are removed from the carriage during this step to prevent damage to the detector or water phantom. If already mounted, the Origin Crosshair Alignment Jig will not interfere with initialization and can remain in place during this process.*

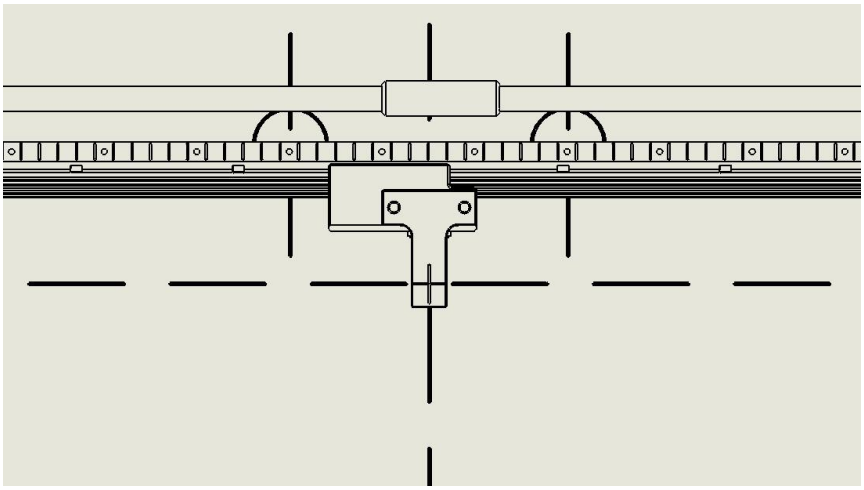
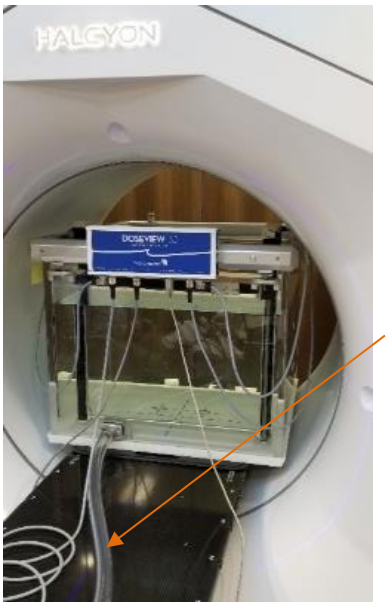


Figure 8-14: The Origin Crosshair Alignment Jig shown properly aligned over the middle crosshairs etched into the bottom of the Water tank.

8. Using the Halcyon system controls, move the treatment couch to position the center of the tank near virtual isocenter.

9. Manually adjust the location of the tank (gently slide on the Varian Service Plate) to closely align the middle crosshairs at the bottom of the tank to the Halcyon virtual isocenter laser lines. This will be the initial location of the tank, and the Halcyon treatment couch will be adjusted in future steps to make minor corrections to produce the final tank position.

10. Using the Halcyon System controls, move the treatment couch into the bore to position the DV3D Water Scanning System at true isocenter.
11. Using the Lift and Reservoir Cart, fill the Water tank with water to the level determined in step 4a. above.



NOTE: A longer water hose may be needed to fill and drain the water tank when using the Lift and Reservoir cart since the Water Phantom and Scanning arms rest on top of the Halcyon treatment couch during measurement. An alternate fill and drain method may be used if desired.

Longer water hose, runs to Lift and Reservoir cart positioned next to the patient couch (not shown).

12. We now seek to place the water surface at exactly 90 cm SSD, or 10 cm above the Halcyon System Isocenter by raising or lowering the Treatment Couch height:
    a. Using the Halcyon System controls, set the MV imager angle to 84.3°, open the upper jaw to 5 cm wide and open the lower jaw to 14 cm wide. This produces an orthogonal beam parallel to the water surface.
    b. Once an MV image is taken, the Halcyon measuring tool can be utilized to measure the distance between the water surface and isocenter (yellow cross, in Figure 8-15 below), which should be 10.0 cm.
    c. **Correct any measured difference by changing the treatment couch vertical height**.

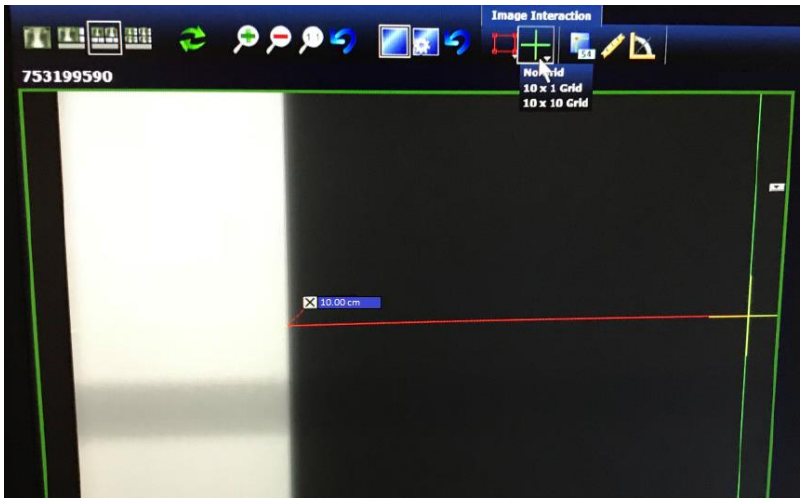


Figure 8-15: Using the Halcyon system tools to set the water column height exactly 10 cm above isocenter.

13. Course leveling of scan arms (see also section 11 of this manual and Figure 8-16 below): Using the three hand screws located between the aluminum frame and the tank of the DoseView 3D, perform initial leveling of the motion assembly, referring to the two bubble levels located on one side of the X-Z axis assembly. Ideally, alignment screws are set at about the middle of their adjustment ranges in order to allow the most flexibility when leveling.

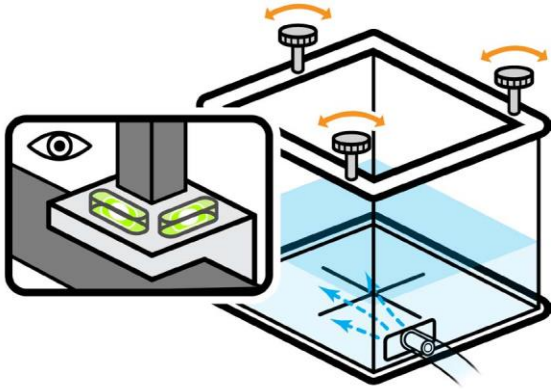


Figure 8-16: Coarse alignment of scan arms

14. Fine Leveling of scan arms (see also section 11 of this manual and Figure 8-17 below):

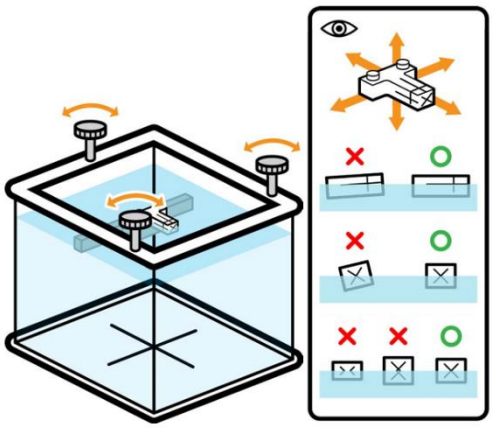


Figure 8-17: Fine alignment of scan arms

a. First – Right Corner - Use the Wireless Pendant to move the Origin Crosshair Alignment Jig, mounted previously to the scan arm, near the front right corner of the tank (as you face the Halcyon bore), and use the Wireless Pendant to move up or down in the Z-axis as needed so the "X" shape at the front of the Origin Crosshair Alignment Jig is aligned properly with the water surface as shown in Figure 9-17 above.
b. Second – Left Corner - Use the Wireless Pendant to scan the carriage along the x-axis of the tank toward the left-hand corner. Verify that the "X" shape at the front of the Origin Crosshair Alignment Jig continues to be aligned properly with the water surface during the transit across the tank. If a small discrepancy exists when you get to the left side of the tank, use the Leveling Knob at the far left corner to adjust the depth of the Origin Crosshair Alignment Jig to bring it back in alignment to the water surface. This sets the alignment of the scan arms to the water surface from the left-right, and you must next correct for front to back.
c. Third – Mid-line front-to-back alignment - Use the Wireless Pendant to move the Origin Crosshair Alignment Jig to the middle-rear of the tank, near the third leveling knob. If necessary, use this Leveling Knob to bring the Origin Crosshair Alignment Jig back to the water surface. Remember that you do not adjust the Z-axis location with the Wireless Pendant during this move. However, if at any point you run out of travel on the leveling knob, then the Wireless Pendant is used to adjust the depth of the probe at that corner of the tank. If this is needed, all water surface alignment steps completed previously must be repeated.
d. Four- Final check - Once completed, drive the probe to all four corners of the water tank using the Wireless Pendant, and verify the leveling across the entire water surface. Repeating the order of this three-point check is the most effective way of quickly aligning the scan arms to the water surface.

15. Once satisfactory leveling is achieved, use the Wireless Pendant to re-position the Origin Crosshair Alignment Jig to the coordinates X = 0.0 mm, Y = 0.0 mm, and Z = value that matches the water surface, just found in the alignment steps above.

    Wireless Pendant Tip: *Note that the step function is particularly useful for precision positioning as each arrow button press corresponds to a step of 0.1 mm. Switch to the step function by pressing the [PROBE SPEED] button until "STEP" is illuminated.*

16. Set this value as a temporary origin of the system by pressing the [ORIGIN] button on the Wireless Pendant. A "beep" will sound, and the green LED will illuminate indicating the origin has been set. The display coordinates will reset to zero.

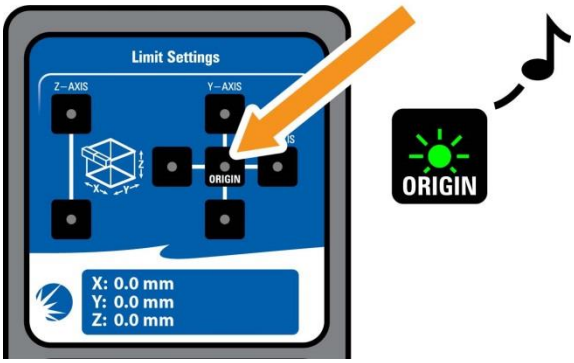


Figure 8-18

17. Using the Wireless Pendant, drop only the Z-axis down into the water so the display reads X: 0.0 mm, Y: 0.0 mm, Z: 100.0 mm. Press and hold the [ORIGIN] button on the Wireless Pendant until a beep sounds, when the button can be released. The Green light will now have turned off to confirm the ORIGIN setting has be released. Now depress the [ORIGIN} button again to lock the current location in as the final Origin. The display coordinates will reset to zero. This is now the true isocenter of the Halcyon System.
18. Measurement preparation: Replace the Origin Alignment Crosshair Jig with the Exradin A28 ion chamber provided with the system, as described in section 11 of this manual.

19. In addition, Standard Imaging offers a Brass build up cap to fit the included Exradin A28 Scanning Ion Chamber. Using this build up cap allows clear visualization of the center of the Ion chamber's measuring volume when imaged with the Halcyon's MV imaging system. It can also be used in a similar fashion to identify and locate the position of the reference channel A28 Ion chamber during setup.

    Tip: *As on alternate to Step 19 for the measurement chamber, use the Auto center finder option in the DoseView software (remove or do not place the brass alignment cap) in order to correctly identify the center of the beam at a chosen depth.*

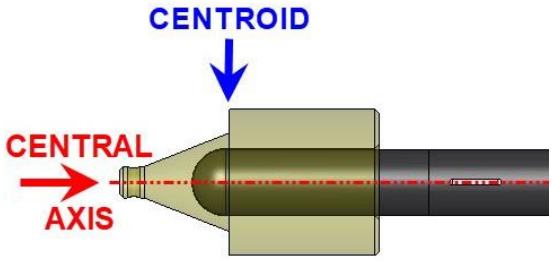


Figure 8-19 Optional Brass Alignment cap (for use with MV Imaging in Halcyon)

9 Verifying System Performance

Since a system such as the DoseView 3D is used relatively infrequently, we recommend verifying that the equipment is functioning properly before performing a series of scans. Below are recommended diagnostic procedures to perform prior to scanning to help ensure time is not wasted due to unexpected issues.

9.1 Check Power

1. Supply power to all components
    a. Connect the included power supplies to the DoseView 3D, Lift, and Reservoir Cart. Next, connect the power supplies to available wall outlets as described in the previous sections. When connected, the amber LED located near the power switches of both the Motion Controller and Lift and Reservoir Cart should illuminate.
    b. Insert (4) AA batteries into the Wireless Pendant by removing the pendant's rear panel with a crosshead screwdriver and placing the batteries in the orientation indicated on the pendant's rear label.
2. Verify Wireless Pendant Power
    a. Power on the DoseView 3D Wireless Pendant using its on-board switch. As the pendant boots, a green communication LED should blink, and after a moment the pendant display should illuminate and display the detector carriage's current coordinates.
3. Verify Water Phantom power
    a. Power on the DoseView 3D Motion Controller and Electrometer using the switch on the side of the Motion Controller. The green LED adjacent to the amber LED should illuminate indicating system power on.
    b. Press and briefly hold the [INITIALIZE] button on the Wireless Pendant control panel until the DoseView 3D arms begin moving the detector carriage to the home position. The carriage should come to a rest near the center of the phantom.
4. Verify Lift and Reservoir Cart power
    a. Power on the DoseView 3D Lift and Reservoir Cart using the switch on the cart's control panel. The green LED adjacent to the amber LED should illuminate indicating system power on.
    b. Use the cart's on-board control panel to raise and lower the phantom.

9.2 Check Motion and Pendant Function

1. Attach the power supply, and power on the water phantom and pendant as described in the previous sections.
2. Remove any brackets or alignment tools from the detector carriage.
3. Perform water phantom initialization. Press and briefly hold the [INITIALIZE] button on Wireless Pendant control panel until the DoseView 3D arms begin move the detector carriage to the home position. The carriage should come to a rest near the center of the phantom.
4. On the Wireless Pendant, use the Probe Control buttons to move the detector carriage. Move to the full extent of each axis individually and check for any binding or inconsistent movement during travel. Modulate the speed using the [PROBE SPEED] button to try both FAST and SLOW options. The carriage should move freely and consistently within its physical limits.
5. Verify the set origin function by pressing the [ORIGIN] button on the top section of the pendant. The coordinates shown on the pendant display should now be 0.0 for all axes.

Move the carriage away from the configured origin and press the [GO TO ORIGIN] button. Verify the system goes to the origin as intended.

9.3 Check Software Setup and Communication

1. Connect the DoseView 3D Motion Controller to the PC using the desired connection method - wired or wireless - as described in the previous sections.
2. Power on the phantom and perform initialization by pressing and briefly holding the [INITIALIZE] button on the Wireless Pendant control panel.
3. Set up the DoseView software as described in previous sections (if needed) and launch the application.
4. Within Measure > Hardware > Water Phantom, make sure that RS 232 is selected (not “Demo”) Select [Connect].
5. If the software successfully connects to the water phantom, “Needs Initialization” (or “Initialized” if the tank already initialized) displays.
6. If the software does not successful connect to the water phantom, an error is presented reminding the user to make sure that physical connections are good.
7. Navigate to the Position tab
8. Enter a new coordinate and click the [Goto Position] button. The phantom should move as directed, and the new coordinates should display on the software status bar.

9.4 Check Water Flow Integrity

1. Move the DoseView 3D to a water accessible area for filling the system.
2. Verify that the petcock valve on the underside of the Lift and Reservoir Cart is tight. This valve is in the middle of the plumbing junction between the two internal reservoirs. This plumbing junction runs underneath middle of the cart perpendicular to the long axis of the cart itself.
3. Fill the water reservoir as described in previous sections.
4. If necessary, connect the tube from the Lift and Reservoir Cart to the water phantom as described in previous sections.
5. Inspect the fit and tightness of all plumbing connections from the cart to the phantom. If necessary, adjust positioning of the tube interfaces and use a slot-head screwdriver to tighten all clamps.
6. Ensure the exterior water valve is open. In the open position, the valve handle will be parallel with the direction of water flow.
7. Initiate the auto fill process by pressing the Automatic [FILL] button on the Lift and Reservoir Cart control panel. Ensure the reservoir tank caps have been loosened to allow air to escape.
8. While fill process is taking place, inspect all plumbing junctions and the seams between the acrylic phantom walls and base for any leaks.
9. When the system has been fully inspected, initiate the auto drain process to return the water to the reservoir. The auto drain process is gravity-driven and will complete more quickly if the water phantom is raised to the maximum lift limit. Ensure the reservoir tank caps have been loosened to allow air to escape.
10. If not scanning in the near future, empty the reservoir using the procedure outlined in the Finishing Scanning section of this manual at the end of the Scan Acquisition section.

9.5 Check Electrometer/Detector Performance

The DoseView 3D electrometer and any accompanying detectors can be tested to varying degrees depending on whether access to the treatment beam is available. Ideally, the system

should be tested under beam conditions prior to scanning to ensure full confidence, however performance of the system can still be reasonably verified even if the beam is not available. Using water in the phantom is not needed for this procedure.

1. Position the system where desired, attach power supplies, power on, initialize the system as described in previous sections.
2. Place the desired detector(s) to be used and connect to the DoseView 3D electrometer.
3. If using a beam to perform measurements, coarsely position the detectors to ensure adequate signal can be measured.
4. Connect the water tank to your PC as described in previous sections.
9. Launch the DoseView 3D software application.
10. Within Measure > Hardware > Water Phantom, make sure that RS 232 is selected (not "Demo") Select [Connect].
5. Navigate to the Detectors tab.
6. Select the detectors that you have connected to the water phantom.
7. Navigate to the Electrometer tab.
8. If using ion chambers, select the desired bias voltage and apply it to both the sample and the reference detector. ***Do not apply a bias to a diode detector.*** After 10-15 seconds the signal levels shown on the status bar should stabilize, though they will not necessarily read 0.00 (units are shown in pC).
9. Zero the electrometer by clicking the [Zero] button. Once this is completed, the signal levels should be stable and remain very close to 0.00 pC. If readings are stable within ±0.10 pC, then the electrometer and detectors are likely functioning properly.
10. Select Measure > Queue
11. If a beam is available, turn it on at this time.
12. After 2-3 seconds, click the [⯭] icon. The Normalize dialog will appear.
13. Select [Normalize]

    The range will be checked, and normalization will occur. Monitor the ratio % displayed on the status bar. Depending on beam conditions, this number should stay relatively stable.

10 Pre-Scan Checklist

Using the preceding sections as a guide, consult the following checklist 1-2 weeks prior to formal scanning. This can help avoid significant delays during scanning procedures. If problems are discovered or questions arise, there will be time to consult with Standard Imaging or a qualified distributor for assistance.

- ☐ The overall water phantom system movement capabilities have been verified.
- ☐ The DoseView software has been set up and configured correctly on the computer to be used for scanning.
- ☐ Communications between DoseView 3D and the PC have been verified.
- ☐ The seals and plumbing connections have been verified.
- ☐ The electrometer and detector performance have been verified.
- ☐ Desired beam modifiers are ready for use (cones, wedges, etc.).
- ☐ Detectors and linear accelerators have been defined.
- ☐ Scan queues have been prepared

11 Setting Up in the Treatment Vault

11.1 Preparing the Treatment Room

Push the treatment couch out of the area beneath the gantry where the DoseView 3D will be positioned. We recommend having at least 1.5 meters of space between the end of the couch and the treatment machine. Keep in mind that rotation of the couch column may be required to provide adequate clearance between the cart and the couch. Ensure that the treatment head is level, such that the beam is directed at the floor.

You may want to use a level for the gantry as the digital readouts can be in error. This is especially recommended for small field measurements.

11.2 Positioning the DoseView 3D

1. Using the Lift and Reservoir Cart, push the DoseView 3D water phantom under the treatment machine gantry into the approximate position as shown.

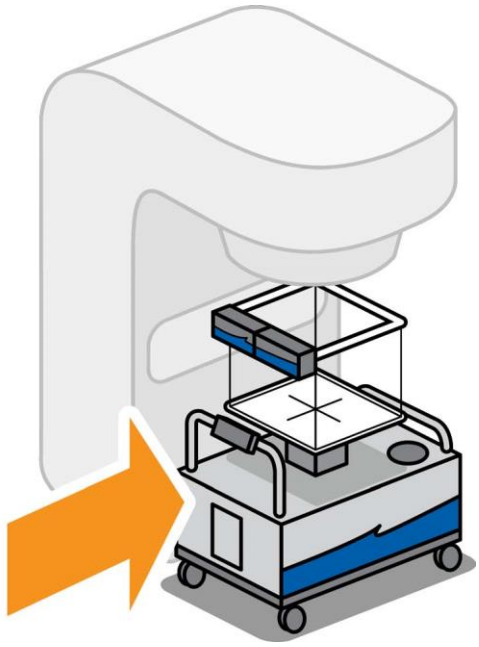


Figure 11-1

2. Using the Precision Positioning Platform, rotate the DoseView 3D 90° to the scan position. This is the orientation in which the motion controller box is located away from the gantry. To rotate, use the following steps:
    a. Release the coarse rotation latch by pulling the latch downward and rotating the lever 180° clockwise, allowing the phantom to rotate freely (Figure 12-2).

Figure 11-2

b. Once the phantom is within 10° of the desired position, return the coarse rotation latch back to the lock position, and continue rotating the phantom towards 90° until a “click” is felt. This will mean that the platform has engaged in a pre-set detent position on the platform. Since rotation of the water phantom occurs about the crosshairs, alignment of the phantom to the light field should still be very close to the position set in step 1.

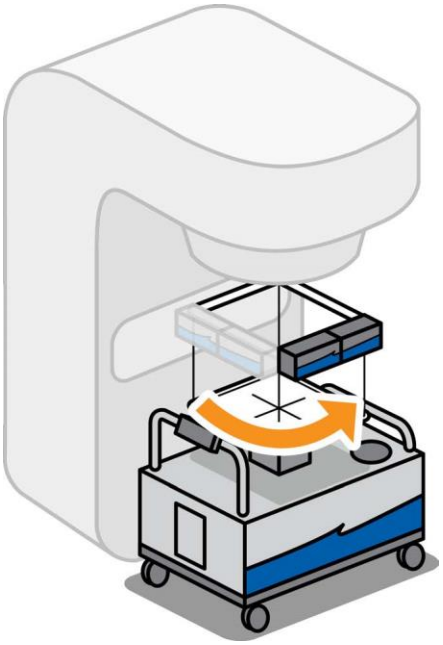


Figure 11-3

3. Using the treatment machine light field as a guide, position the cart such that the light field crosshairs line up with the black crosshairs on the bottom of the water phantom. Alignment does not have to be perfect as further adjustment will be done using precision positioning controls on a future step.

See Section 12 Half-Field Scans, if you are setting up to do half scans.

Figure 11-4

The precision positioning controls have a finite range of travel, so it is best to check that they are initially set approximately halfway between their limits to allow easy adjustment in either direction to be performed during setup.

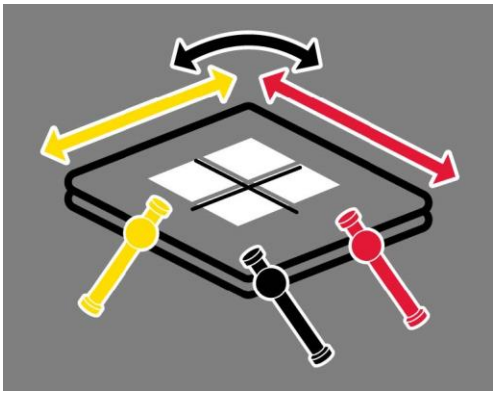


Figure 11-5

4. Lock the three casters with black levers on the Lift and Reservoir Cart by pressing down on the levers with a foot or hand to prevent the phantom from moving during the next steps.
5. Attach the two included power supplies using the following steps:
    a. On one end of the cart with the taller handle, locate the large sliding door and open it, revealing a storage compartment with two power connectors.

b. Connect a power supply to each port. Since both supplies are the same, it does not matter which port is used with which power supply.
c. Connect the provided wall outlet power cord to each power supply.

Figure 11-6

d. From the top of the cart, extend the power extension cable to the Motion Controller connector port allowing for adequate slack for when the phantom is rotated.

Figure 11-7

Figure 11-8

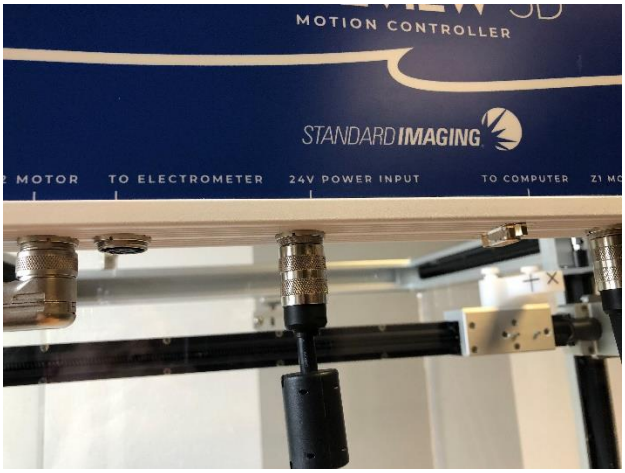


Figure 11-9

e. Verify power is present to the Lift and Reservoir Cart by confirming the amber LED is lit on the control panel. Verify power is present to the DoseView 3D Motion Controller and Electrometer by confirming the amber LED is lit on the side of the Motion Controller.
f. If using a cart other than the DoseView 3D Lift and Reservoir Cart, simply connect the single power supply directly to the motion controller.

6. The DoseView 3D Electrometer should be placed at the end of the treatment couch away from the water phantom. On the Electrometer connect the included electrometer cable to the connector labeled “Motion Controller Remote Connection” connect the other end of the cable to the connector marked “To Electrometer” on the Motion Controller.

Figure 11-10

7. Power on the DoseView 3D Lift and Reservoir cart using the power switch located on the control panel, and power on the DoseView 3D Motion Controller and Electrometer using the power switch located on the side of the Motion Controller. Verify power is present by confirming the green LED is lit.

8. Initialize the DoseView 3D.

CAUTION: Ensure any detectors are removed from the carriage during this step to prevent damage to the detector or water phantom. If already mounted, the Origin Crosshair Alignment Jig will not interfere with initialization and can remain in place during this process.

To initialize the phantom, press and hold the [INITIALIZE] button on the Wireless Pendant. When the carriage begins to move after a moment, release the button. Until this step is performed, the Detector Control movement buttons are not operational.

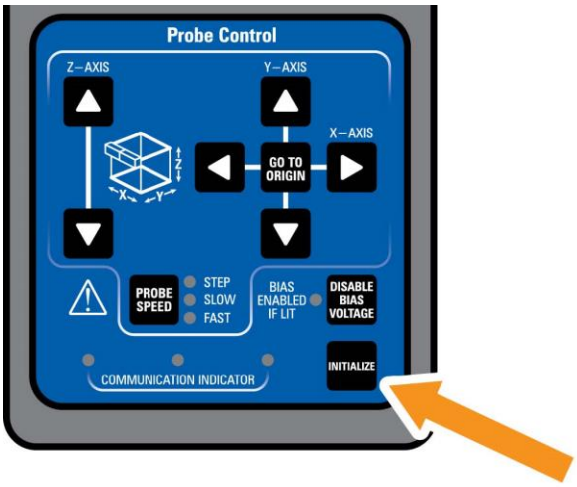


Figure 11-11

9. Lift the phantom such that the scribed line on the front corner of the tank (or the Origin Crosshair Alignment Jig) is roughly aligned at the desired SSD using the room lasers as a guide. This is accomplished using the Lift and Reservoir Cart control panel.

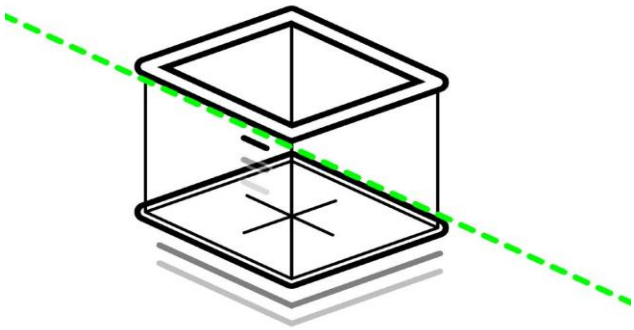


Figure 11-12

We recommend using the crosshairs and optical distance indicator (ODI) for fine setup adjustment after the water tank has been filled. Diffraction through the water tank walls can cause laser lines to shift.

10. Once approximate alignment is achieved, using the Wireless Pendant, move the carriage away from the default origin such that the shadow does not block the light field from projecting on the crosshairs.

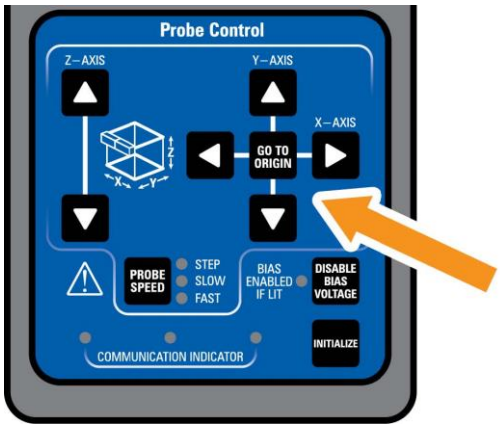


Figure 11-13

11. If after lifting the cart, the crosshairs on the base of the phantom have deviated from the light field by more than 2 cm, unlock the casters and bring the cart to closer alignment with the light field. If the alignment is already quite close, use the Precision Positioning Platform to fine tune alignment of the phantom to the light field. Three knobs located on the sides of the platform can be used to adjust the X, Y, and rotational alignment.

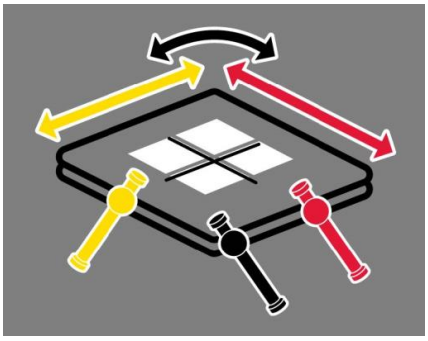


Figure 11-14

11.3 Filling the Phantom and Initial Leveling

CAUTION: Before proceeding, ensure that proper steps were taken to attach the filling/draining tube from the DoseView 3D water phantom to the DoseView 3D Lift and Reservoir Cart. The following instructions assume that the reservoir has been filled as earlier described.

1. Ensure the exterior water valve, in line with the filling/draining tube, is open. In the open position, the valve handle will be parallel with the length of the valve itself.

Start the automatic fill process by pressing the [FILL] button adjacent to the Automatic designation on the Lift and Reservoir Cart control panel. A float switch within the reservoir will stop the filling process automatically before the water tank will overflow. When the automatic fill process is complete, adjust the water level manually as needed. Use the manual fill button to adjust the water level after the automatic fill process has stopped. The automatic fill process takes approximately 6-8 minutes.

CAUTION: When using the manual fill buttons, care should be taken while monitoring the water level to prevent an overflow condition.

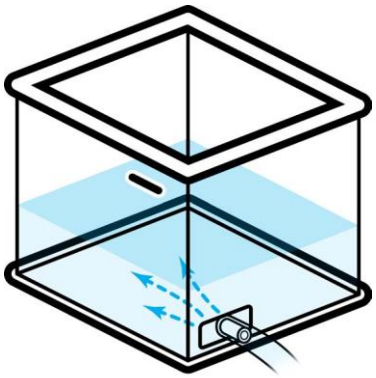


Figure 11-15

While the filling process is taking place, the following steps can be started:

a. Power on the Motion Controller/Electrometer and perform initialization, if this has not been done already.
b. Mount the Origin Crosshair Alignment Jig on the field detector carriage.

