



PHILIPS

Pinnacle³

DICOM Acceptance Tests

Release 16.4 (English)

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Medical Device Directive

Pinnacle³ Radiation Therapy Planning System is CE Marked to the Medical Device Directive 93/42/EEC.

**Australia/New Zealand Sponsor**

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Device Description

The Pinnacle³ Radiation Therapy Planning (RTP) software is composed of several modules including the core Pinnacle³ functionality, Syntegra[™], P³IMRT[®], and AcQSim^{3™}. The Pinnacle³ RTP software runs on a Solaris UNIX (or UNIX compliant) computer, which allows qualified medical personnel to enter patient data into the system, use that data to construct a plan for radiation therapy, and evaluate the plan. Optionally, the qualified medical personnel may output the plan in an electronic or printed form for use by other systems in the delivery of treatment to a patient.

Pinnacle³ includes networking capabilities to provide connectivity to other Pinnacle³, Syntegra, AcQSim³, or P³IMRT workstations, input devices and output devices, as well as access to the Pinnacle³ database from any Pinnacle³ workstation available on the network. The system can be run from a single workstation but has network capability to other Pinnacle³ workstations and to both input and output devices via local area network (LAN) or wide area network (WAN). The Pinnacle³ RTP System also has an enterprise configuration for larger sites requiring a centralized data center environment. This system consists of one or multiple rack mountable servers on which Pinnacle³ sessions run which enables display on any network accessible computer. The expected service lifetime of the software is five (5) years.

To enable use of the software, a license key must be issued by the installer after software installation has been completed. If you have any software issues, please contact your service representative: Customer Support (1-800-722-9377 for US and Canada), your local Philips Customer Service provider, or your local Distributor. Beginning with Pinnacle³ 16.4, you will need to provide your service representative with the equipment ID assigned to your software kit. Your equipment ID can be found in the **About** window and is used to direct your call to the appropriate service personnel.

Intended Use

Pinnacle³ Radiation Therapy Planning System is a software package intended to provide planning support for the treatment of disease processes, utilizing photon, proton, electron and brachytherapy techniques.

Indications for Use

Pinnacle³ Radiation Therapy Planning System is a software package intended to provide planning support for the treatment of disease processes. Pinnacle³ Radiation Therapy Planning System incorporates a number of fully integrated subsystems, including Pinnacle³ Proton, which supports proton therapy planning. The full Pinnacle³ Radiation Therapy Planning System software package provides planning support for the treatment of disease processes, utilizing photon, proton, electron and brachytherapy techniques.

Pinnacle³ Radiation Therapy Planning System assists the clinician in formulating a treatment plan that maximizes the dose to the treatment volume while minimizing the dose to the surrounding normal tissues. The system is capable of operating in both the forward planning and inverse planning modes. Plans generated using this system are used in the determination of the course of a patient's radiation treatment. They are to be evaluated, modified and implemented by qualified medical personnel.

Contraindications

There are no known contraindications regarding the use of the Pinnacle³ RTP system.

Intended Audience

This manual is written for qualified medical personnel trained as users of Pinnacle³ RTP systems. You should make sure that you have thoroughly read and completely understand the manuals and release notes that are delivered with the software. Keep this manual and all other manuals delivered with the software near your Pinnacle³ system and review them periodically. The initial installation procedure will be performed by a Field Service Engineer. If you suspect that your system has an error, discontinue its use and contact Customer Support or your local distributor.

Minimum Requirements

This section provides the minimum requirements concerning hardware and software related to running the current product release as intended.

Professional

- Solaris 11 version 11.3 or later with Oracle X6-2
(*Note for existing sites: 11.2 or later with Oracle X5-2*)
- 64GB RAM (based on number of concurrent users)
 - Additional RAM requires upgrade
 - Upgradeable to 384GB RAM
- Rack Management: 1U each server

Network

- 10,000/1,000/100 Mbps Base-T Ethernet
- 1,000/100 Mbps Base-T Ethernet for remote management (ILOM)
- 4/8/16GBs HBA ports supported for communication between Smart Enterprise Cluster servers and the SAN

Third-Party Software

- OVDC(VCC) is used to access Pinnacle³
- Third-party software installations are not supported on any Pinnacle³ system server without proper validation.

Notes

Equipment specifications are subject to alteration without notice. All changes will be in compliance with regulations governing manufacture of medical equipment.

Pinnacle³ and P³IMRT are registered trademarks, and AcQSim³ and Syntegra are trademarks of Philips. Other brand or product names are trademarks or registered trademarks of their respective holders.

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Use of Symbols in Labeling

Philips Healthcare complies with International Standards and FDA requirements for the use of symbols in labeling. An online glossary of symbols used by Philips Healthcare is available at <http://www.symbols.philips.com>.

Smart Enterprise (Cluster Server Nodes)

- Solaris 11 version 11.3 or later with Oracle X6-2
(*Note for existing sites: 11.2 or later with Oracle X5-2*)
- Solaris Cluster required on cluster nodes
- 64GB RAM (based on number of concurrent users)
 - Additional RAM requires upgrade
 - Upgradeable to 384GB RAM
- Rack Management: 1U each cluster server

Smart Enterprise (Application Servers)

- Solaris 11 version 11.3 or later with Oracle X6-2
(*Note for existing sites: 11.2 or later with Oracle X5-2*)
- 64GB RAM (based on number of concurrent users)
 - Additional RAM requires upgrade
 - Upgradeable to 384GB RAM
- Rack Management: 1U each application server



General Device Warnings

Do not load non-system software onto the computer used by this system without the direct authorization of Philips Medical Systems. Feature performance and safety may be compromised.

To assure proper treatment, it is critical that a qualified medical person review and verify all system treatment plan parameters using an independent verification method prior to treating patients using the plan.

Report the occurrence of a serious incident in relation to this device to Philips Customer Support and the competent authority of the Member State in which the user and/or patient is established.

We recommend that you review TG40, TG53, and other pertinent radiation therapy treatment standards and incorporate those methods into your clinical practice to ensure that your use of the system results in the most accurate treatment plans. TG40, TG53, and other reports are available publicly at the American Association of Physicists in Medicine (AAPM) website.

- Comprehensive QA for radiation oncology: Report of AAPM Radiation Therapy Committee Task Group 40. *Medical Physics* 21(4), 1994.
- American Association of Physicists in Medicine Radiation Therapy Committee Task Group 53: Quality assurance for clinical radiotherapy treatment planning. *Medical Physics* 25(10), 1998.

The following clinical practices are recommended to verify the accuracy of each treatment plan:

- An independent calculation of the monitor units for each beam of a plan and treatment time for each brachytherapy plan.
- Acquisition and review of portal images or review of multi-leaf collimator (MLC) leaf positions after import to the treatment system.
- A chart check prior to the plan being delivered or during the first week of treatment.
- Independent review of the treatment plan prior to the delivery.
- Cross-functional review of the plan in a weekly chart round.
- Manual verification of record and verify settings after transfer to the treatment machine.
- Verification of the SSD and field shape during patient setup.

These reviews should be performed for a new plan or when a change is made to any component of a plan.

U.S.A. law: CAUTION: Federal law restricts this device to sale by or on the order of a physician.

This software product is a Medical Device.

Only qualified medical personnel should operate the system. New personnel should receive training prior to unsupervised operation of the system. For more information, contact Customer Support or your local distributor.

Serious injury to patients can result due to the misapplication of this product. Make sure that you thoroughly understand all the user instructions prior to using this device.

Pinnacle³ treatment plans may include the statement NOT FOR CLINICAL USE. Based on the machine or isotope data and the treatment plan, the software determined that the plan cannot be delivered clinically. Do not treat patients with plans that are not for clinical use.

Pinnacle³ includes sample data. This information is for reference purposes only. Do not treat patients with plans based on sample machines or other sample data.

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1 DICOM Image Acceptance Test Plan



CAUTION

All information must be recorded at the Pinnacle³ workstation for a valid comparison to be made. You should use actual patient data when you perform these tests.