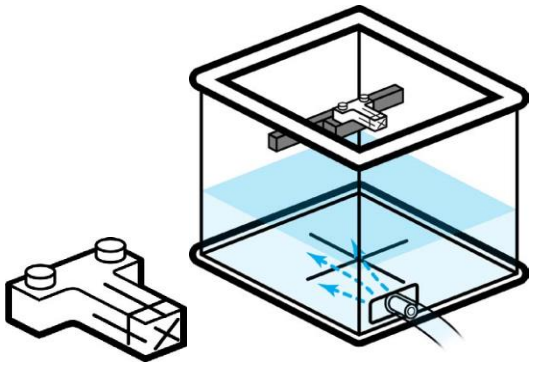


Figure 11-16

c. Using the three hand screws located between the aluminum frame and the tank of the DoseView 3D, perform initial leveling of the motion assembly, referring to the two bubble levels located on one side of the X-Z axis assembly.

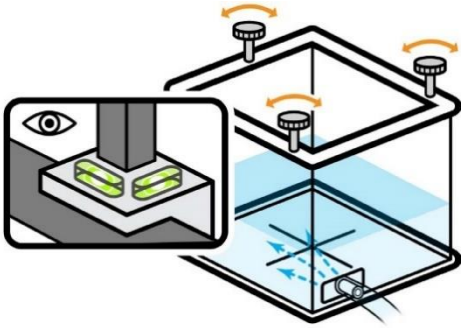


Figure 11-17

Prepare the detectors to be used for scanning. The following diagrams depict Exradin A28 Ion Chambers being prepared.

1. Place the desired chamber bracket onto the Field Detector Centroid Alignment Jig with the horizontal line facing the line on the Field Detector Centroid Alignment Jig.

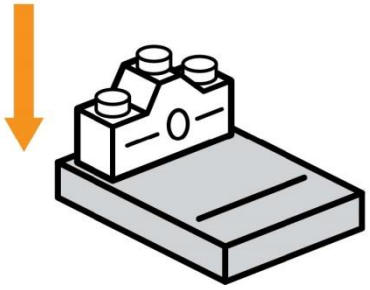


Figure 11-18

2. Insert the appropriate detector into the jig.

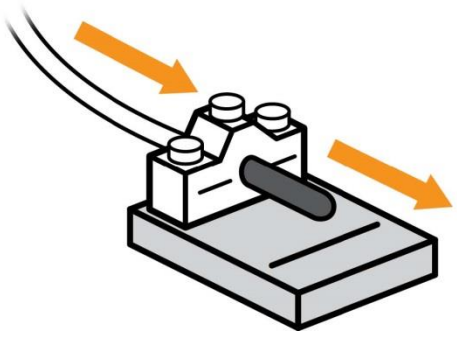


Figure 11-19

3. Place the included build-up cap onto the chamber tip.

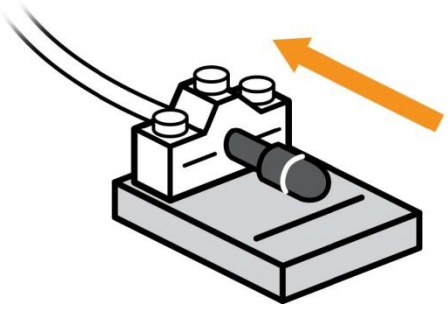


Figure 11-20

4. The fiducial line on the cap indicates the centroid position. Adjust the chamber position such that the line on the build-up cap matches with the line on the jig. Once this is completed, the centroid of the chamber's collecting volume will match with the center of the crosshairs on the Origin Crosshair Alignment Jig.

d. If necessary, connect the DoseView 3D system to the PC as described in the "Before Getting Started with Scanning" section of this manual and launch the DoseView software and the DoseView 3D software component by selecting the DoseView 3D Icon on the splash screen.

1. Once the auto fill process has been completed, submerge the Origin Crosshair Alignment Jig using the Motion Controller and Wireless Pendant.

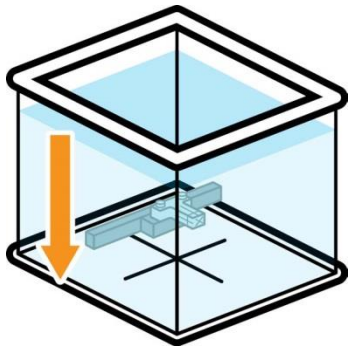


Figure 11-21

2. Using the Lift and water level controls, make any necessary final adjustments to align the water surface at the desired height indicated by the ODI.

   TIP: Use a piece of paper or a paper towel floating on the water surface to enable viewing of the machine crosshairs and ODI.

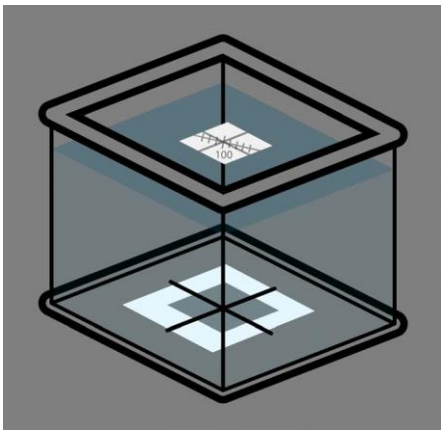


Figure 11-22

   CAUTION: Once water can no longer be extracted from the Lift and Reservoir Cart using the on-board controls, do not put additional water into the reservoir fill ports. This will prevent overflow when water is returned to the reservoir from the phantom upon completion of scanning. Furthermore, do not fill the water phantom more than 0.5cm above the black etched lines surrounding the phantom with water from an external source. Exceeding this level could cause overflow when water is returned to the reservoir using the manual or automatic draining functions.

3. Close the exterior water valve to prevent any water from flowing back into the Lift and Reservoir Cart. When closed, the valve handle will be perpendicular to the valve itself.

11.4 Fine Leveling and Confirming the Origin

While the bubble levels mounted to the DoseView 3D provide an accurate indication of system leveling, it is best to fine tune the control arm leveling using the Origin Crosshair Alignment Jig and the surface of the water. The recommended procedure is described below:

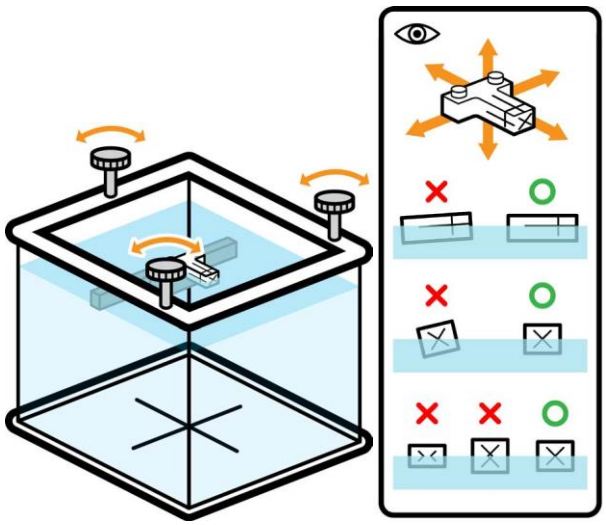


Figure 11-23

1. Right Corner - Use the Wireless Pendant to move the Origin Crosshair Alignment Jig, mounted previously to the scan arm, near the front right corner of the tank (as you face the Halcyon bore), and use the Wireless Pendant to move up or down in the Z-axis as needed so the "X" shape at the front of the Origin Crosshair Alignment Jig is aligned properly with the water surface as shown in Figure 8-17 above.
2. Left Corner - Use the Wireless Pendant to scan the carriage along the x-axis of the tank toward the left-hand corner. Verify that the "X" shape at the front of the Origin Crosshair Alignment Jig continues to be aligned properly with the water surface during the transit across the tank. If a small discrepancy exists when you get to the left side of the tank, use the Leveling Knob at the far-left corner to adjust the depth of the Origin Crosshair Alignment Jig to bring it back in alignment to the water surface. This sets the alignment of the scan arms to the water surface from the left-right, and you must next correct for front to back.
3. Mid-line front-to-back alignment - Use the Wireless Pendant to move the Origin Crosshair Alignment Jig to the middle-rear of the tank, near the third leveling knob. If necessary, use this Leveling Knob to bring the Origin Crosshair Alignment Jig back to the water surface. Remember that you do not adjust the Z-axis location with the Wireless Pendant during this move. However, if at any point you run out of travel on the leveling knob, then the Wireless Pendant is used to adjust the depth of the probe at that corner of the tank. If this is needed, all water surface alignment steps completed previously must be repeated.
4. Final check - Once completed, drive the probe to all four corners of the water tank using the Wireless Pendant, and verify the leveling across the entire water surface. Repeating

the order of this three-point check is the most effective way of quickly aligning the scan arms to the water surface.

5. If satisfactory leveling is achieved, re-position the Origin Crosshair Alignment Jig to the center of the water tank and fine adjust the x- and y-axis to match the linac crosshairs. The step function is particularly useful for precision positioning as each arrow button press corresponds to a step of 0.1 mm. Switch to the step function by pressing the [PROBE SPEED] button until “STEP” is illuminated.
6. When completed, confirm the initial origin setting by pressing the [ORIGIN] button the Wireless Pendant. A “beep” will sound, and the green LED will illuminate indicating the origin has been set. The display coordinates will reset to zero.

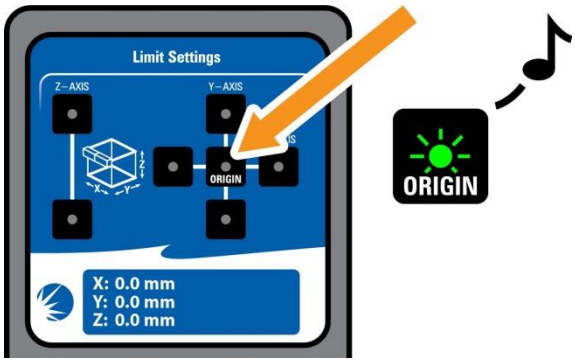


Figure 11-24

11.5 Soft Positional Limits

During initialization, “hard” positional limits on carriage motions are set. Depending on the size of the detector used in the carriage, a reduced range of motion, “soft” positional limits, may be necessary to prevent the detector or its signal cable from coming in contact with the sides of the phantom during scanning.

Soft limits can be defined for both directions of all three axes. To define limits, use the following procedure:

1. Using the Wireless Pendant, move the carriage along any axis to a point which the detector should not travel past.
2. On the Wireless Pendant Limit Settings area, press the button that corresponds to the limit to be defined. The green LED on the button will illuminate, indicating the definition has been made.

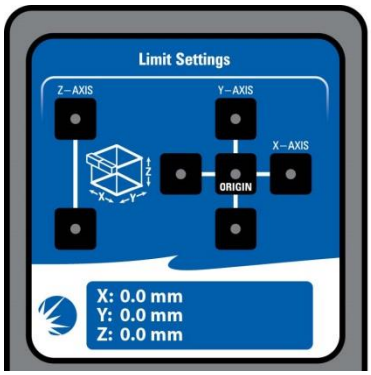


Figure 11-25

3. Continue repeating steps 1 and 2 until all desired limits are defined.
4. To disengage any limit, hold its corresponding button until a “beep” is heard. The limit’s green LED should no longer be illuminated indicating the limit is no longer set.
5. To save batteries, turn the Wireless Pendant off.

As with hard limits, soft limits are stored in the Motion Controller, so no settings are lost when turning off the pendant. However, if the Motion Controller is turned off or unplugged, all settings are lost.

11.6 Placement of the Field Detector

Once the motion controller arms are level with the water surface and the origin has been defined, the Origin Crosshair Alignment Jig can be replaced with the desired detector and accompanying bracket. If the detectors to be used are not already set up in their brackets, read the previous section for this procedure.

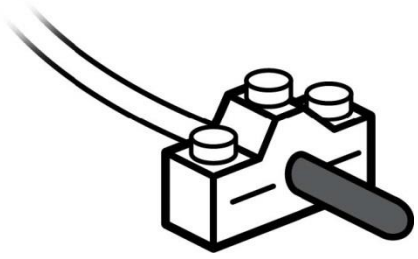


Figure 11-26

Once the detector(s) are prepared, follow the instructions below for placing the detectors:

1. Remove the Origin Crosshair Alignment Jig by loosening the two thumbscrews and set these components aside.
2. Place the desired detector bracket on the carriage and tighten the two securing thumbscrews. Brackets containing horizontally oriented cylindrical ion chambers (such as the Exradin A28 Ion Chamber) or parallel plate ion chambers (such as Exradin A11 Ion Chamber or the PTW Markus®) should be mounted on the top of the carriage (i.e. horizontally), in the same place and orientation as the Origin Crosshair Alignment Jig.

For vertically oriented detectors, the bracket should be mounted on the face of the carriage.

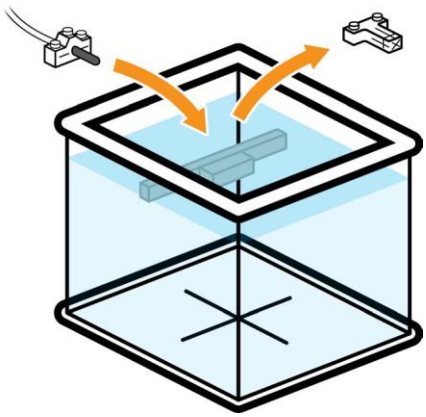


Figure 11-27

Once placed on the carriage, the physical center of a cylindrical ion chamber will be positioned at the center of the crosshairs on the alignment jig. For most parallel plate ion chambers, the surface of the collecting volume will be placed at the center of the crosshairs on the alignment jig.

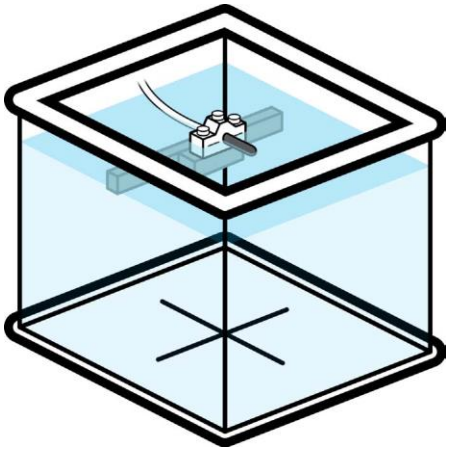


Figure 11-28

3. If necessary, connect the included 1-meter triaxial junction cable from the DoseView 3D Electrometer “Sample Probe” connector to the triaxial junction point (figure 12-29). If used, connect the detector’s signal cable to the other end of this triaxial junction point. If not, connect the field detector connector directly to the “Sample Probe” connector on the electrometer.

Figure 11-29

11.7 Setting the Field Detector Vertical Orientation

If you want to use your field detector in a vertical orientation, first align in a horizontal orientation and zero the detector. Then flip the detector holder from the top of the carriage to the side with the detector pointing upwards. Then add a -10.4 mm correction to the origin in the InPlane direction. This should move the detector 10.4 mm closer to the Motion Controller and Electrometer. Reset the origin

11.8 Mounting the Reference Detector

1. Loosen the combination fastener and insert the reference holder tube into it.
2. If the diameter is sufficient for the detector used (less than or equal to 8 mm such as the Exradin A28 Ion Chamber), slide the detector into the tube and, if desired, attach the reference detector holder onto the tube assembly. If used, tighten the white thumbscrew to fix the reference detector in place. For larger detectors a small piece of tape can be used to secure the detector in place.

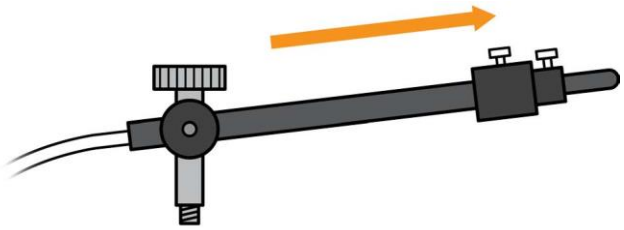


Figure 11-30

3. Position the reference detector such that the detector's shadow can be partially seen in the field area. The corner is an ideal spot as it prevents the reference detector from obstructing the measurement path of the field detector (unless you are scanning diagonally).

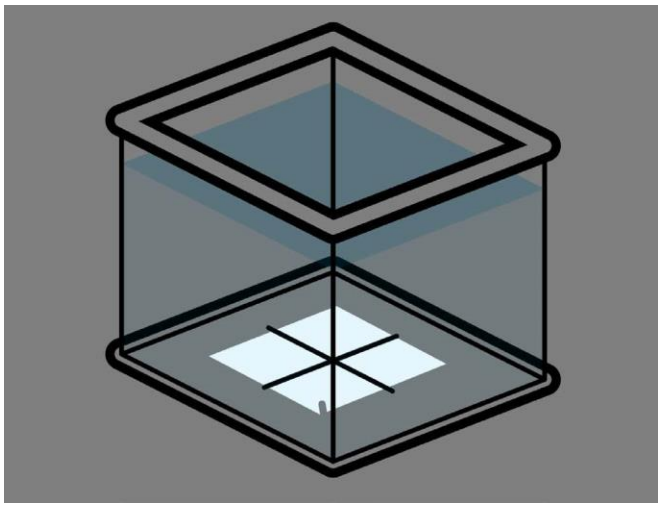


Figure 11-31

4. Place the included build-up cap on the reference detector.

11.9 Ready to Scan!

At this point, the DoseView 3D water phantom is ready for scanning.

1. Start DoseView software and select the DoseView 3D module.
2. Go to the Setup page
    a. Define your linear accelerator (Section 14.1).
    b. Define your detectors (Section 14.2)
    c. Prepare at least one scan queue (Section 14.4).
3. Go to the Measure page
4. Select the Hardware tab - Proceeding from top to bottom set up your hardware (Section 15.1)
5. Select the Queue tab. (Section 15.2)
    a. Load a scan queue
    b. Specify an optional tag *(e.g.,* Annual 2018)
    c. Zero the electrometer
    d. Normalize the measurements (*e.g.,* at D_{max})
    e. Start the queue execution ▶
6. After scanning, go to the Analyze page

11.10 Shut Down after Scanning

Turn Off Electrometer Bias Voltage

Before disconnecting ion chambers from the DoseView 3D Electrometer, be sure to turn the bias voltage off using one of the two following methods to prevent shock and potential damage to the electrometer and/or detectors.

Using the DoseView Software

1. Navigate to Measure > Hardware > Electrometer
2. Uncheck “Field” and “Reference” and the bias voltage will be disabled.

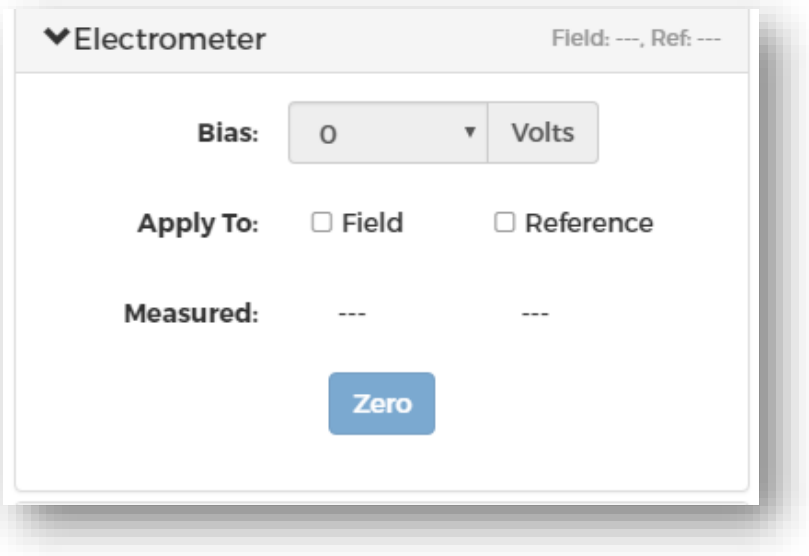


Figure 11-32 Hardware Electrometer Expander

3. Before disconnecting the detectors, verify the bias enabled lights are not lit on the electrometer.

Using the DoseView 3D Hardware

1. On either the DoseView 3D Motion Controller control panel or the Wireless Pendant, press and hold the [DISABLE BIAS VOLTAGE] button.
2. Before disconnecting the detectors, verify the bias enabled lights are not lit on the electrometer.

Drain the Water Phantom

Drain from Phantom to Reservoir

1. Ensure the exterior water valve is open. In the open position, the valve handle will be parallel with the direction of water flow.

2. Loosen reservoir tank caps to allow air to escape.
3. Press the Automatic [Drain] button on the DoseView 3D Lift and Reservoir Cart to gravity drain the phantom. After approximately 20 minutes the auto process will complete, and a small amount of water will remain in the phantom. The remaining water can be absorbed with a towel or left to evaporate.

Drain the Reservoir

1. Drain most of the water from the DoseView 3D Lift and Reservoir Cart
    a. Move the cart to a location where the water can be disposed of such as a sink or floor drain.
    b. Ensure the exterior water valve is open. In the open position, the valve handle will be parallel with the direction of water flow.
    c. Loosen reservoir tank caps to allow air to escape.
    d. Disconnect the water hose from the DoseView 3D water tank by first loosening the clamp closest to the tank with a slot-head screwdriver and then pulling the tube from the connection port. Use caution to prevent spillage if any water remains in the tube from the draining process.
    e. Place the tube end near the water destination (sink, drain, etc.) and press the Automatic [Fill] button on the cart's control panel. This will push the water out until the float switch in the bottom of the reservoir is tripped.
2. Drain the remaining water from the DoseView 3D Lift and Reservoir Cart
    a. Position the center of the cart over a drain or a surface that will direct the water to an acceptable disposal location.
    b. Locate petcock valve on the underside of the cart. This valve is in the middle of the plumbing junction between the two internal reservoirs. This pumping junction runs underneath the middle of the cart perpendicular to the length of the cart.
    c. Loosen the petcock valve with a wrench or pliers by turning it counterclockwise and spin the valve cover until it comes free from the system. The remaining water will pour from the reservoir.
    d. When the water has fully drained, replace the petcock valve cover and ensure it is tight to prevent leakage from the reservoir.

12 Half-Field Scans

To ensure the DoseView 3D motors do not receive direct beam exposure during scanning of split fields, set up the water phantom in a special position using the following instructions. This phantom position relative to the beam will provide at least 5 cm overlap from beam center, 5 cm past the field edge and maintain an additional 5 cm for scatter when performing half scans, in plane or cross plane scans of a 40x40 field at 30 cm depth.

To begin, first follow the instructions in Section 11.2 Positioning the DoseView 3D

Instead of using the primary crosshairs at the center of the phantom base, use the alternative position(s) described in the following two sections. Choose the section that matches the design of your phantom.

Phantoms with Secondary Crosshairs on Base

Proceed with typical setup but align the center of your field with one of the secondary crosshairs as shown for coarse and fine positioning.

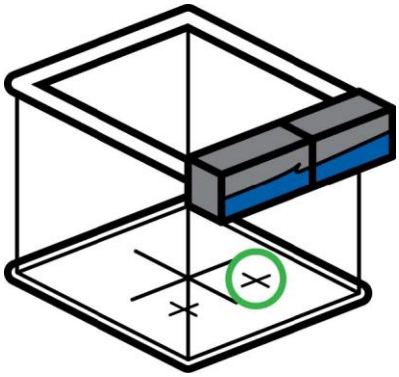


Figure 12-1

Phantoms without Secondary Crosshairs on Base

1. Before performing coarse positioning, ensure the power supply is connected.
2. Power on and initialize the phantom using the Wireless Pendant or Motion Controller control panel.
3. mount the Crosshair Alignment Jig onto the X-arm.

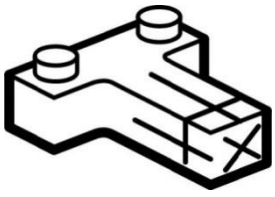


Figure 12-2

4. From the carriage resting position following initialization, move the carriage to either position shown here.

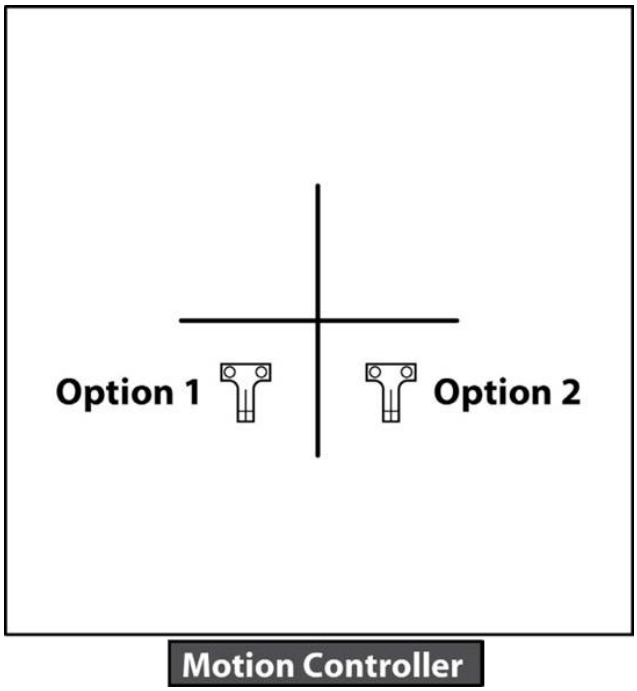


Figure 12-3

Option 1		Option 2	
X	-80.0 mm	X	+80.0 mm
Y	-100.0 mm	Y	-100.0 mm
Z	0 mm	Z	0 mm

Proceed with typical setup but align the center of your field with the crosshairs on the Crosshair Alignment Jig for coarse and fine positioning instead of the crosshairs on the bottom of the phantom.

13 The Initial Screen

The initial screen is presented when the DoseView Software starts.

- To enter the DoseView 3D module click on the “Enter DoseView 3D” icon.
- To enter the DoseView 1D module click on the “enter DoseView 1D” Icon.

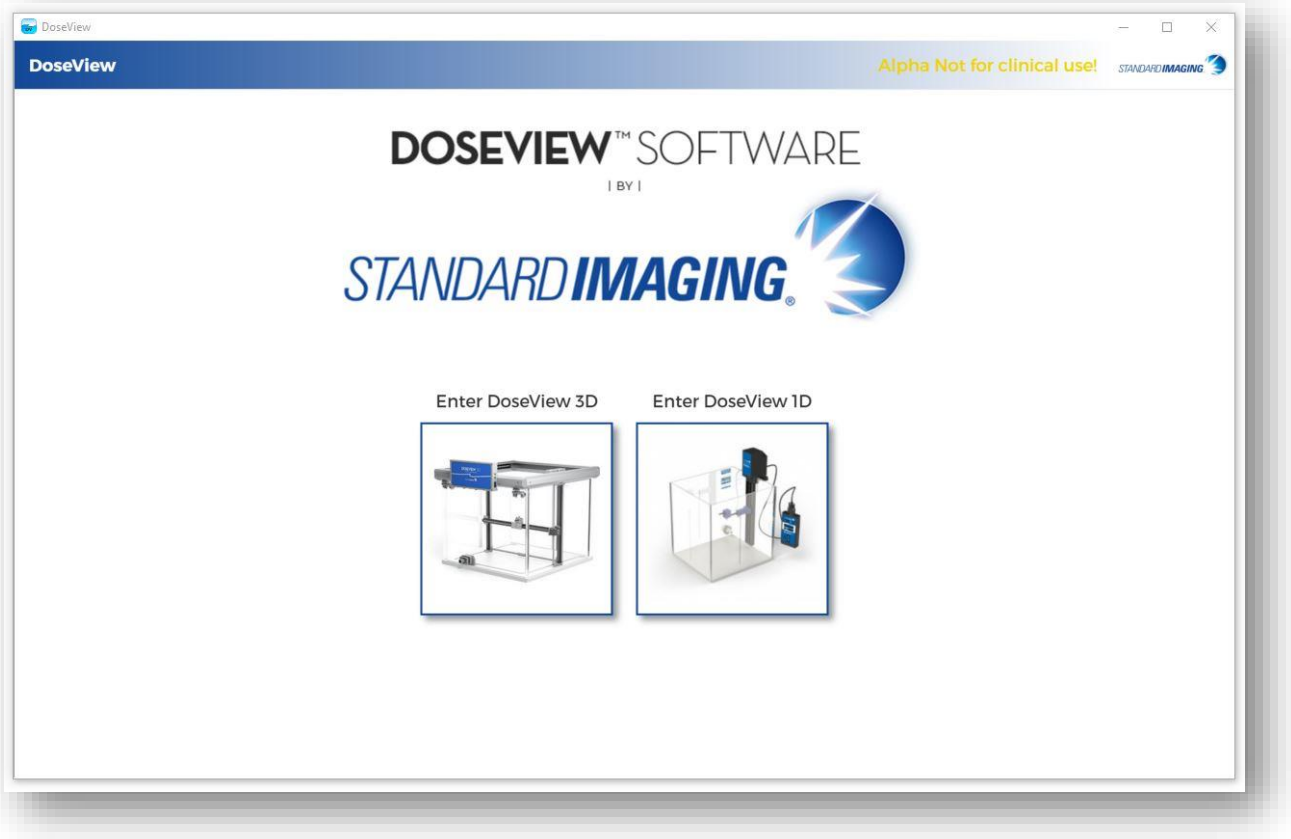


Figure 13-1: Initial Screen

14 The Setup Page

The Setup page is shown when [Setup] is selected. It allows access to subtabs for clinics and machines, detectors, scan queues, and preferences to be created, edited, and maintained. This will be the same in both the DoseView 3D module and the DoseView 1D module with one exception. The DoseView 1D Module will have one additional tab for "Electrometers." This tab is addressed below in Section 14.3.

The initial installation of your DoseView Software will have a preconfigured clinic, machine, and detector. The clinic, machine, and detector correspond to the sample scans that are also part of the initial set up. Make sure that you create new clinics and machines to keep track of your measured scans more easily.

Figure 14-1: The Setup Page

14.1 The Clinics & Machines Tab

The Clinics & Machines tab allows clinics and machines to be created, edited, archived, and restored. Note that machines belong to clinics, so if you have several clinics, access to machines will require their clinics to be selected. To import scans from another DoseView 3D or another scanning system, make sure to create a machine to import the scans to, unless the import target machine already exists.

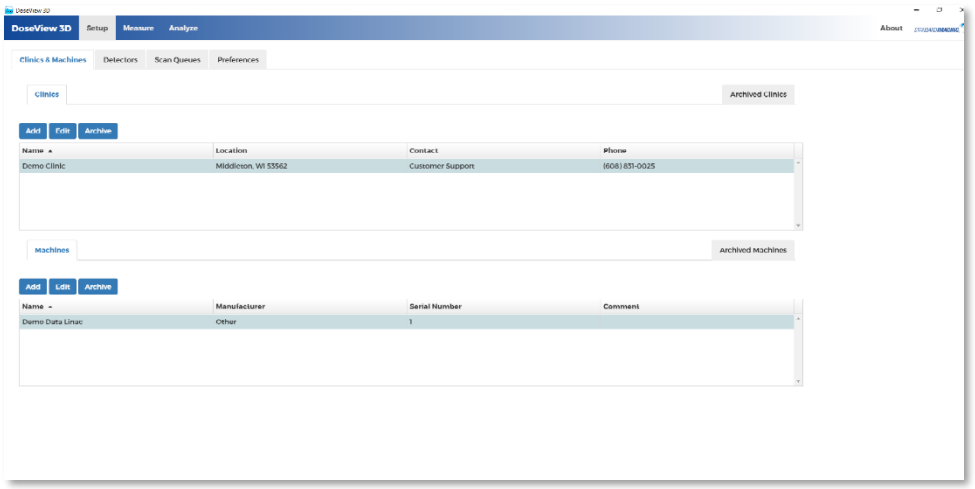


Figure 14-2: The Clinics & Machines Tab

To add a new clinic or machine, select an [Add] button. Add dialogs will appear. If you wish to edit an existing clinic or machine, select an [Edit] button. Edit dialogs are similar to the Add dialogs.

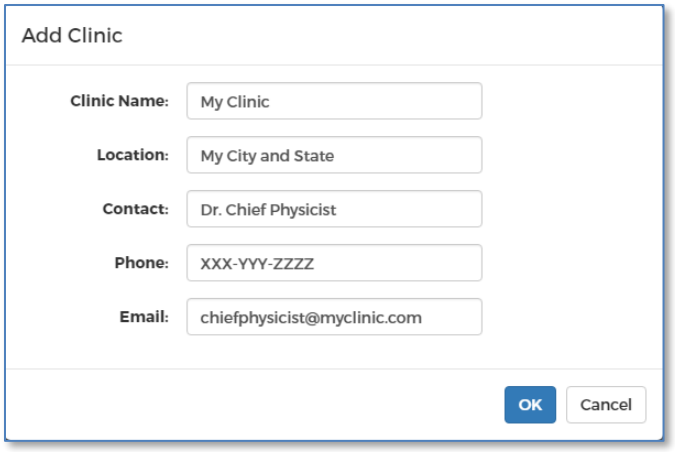


Figure 14-3: Add Clinic Dialog

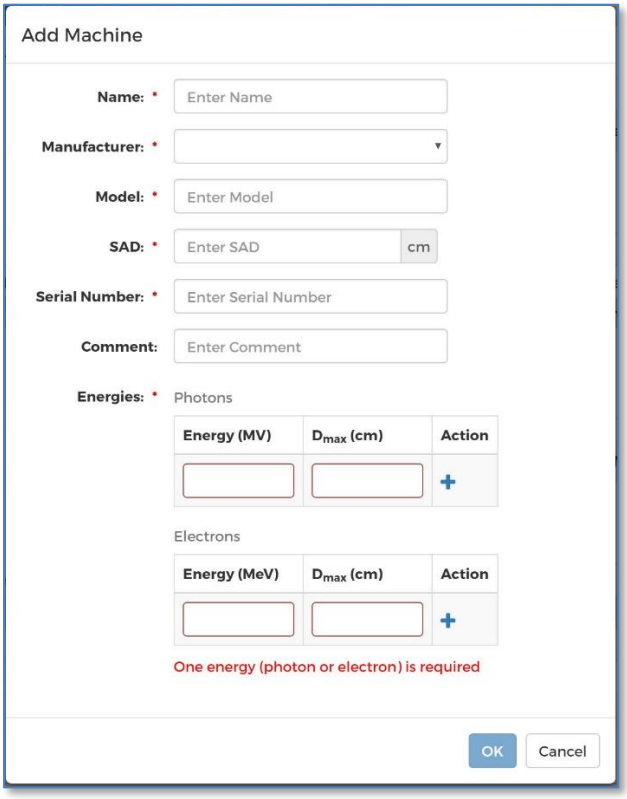


Figure 14-4: Add Machine Dialog

14.2 The Detectors Tab

The Detectors tab allows detectors to be created, edited, archived, and restored. Unlike machines, detectors are not associated with only a single clinic because they may be shared by different clinics.

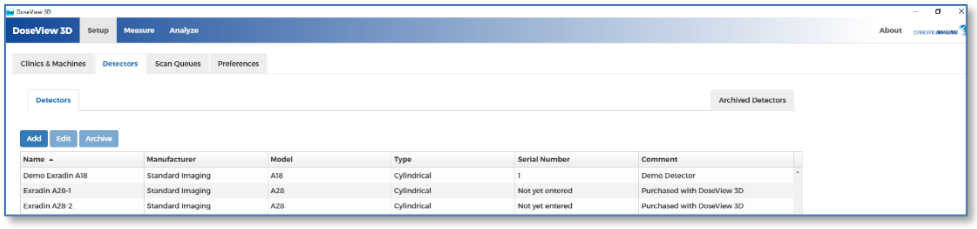


Figure 14-5: Detectors Tab

Adding and editing detectors works the same way as adding or editing clinics and machines.

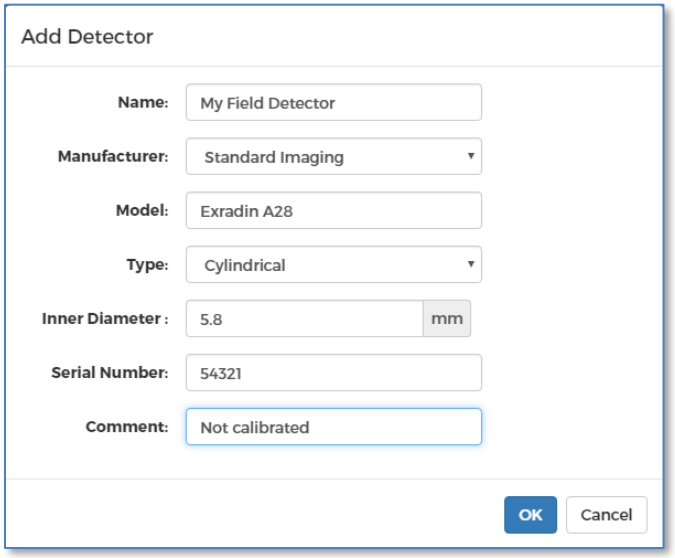


Figure 14-6: Add Detector Dialog

14.3 Electrometers Tab (DoseView 1D only)

The Electrometers tab will be visible only in the DoseView 1D module of the DoseView Software since it is only applicable to DoseView 1D users.

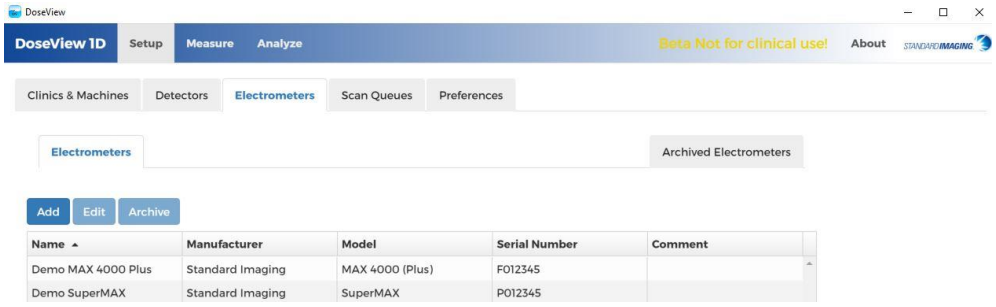


Figure 14-7: Electrometer Tab

The “Electrometers” tab allows electrometers to be created, edited, archived, and restored. The DoseView 1D module can connect to Standard Imaging’s SuperMAX, Max4000 Plus, and

Max4000 (firmware version 4.4 and higher) electrometers. If you have questions on the compatibility of your Max4000 please contact support@standardimaging.com.

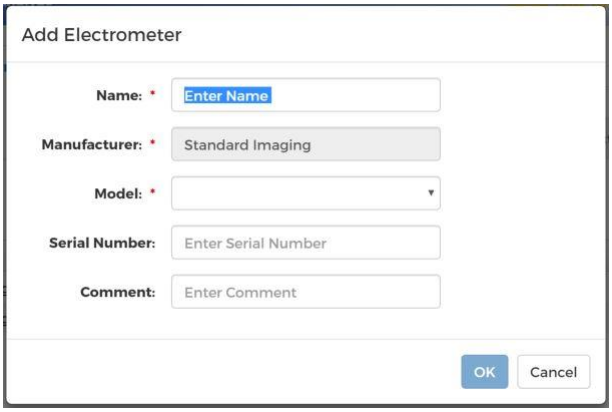


Figure 14-8: Add Electrometer Dialog

To add an electrometer, enter the Name you wish to use to identify the electrometer along with its Model and Serial Number. The serial number will be used by the system to ensure you are using the intended electrometer. If a serial number mismatch is detected between your selected equipment in DoseView and the electrometer connected with the system, you will be notified on the Measure page of the software. You have the option of then adding this additional electrometer to your equipment list or bypassing and using the non-registered electrometer.

14.4 Scan Queue Tab

The “Scan Queue” tab allows scan queues to be created [Add Queue], concatenated [Combine Queues], copied, edited, deleted, exported, and imported

Figure 14-9: Scan Queue Maintenance Options

Of these options, only queue creation and queue editing need explanation.

Add Queue

Creating a queue is extremely easy. A wizard-like series of dialogs leads you through the process. One very powerful aspect of the queue creation process is that queues that are the cross product of all selected parameters are produced.

Example: 6MV – Depths and Profiles Multiple Field Sizes

When [Add Queue] is selected, the Add Queue Dialog presents.

The first step, General, involves specifying a name and description for the new queue as well as other parameters that may guide the wizard in later steps. The description is optional.

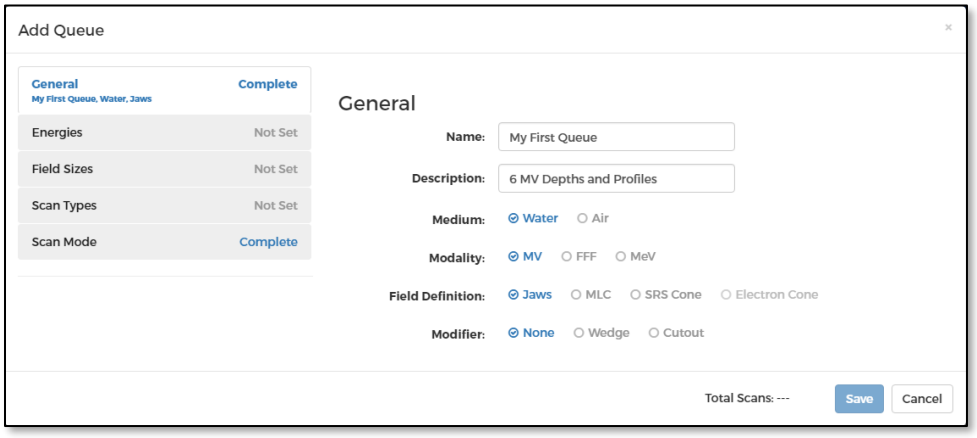


Figure 14-10: Add Queue, General

The second step, Energies, allows you to specify and select energies that may be used in your queue.

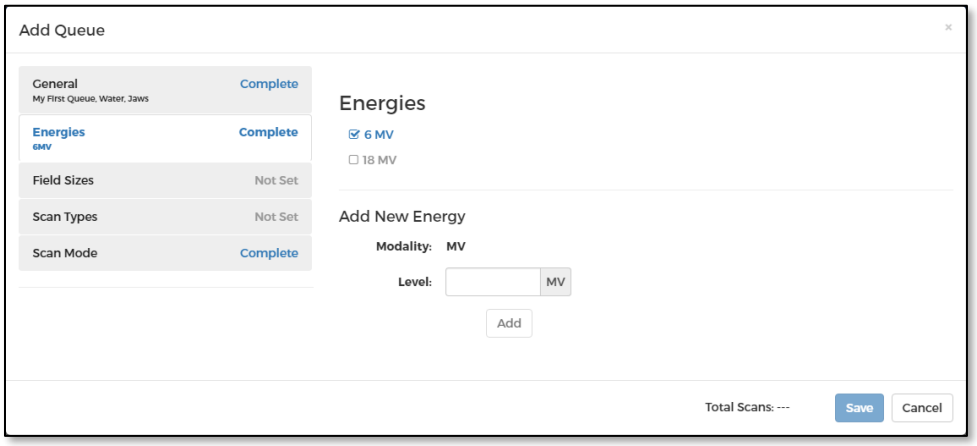


Figure 14-11: Add Queue, Energies

To add a new energy, type a value into the "Level" text box, the select [Add].

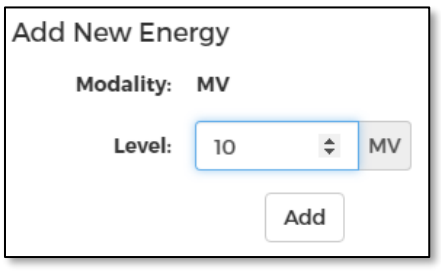


Figure 14-12: Adding a New Energy

To delete an energy, mouse near a current energy. A red “X” will appear. Click on the “X”.

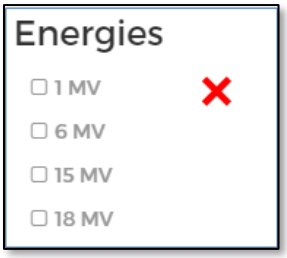


Figure 14-13: Deleting a Current Energy

This means of adding and deleting energies is used to add and delete other parameters during the queue creation process.

The third step, Field Sizes, allows you to specify and select field sizes that may be used in your queue. Rectangular and Circular field sizes may be specified and selected. Circular field sizes would be used for stereotactic cones. Field sizes are added and deleted in the same way as energies.

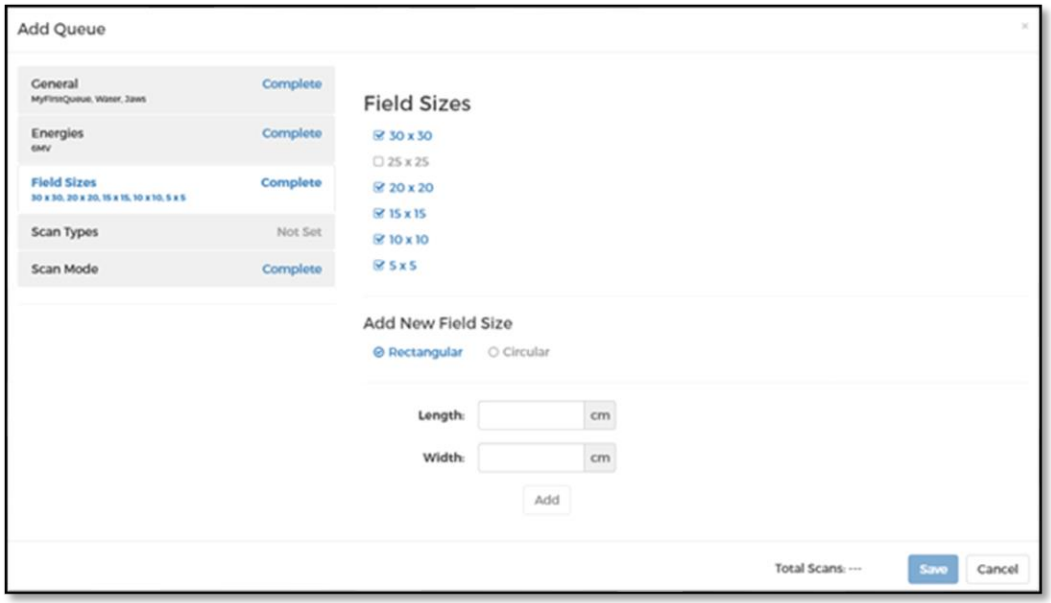


Figure 14-14: Add Queue, Field Sizes

The fourth step, Scan Types, allows you to select scan types that will be used in your queue. For DoseView 1D, only Depth scans are allowed.

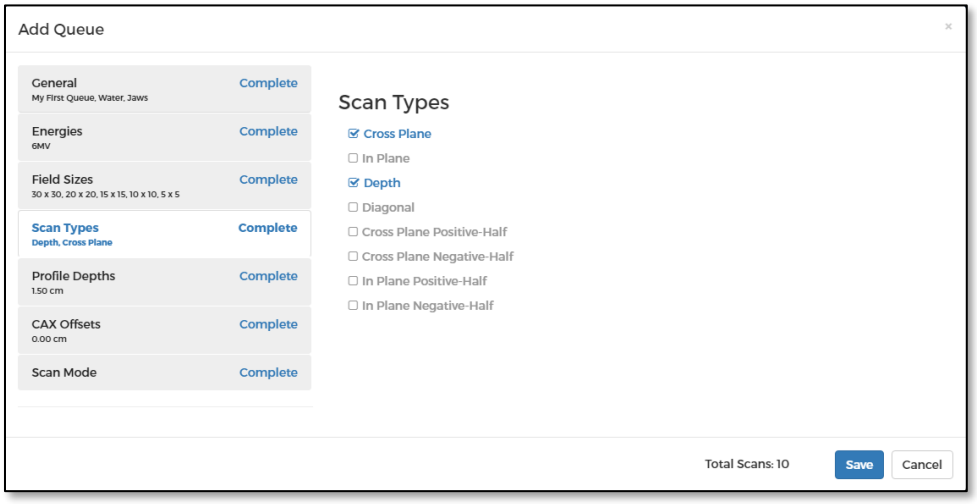


Figure 14-15: Add Queue, Scan Types

The fifth (optional) step, Profile Depths is only visible in the DoseView 3D module. This step allows you to specify and select profile depths that will be used in your queue. If you do not select profile scans, this part of the wizard does not appear.

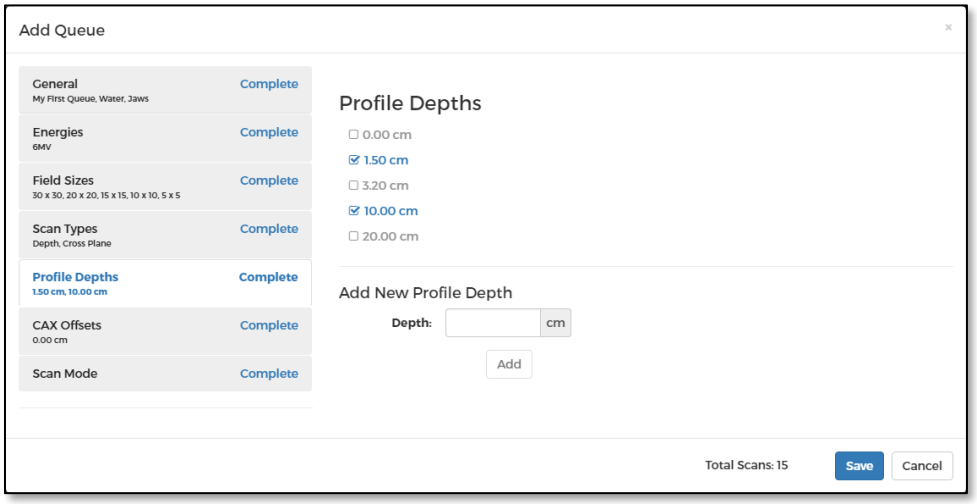


Figure 14-16: Add Queue, Profile Depths

The sixth (optional) step, Profile CAX Offsets is also only available for DoseView 3D. This step allows you to specify and select profile central axis offsets that will be used in your queue. If you do not select profile scans, this part of the wizard does not present.

Central axis offsets allow profiles to be measured away from the central axis. These are useful for characterizing relative dose planes at depth.

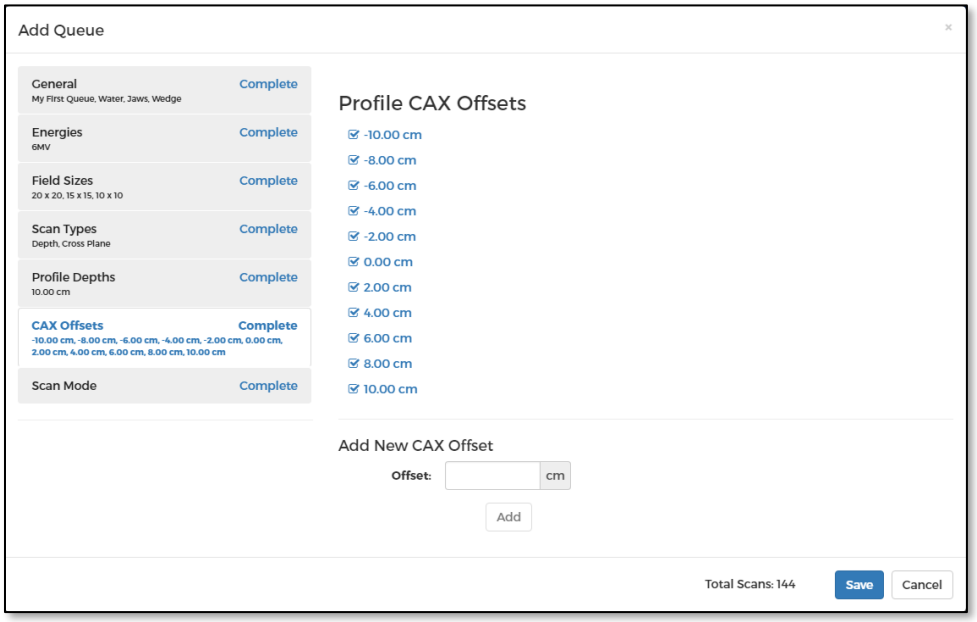


Figure 14-17: Add Queue, Profile CAX Offsets

The seventh (optional) step, Scan Mode, allows you to specify how profiles, depth, and diagonal scans will be measured. This step is "Complete" by default. Setup for profiles and diagonal scans is the same.

The default for each scan type is step mode, single zone. In step mode, sample spacing is specified; alternatively, in continuous mode (available for DoseView 3D only), sample speed is specified. In single zone scanning, sample spacing or sample speed is constant throughout each scan.

Overscan for profiles is the additional distance from the full width half maximum (FWHM) that will be scanned on each side of a profile. There are two ways to specify the overscan: a fixed distance, which is preferred, and a percent of FWHM.

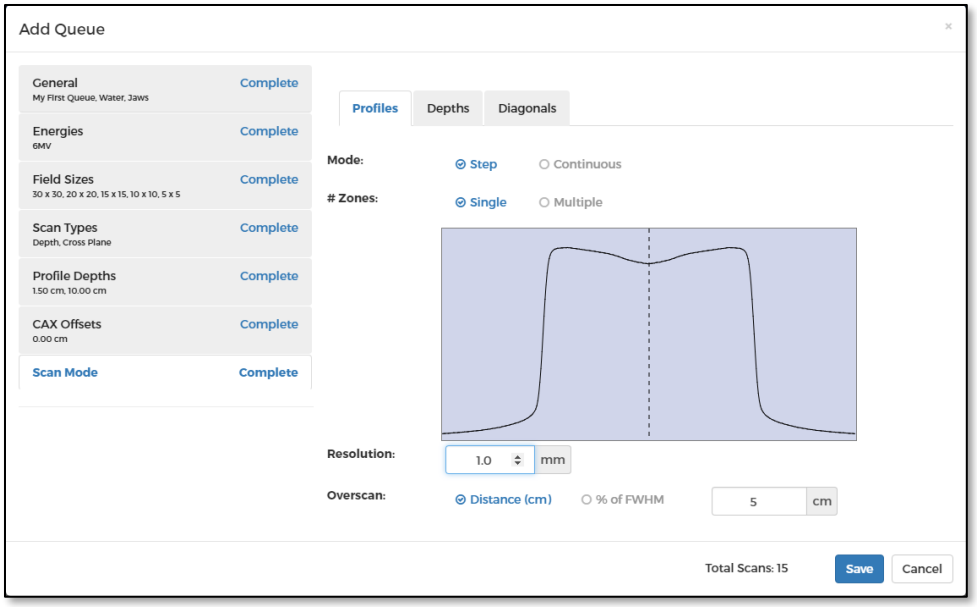


Figure 14-18: Profile scan step mode, single zone (default)

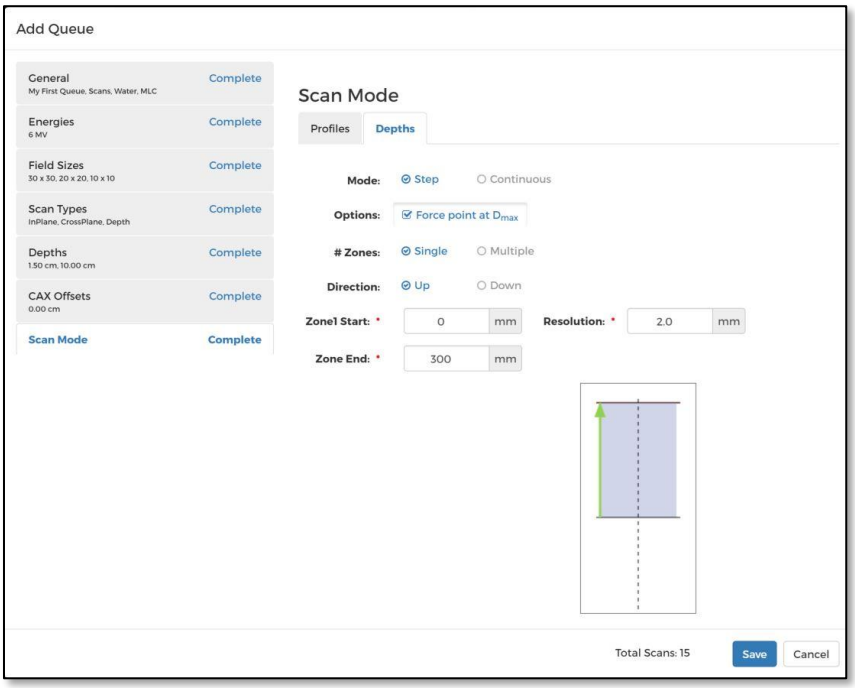


Figure 14-19: Depth scan step mode, single zone (default)

Multiple zone measurement is useful for speeding up data acquisition, while keeping scan data accuracy. The concept is simple: Sample with greater density or slower speed where gradients are the largest. In low gradient areas where doses change gradually, sample with less density or faster speeds. The orange areas in Figure 14-20 and Figure 14-21 show regions in which sampling with greater density or slower speed would be beneficial.

Figure 14-20: Profile scan step mode, multiple zones

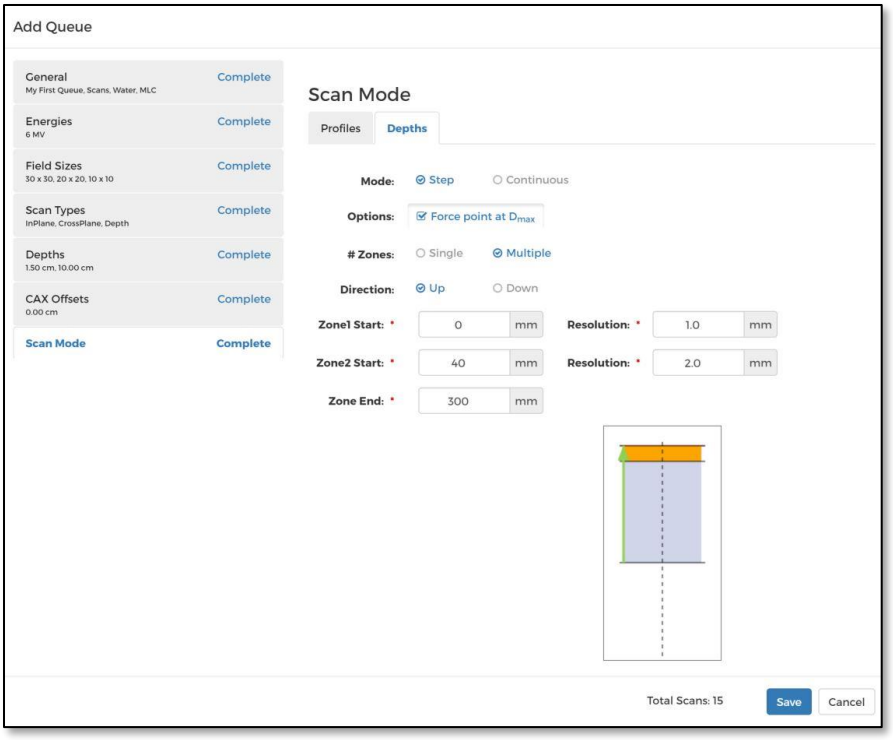


Figure 14-21 : Depth scan step mode, multiple zones

For depth scans in step mode, an option exists to force a measurement point at d_{max}, so you can still capture the nominal d_{max} point even if it doesn't fall within your set measurement spacing. For instance, if the step size is set to 2 mm for a 6 MV beam, but you still wish to capture a measurement at 1.5 mm, use the Force d_{max} option.

When all parameters have been set, selecting [Save] will create a queue as shown in Figure 14-2.

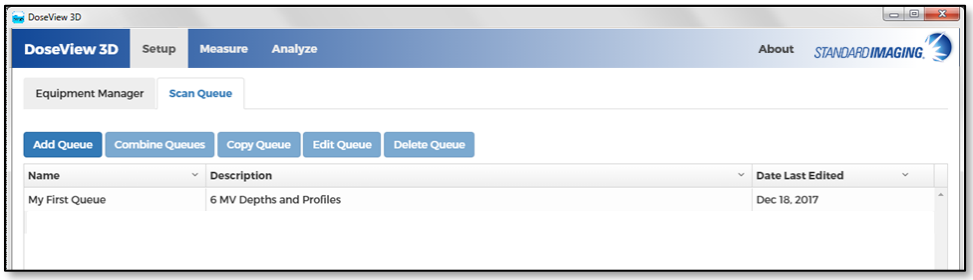


Figure 14-22: Scan queue with completed queue

The Edit Queue (optional) step

Example: Conversion of 6MV Queue to an 18MV Queue

When [Edit Queue] is selected, the Edit Queue Dialog presents.

A good practice is to create a new queue and edit it if there are small differences that you need between queues. Between a set of 6 MV and 18 MV measurements, the only difference is typically the depth of maximum dose scans.

Steps:

1. Copy the queue that you want to edit.
2. Select the copied queue and select [Edit Queue].
3. Change name and description to something meaningful.
4. Select all scans.

   Display is as in Figure 14-23

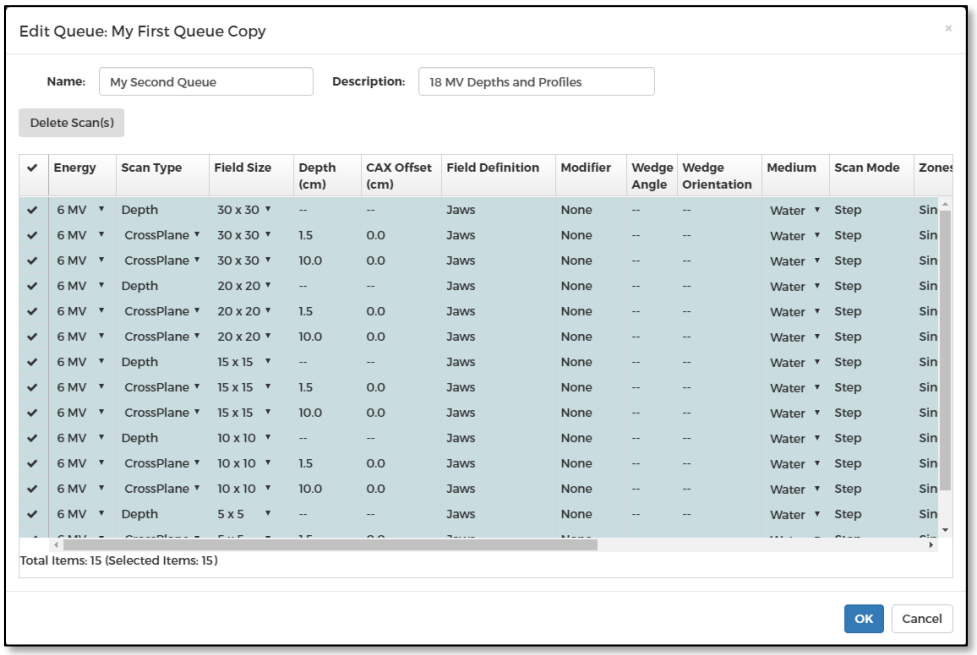


Figure 14-23: Edit Queue Dialog upon presentation

5. With all scans selected, select the dropdown for the energy and select 18 MV.
6. Select a single scan that has a depth of 1.5.
7. Select the depth dropdown and select 3.2.

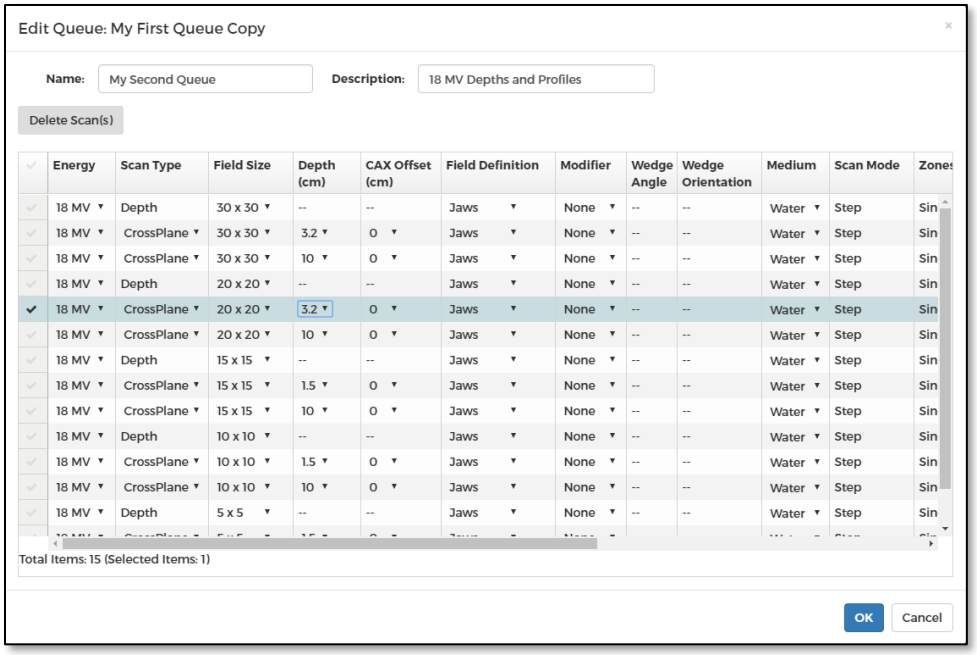


Figure 14-24: Edit Queue Dialog with selected scan

Note that values that appear in dropdowns are specified during queue creation, so a little forethought is required. That is, 18MV and 3.2 cm depth must be specified prior to editing.

When all parameters have been set, selecting [OK] will save the queue as shown in Figure 14-25.

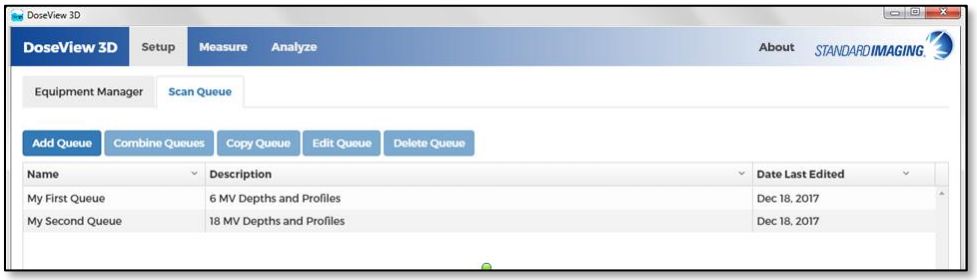


Figure 14-25: Scan queue with copied and edited queue

14.5 The Preferences Tab

The purpose of the preferences tab is to allow you to explicitly choose formatting according to region or requirements (e.g. using commas or semicolons between values in CSV files or commas in place of decimal points in numerical values). The "CSV Output List Delimiter" and "Decimal Separator" allow you to format your CSV outputs in a way that your local software can interpret.

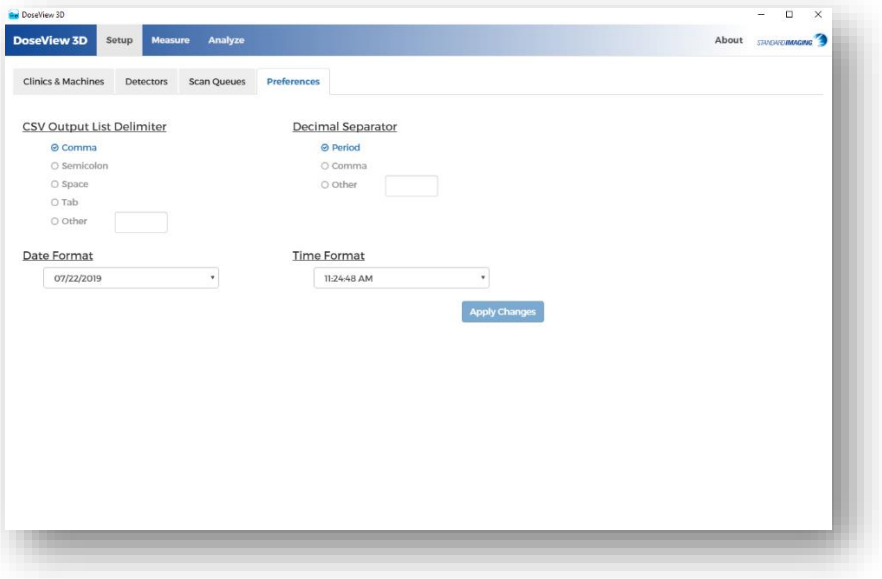


Figure 14-26: The Preferences Tab

15 The Measure Page

The Measure page is shown when the [Measure] tab is selected.

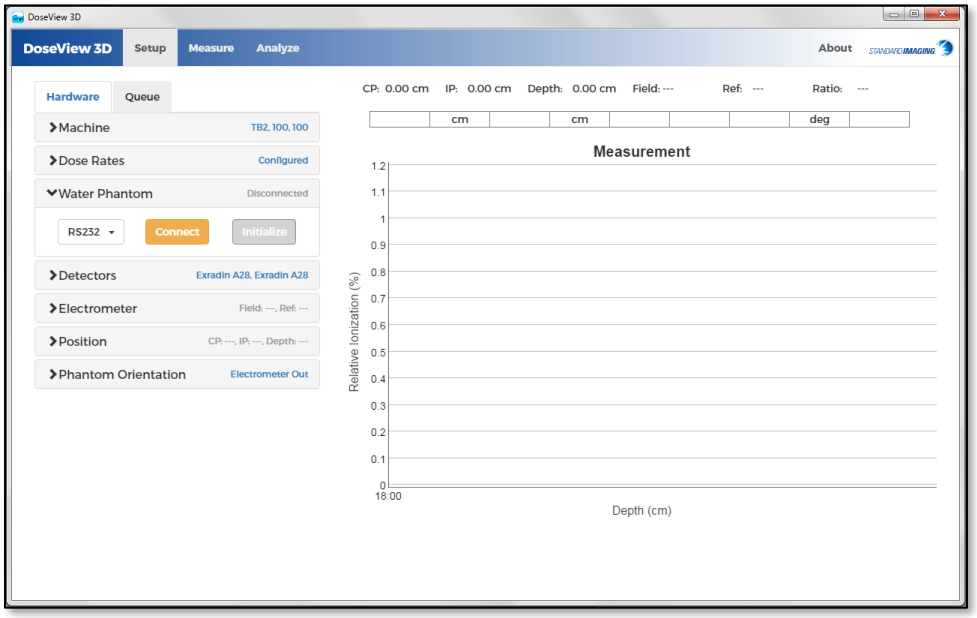


Figure 15-1: Measure Page initial presentation

15.1 Hardware

The Hardware tab is composed of several expanders. Expanders remember your prior selections (e.g., machine choices, SSD of measurements, etc.). When all expanders have blue results in their title bars (e.g., "TB2, 100, 100, below), scanning may be done.

Machine

The Machine expander allows choice of a machine previously defined in the Equipment Manager and the setting of a source to surface distance (SSD) to be used for the scans.

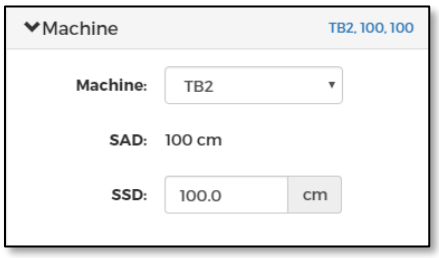


Figure 15-2: Machine expander

Dose Rate

The Dose Rate expander allows the user to specify dose rates, settling durations, and sample times for both photon and electron scan acquisition. Settling time, which is a delay before measurements are accumulated, only affect step mode scans.

The dose rate that you select should be the dose rate that you will use during scan acquisition. When the dose rate is selected, the sampling time selected will be optimal for both step mode and continuous mode scans. For step mode scans, the sample time is the duration that the detector movement will pause and accumulate electrometer readings. For continuous mode scans (3D Only), the sample duration is the time that electrometer readings are accumulated as the detector moves; accumulated readings are averaged during this period.

Optimal sample time minimizes noise, and measurement curvatures are not rounded off.

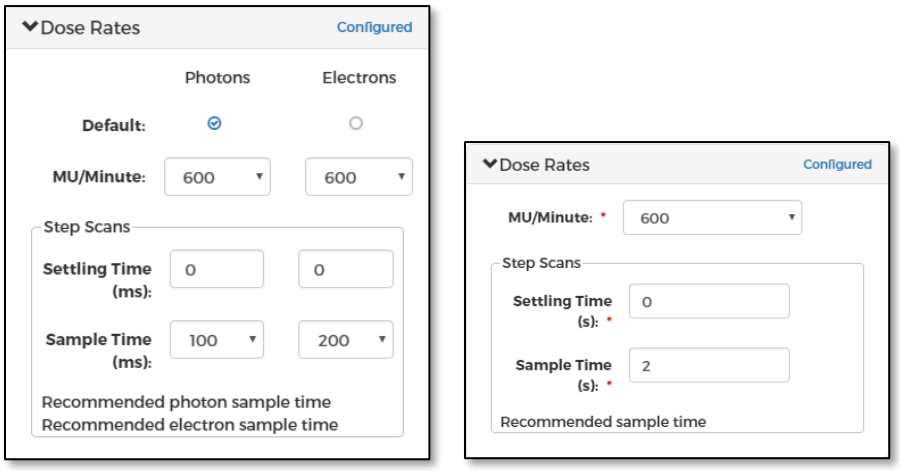


Figure 15-3: Dose Rates expander for DoseView 3D Module (left) and DoseView 1D Module (right)

For the 3D Module The "Default" is the modality that will be used to determine sampling rates. It should be changed to the type of scan currently being acquired.

For the DoseView 3D the recommended sample times are for scans taken using the A28 detectors that come with your water tank. Depending on your detectors' sensitivity, sample times may be adjusted up or down with varying results. Measurements taken using the W2 Scintillator should always use step mode. The sample duration for the W2 must be at least one second. You may need to experiment with this parameter to optimize your results.

The DoseView Software 1D Module Dose Rates expander has a slightly different look as seen in Figure 16-3. *Depending on your detectors' sensitivity, sample times may be adjusted up or down with varying results.*

Water Phantom – Demo Mode

The Water Phantom expander allows the user to either simulate connection to the water tank or, more typically, connect using the RS-232 interface. The tank can be initialized from the

Water Phantom expander or using the hardware pendant associated with the water tank. It is more typical to initialize using the hardware pendant.

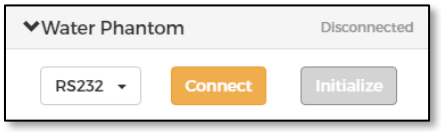


Figure 15-4: Water Phantom expander

When Demo mode is selected, you can simulate measurements being taken using scan queues that you have created.

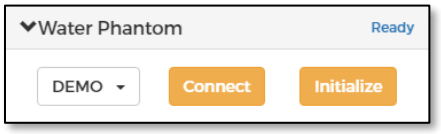


Figure 15-5: Water Phantom expander showing demo mode selection and completed setup

Detectors

The Detectors expander allows the user to select a sample and a reference detector previously defined in the Equipment Manager. For the DoseView 1D module, no reference detector can be used if the MAX400 or MAX4000 Plus electrometer is selected. A reference detector is optional if the SuperMAX electrometer is selected in the Electrometers expander below.

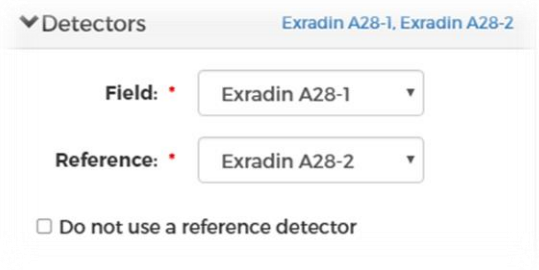


Figure 15-6: Detectors expander

Electrometer

For the DoseView 3D, the Electrometer expander allows the user to set the voltage applied to detectors. For the DoseView 1D, the electrometer is selected, and bias can be selected and applied. Note that the MAX4000 and MAX4000 Plus electrometers must be zeroed before bias is applied.

If a detector is a diode or "other", no bias is applied. The electrometer can be zeroed here as well as in the Queue Runner.

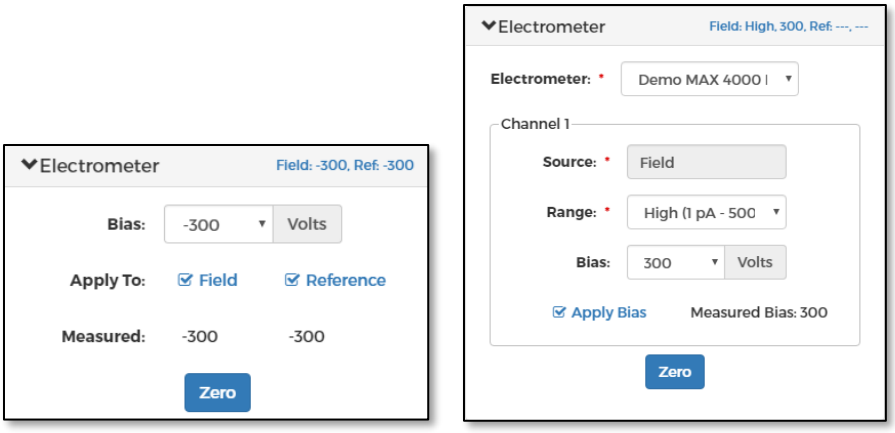


Figure 15-7: Electrometer expander for DoseView 3D (left) and DoseView 1D (right).

Position

The Position expander allows the user to:

- Goto Position – Move the field detector to a specific position.
- Goto Origin – Move the field detector to the 0, 0, 0 position.
- Set Origin – Set the current position to 0, 0, 0.
- Locate Beam Center – Find the halfway points between CrossPlane and InPlane edges.

NOTE: The Inplane and Crossplane Position Selections are not present in the DoseView 1D Module. The Locate Beam Center is also not present in the 1D Module.

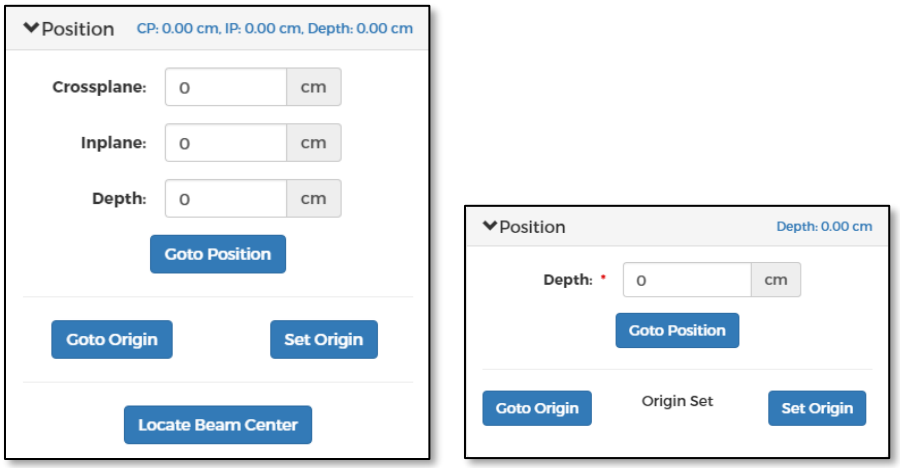


Figure 15-8: Position expander for DoseView 3D (left) and DoseView 1D (right).

A good practice for DoseView 3D is to set up the field chamber in the treatment room, including leveling and centering. Set the origin using the pendant in the treatment room. Go outside of the room, lower the field chamber to the depth of maximum dose and apply a

square field radiation beam. Select [Locate Beam Center], the Locate Beam Center dialog appears.

NOTE: The Locate Beam Center Selection is not present in the DoseView 1D Module.

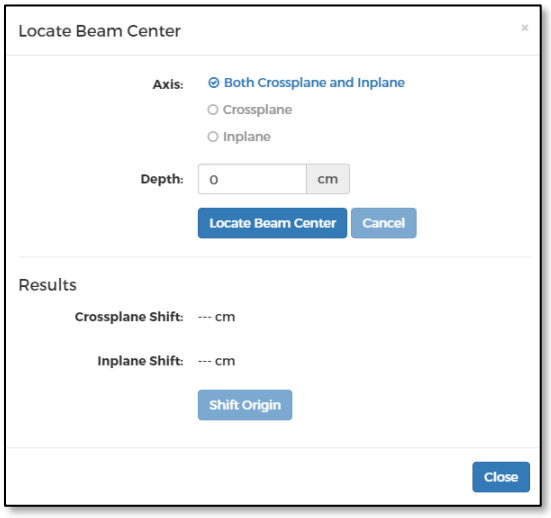


Figure 15-9: Locate Beam Center dialog

Select [Locate Beam Center] for both CrossPlane and InPlane. Let the software complete the centering process. Shift the origin to the new center position. Close. Then, if you are using a cylindrical chamber, drop it by 0.5 times the radius for photons and 0.6 times the radius for electrons. Reset the origin to the new depth.

Phantom Orientation (DoseView 3D Only)

The Phantom Orientation expander allows the user to specify the 3D tank orientation as it is set up. "Controller out" is a good orientation as it minimizes robot movements and therefore water perturbation for CrossPlane scans. The Phantom Orientation expander is not present in the 1D Module of the DoseView Software.

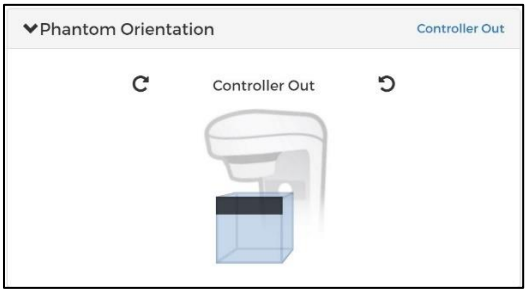


Figure 15-10: Phantom Orientation expander

Note that the CrossPlane scans are always assigned to the x-axis and that InPlane scans are assigned to the y-axis. X increases from left to right and Y increases from couch towards the gantry.

15.2 Queue Runner

The Queue Runner is shown below. It is the means by which the user can load and clear queues, execute queues, and monitor the status of scan acquisition.

The Queue Loading subpanel allows one or more queues to be loaded and cleared when they are no longer needed. Queues load and execute sequentially. For instance, if you were to load the previously created 6MV queue before the 18MV queue, the 6MV scans would appear (and be scanned) before the 18MV scans.

The Queue Status subpanel shows the status of scan acquisition and allows scans to be selected or deselected according to the Selection check box column. The Completion column shows if a scan is yet to be done (0%), being acquired (1-99%) or is completed (100%).

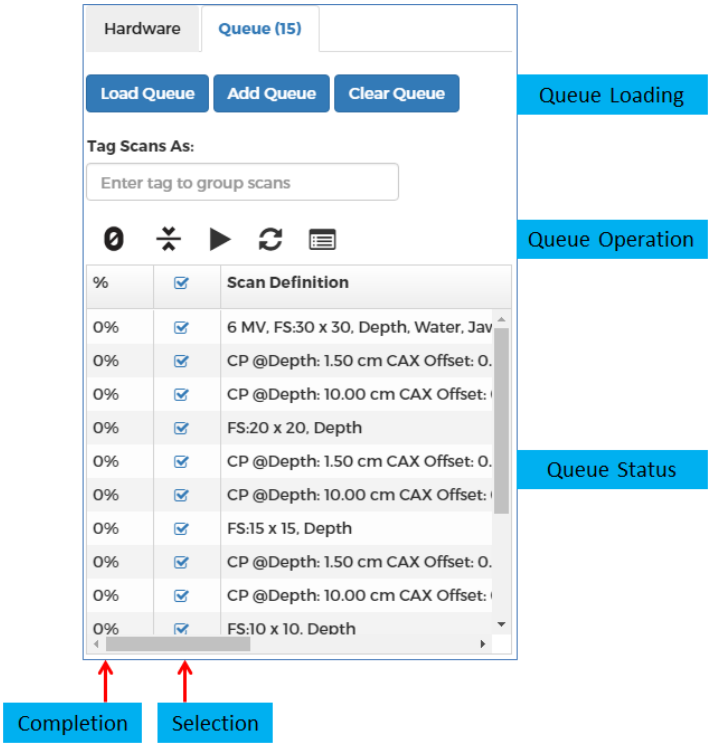


Figure 15-11: Queue Runner layout

The Queue Operation subpanel has several icons that mediate commands used in scanning.

- Zero Electrometer – Same as in the Electrometer expander of the Hardware tab.
- Normalize – Normalize readings to a particular dose intensity (See description below)
- Start/Pause – Start from next selected scan. Pause during scanning.
- Reload Queue – Keep current loaded queues, but restart scanning at beginning.
- View Queue Details – Look at expanded details of scans and select or deselect them.

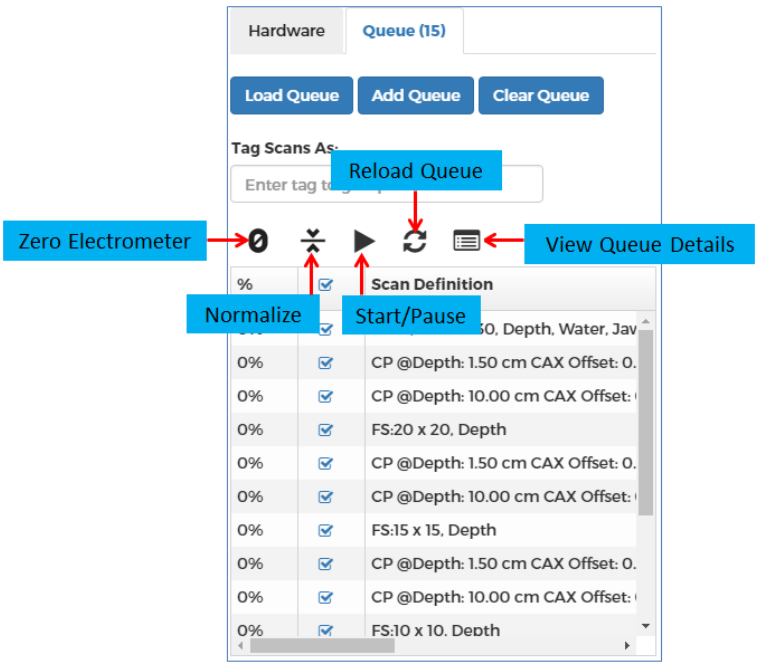


Figure 15-12: Queue Operation icons

Queue execution automatically pauses at the end of scan groups to allow the user to reset for the next group of scans.

Red highlighting is used to indicate a scan that cannot be completed, for instance if the beam energy does not exist for the linac that has been selected. Yellow highlighting is used for a scan that has been altered to allow scanning, such as a depth scan that exceeds the limits of the current tank setup.

An audible notification occurs after each scan group is complete, so that you do not have to be paying attention to the scanning process until machine reconfiguration is required.

Alarm sounds are saved in this location on your computer:

C:\Program Files (x86)\Standard Imaging\DoseView\Content\audio

The sound that is used is “scanGroupChange.wav”.

Other sounds are also in the folder if you want to customize. You can also find and use your own audible notifications as long as they are*.wav files.

The Normalize function allows scan readings to be normalized to a dose intensity at a specific location. Typically, this will be the central axis dose at D_{max}. To normalize for the DoseView 3D to D_{max}, set the position to 0, 0, D_{max} and select [Goto Position], then select [Normalize]. To normalize for the DoseView 1D to D_{max}, set the position to the D_{max} value and select [Goto Position], then select [Normalize].

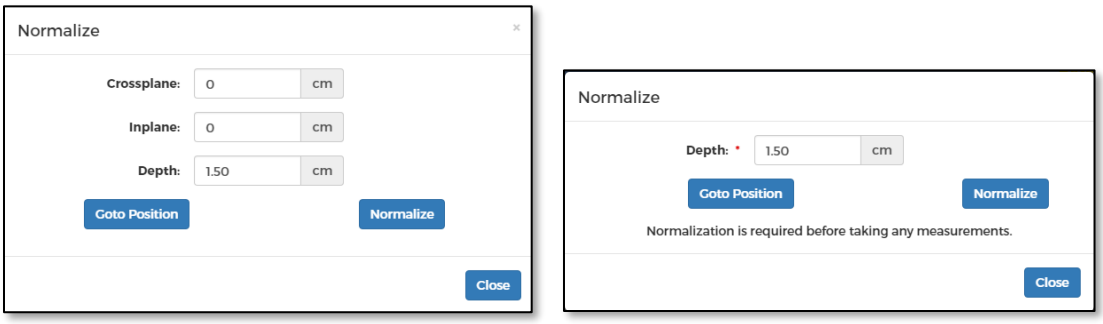


Figure 15-13: Normalize dialog for DoseView 3D (left) and DoseView 1D (right)

15.3 Single Point tab (DoseView 1D only)

The Single Point tab allows the DoseView 1D user to make individual measurements rather than preset scans. This allows the system to be used for calibration or output factor type measurements when needed. The Electrometer and Position expanders within this tab mirror those of the Machines tab, so the user can control the system without having to switch between tabs.

Measurement Configuration

The Measurement Configuration expander allows you to choose whether the measurements are timed, triggered, or continuous (started and stopped manually).

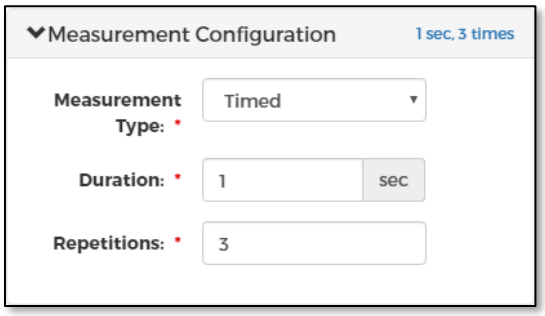


Figure 15-14: Single Point Measurement Configuration for DoseView 1D

For Timed measurements, you can select the number of times you would like the measurement to be repeated. Please note that the MAX4000 and some MAX4000 Plus electrometers are limited to 15 second increments for measurement duration. Be sure to use a setting in the DoseView software that matches the capabilities of these older electrometers.

Triggered measurement configuration must have the trigger stop value greater than the trigger start value. If you change these trigger values away from the default values, a button will appear to enable you to restore the default trigger values for your electrometer.

Point Measurement

The Point Measurement expander allows you to select the energy used with each measurement as well as enter the field size you are measuring and the temperature and atmospheric pressure at the time of the measurement.

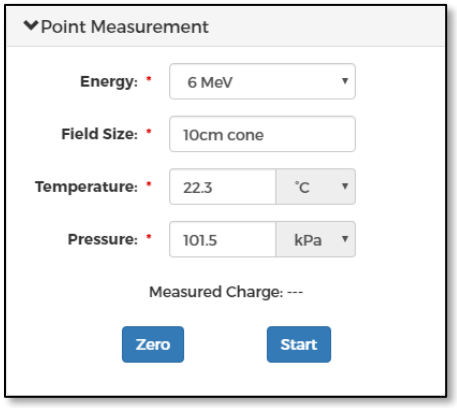


Figure 15-15: Single Point Measurement Expander

Temperature may be entered in either degrees Fahrenheit or degrees Celsius. Pressure may be entered in either mmHg or kPa.

16 The Analyze Page

The “Analyze” page is where scans can be viewed, and metrics calculated. It is also the place where:

- Scans can be modified by filters
- Scans can be collected into ”scan sets”
- Half profile scans can be merged to create complete profiles
- Scan sets can be edited and deleted
- Scans can be exported in various formats, including native DoseView format.
- Native DoseView format scans can be imported (other formats import with external scan importers, see section 16.7, Import Scans).
- Reports can be created.
- Scan comparisons/Gamma can be viewed (if Reference Scans are set) by checking the <Show Reference Scans> checkbox.

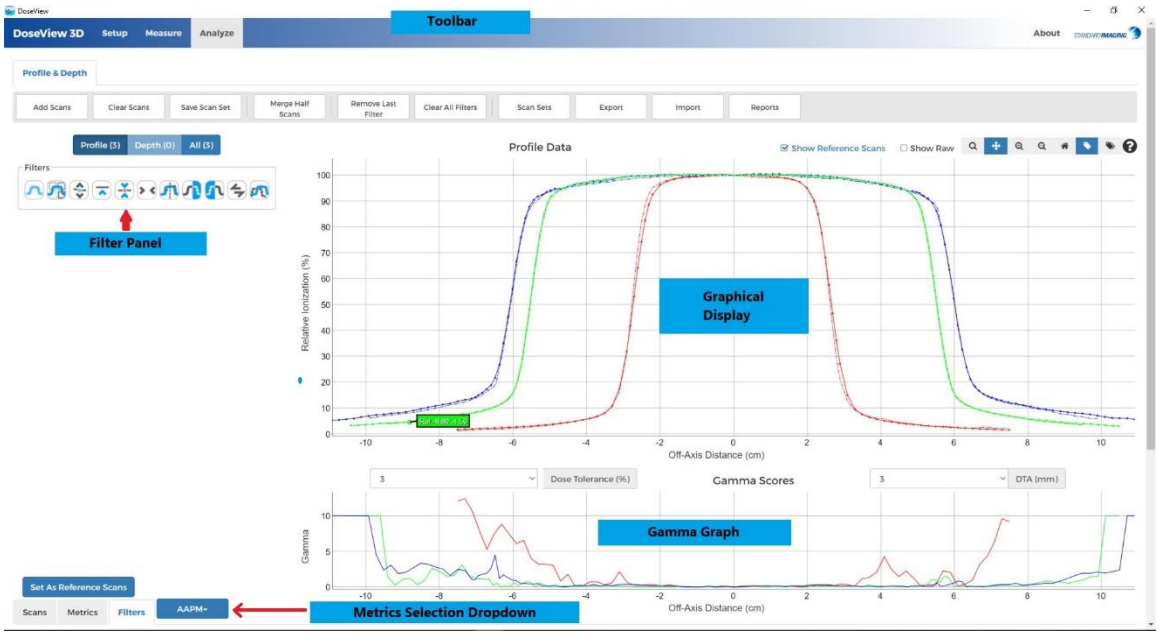


Figure 16-1: Analyze Page showing different control regions

Toolbar

A number of Toolbar options are available:

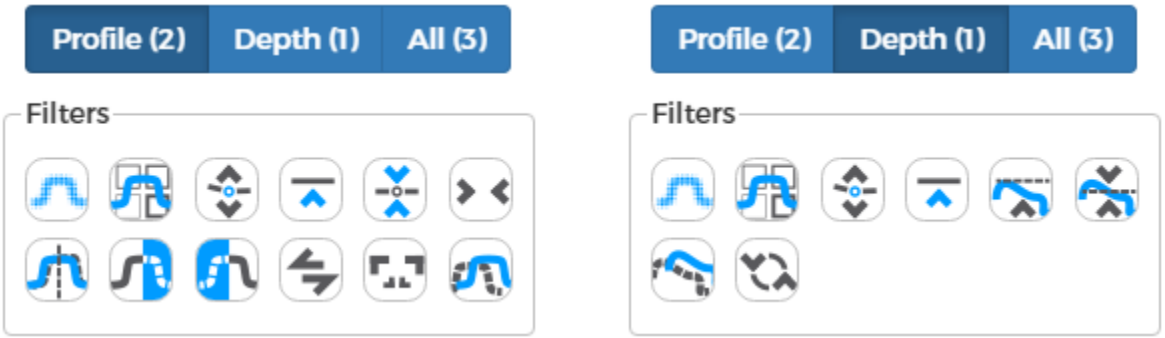
- Add Scans – Load scans from the “Scan Selection Dialog”.
- Clear Scans – Remove all scans from the Analyze Page.
- Save Scan Set – Save all selected scans in a new scan set.
- Merge Half Scans – Combine two half profile scans to make a complete profile.
- Remove Last Filter – Remove the last modification of selected scans.
- Clear All Filters – Remove all filters applied to selected scans.
- Scan Sets – Invoke the “Edit Scan Sets Dialog” (create, edit, delete, archive scan sets).
- Export – Invoke the “Export Scans Dialog”.
- Import – Invoke a file browser to import scans in DoseView 3D native file format.
- Reports – Create reports based on the currently loaded scans.

Graphical Display

The Graphical Display shows loaded and selected scans in color and deselected scans in gray. It allows several display options including zooming, panning, and readout of point values using the mouse. A checkbox allows "raw" data (dotted lines) to be displayed along with processed data (solid lines), providing a convenient way to visualize data modifications due to filtering.

Filter Panel

Modification of scans is done through choices of filters shown in the Filter Panel. The filters, which are scan-type dependent, are discussed in detail in Section 0.



Profile Filters Depth Filters

Figure 16-2: Filter Panel

Filter subpanels, e.g., "Profile", "Depth", "All", can be selected to show the available filters for that type of scan. Many filters are shown under both Profile and Depth, but their selection will only be applied to the type of scan from which they are selected. Filters are discussed in detail in Sec 17.10, Scan Filtering.

Tab Panel

The Tab Panel has three tabs:

- Scans – Identifies each loaded scan according to standard and non-standard, but very useful, parameters. Two non-standard parameters are the "Id", which uniquely identifies each scan with a number and "CAX Offset" which describes the distance from central axis for profiles. The Id is set during scanning and cannot be changed.

✔	Color	Id	Ion/Dose	Energy	Scan Type	Field Size (cm)	Depth (cm)	CAX Offset (cm)	Modifier	Wedge Angle
✔		2258	Ion	12 MeV	CrossPlane	10 x 10	2.8	0.0	Open	--
✔		2260	Ion	12 MeV	InPlane	10 x 10	2.8	0.0	Open	--

Figure 16-3: Tab panel, scans tab

- Metrics – Shows metrics for each scan according to the metrics selection dropdown. Metrics selections include: AAPM, Elekta USA, Elekta IEC, Varian, AERB, and Flattening Filter Free (FFF). The metrics, which are protocol and scan-type dependent, are discussed in detail in Section 17.9, Profile Metrics

✔	Color	Id	FWHM (cm)	Center (cm)	Edge (cm)	Penumbra ...	CAX (%)	Max (%)	Min (%)	Flatness (%...	Area Asym...	Point Asym...
✔		2258	10.47	0.00	-5.24 | 5.23	1.40 | 1.40	99.41	99.56	88.19	6.06	-0.09	-0.52
✔		2260	10.44	0.00	-5.22 | 5.23	1.38 | 1.45	99.30	99.70	86.85	6.89	0.44	0.75

Figure 16-4: Tab panel, metrics tab

- Filters – Shows the sequence of filters with selected parameters applied to each scan.

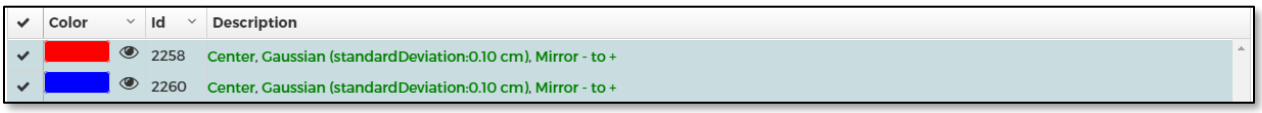


Figure 16-5: Tab panel, filters tab

16.1 Scan Comparisons

Setting Reference Scans

DoseView Software offers the user the ability to identify scans as Reference Scans. These reference scans can then be compared quantitatively with similar scans. Comparison of a scan or set of scans back to the reference scans can assist in evaluating how beam quality or machine output may have changed over time. Reference Scans are set in the Analyze page of the software.

Once in the Analyze page click the <Load Scans > button and select your scans to analyze. Review the displayed scans, select those that you want to use as reference scans, and click on the <Set as Reference Scan> button. Your selection of each reference scan will persist until another scan with the same parameters is set as a new reference scan.

Figure 16-6: Set Reference Scans button

When a scan has been designated as a reference scan, other scans with the same parameters can be compared with that reference scan. The matching parameters include:

- Scan Orientation
- Scan Angle
- Central Axis Offset
- Scan Medium
- Scan Type (full scan, half scan positive side of CAX, depth scan, etc.)
- Profile Depth
- SSD
- Field Delimiter (jaws, MLC, cone, etc.)
- Beam Modifier
- Field Shape
- Field Size
- Modality (photon, electron, FFF)
- Beam Energy
- Wedge Angle

Once the reference scans are selected and set, scans with matching parameters can be compared. In the Analyze page load the scans you would like to view. They will display in the scan display window. Check the "Show Reference Scans" box to display the reference scans on the plot and show the gamma scores in a graphical display below the scan display. In the Scan Display window the reference scans will be displayed in a dot dash dot pattern. The active scan will be solid in the same color for easy comparison.

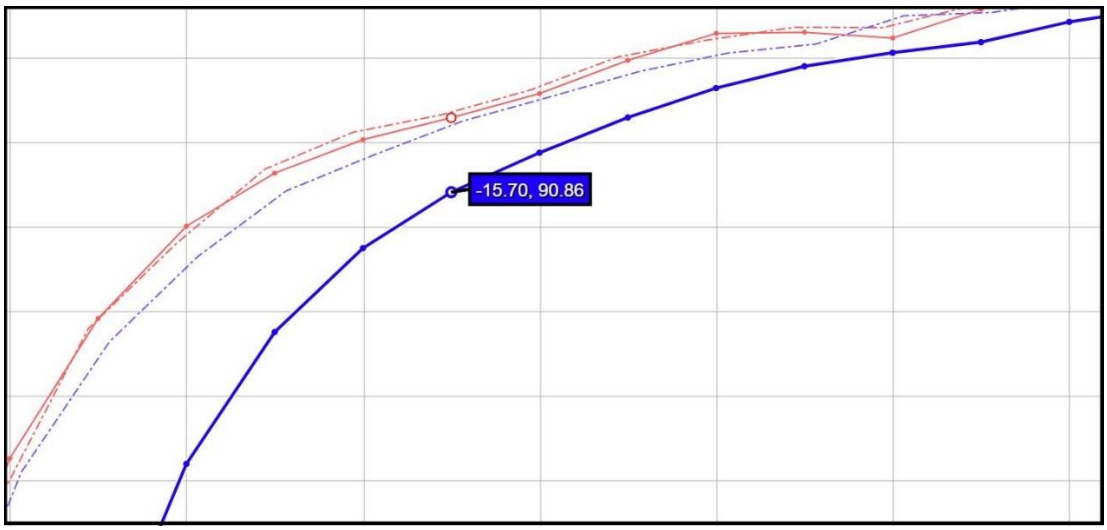


Figure 16-7: Active Scan (solid), Reference Scan (dot, dash, dot)

In the Metrics table, reference scan information will be displayed as well, noted by a second line of numerical data under the bolded active scan data. Reference scans themselves will not have reference data displayed but will have dual asterisks (**) displayed instead to indicate that the scan itself is a reference scan. Displayed scans with no reference scan set for comparison will display two dashes (--) below the active scan data.

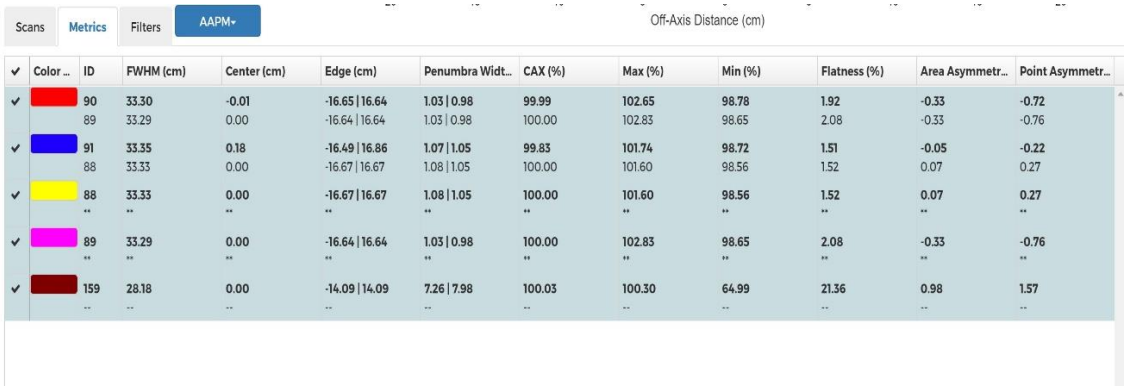


Figure 16-8: Metrics tab reference scan indicators

The reference scan comparison provides both visual comparison and quantitative metrics for users to evaluate differences between scans.

Gamma Analysis

DoseView software provides a 1D gamma analysis as part of the scan comparison functionality. If the "Show Reference Scans" box is checked the Gamma Scores display will appear below the Scan Data display.

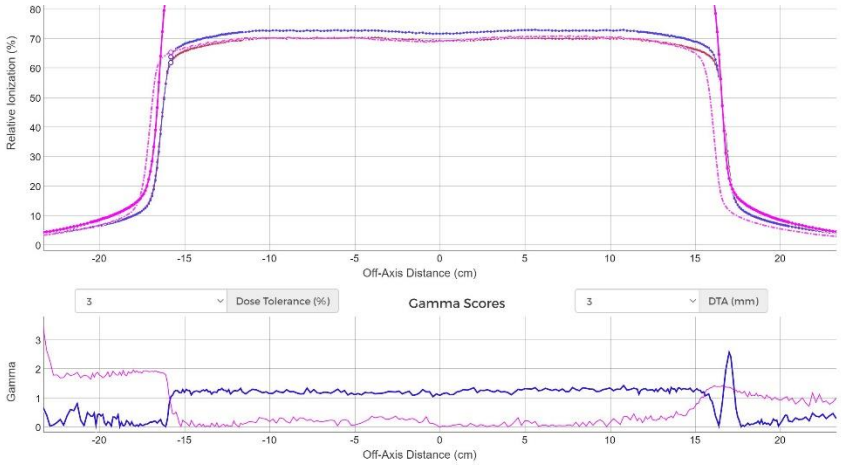


Figure 16-9: 1D Gamma Graph

The gamma thresholds for distance to agreement (mm) and dose tolerance (%) have defaults of 3mm and 3% respectively. They can be adjusted from 1 – 3 via the respective dropdown boxes.

16.2 Select Scan Dialog

The Select Scans dialog presents when [Load Scans] is selected. It uses progressive search to help the user find specific scans to load or add to the scans on the Analyze page. It also is where scans can be archived or restored from archive.

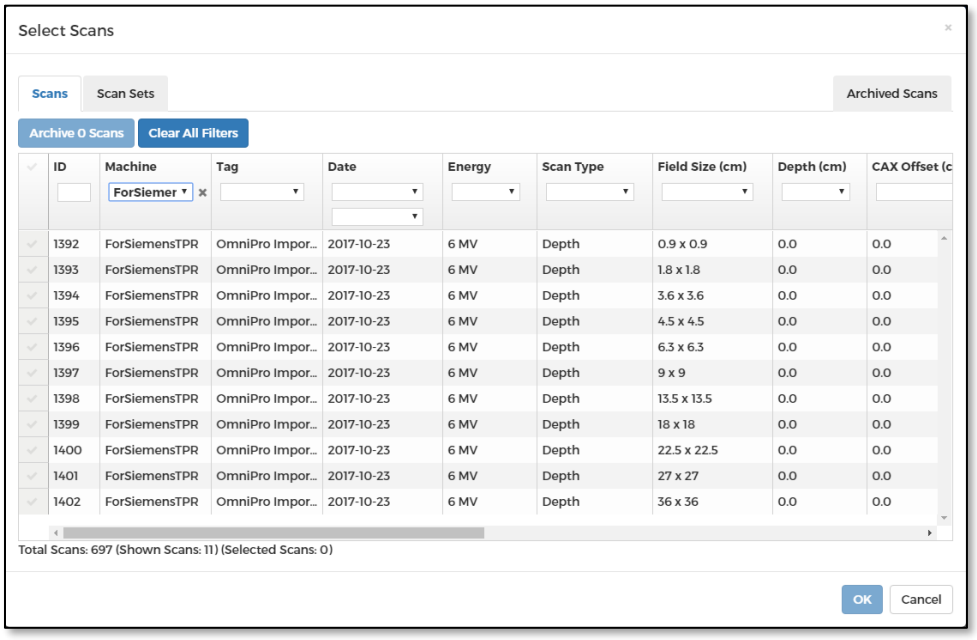


Figure 16-10: Select Scans Dialog

The fields should be self-explanatory and populated with the settings selected when the scans were taken. You can set filters for any one of the fields to narrow the dataset.

The “ID” field is a unique number automatically assigned to each scan when measured and cannot be edited.

The “Tag” field is optional and available for the user to identify a group of scans. All scans from a particular scanning session can be tagged with an identifier from that session, e.g. 2018 Annual, 2019 Annual, or 2018 Beam Steering. Care should be used when creating tags to select names that are easy to identify from a potentially long list of tags during future uses.

16.3 New Scan Set Dialog

The New Scan Set dialog presents when [Save Scan Set] is selected. A required name and optional description field are provided. When “OK” is selected, a scan set is created that contains all currently selected scans on the Analyze page.

Figure 16-11: New Scan Set Dialog

16.4 Merge Scans Dialog

The Merge Scans dialog presents when [Merge Half Scans] is selected.

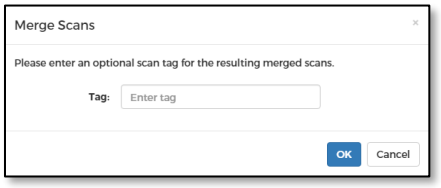


Figure 16-12: Merge Scans Dialog

The system will attempt to merge any currently selected scans. To be successfully merged, scans must be pairs of profiles (CP-Half, CP+Half) or (IP-Half, IP+Half) from the same machine that have the same energy, field size, and depth.

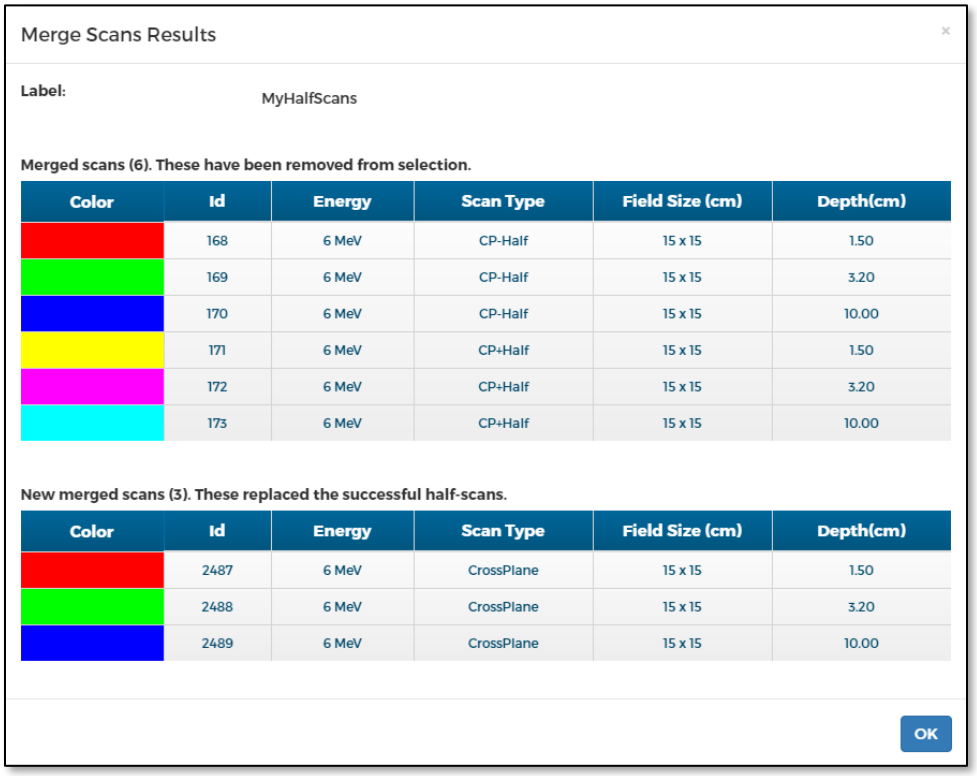


Figure 16-13: Merge Scans Results Dialog

16.5 Edit Scan Sets Dialog

The Edit Scan Sets dialog presents when [Scan Sets] is selected. It is similar in layout to the Select Scans dialog and uses progressive search function with dropdowns to assist the user in filtering the scan list to find specific scans from which to create scan sets. As with the Select Scans dialog, it is also where scans can be archived or restored from archive.

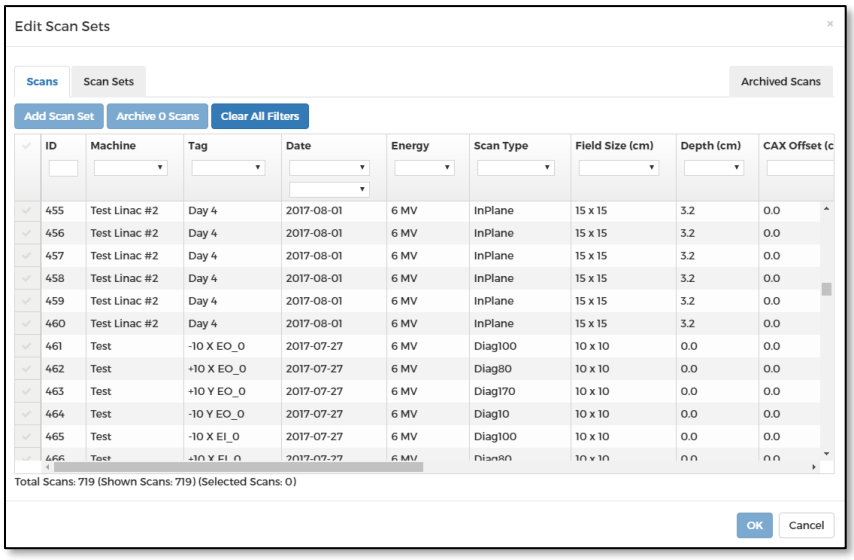


Figure 16-6: Edit Scans Dialog

16.6 Export Scans Dialog

The Export Scans dialog presents when [Export] is selected. Upon presentation it shows, as a default, the currently loaded scans from the Analyze page. Again, it is similar in layout to the Select Scans Dialog. In this case, it uses progressive search to help the user find specific scans to export. Individual scans as well as scan sets can be exported.

When more than one scan is exported scans are placed in a zipped file. To reimport DoseView Native scans, they must be unzipped.

Export types include:

- Varian Eclipse – Save selected scans for *Eclipse* commissioning
- Elekta Monaco – Save selected scans for *Monaco* commissioning
- Elekta AQUA – Save selected scans for import to Elekta *AQUA*
- Philips Pinnacle – Save selected scans for *Pinnacle* commissioning
- RaySearch RayPlan – Save selected scans for *RayPlan* commissioning
- CyberKnife - Save selected scans for *CyberKnife* commissioning
- DoseView Native – Save selected scans with complete scan information for later re-import to DoseView
- DoseView CSV– Save selected scans in Comma Separated Value format
- PDD (Percent Depth Dose) – Create CSV files containing PDD tables

- TPR (Tissue Phantom Ratio) – Create CSV files containing TPR tables.

On save, a folder browser is presented allowing scan files to be placed anywhere that you have permission.

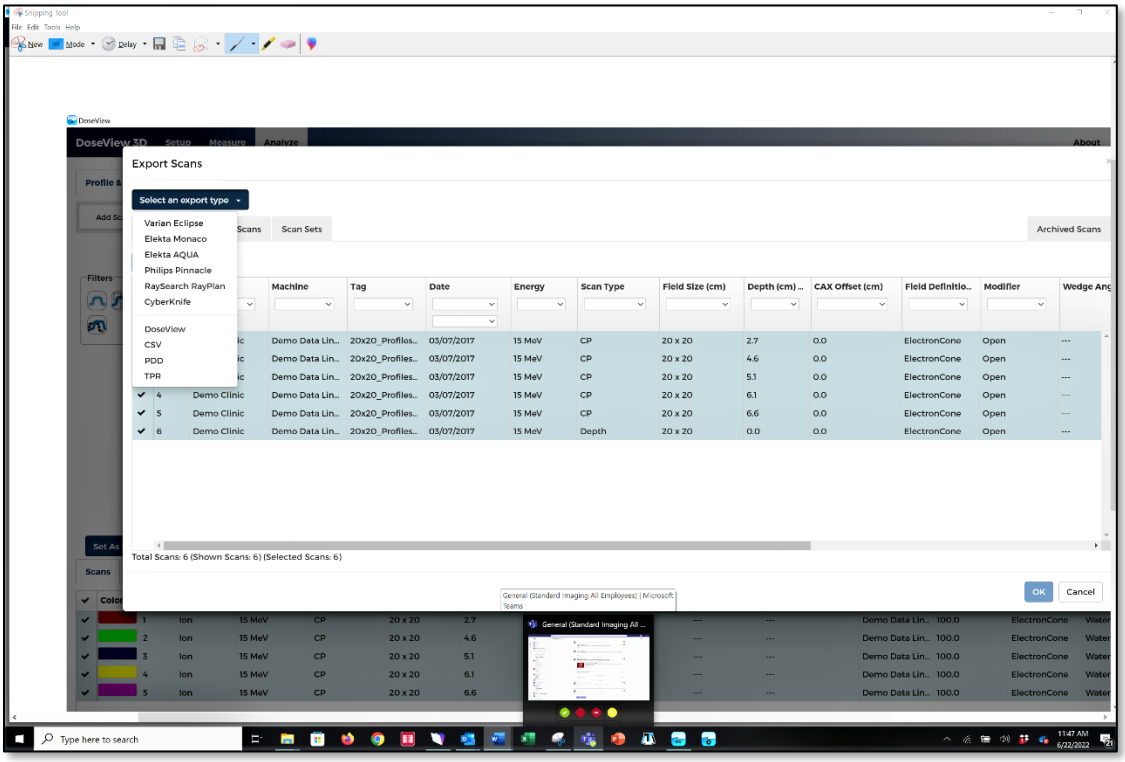


Figure 16-7: Export Scans Dialog

Treatment Planning System Export

To export scan data to treatment planning systems requires all scan data that will be exported to be converted to dose. For depth scans the reason is simple enough; once imported into your treatment planning system, information about acquisition critical to conversion is not available (e.g., chambers used, diameters, chamber drops). For profiles, normalization to percent depth dose is required by some treatment planning systems, so to make treatment planning system export consistent, profile conversion is required for all treatment planning system export types (it is easy enough).

Multiple depth dose conversions can be done when either photon or electron depth scans are selected and when the same field detector was used to acquire the selected scans.

Multiple dose conversions should not be done on scans that were acquired with different “chamber drops”.

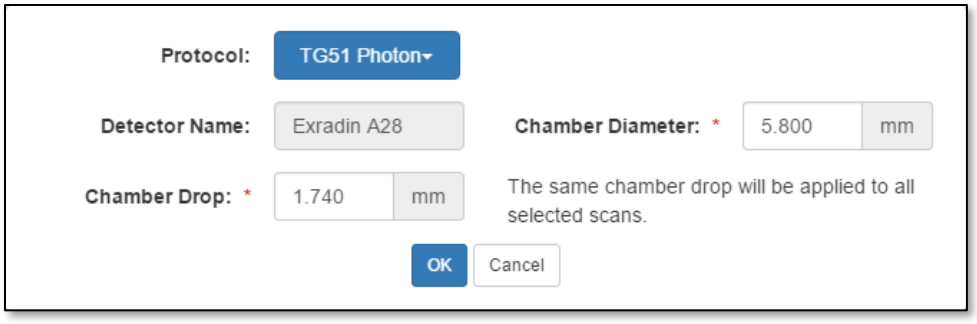


Figure 16-16: Photon multiple depth dose conversion dialog showing same chamber drop will be used for all scans

For electron dose conversion, check that the practical range of each electron scan is correct as it does not show up in the dose conversion dialog, but does show up in the scan metrics tab, below.

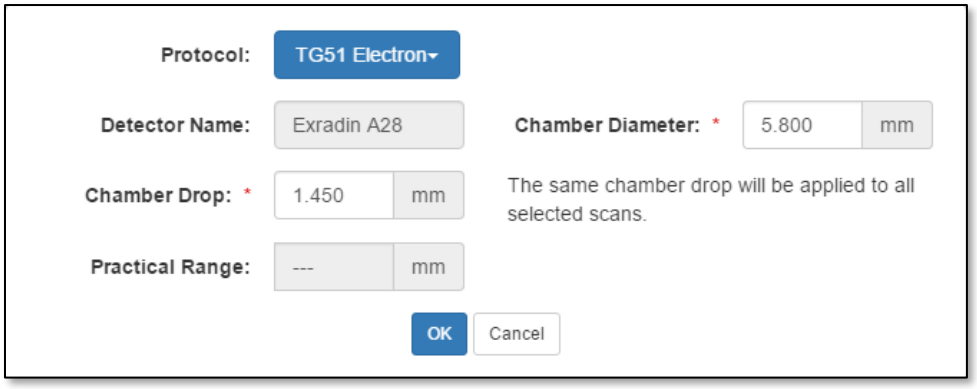


Figure 16-817: Electron multiple dose conversion dialog showing same chamber drop and not showing the practical range of electron depth doses to be converted

Figure 16-18: Dose conversion process

For profile dose conversion, to avoid complexity and delays in processing, convert subgroups of scans at the same time (e.g., 6 MV, 10 MV, 6 MeV, 9 MeV, 12 MeV, etc.).

Figure 16-9: Profile normalization to percent depth dose process

Native Scan File Export / Import

Native scan file export allows you to export scans in a format that is later importable back into the DoseView software. This allows you to share your scans with other users and DoseView installations and save scans to secure folders for data safety. The file format is binary and should not be edited to ensure future successful imports. The goal in the export / import scheme is to make sure that scans created in one database correspond faithfully to scans in another database and are not duplicated if exported and reimported to the same DoseView installation.

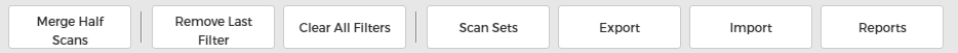


Figure 16-1020: Portion of toolbar showing export and import buttons

Native scan file export works the same as other export types. On save, as with other exports, all files are placed in user-specifiable folders.

Native scan import has protection mechanisms that ensure as much as possible that imported scans are consistent and irredundant across all installation databases.

When more than one scan is exported, scans are placed in a zipped file. To reimport DoseView Native scans, they must be unzipped.

Native scans are identified by a "GUID", a Globally Unique Identifier. When transferring scans from one installation to another, DoseView will identify if a scan is new to your local database or is already present. If a scan is already present and the filtering and filter ordering is unchanged, no import will occur. If a scan is already present and the filtering or filter ordering is different, DoseView will prompt the user to choose either to replace filters in the existing scans with those in the import dataset, or not.

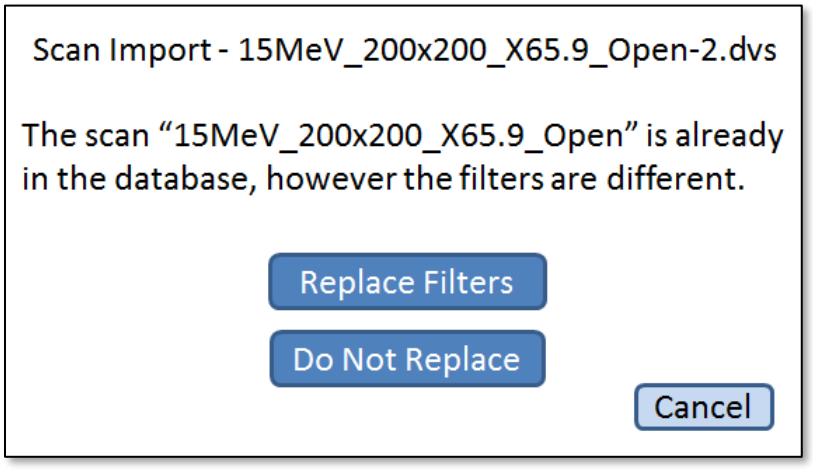


Figure 16-21: Dialog for replacement of filters for existing scans

Note: To successfully import native scans the names of clinics, machines, and detectors must already be in the existing database with identical spelling to that in the importing dataset. DoseView will show the user a dialog box with the list of these names that do not match, and these must be resolved before proceeding. The user can create or change the matching items using the setup page on the local installation or change the information in the dataset before exporting.

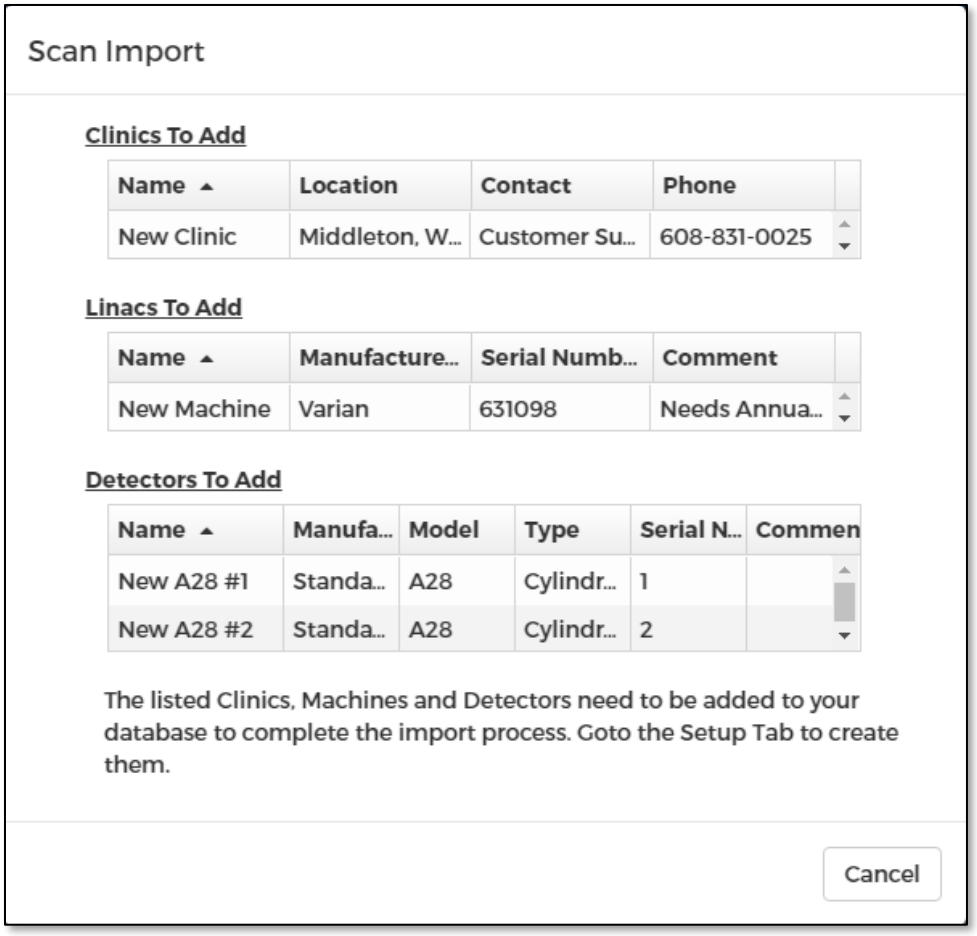


Figure 16-22: Dialog with items with names that do not exist in a local database

CSV Scan File Export

Comma Separated Variable (CSV) scan files contain one scan each and header information that can be helpful in identifying the conditions of measurement for the scan. Other information, for instance, to identify wedges, appears in the scan file name. CSV files can contain either raw or processed data.

On save, as with other exports, all files are placed in user-specifiable folders.

Version: 2			
Machine:	Energy: 6 I	Scan date: 10Jan2011	
Label: Om	Descriptic	Orientation: Depth	
Data type:	SSD: 1000	Medium: '	Detector: ParallelPlate
Left: 50 m	Right: 50 r	Gantry: 50	Couch: 50 mm
X	Y	Z	Dose
0	0	-0.2	80.6
0	0	-0.1	80.7
0	0	0.2	81
0	0	0.6	81.3
0	0	0.9	81.6
0	0	1.4	82.1
0	0	1.9	82.6
0	0	2.4	83.1
0	0	2.9	83.5
0	0	3.2	83.8
0	0	3.7	84.3
0	0	4	84.6
0	0	4.3	84.8
0	0	4.7	85.2
0	0	5.2	85.7
0	0	5.5	86
0	0	6	86.4
0	0	6.5	86.9
0	0	6.8	87.2
0	0	7.1	87.4

Figure 16-23: Example comma separated variable scan file

PDD Tables

Only depth scans from the same machine with the same energy, modality, and SSD that have been converted to dose can be used to create PDD tables.

The Export PDD Dialog presents when "PDD" is selected. Upon first presentation it shows, as a default, a range of field sizes from the selected scans rounded down to the nearest integer centimeter and a range of depths from zero to the deepest common measured depth, rounded down to the nearest integer centimeter. To create a PDD table only requires the further specification of a reference depth, but you will likely want to specify parameters different from the defaults. For instance, if you are saving a PDD table for fixed SRS cones, you will want to use the scan field sizes in your PDD table because you will only be using these field sizes in your second checks.

On save, as with other exports, all files are placed in user-specifiable folders. The system also saves the reference depth with machine, energy, modality, and SSD information in the database. When scans from the same machine with the same energy, modality, and SSD are selected for PDD table creation, the system recalls the previously-used reference depth and alerts the user to when this parameter was last set as shown in Figure 16-11.

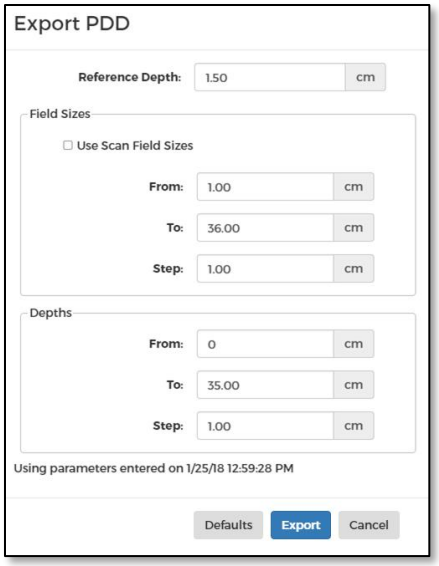


Figure 16-1124: Export PDD Dialog

TPR Tables

Only depth scans from the same machine with the same energy, modality, and SSD that have been converted to dose can be used to create TPR tables.

The Export TPR Dialog presents when "TPR" is selected. The left-hand side of the dialog is the same as the Export PDD dialog, with the same defaults and behavior. Below is a description of the additional functionality for TPR table creation.

Upon first presentation, TPR-related parameters are all blank. As with PDD tables, a TPR table requires specification of a reference depth. Also required is a reference field size and at least 5 entries in the scatter factor table.

Note; To export a TPR table for Accuray CyberKnife, use the checkbox in the upper left of the Export TPR. When this box is checked the reference depth will be set to 1.5cm and the TPR tables will use the scan field sizes as required by Accuray.

On save, as with other exports, all files are placed in user-specifiable folders. The system also saves the reference depth, reference field size and scatter factors with machine, energy, modality, and SSD information in the database. When scans from the same machine with the same energy, modality, and SSD are selected for PDD table creation, the system recalls the previously-used parameters and alerts the user to when this parameter was last set as shown in Figure 16-.

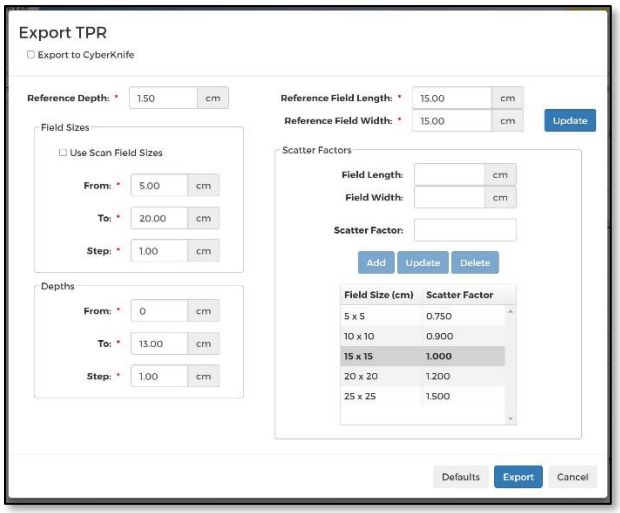


Figure 16-25: Export TPR Dialog

16.7 Import Scans

DoseView 3D native format scan files are imported from the Analyze page using the Import button, Native Scan File Export / Import

All other imports are done using two separate external utilities:

ImportOldDV3DDatabase.exe - Import legacy DoseView 3D 1.2 scans

ScanImporter.exe - Import PTW and IBA ASCII V7 format and RFA 300 format scans

Both executables may be found in “C:\Program Files (x86)\Standard Imaging\DoseView\”. Make a link to these executables on your desktop for convenience.

The use of these utilities is simple and self-explanatory, the only complicating factor being that target clinics, machines, and detectors must be declared in the DoseView 3D database prior to import. For instance, if there are scans to be imported from St. Joseph’s hospital and a TrueBeam, the St. Joseph’s hospital clinic and TrueBeam must be created before import. Typically, this is done once. Once scans are imported, they appear as any other scan in the DoseView 3D database.

16.8 Reports

When [Reports] and then [Select a report type} is selected the software will provide the user with two options to create reports for the selected scans on the Analyze page. The report type options are either a CSV report of displayed scan information or as an Isodose Curve plot in the form of a PDF.

CSV Reports

If selecting CSV, a file save dialog presents allowing saving of reports to any available location. After selecting save, the Reports Results dialog presents showing the reports that have been created. Any number of scans can be selected. When reports are created, they are partitioned according to machine, modality (photon, electron), measurement type (depth scans, profiles) and medium (water, air).

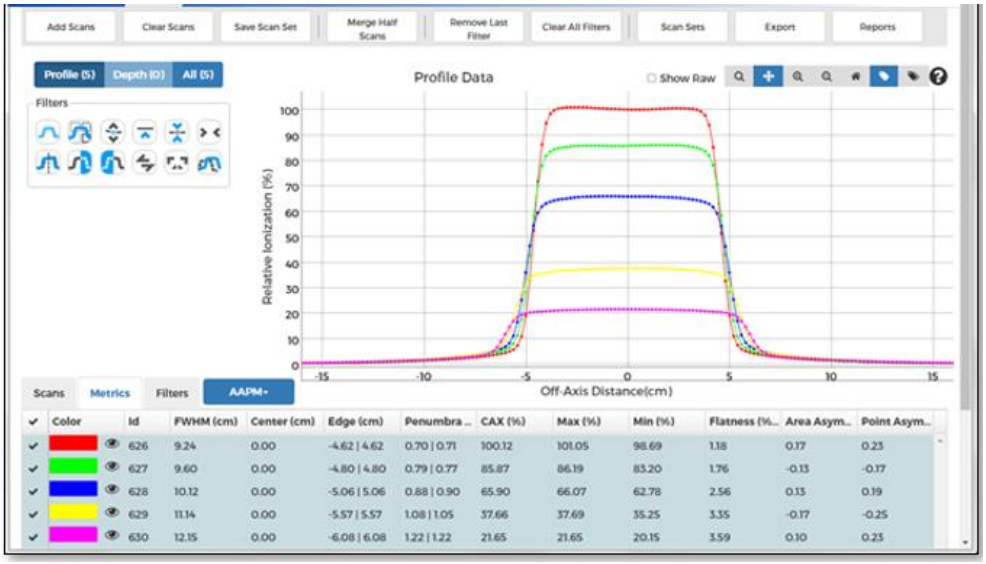
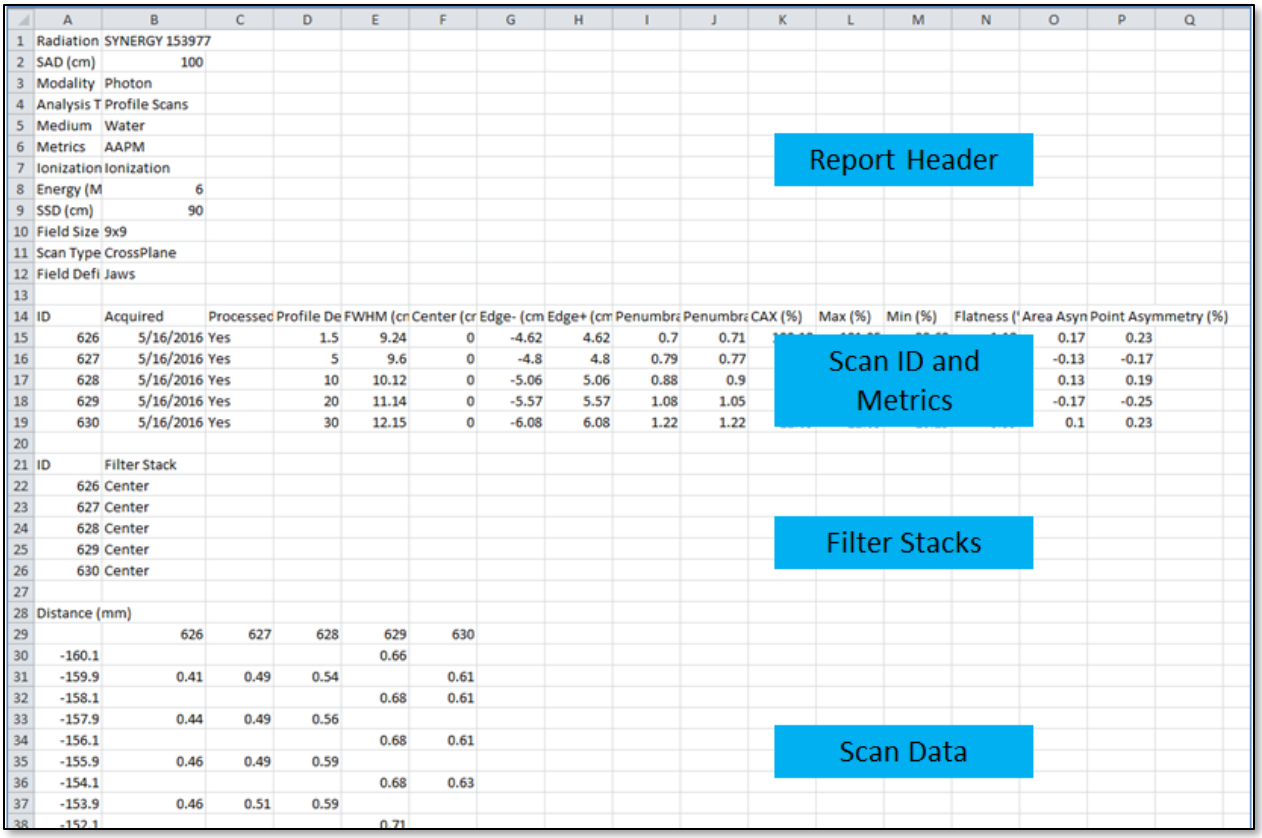


Figure 16-1226: Analyze page with selected profiles

Scan Reports are saved in comma-separated variable (CSV) format that the user can use to populate or create custom reports. Reports are composed of a header, a scan ID and metrics area, a filter stacks area, and a table of scan data from which plots can be created. The header has fixed fields, but whenever fields in the ID and metrics area are the same in a column, they are "pivoted" into the header. For example, in Figure 16-27, Ionization/Dose, Energy (MV), SSD (cm), Field Size (cm), Scan Type, and Field Definition were pivoted. Pivoting makes clear commonalities among scans as well as simplifying the ID and metrics area by removing redundant columns.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Radiation	SYNERGY 153977															
2	SAD (cm)	100															
3	Modality	Photon															
4	Analysis T	Profile Scans															
5	Medium	Water															
6	Metrics	AAPM															
7	Ionization	Ionization															
8	Energy (M	6															
9	SSD (cm)	90															
10	Field Size	9x9															
11	Scan Type	CrossPlane															
12	Field Defi	Jaws															
13																	
14	ID	Acquired	Processed	Profile De	FWHM (cn	Center (cr	Edge- (cm	Edge+ (cm	Penumbra	Penumbra	CAX (%)	Max (%)	Min (%)	Flatness ('	Area Asyn	Point Asymmetry (%)	
15	626	5/16/2016	Yes	1.5	9.24	0	-4.62	4.62	0.7	0.71					0.17	0.23	
16	627	5/16/2016	Yes	5	9.6	0	-4.8	4.8	0.79	0.77					-0.13	-0.17	
17	628	5/16/2016	Yes	10	10.12	0	-5.06	5.06	0.88	0.9					0.13	0.19	
18	629	5/16/2016	Yes	20	11.14	0	-5.57	5.57	1.08	1.05					-0.17	-0.25	
19	630	5/16/2016	Yes	30	12.15	0	-6.08	6.08	1.22	1.22					0.1	0.23	
20																	
21	ID	Filter Stack															
22	626	Center															
23	627	Center															
24	628	Center															
25	629	Center															
26	630	Center															
27																	
28	Distance (mm)																
29		626	627	628	629	630											
30	-160.1				0.66												
31	-159.9	0.41	0.49	0.54		0.61											
32	-158.1				0.68	0.61											
33	-157.9	0.44	0.49	0.56													
34	-156.1				0.68	0.61											
35	-155.9	0.46	0.49	0.59													
36	-154.1				0.68	0.63											
37	-153.9	0.46	0.51	0.59													
38	-152.1				0.71												

Figure 16-1327: Excerpt from CSV report

CSV Report Formatting

The simplest report formatting can be done by converting Scan Data to a plot using an analysis program such as Microsoft Excel.

Isodose Curve Reports

The DoseView Software offers the ability to produce Isodose Curve Reports in PDF format. To produce this report select a set of scans with similar parameters at different depths. The scans selection must be selected with the following constraints:

1. Same Field Size
2. Same Machine Name
3. Same Energy
4. Same SSD
5. Have three or more profile scans with similar Scan Types (IP or CP or Diagonal). Diagonal scans must be of similar angle
6. All profiles must have different depths
7. The profiles must be full profiles (no half scans), Merged half scans are allowed.
8. Have zero or one Depth scan selected

A PDD scan may be selected to adjust the profile scans to match the PDD at depth.

Once the scans are selected and displayed on the analysis page select the [Reports] button and [Select a report type] and select [Isodose PDF] from the pull down menu, a file save dialog presents allowing saving of reports to any available location.

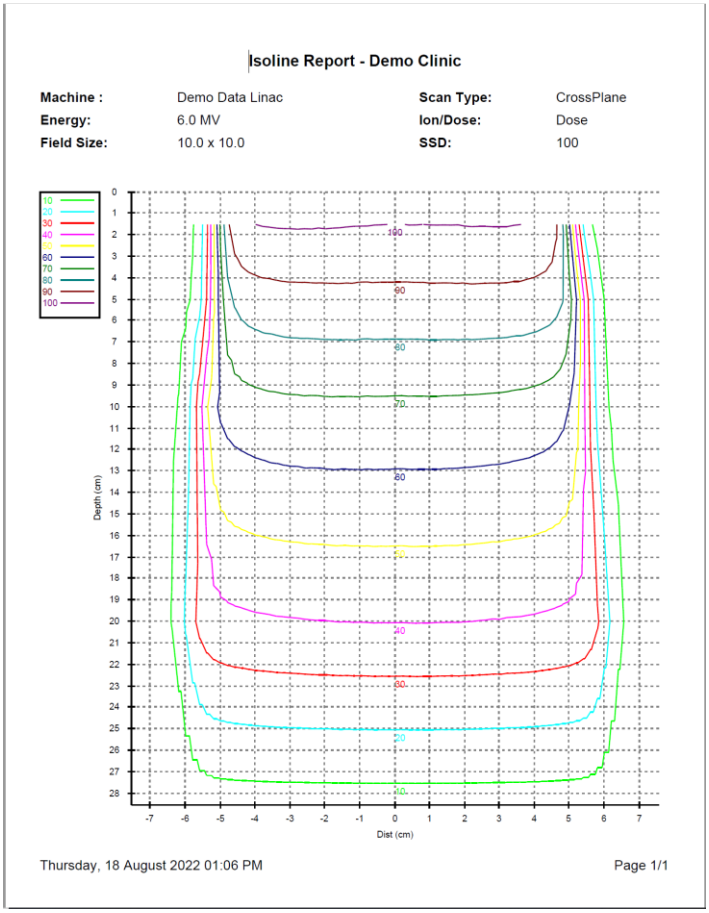


Figure 16-28: Sample Isodose Curve Report

16.9 Metrics

DoseView Software implements several profile and depth metrics that can help you analyze your scan results. Metrics are available on the Analyze page and in CSV reports.

Profile Metrics

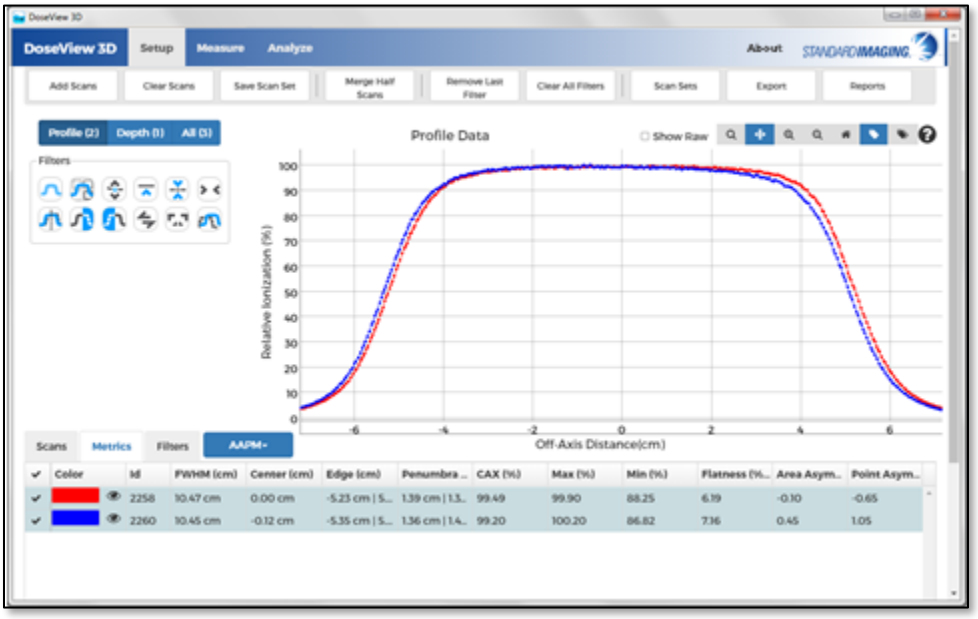


Figure 16-29: Analyze page showing profiles and metrics

Profile metrics consist of "general" metrics and "specialized" metrics. When calculating profile metrics, the normalization point can affect results. *Note that Varian profile metrics use maximum dose normalization and all other metrics use central axis normalization.*

General Profile Metrics

- General profile metrics apply to both flattened and flattening filter free profiles. They consist of the Edge Positions – The left and right beam edge positions that are 50% of the central axis (generally) or maximum (for Varian) profile intensity.
- Full-Width Half Max (FWHM) – The distance between 50% edge positions.
- Beam Center – The halfway point between 50% edge positions.
- Penumbra – The left and right beam distance between 20 and 80% profile intensities.
- Central Axis Percent (CAX (%)) – The relative percent at the beam center.
- Maximum Percent (CAX (%)) – The relative maximum percent in the beam "flat area"
- Minimum Percent (CAX (%)) – The relative minimum percent in the beam "flat area"

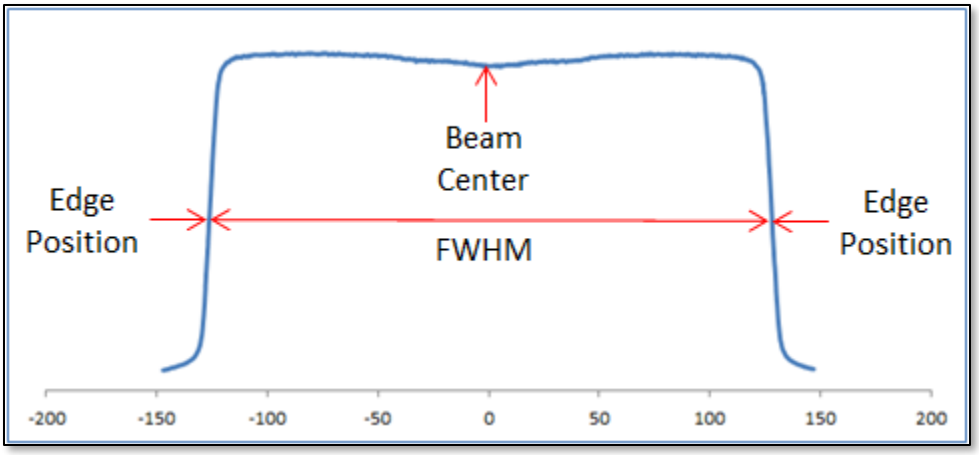


Figure 16-1430: Edges, Full-Width Half Max, and Beam Center

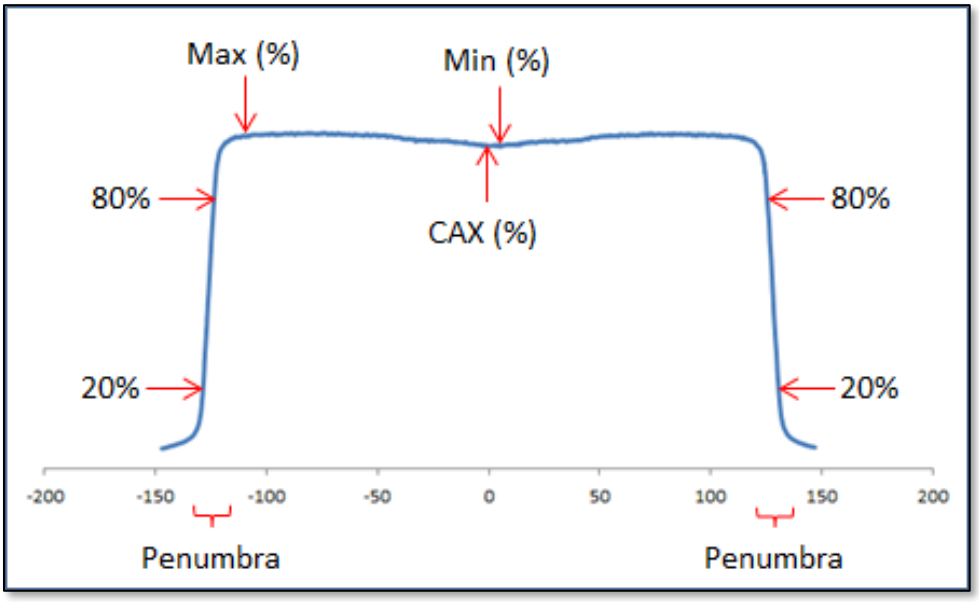


Figure 16-31 Penumbra, Central Axis Percent, Maximum Percent, and Minimum Percent

The Flat Region

The definition of the beam flat area depends on the selected metrics protocol. At this time, DoseView Software supports protocols from the AAPM, Elekta (IEC and USA), Varian and the AERB. Of course, with flattening filter free beams, there is no flat region; special logic is applied to calculate above.

Maximum and minimum percent and all specialized profile metrics are calculated in a region inside of the center of the beam that is relatively flat. These protocol-specific methods to determine the flat regions of a beam are different, yet they give similar results.

- The AAPM and Varian define flat regions for both photon and electron beams to be the central 80% of the beam as determined by the 50% edge positions. Elekta USA flat regions are calculated the same way.

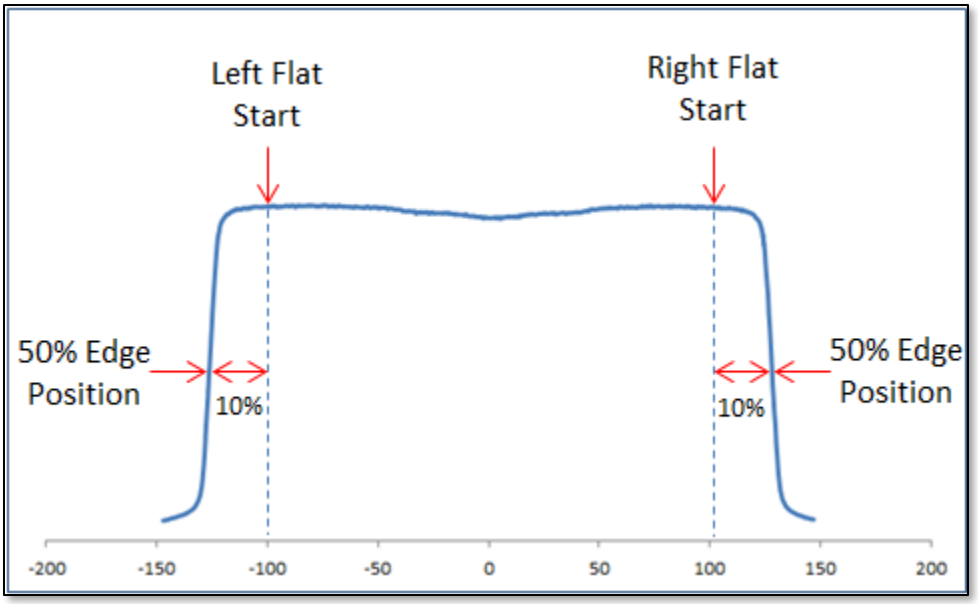


Figure 16-32: Flat region definition for AAPM, Varian and Elekta USA electrons

- For photons, the IEC and Elekta (IEC) define flat regions to be the central part of the beam as determined by the edge positions less a margin on either side of the beam.

	Minimum (cm)	Between (cm)	Maximum (cm)
CrossPlane, InPlane	1	FWHM * 0.1	3
Diagonal	2	FWHM * 0.2	6

Table 16-1: IEC and Elekta photon margins

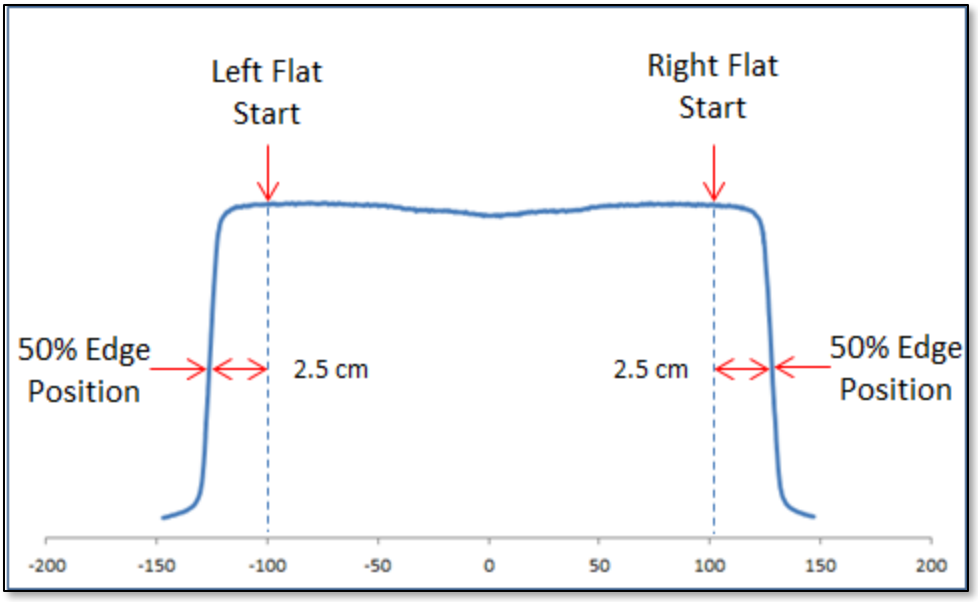


Figure 16-33: Flat region definition for IEC and Elekta InPlane and CrossPlane photons

- For electrons, the IEC and Elekta define flat regions to be the central part of the beam as determined by the 90% edge positions less a margin on either side of the beam of 1 cm.

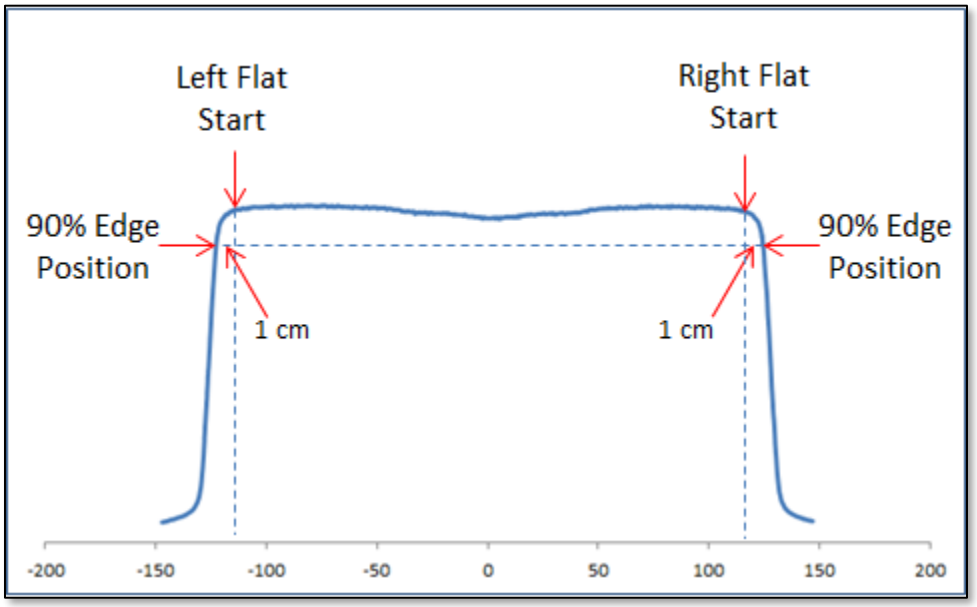


Figure 16-34: Flat region definition for IEC and Elekta electrons

Specialized Profile Metrics

Table 16-2 shows the profile metrics used in DoseView software. For each metric in the table, there is the equation, name, and source used to calculate and label for DoseView 3D scans. These names and the computed values are shown on the Analysis page and within the reports.

AAPM/USA	Equation	Name	Source
Flatness (%)	$Flatness = \frac{Value_{Max} - Value_{Min}}{Value_{Max} + Value_{Min}} \times 100\%$	Flatness (Standard)	TG45
Asymmetry (%)	$Asymmetry = \left[\frac{LeftArea - RightArea)}{LeftArea + RightArea}\right] \times 100\%$	Area Asymmetry	TG45
Asymmetry (%)	$Asymmetry = \left[\frac{(Value(-x) - Value(+x))}{Value(-x) + Value(+x)}\right]_{Max} \times 100\%$	Point Asymmetry	IEC 1989
Varian (CAT)			Source
Flatness (%)	$Flatness = \frac{Value_{Max} - Value_{Min}}{Value_{Max} + Value_{Min}} \times 100\%$	Flatness (Standard)	TG45
Asymmetry (%)	$Asymmetry = \frac{[Value(+x) - Value(-x)]_{Max}}{Value_{CAX}}$	Max-Min Difference	Varian
Elekta Photons			Source
Flatness (%)	$Flatness = \frac{Value_{Max}}{Value_{Min}} \times 100\%$	Max/Min Ratio	IEC 1989, 2007
Symmetry (%)	$Symmetry = \left[\frac{Value(+x)}{Value(-x)}\right]_{Max} \times 100\%$	Max Point Ratio	IEC 2007
Elekta IEC Electrons	90% - 1 cm		Source
Flatness (%)	$Flatness = \frac{Value_{Max}}{Value_{CAX}} \times 100\%$	Max/CAX Ratio	IEC 2007 Variation
Symmetry (%)	$Symmetry = \left[\frac{Value(+x)}{Value(-x)}\right]_{Max} \times 100\%$	Max Point Ratio	IEC 2007
50-90% Distance	The distance from 50% (field edge) to 90% on both sides.		IEC 2007 Variation
Elekta USA Electrons	80% Flat Region		Source
Flatness (%)	$Flatness = \frac{2 \times (Max - Min)}{Min + Max} \times 100\%$	2 x Standard Flatness	TG45 Variation
Asymmetry (%)	$Asymmetry = \left[\frac{LeftArea - RightArea)}{LeftArea + RightArea}\right] \times 100\%$	Area Symmetry	TG45

Table 16-2: Profile metrics as described and used in DoseView software

Flattening Filter Free Profile Metrics

Profile metrics for Flattening Filter Free (FFF) beams present two issues. First, as their name indicates, there is no flat area inside the beam, so flatness metrics do not apply. Second, because there is typically a highly-peaked beam center, determination of 20, 50, and 80% of

the beam center, values that are used to calculate Full-Width Half Max (FWHM), the beam penumbra and the central portion of the beam, cannot be calculated in the normal way. Notice, *purely as a point of interest*, in Figure , that the positions of 20, 50, and 80% of the beam center are roughly the same for narrower beams, in this case 10x10 fields. Most metrics protocols, however, focus on larger beams, particularly calculating their relative, normalized intensity and symmetry, rather than their flatness.

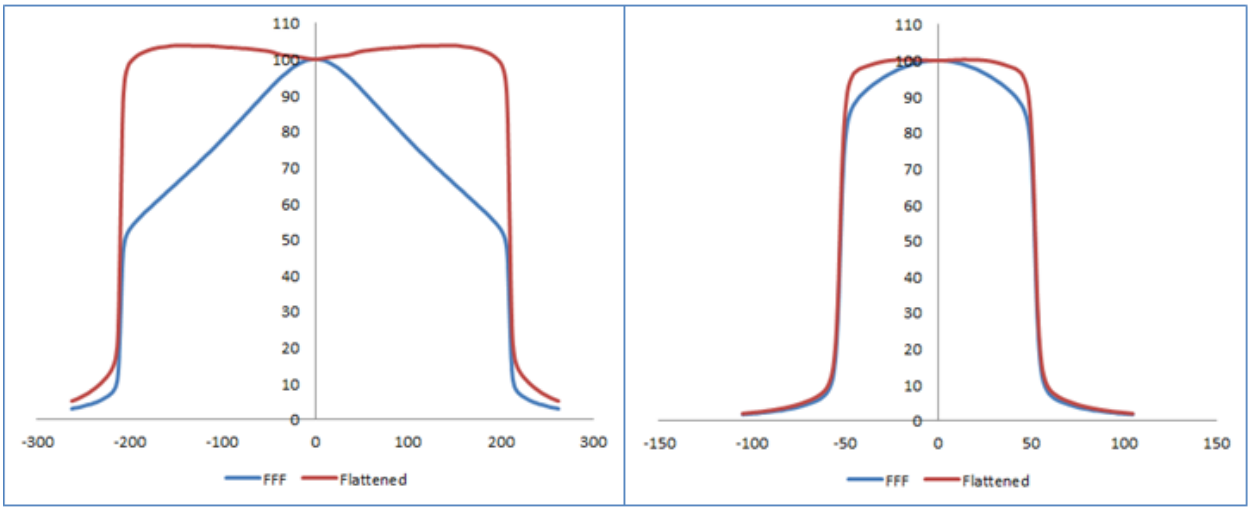


Figure 16-35: 40x40 and 10x10 beams, both FFF and Flattened

As with metrics for flattened beams, there is no consensus among professional organizations or commercial interests on what or how to quantify important aspects of FFF beams. We have investigated and tested methods proposed by several sources, listed as references 1-7 in the reference list in Appendix C.

DoseView Software determines the FWHM, the beam penumbra and the central portion of the beam, using ideas found in the sources consulted above. We believe that our method is an improvement on those ideas and leads to more consistent results--both self-consistent and consistent with respective metrics for flattened beams.

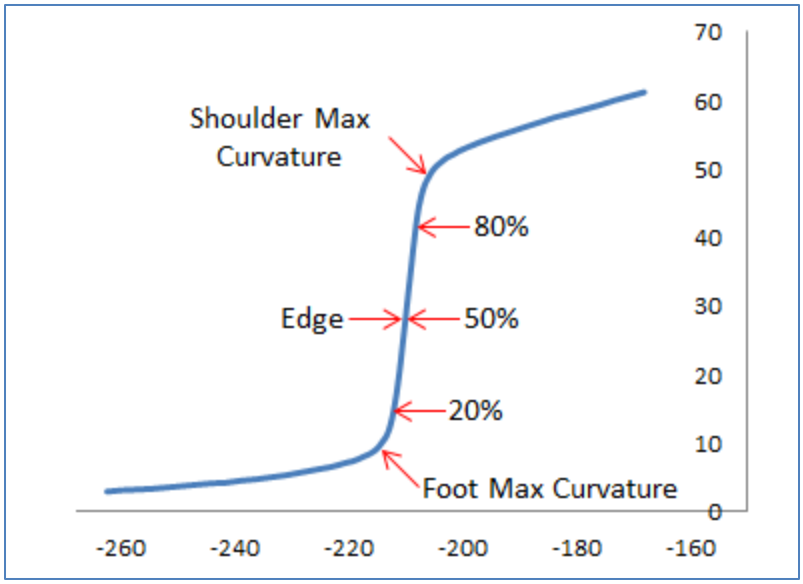


Figure 16-36: Positions of maximum curvature and important metrics locations

The method: DoseView Software determines the positions of maximum curvature at the beam foot and shoulder. These are considered 0 and 100%, respectively. The 20, 50, and 80% locations are then mapped proportionately between the 0 and 100% locations.

General FFF Metrics

To calculate general profile metrics, the 20, 50, and 80% locations are used exactly as with flattened beams; that is, the beam edges and FWHM are calculated from 50% locations and beam penumbrae are calculated using the 20 and 80% locations.

Using the curvature, instead of inflection points as with other systems, seems to yield consistently good results, so the need to renormalize the 50% position, as with other systems, is not required.

Specialized FFF Metrics

DoseView Software specialized metrics are the same FFF metrics specified in the acceptance tests for FFF beams of Elekta linear accelerators [1]. We selected these metrics, because at the time of writing, they seemed the most well-thought-out and complete metrics available. They also seem to cover the needs of other protocols.

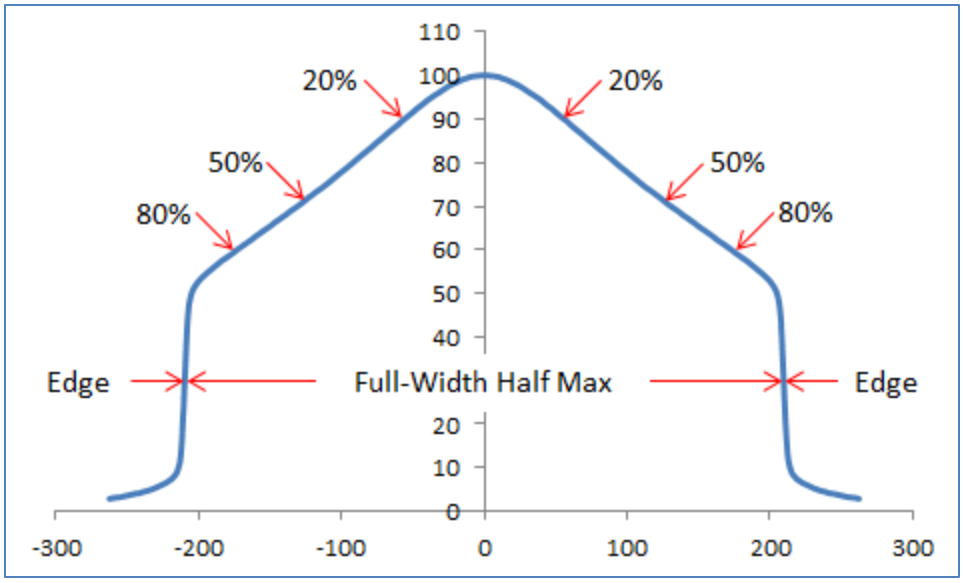


Figure 16-37: Positions of relative dose measurements

As shown in Figure , the system reports relative dose values at ±20, ±50, and ±80% of the FWHM. The Elekta acceptance tests mention target values for the relative dose at these points. These values will likely be different for Varian and other vendor's FFF beams. Please consult your selected metrics protocol for target values.

Symmetry is calculated according to the Elekta protocol using the "Max Point Ratio" method.

Note that although FFF depth doses will differ from flattened depth doses, that there are no specialized metrics for FFF depth doses.

Depth Metrics

Photon Depth Metrics

For photon depth ionization or dose, DoseView Software shows depth of maximum and the percent of maximum ionization or dose at 5, 10, 15, and 20 centimeters.

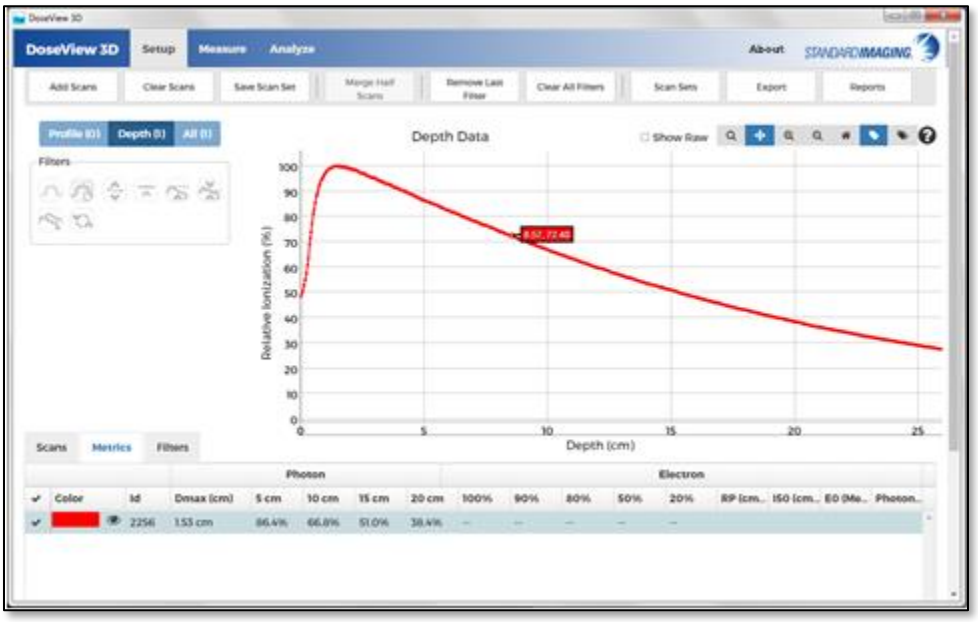


Figure 16-38: Analyze page showing photon depth metrics

Electron Depth Metrics

For electron depth ionization or dose, DoseView Software shows depth of maximum and the depths at which 90, 80, 50, and 20 percent of maximum occur. Additionally, the values of R_p, $I_{50,}$ and E_0 that may be used in dose conversion are shown (as well as the percent photon contamination).

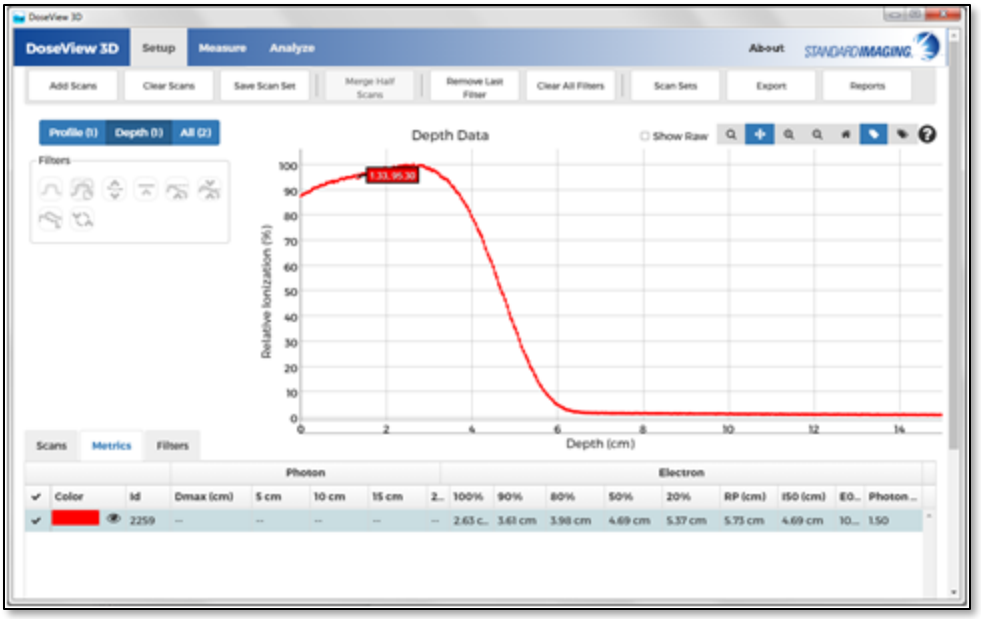


Figure 16-39: Analyze page showing electron depth metrics

16.10 Scan Filtering

Several "filtering" tools are available to modify or edit depth and profile scans. Different filters are available for different scan types. There are three tabs available, (Profile, Depth, and All) to choose the filters that apply to each type of scan selected. The tab also shows the number of selected scans of that type that the filters will be applied to.

Filters can be applied in any order and, except for dose conversion, may be applied multiple times. When a filter is selected, it will apply to all selected scans of the type selected (*e.g.*, Profile, Depth, All).

To see the filters that have been applied to scans, select the "Filters" tab at the bottom of the page, as shown in Figure 16-.

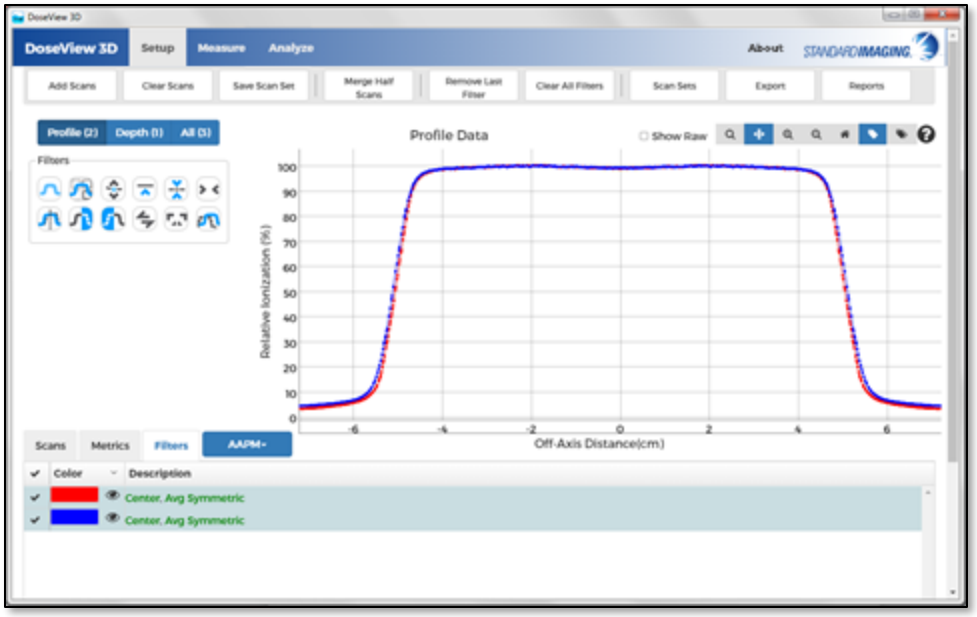


Figure 16-40: Filter tab selected showing filters applied to profiles.

Suggested Filtering Approaches

Often scan filtering is not needed or desirable. For instance, if you are doing spot measurements or measurements for an annual and you are checking beam flatness and symmetry, there is no need for profile centering as the results that you need are not dependent on profiles being explicitly centered. Other filters, such as those that make the beam more symmetric (*e.g.,* average symmetric and mirroring) will give your false results since they affect the true flatness and symmetry of the beam, which is what you are checking.

Smoothing filters (*e.g.,* Boxcar or Gaussian) should be used very sparingly as they will affect the general shape of all scans. For depth doses, this could mean a shift in maximum ionization or dose. For profiles, this could mean a broadening of the penumbra or misidentification of the "flat region" of the beam. In general, if you think your scans need smoothing, consider changing your scan technique. This could mean increasing dose rate, increasing sample duration, or decreasing scan speeds or any combination of these.

If you normalize profiles to a central axis depth scan ("All" is selected), do not change filters for the depth scan or profiles afterwards. The normalization is not updated automatically to account for changes as it is executed in order of filter application. To ensure proper normalization with filter changes, remove the profile normalization before changing filters and then re-apply profile normalization as the last step in filtering.

Ordering of filters matters and depending on the ordering selected your results may vary.

Final thoughts:

- For depth scans, you may not need to do any filtering besides conversion to dose. Dose is automatically normalized and the dose conversion filter accounts for the effective point of measurement.
- For profile scans, prior to export to treatment planning systems, you may want to center and symmetrize profiles and normalize profiles to a dose-converted depth scan.
- Export to a treatment planning system requires both depth scans and profiles to be dose converted or dose normalized.

Profile Scan Filters

The Profile tab will show all the available filters that can be applied to the selected profile scans, the profile filter selections are as shown in Figure 16-15. In this example only one profile scan is selected to apply a chosen filter.

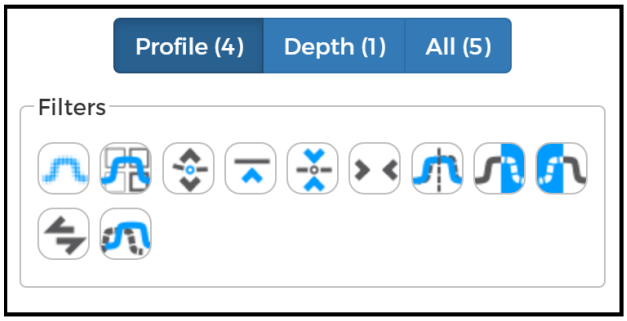


Figure 16-1541: Filters available for profile scans

Gaussian – Replace values with values smoothed by a Gaussian with a standard deviation specified in centimeters.

Boxcar – Replace values with a moving average of values in a window specified in centimeters.

Point Edit – Change a value at a particular coordinate to a new value.

Normalize to Value – Set a percent value to 100%.

Normalize at Center – Set profiles center to 100%.

Center – Shift profiles so that beam edges are centered about zero.

Average Symmetric – Replace profile with averaged symmetric values from left and right-hand sides.

Mirror Minus to Plus – Replace profile right-hand side with left-hand side.

Mirror Plus to Minus – Replace profile left-hand side with right-hand side.

Flip – Exchange profile values symmetrically across the beam center.

Shift – Move profile measurement to axis left or right.

Depth Scan Filters

The Depth tab will show all the available filters that can be applied to the selected Depth scans, the depth filter selections are as shown in Figure 16-. In this example there are 7 total scans selected, of which 3 are depth scans that a chosen filter will be applied to.

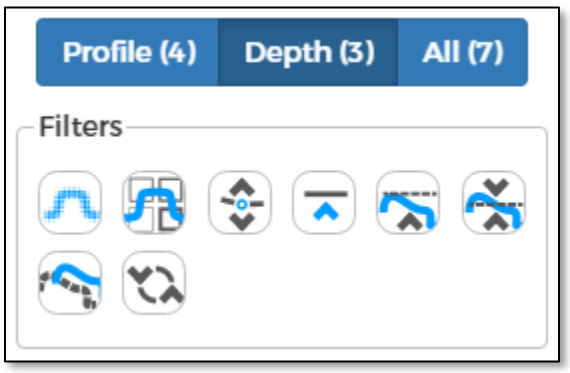


Figure 16-42: Filters available for depth scans

Gaussian – Replace values with values smoothed by a Gaussian with a standard deviation specified in centimeters (same as for profiles).

Boxcar – Replace values with a moving average of values in a window specified in centimeters (same as for profiles).

Point Edit – Change a value at a particular coordinate to a new value (same as for profiles).

Normalize to Value – Set a percent value to 100% (same as for profiles).

Normalize at Maximum – Set depth scan maximum to 100%

Normalize at Depth – Set a depth scan at a particular depth to 100%

Shift – Move depth measurements to deeper or shallower locations.

Dose Convert – Convert a depth measurement to dose according to one of several protocols.

The Dose Conversion Filter

Depth measurement conversion from ionization to dose is considered a type of filtering as it takes a collection of measurements and transforms them by a known process. Like other filters conversion of depth ionization to dose can be done one at a time or in multiples. This section shows the workflow and rationale for single dose conversion. Section 17.6, Treatment Planning System Export, describes multiple dose conversion.

TG-51 and TRS-398 protocols are both supported. For a complete description of these dose conversion methods, see Appendix A.

For photons, when [Dose Convert] is selected, the dialog as shown in Figure 16-16 presents. If there is a cylindrical detector associated with the depth scan, it is assumed that the chamber was "dropped" prior to measurement by 0.6 times its radius (as shown in the figure). If a parallel plate chamber or other detector was used, the chamber diameter is set to zero and the chamber drop is set to zero. If the cylindrical chamber measurements were taken with no prior drop, the chamber drop field must be set to zero by the user. Setting a cylindrical chamber drop to zero has the effect of shifting measurements toward the phantom surface by 0.6 times its radius.

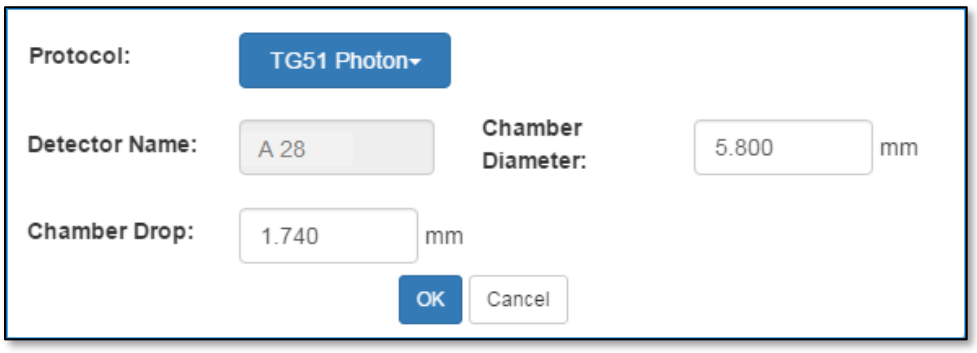


Figure 16-1643: Photon dose conversion dialog for single depth scan

For electrons, when [Dose Convert] is selected, the dialog as shown in Figure 16- presents. The chamber drop logic with cylindrical chambers is the same as for photons, except that 0.5 times the radius is used.

A field is provided that can be used to set the practical range (R_P) of the beam. If not enough photon "tail" is measured, it may be necessary to enter a value, because R_p is defined as an intersection of line segments, one of which is a line fit to the photon tail. A good value for R_p is somewhat less than one-half the nominal energy in centimeters. For instance, the dialog in Figure 16- is for a 12 MeV electron beam and the calculated practical range is 5.7 centimeters.

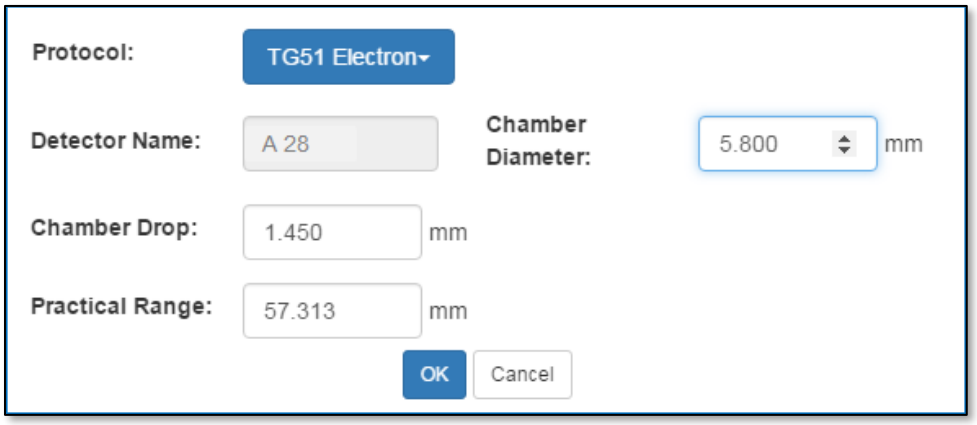


Figure 16-1744: Electron dose conversion dialog for single depth scan

When measuring electron depth ionization, it is good to have at least 5 centimeters of photon tail past the practical range. So, for a 12 MeV beam, measurements should go to at least a depth of 11 centimeters.

All Scan Filters

The All tab will show all the available filters that can be applied to all selected scans, the filter selections are as shown in Figure 16-.

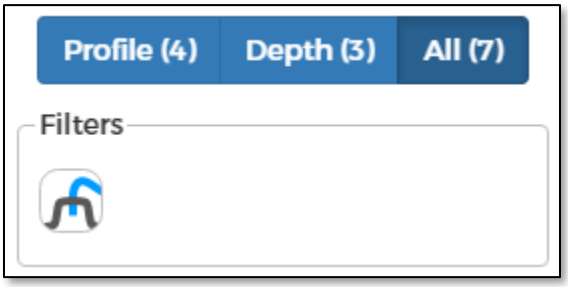


Figure 16-45: Filters available for all scans

Normalize Profile – Set the profile central axis normalization to ionization or dose values of a depth scan.

As mentioned earlier in this section, "Normalize Profile" must be the last filter applied in any sequence as any later filtering may destroy the normalization between profiles and depth scans.

16.11 Single Point Tab (DoseView 1D)

This tab allows you to load and view your saved single point set measurements performed with the DoseView 1D. The ability to export your single point measurements to a CSV file is also available from this tab.

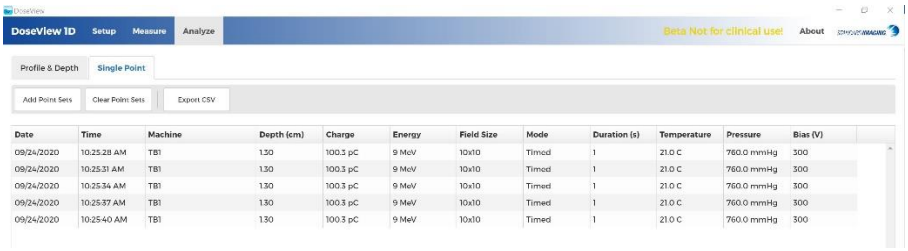


Figure 16-46: Analyze Page showing Single Point Tab

Appendix A: Dose Conversion Protocols

DoseView 3D supports both the AAPM TG-51 and the IAEA TRS-398 dose conversion protocols, which are very similar, with the major exception that IAEA TRS-398 requires the use of "well-guarded" parallel plate chambers for collecting electron depth ionization. The AAPM TG-51 protocol allows cylindrical chambers to be used for electron ionization measurements and introduces a "replacement factor" (P_{repl}) to account for measurement perturbations due to the use of cylindrical chambers for electron measurements. When a "well-guarded" parallel plate chamber is used for AAPM TG-51 electron ionization measurements, P_{repl} is 1.

Photon Ionization to Dose Conversion

For photons, the "effective point of measurement" is where the relative ionization reading can be interpreted as relative dose.

- For both protocols, when parallel plate chambers are used, the effective point of measurement is at the surface of the chamber.
- For both protocols, when cylindrical chambers are used, the effective point of measurement is "upstream" 0.6 times the chamber radius from the center of the chamber.

Therefore, with parallel plate chambers, relative ionization is relative dose. With cylindrical chambers, conversion to dose requires ionization measurements to be shifted by 0.6 x radius "upstream" from the center of the chamber (assuming the chamber was not already dropped).

Electron Ionization to Dose Conversion

For electrons, determining the "effective point of measurement" is the first part of a process involving other corrections for converting ionization to dose.

- For both protocols, when parallel plate chambers are used, the effective point of measurement is at the surface of the chamber.
- For TG-51, when cylindrical chambers are used, the effective point of measurement is "upstream" 0.5 times the chamber radius from the center of the chamber.

Step 1: Correct for Effective Point of Measurement (TG-51 Cylindrical Chamber Only)

Shift all measurements by 0.5 x radius "upstream" from the center of the chamber (assuming chamber was not already dropped).

Step 2: Determine Depth of 50% Ionization

Normalize the depth ionization curve to the depth of maximum ionization, I_{max}.

Locate the depth of 50% ionization (I_{50} for TG-51, $R_{50,ion}$ for TRS-398).

Step 3: Calculate R_{50}

Calculate R_{50} from $I_{50}/R_{50,ion}$, which is the depth in water at which the ionization is 50% of its maximum value.

$$R_{50} = 1.029I_{50} - 0.06 \; for \; I_{50} \leq 10cm$$

Equation A-1

$$R_{50} = 1.059I_{50} - 0.37 \; for \; I_{50} > 10cm$$

Equation A-2

Step 4: Calculate P_{repl} (TG-51 Cylindrical Chamber Only)

Calculate the mean incident energy E_0 using either R_{50} or I_{50}

$$\overline{E_0} = 0.656 + 2.059R_{50} + 0.022R_{50}^2$$

Equation A-3

$$\overline{E_0} = 0.818 + 1.935I_{50} + 0.040I_{50}^2$$

Equation A-4

Calculate R_p, the electron practical range

1. Calculate a least square line fit between the 65 and 25 percent points on the curve.
2. Determine the point at which the 65-25% line intersects the depth axis.
3. Calculate a least square line fit between the intersection point plus two centimeters and the remainder of the curve
4. Determine the intersection of the two lines. The depth value of this intersection is R_p.

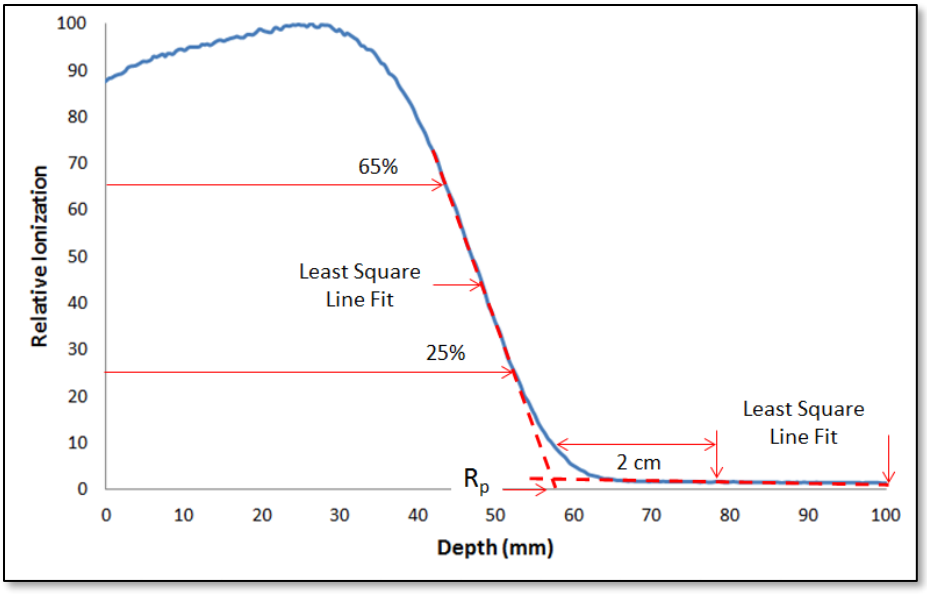


Figure A-0-1: Calculation of Rp

For each point (depth) to be converted to dose, calculate E_z using E_0, R_p, and z (a calculation depth)

$$E_z = \overline{E_0} \times \left(1 - \frac{z}{R_p}\right)$$

Equation A-5

For each depth point, look up the chamber replacement factor (P_{repl}) as shown in Table A-1 using E_z and the inner diameter of the ion chamber.

Diameter (mm)	Energy E_z (MeV)						
	2	3	3	7	10	15	20
3	0.977	0.978	0.982	0.986	0.990	0.995	0.997
5	0.962	0.966	0.971	0.977	0.985	0.992	0.996
6	0.956	0.959	0.965	0.972	0.981	0.991	0.995
7	0.949	0.952	0.960	0.967	0.978	0.990	0.995

Table A-1: Chamber replacement correction factor, P_{repl}

Step 5: Calculate Stopping Powers

For each point to be converted to dose, calculate the stopping power ratio ($s_{w,air}$ for TRS-398)

$$\left(\frac{\bar{L}}{\rho}\right)_{air}^{water} = \frac{a + b \times (lnR_{50}) + c \times (lnR_{50})^2 + d \times \left(z/R_{50}\right)}{1 + e \times (lnR_{50}) + f \times (lnR_{50})^2 + g \times (lnR_{50})^3 + h \times \left(z/R_{50}\right)}$$

Equation A-6 and the factors in Table A-2.

$$\left(\frac{\bar{L}}{\rho}\right)_{air}^{water} = \frac{a + b \times (lnR_{50}) + c \times (lnR_{50})^2 + d \times \left(z/R_{50}\right)}{1 + e \times (lnR_{50}) + f \times (lnR_{50})^2 + g \times (lnR_{50})^3 + h \times \left(z/R_{50}\right)}$$

Equation A-6

a = 1.0752	b = -0.50867	c = 0.088670
d = -0.08402	e = -0.42806	f = 0.064627
g = 0.003085	h = -0.12460	

Table A-2: TG-51 Stopping Power Factors

Step 6: Calculate Dose

Calculate dose using:

$$Dose(z) = \left(\frac{\bar{L}}{\rho}\right)_{air}^{water} \times R_p \times M(z)$$

Equation A-7

where M(z) is the ionization measured at depth z corrected for the effective point of measurement.

Step 7: Re-normalize to the new maximum

$$PDD(z) = \frac{Dose(z) \times 100\%}{Dose(z_{max})}$$

Equation A-8

Appendix B: File Naming Conventions

Files exported from DoseView 3D will be automatically named according to the export type using the following conventions:

B1: Varian Eclipse

(Energy Value)(Energy Type)(Field Size)(Variable)_(# file of this name).acs

- (Energy Value) = Nominal value of energy
- (Energy Type) = Displays one of the following:

  c = Cobalt
  e = Electron
  p = Photon

- (Field Size) = Displays field size (in centimeters)
- (Variable) = Displays one of the following, depending on the type of scan:

  Profiles: SSD value
  Wedge: "W" + wedge angle
  Longitudinal Wedge: "L" + wedge angle
  Diagonal: "DIA"
  Blocked: "BLK"

- P(# file of this name) = The first file with this name/configuration will be labeled "P00", the second will be "P01" and so on.

Examples:

1. 6P10L35_00.W2C

   "6 MV, photons, 10cm field size, longitudinal wedge with 35° angle, first file of this name"

2. 6E10BLK_02.W2C
   "6 MeV, electrons, 10cm field size, blocked field, third file of this name"

B2: Elekta Monaco

Photons
X(Energy Value)_(Beam Type)_(Field Size)_(SSD).(Scan Type Acronym)

- X = Photons
- (Energy Value) = Nominal value of energy
- (Beam Type) = Displays one of the following:

  Wedged Field: "WED" + wedge angle
  Open Field: "OPEN"

- (Field Size) = Displays field size (in centimeters) in an "xxyy" format.
- (SSD) = SSD value, optionally included.
- (Scan Type Acronym) = Displays one of the following:

D = Depth Dose
D_Xxxx_Yyyy = z-scan starting from x=xxx mm and y = yyy mm.
PX_zzz = Profile along the x-axis at depth zzz (in mm) with y = 0.
PY_zzz = Profile along the y-axis at depth zzz (in mm) with x = 0.
PY_zzz_Xxxx = Profile parallel to the y axis at depth zzz with x=xxx mm.
PX_zzz_Yyyy = Profile parallel to the x axis at depth zzz with y=yyy mm.
PS_zzz_deg = A profile from a star measurement at depth zzz and scan angle degrees.

Electrons
E(Energy Value)_(Collimating Type)(Field Size)_(SSD).(Profile Type)_(Depth)

- E = Electrons
- (Energy Value) = Nominal value of energy
- (Collimating Type) = Displays one of the following:

  A = Applicator mounted.
  T = Tube mounted.
  V = Variable collimator mounted (Variable collimators not presently supported).
  U = Uncollimated, i.e. No applicators or tubes mounted (not analogous to MLC collimation).

  Note that MLC collimation is presently not supported.

- (Field Size) = Displays field size (in centimeters) in an "xxyy" format.
- (SSD) = SSD value
- (Profile Type) = Displays one of the following:

  D = Depth Dose
  PX = Profile Scan in x
  PY = Profile Scan in y

- (Depth) = Displays the depth value in millimeters for the scan (omitted for a depth dose scan).

Examples:

1. X06_OPEN_1010_100.D

   "Photons, 6 MV, open field, 10x10cm field size, 100 SSD; depth dose scan"

2. E06_A1010_100.PX_100

   "Electrons, 6 MeV, applicator mounted, 10x10cm field size, profile scan in x, 100 mm depth"

1. Lower bounding value of Z-coordinate (= Z1)
2. Upper bounding of Z-coordinate (= Z2)
3. Lower bounding value of dose at Z1 (= D1)
4. Upper bounding value dose at Z2 (= D2)

cm Dose X Y Z

0.00	87.65	0.00	0.00	0.00	<= D1 is 87.65, Z1 is 0.00 cm
0.20	87.37	0.00	0.00	0.20	<= D2 is 87.37, Z2 is 0.20 cm

To interpolate what the dose (Dn) is at non-measured point of 0.10 cm (Zn), the algorithm will calculate as follows:

Zdiff = Z2 – Z1 = 0.2 – 0.0 = 0.2
Zratio = (Zn - Z1) / Zdiff = (0.10 – 0.0) / 0.2 = 0.10 / 0.2 = 0.5
Dn = (ZRatio * (D2 – D1)) + D1
Dn = (0.5 * (87.37 – 87.65)) + 87.65
Dn = (0.5 * -0.28) + 87.65
Dn = -0.14 + 87.65
Dn = 87.51

B3: Phillips Pinnacle

(Energy Value)(Energy Type)(Field Size)(Variable].P(# files of this name)

- (Energy Value) = Nominal value of energy
- (Energy Type) = Displays one of the following:

  c = Cobalt
  e = Electron
  p = Photon

- (Field Size) = Displays field size (in centimeters)
- (Variable) = Displays one of the following, depending on the type of scan:

  Profiles: SSD value
  Wedged Profiles: “W” + wedge angle
  Circular Collimator: “D” + circular diameter in centimeters

- P(# file of this name) = The first file with this name/configuration will be labeled “P00”, the second will be “P01” and so on.

Examples:

1. 06p10100.P00

   “6 MV, photons, 10cm field size, 100 SSD; first file of this name”

2. 06p10W35.P01

   “6 MV, photons, 10cm field size, wedge with 35° angle; second file of this name”

B4: Elekta AQUA, RaySearch RayPlan, DoseView Native and CSV

All these output formats have the same file name coding:
(Energy Value)(Energy Type)_(FieldSize)_(Scan Type Letter(s))(ProfileDepth)
(Diagonal Scan Angle)_(Half Scan Flag)_(Wedge Info String) .extension

- (Energy Value) – Nominal energy
- (Energy Type) – Displays one of the following:
  - MeV = Electron

- MV = Photon

- (FieldSize) – XXXxYYY where numbers are in millimeters

- (Scan Type Letter(s))
  - X = CrossPlane
  - Y = InPlane
  - Z = Depth
  - XY = Diagonal
  -
- (ProfileDepth) – a number in millimeters

- (Diagonal Scan Angle) – a number in degrees

- (Half Scan Flag)
  - "-H" = Towards left-hand near corner of tank
  - "+H" = Towards right-hand far corner of tank

- (Wedge Info String)
  - Open = No wedge
  - Angle = 15 , 30, 45, 60
  - Direction = Left, Right, In, Out

"extension" is
".xml" for Elekta AQUA
".csv" for RaySearch RayPlan
".dvs" for DoseView 3D Native Format
".csv" for DoseView 3D Comma Separated Variable Format

Examples:

1. 6MV_100x100_X13_Open.dvs, 6MV_100x100_Y13_Open.dvs, 6MV_100x100_Z_Open.dvs
   6MV photons, 10x10 cm, CrossPlane at 1.3 cm, InPlane at 1.3 cm, Depth scans

2. 6MV_100x100_X15_-H_Open.dvs, 6MV_100x100_X15_+H_Open.dvs
   Left-half and right-half plane scans

3. 6MV_100x100_XY15A45_Open.dvs, 6MV_100x100_XY15A135_Open.dvs
   45-degree and 135-degree diagonal scans

4. 6MV_100x100_X15_W30In.dvs, 6MV_100x100_X15_W30In.dvs, 6MV_100x100_X15_W30In.dvs
   30-degree wedged scans

Appendix C: References

1: Elekta Medical Linear Accelerator Customer Acceptance Tests for: Precise Digital Accelerator (Precise Treatment System™), Elekta Synergy® Platform, Elekta Synergy®, Elekta Infinity™, Elekta Axesse™, Versa HD™, Document ID: 1503568 04, Publication date: 2014-09

2: On the determination of reference levels for quality assurance of flattening filter free photon beams in radiation therapy. Clivio A, Belosi MF, Cozzi L, Nicolini G, Vanetti E, Bolard G, Fenoglietto P, Krauss H, Fogliata A. Med Phys. 2014 Feb;41(2)

3: Definition of parameters for quality assurance of flattening filter free (FFF) photon beams in radiation therapy. Fogliata A, Garcia R, Knoos T, Nicolini G, Clivio A, Vanetti E, Khamphan C, Cozzi L. Med Phys. 2012 Oct;39(10)

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5: IPEM topical report 1: guidance on implementing flattening filter free (FFF) radiotherapy. Budgell G, Brown K, Cashmore J, Duane S, Frame J, Hardy M, Paynter D, Thomas R. Phys Med Biol. 2016 Dec 7;61(23)

6: Flattening filter-free accelerators: a report from the AAPM Therapy Emerging Technology Assessment Work Group. Xiao Y, Kry SF, Popple R, Yorke E, Papanikolaou N, Stathakis S, Xia P, Huq S, Bayouth J, Galvin J, Yin FF. J Appl Clin Med Phys. 2015 May 8;16(3)

7: Acceptance criteria for flattening filter-free photon beam from standard medical electron linear accelerator: AERB task group recommendations. Sahani G, Sharma SD, Sharma PK, Deshpande DD, Negi PS, Sathianarayanan VK, Rath GK. J Med Phys. 2014 Oct;39(4)

8: AAPM's TG-51 protocol for clinical reference dosimetry of high-energy photon and electron beams. Almond PR, Biggs PJ, Coursey BM, Hanson WF, Huq MS, Nath R, Rogers DW. Med Phys. 1999 Sep;26(9)

9: Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry based on Standards of Absorbed Dose to Water, from Technical Report Series No. 398 by the International Atomic Energy Agency (IAEA).

10: SU-K-205-14: The Use of Large-Volume Ion Chambers in Out-Of-Field Locations for Radiotherapy Beam Scanning. Culberson WS. Med Phys. 2017 Jun;44 (6)

Appendix D: Other Information

D1: Parts and Accessories for DoseView 3D

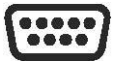
Part Number	Description
92260	**DoseView 3D** (includes water phantom and all originally included accessories)
72441	Alignment Cap for Halcyon, A28, brass
50254	DoseView 3D Wireless Pendant
20492	USB Wireless Radio Dongle
20493	35m USB Extension Cable
20193	Cable, Serial Extension, DB9 Male/DB9 Female, 100 ft
20194	Cable, Serial Extension, DB9 Male/DB9 Female, 25 ft
70503	Serial to USB Adapter
70004-3-AA	3m triax extension cable for scanning detector
70004-3-AB	3m triax extension cable for reference detector
50363	DoseView 3D Electrometer
50263	Universal Thimble Detector Bracket Kit
50278	6.35 mm Detector Bracket Kit
50279	7.0 mm Detector Bracket Kit
50306	8.0 mm Detector Bracket Kit
50280	12.7 mm Detector Bracket Kit
50281	Exradin A10 Ion Chamber/PTW Markus® Bracket Kit
50282	Exradin 11/11TW Ion Chamber Bracket Kit
50283	PTW Roos® Ion Chamber Bracket Kit
50284	Origin Crosshair Alignment Jig Kit
31237	Scanning Detector Centroid Alignment Jig
50286	DoseView 3D Reference Detector Positioning Kit
50285	Detector Alignment Replacement Screw Set
50272	DoseView 3D Phantom Shipping Crate
72260	**DoseView 3D Lift and Reservoir Cart** (includes all originally included accessories)
50275	DoseView 3D Precision Positioning Platform
50276	DoseView 3D Lift and Reservoir Cart Control Panel Assembly
50294	DoseView 3D Lift and Reservoir Cart Fuse and Relay Replacements
50277	DoseView 3D Lift and Reservoir Cart Undercarriage Drain Valve Assembly
50273	DoseView 3D Lift and Reservoir Cart Shipping Crate
80614	DoseView User Manual
50271	DoseView 3D External Plumbing Kit
40339	24 VDC Power supply
72730	IEC Int'l Power Cord Set
20177	Power Cord. A.C., U.S.

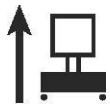
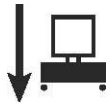
D2: Parts and Accessories for DoseView 1D

Part Number	Description
91800	DoseView 1D (34 x 30 x 36 cm Tank)
91810	DoseView 1D (42 x 40 x 36 cm Tank)
70800	DoseView 1D Scanning Arm (includes Pendant)
50262	Wired Pendant
20193	Serial Extension Cable, 100 ft, DB9 M+F
20215	AC Power Adapter
50043	Chamber Holder Assembly
50325	Reference Detector Positioning Kit
11253	Drain Tube
70503	USB to Serial Adapter

D2: Description of Symbols

The following symbols appear on DoseView 3D system labeling.

	Consult user manual for information about equipment usage.
	Potential user hazard present
	Dangerous voltage (Potential shock hazard present)
	Input / Output connection
	Reset
	RS-232 connector
	Motion Controller power connector
	Power is present
	System is turned on
	CE Compliance
	Pinch hazard present

	Avoid inclines when moving system
	Fill port or operation
	Drain operation
	Lift or raise operation
	Lower operation
	Fine adjustment knob, adjusts direction shown
	Fine adjustment knob, adjusts platform rotation
	Fine adjustment knob, adjusts direction shown
	Function is around corner from symbol
	Functional earth ground

D3: DoseView 3D Specifications

Motion Control System

Max Scanning Speed	50 mm/s
Positioning Accuracy	± 0.1 mm per axis
Positioning Repeatability	± 0.1 mm per axis
PC Communication	Wireless or wired via RS-232
Wireless Communication Protocol	XBee RF
FCC ID	MCQ-XBEE3
IC ID	1846A-XBEE3
Control Method	Onboard controls, PC or via wireless pendant

Water Tank

Dimensions	(Length x Width x Height)
Outer Dimensions (including scanning arms)	735 x 830 x 646 mm
Scanning Dimensions	480 x 480 x 410 mm
Wall Thickness	19 mm
Tank + Scanner Assembly Weight (Empty)	130 lbs
Tank + Scanner Assembly Weight with water to fill line	595 lbs
Phantom water capacity	55.7 gallons (filled to fill line)
Other	Replaceable fill/drain port

Lift and Reservoir Cart

Vertical Range	685 – 1185 mm (tank base to floor)
Water Pump	Electric fill, gravity drain
Water Capacity	227.1 liters (60 gallons)
Fill Time	6 – 8 min
Drain Time	16 – 20 min
Weight of Lift/reservoir cart with Phantom and full Reservoir	916 lbs

Precision Positioning Platform

X / Y Fine Adjustment	±12.5 mm
Fine rotational adjustment	±1°
Discrete engagement	10°, 45° and 90° intervals

DoseView 3D Electrometer

Channels	2
Bias Voltage	0, ±100 – 450 VDC (50 V increments)
Range	10 pC – 999,999 nC
Resolution	10 fC
Connector Type	Triaxial BNC
Max. Current	±10.0 nA

Operating Parameters

Temperature	15 – 35 °C
Relative Humidity	20 – 80% non-condensing
Pressure	650 – 770 mmHg (867 — 1027 hPa)

Storage/Shipping Parameters

Temperature	-15 – 50 °C
Relative Humidity	10 – 95% non-condensing
Pressure	600 – 800 mmHg (800 – 1067 hPa)

DoseView 3D Power Requirements

Lift and Reservoir Cart Motion Controller/Electrometer Power Supply

Protek Power, Model PMP150-14, Input: 100 – 240 VAC, 47 – 63 Hz Output: 24 VDC, 6.25 A, 150 W max IEC 60601-1 rated or equivalent as identified by Standard Imaging. Contact Standard Imaging for additional information.	
Wireless Pendant	(4) standard AA batteries, 1.5V

Classification Information

Equipment Shock Classification:	Class I – External Power Supply for DoseView 3D Internally Powered – Wireless Pendant
Mode of Operation:	Continuous
Method of sterilization or disinfection recommended:	No sterilization required

Protection against harmful ingress of water:	Ordinary equipment, no protection

Atmospheric degree of safety: The DoseView 3D and external power supplies are not suitable for use in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Specifications are subject to change without notice.

D.4 DoseView 1D Specifications

Dimensions
DoseView 1D Scanning Arm
Length 7.62 cm (3.0 in)
Width 20.32 cm (8.0 in)
Height 48.26 cm (19.0 in)
Water Tank Internal Dimensions
REF 91800
Length 34 cm (13.39 in)
Width 30 cm (11.81 in)
Height 36 cm (14.17 in)
REF 91810
Length 42 cm (16.54 in)
Width 40 cm (15.75 in.)
Height 36 cm (14.17 in)
Water Tank material: Clear acrylic 0.95 cm (0.375 in)
Weight
1D Scanning Arm 1.74 kg (3.85lbs)
Hand pendant 0.23 kg (0.5 lbs.)
Water Tank 34 x 30 x 36 (empty) 6.35 kg (14 lbs.)
Water Tank 42 x 40 x 36 (empty) 10.43 kg (23 lbs.)
Max scanning arm travel: 29.5 cm (11.6 in)
Ionization chamber holder diameter accommodation:
Maximum: 20 mm (0.79 in)
Minimum: 6 mm (0.24 in)
Max chamber depth position backscatter: ~7 cm (2.76 combined (tank + water))
Accuracy of position: +0.05 mm (0.002 in) over the TG-51 range (200.00 mm)
Repeatability of position: +0.05 mm (0.002 in) over the TG-51 range (200.00 mm)
Operating conditions:
Pressure 600 - 700 mm Hg
Temperature 10 - 40 °C
Relative Humidity 30 to 75%, non-condensing
Storage conditions:
Temperature -40 - 70 °C
Relative Humidity 0 to 95%, non-condensing

Power Requirements:
AC Output 12 VDC @ 1.25 A
Specifications are subject to change without notice.

D5: Maintenance

Exterior cleaning of the DoseView 3D components can be done with a soft brush or cloth used with soap and water if necessary. Gently brush or wipe all surfaces to remove dirt and dust. Be especially careful that this is an external cleaning only and do not permit any liquid to seep into the DoseView 3D components in any manner during cleaning.

Do not clean the water tank with abrasive cleansers, isopropyl alcohol or other volatile solvents. Do not submerge or scrub the Motion Controller, Electrometer, and Lift and Reservoir Cart in water or solvent to clean.

There are no user serviceable parts on the DoseView 3D. The warranty will become void if the DoseView 3D is disassembled.

If assistance is desired in the proper disposal or recycling of this product (including accessories and components), after its useful life, please return to Standard Imaging.

WARRANTY STATEMENT 4424-18

Standard Imaging, Inc. sells this product under the warranty herein set forth. The warranty is extended only to the buyer purchasing the product directly from Standard Imaging, Inc. or as a new product from an authorized dealer or distributor of Standard Imaging, Inc.
For a period provided in the table below from the date of original delivery to the purchaser or a distributor, this Standard Imaging, Inc. product, provided in the table, is warranted against functional defects in design, materials and workmanship, provided it is properly operated under conditions of normal use, and that repairs and replacements are made in accordance herewith. The foregoing warranty shall not apply to normal wear and tear, or if the product has been altered, disassembled or repaired other than by Standard Imaging, Inc. or if the product has been subject to abuse, misuse, off-label use, negligence or accident.

Product	Warranty Period
Standard Imaging Ionization Chambers	5 years
Standard Imaging Detectors	1 year
Standard Imaging Well Chambers	2 years
Standard Imaging Electrometers	5 years
Standard Imaging BeamChecker Products	2 years
TomoScanner and TomoElectrometer	2 years
Standard Imaging Software Products	1 year
All Other Standard Imaging Products	1 year
Standard Imaging Custom Products	1 year
Standard Imaging Remanufactured Products	180 days
Standard Imaging Custom Select Products	90 days
Consumables	90 days

Serviced Product	90 days (for service performed)
Resale Products	As defined by the Original Equipment Manufacturer
ADCL Product Calibration (Standard Imaging uses the UW-ADCL for recalibrations required under warranty, unless otherwise requested)	0 - 90 days = 100% of ADCL Calibration Costs 91 - 182 days = 75% of ADCL Calibration Costs 183 – 365 days = 50% of ADCL Calibration Costs 366 – 639 days = 25% of ADCL Calibration Costs (days from date of shipment to customer)

Standard Imaging's sole and exclusive obligation and the purchaser's sole and exclusive remedy under the above warranties are, at Standard Imaging's option, limited to repairing, replacing free of charge or revising labeling and manual content on, a product: (1) which contains a defect covered by the above warranties; (2) which are reported to Standard Imaging, Inc. not later than seven (7) days after the expiration date of the warranty period in the table; (3) which are returned to Standard Imaging, Inc. promptly after discovery of the defect; and (4) which are found to be defective upon examination by Standard Imaging Inc. All transportation charges (including customs, tariffs, duties and brokerage fees) are the buyer's responsibility. This warranty extends to every part of the product excluding consumables (fuses, batteries, or glass breakage) or material reactions. Standard Imaging, Inc. shall not be otherwise liable for any damages, including but not limited to, incidental damages, consequential damages, or special damages. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

This warranty is in lieu of all other warranties, express or implied, whether statutory or otherwise, including any implied warranty of fitness for a particular purpose. In no event shall Standard Imaging, Inc. be liable for any incidental or consequential damages resulting from the use, misuse or abuse of the product or caused by any defect, failure, malfunction or material reactions of the product, whether a claim of such damages is based upon the warranty, contract, negligence, or otherwise.

This warranty represents the current standard warranty of Standard Imaging, Inc. Please refer to the labeling or instruction manual of your Standard Imaging, Inc. product or the Standard Imaging, Inc. web page for any warranty conditions unique to the product.

Serialization Information

Standard Imaging products that are serialized contain coded logic in the serial number which indicates the product, day and year of manufacture, and a sequential unit number for identification:

A YY DDD X

A Unique product ID
YY Last two digits of the year
(e.g. 1999 = 99, 2000 = 00)
DDD Day of the year (1≤ DDD ≤ 365)
X Unique unit ID number (0 ≤ X ≤ 9)

Customer Care Policy Statement

Standard Imaging, at its discretion, may extend customer support only to the buyer purchasing the product directly from Standard Imaging, Inc. or as a new product from an authorized dealer or distributor of Standard Imaging, Inc. This customer care statement is in lieu of all other customer support statements, express or implied, whether statutory or otherwise, including any implied statements of fitness for a particular purpose.

Standard Imaging:

- Technical support is preferentially biased to those customers with valid and applicable Standard Imaging Certificate of Maintenance agreements.
- Technical support may range from providing detailed solutions to upgrade recommendations to the latest version of software for discontinued products.
- Will, at a minimum, provide technical support during its normal hours of operation.
- May, at its discretion, limit support of ancillary systems beyond its direct control, such as information technology systems, database management and 3rd party programs.
- Will provide technical support for the product for a minimum of 7 years from the date of delivery or discontinuance.
- Will not provide technical support for obsolete products, those products which are 7 years past the date of discontinuance.
- Will provide technical support for any and all involving issues with significant product risk, regardless of product age.

This customer care statement represents the current standard customer care statement of Standard Imaging, Inc. Please refer to the labeling or instruction manual of your Standard Imaging, Inc. product or the Standard Imaging, Inc. web page for any customer care statement conditions unique to the product. Specifications subject to change without notice.

Customer Responsibility

This product and its components will perform properly and reliably only when operated and maintained in accordance with the instructions contained in this manual and accompanying labels. A defective device should not be used. Parts which may be broken or missing or are clearly worn, distorted or contaminated should be replaced immediately with genuine replacement parts manufactured by or made available from Standard Imaging Inc.

⚠ CAUTION: Federal law in the U.S.A. and Canadian law restrict the sale, distribution, or use of this product to, by, or on the order of a licensed medical practitioner. The use of this product should be restricted to the supervision of a qualified medical physicist.

⚠ CAUTION: As desired by IAEA, English is the default language for labeling and manuals. If translated versions are available, resolve any differences in favor of the English versions.

⚠ WARNING: Measurement of high activity radioactive sources is potentially hazardous and should be performed by qualified personnel.

⚠ WARNING: Proper use of this device depends on careful reading of all instructions and labels.

⚠ WARNING: Standard Imaging products are intended for radiation quality assurance for healthcare uses. They are not designed and/or labeled for the purpose of medical diagnosis and/or treatment. Diagnosis and/or treatment decisions are the direct responsibility of the attending and licensed medical professional.

⚠ WARNING: Where applicable, Standard Imaging products are designed to be used with the versions of common radiation delivery devices, treatment planning systems and other products or systems used in the delivery of ionizing radiation, available at the time the Standard Imaging product is released. Standard Imaging does not assume responsibility, liability and/or warrant against, problems with the use, reliability, safety or effectiveness that arise due to the evolution, updates or changes to these products or systems in the future. It is the responsibility of the customer or user to determine if the Standard Imaging product can be properly used with these products or systems.

Should repair or replacement of this product become necessary after the warranty period, the customer should seek advice from Standard Imaging Inc. prior to such repair or replacement. If this product is in need of repair, it should not be used until all repairs have been made and the product is functioning properly and ready for use. After repair, the product may need to be calibrated. The owner of this product has sole responsibility for any malfunction resulting from abuse, improper use or maintenance, or repair by anyone other than Standard Imaging Inc.

Standard Imaging will make numerous and reasonable attempts to contact a customer following completed manufacture or service of a product. Should a customer product remain at Standard Imaging for more than 1 year following its completed manufacture or service, Standard Imaging reserves the right to resell, restock, donate, discard or destroy the product.

If, in relation to the use of this product, a death or a serious deterioration of health has occurred, this should be reported to Standard Imaging, Inc. and the National Competent Authority of the country in which the incident occurred. When in doubt, please consult with an advisor or reach out to Standard Imaging, Inc. for further assistance.

The information in this manual is subject to change without notice. Please see www.standardimaging.com for the latest information. No part of this manual may be copied or reproduced in any form or by any means without prior written consent of Standard Imaging Inc.

Service Policy

If service, including recalibration, is required, please contact Standard Imaging's Customer Service department by phone or email prior to shipping the product. Standard Imaging's Customer Service and Technical Service staff will attempt to address the product issue via phone or email. If unable to address the issue, a return material authorization (RMA) number will be issued. With the RMA number, the product can be returned to Standard Imaging. It is the responsibility of the customer to properly package, insure and ship the product, with the RMA number clearly identified on the outside of the package. The customer must immediately file a claim with their carrier for any shipping damage or lost shipments. Return shipping and insurance is to be pre-paid or billed to the customer, and the customer may request a specific shipper. Items found to be out of warranty are subject to a minimum service fee of 1 hour labor (excluding recalibrations) for diagnostic efforts and require a purchase order (PO) before service is performed. With concurrence from customer, the product may be replaced if it is unserviceable or if the required service is cost prohibitive. Products incurring service charges may be held for payment. Standard Imaging does not provide loaner products. See the Standard Imaging Warranty and Customer Responsibility for additional information.

Return Policy

No merchandise will be accepted for credit without prior approval of return. Please contact Standard Imaging's Customer Service Department to receive a return authorization number before returning any merchandise for exchange or credit. Products manufactured by Standard Imaging must be returned within thirty days of receipt of order in 'like new' condition. No credit will be given for products returned after thirty days from receipt of order. A minimum twenty percent restocking fee will be charged on all returned merchandise. All materials returned must be shipped pre-paid. Credit for returned goods will be issued to customer's account for use against future purchases of merchandise only. Special orders, custom products, re-sale (not manufactured by Standard Imaging) products, and ADCL calibrations will not be accepted for return credit or exchange.

All products may not be registered, cleared, licensed or approved for sale in all countries or territories. Please contact Standard Imaging Customer Care for details.

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b. Make backup copies of the product only for back-up, recovery and archival purposes;

c. Authorize SI to use non-patient related data compiled, free of charge, from the Licensee's use of the product for its own use, shared use with other medical device manufacturers for quality assurance purposes and/or the independent promotion of scientific knowledge, provided that SI does not identify the name of the Licensee to the general public;

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This agreement shall be deemed executed in the State of Wisconsin and shall be interpreted and construed in accordance with the laws of the State of Wisconsin. If any provision of this agreement is judicially declared to be invalid, unenforceable, or void by a court of competent jurisdiction, such decision shall not have the effect of invalidating or voiding the remainder of this agreement and the part or parts of this agreement so held to be invalid, unenforceable, or void shall be deemed to be deleted from this agreement and the remainder of this agreement shall have the same force and effect as if such part or parts had never been included.

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DoseView 1D

CE

DoseView 3D

CE 2862

EC	REP	Hoff & Lowendahl AB Högåsvägen 125 SE-741 41 Knivsta, Sweden

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