The purpose of this test is to validate acquired image information for a phantom of known geometry and one with regions of different material properties (for CT data, different materials). The images and associated data acquired during the test will be read into Pinnacle³, and the same information will be recorded and compared in Pinnacle³.

Using the acceptance test

This test document is written for all scanner types and may contain tests that are not of interest for a particular scanner type. **Tests that are not applicable should be marked as “Not Applicable”, initialed, and dated by the tester.**

The number of iterations of some tests can be determined by the tester. In these cases the tester may be limited by the number of image files available. However, the tester should perform tests of as many different settings as possible. All rationale for additional tests must be documented by the tester.

To run this test plan, you must have:

- A working knowledge of Pinnacle³.
- A Pinnacle³ RTP application and workstation with the DICOM Image software installed.
- The DICOM image acceptance test (which begins on the next page).
- A printer.
- CT phantoms.

DICOM Image acceptance test

System information

Pinnacle³ version information can be obtained from the **About** window in the Pinnacle³ Radiation Therapy Planning (RTP) software.

Pinnacle³

Version	
Platform	

Imaging Device

Manufacturer	
Model	
Software Version	
Serial Number	

Phantom Information (of known geometry)

Manufacturer	
Model	
Serial Number	

Phantom Information (with regions of different material properties)

Manufacturer	
Model	
Serial Number	

Site Information

Tester Name	
Testing Location	
Testing Address	

Tester Signature: _____

Date: _____

Scan information

For each CT, MR, PET, and SPECT scanner, you should test every patient orientation that each scanner supports. For example, if your facility has four scanners that all support Head First Supine, Feet First Supine, Head First Prone, and Feet First Prone patient orientations, you should export and test sixteen image sets (four for each scanner).

Determine the number of image sets that you need to test at the time that you perform the test plan. Copy the worksheet that follows and use it as many times as you need it. To maintain the integrity of this document, enter the number of the worksheet and the total number of worksheets in the spaces provided.

Record the associated scan information exactly as it appears at the scanner in the 'At the Scanner' fields. After you record all of the 'At the Scanner' information, read the patient image data sets into Pinnacle³. Record what you see at the workstation in the 'At Pinnacle³' fields.

NOTE

You can import decubitus image sets into Pinnacle³; however, you cannot import or export structure sets, dose, or spatial registration from a decubitus image set.

NOTE

The software does not correct for gantry tilt, table motion, or oblique (non-transverse) images. If you acquire images when the gantry is tilted or when the table is moving in the X or Y directions, patient geometry will be distorted. Also, if you acquire MR images that were not reconstructed in the transverse direction, the software may interpret these image sets as oblique even when the gantry was not tilted. You can import image sets containing gantry tilt, table motion or that are oblique using DICOM Image, but you cannot use them as the primary image set.

Image sample ___ of ___

Criteria	At the Scanner	At Pinnacle ³
Unique Identifier (File Name)		
Patient Orientation		
Image Set Orientation		
Scan Direction		
Fiducial Description		
Number of Images		
Medical Record Number		
Field of View (cm)		
X and Y Pixel Dimension		
Scan Time and Date		
Image Appears to be Correct	Not Applicable	

Notes

Tester Signature: _____

Date: _____

Phantom orientation

In order to validate the conservation of scan orientation by the DICOM server, it is necessary to compare the relative orientation of the image data to the axes of the phantom.

This portion of the testing involves reading the scanned images into Pinnacle³ and ensuring that each of the six image axes are correctly oriented to their adjacent axes. For each orientation verify that the image axes are correctly oriented to their adjacent axes.

Please write your initials in each box to the left of the item being verified. Place a “P” in each Pass/Fail box if the axes are correctly oriented, and place an “F” in the box if the axes are incorrectly oriented.

This may involve rendering the data set in a three dimensional window with several different viewpoints. In addition, print and attach to this test plan a copy of each image set that shows the orientations of the axes for each of the different scan permutations.

If the orientation is not supported by the scanner, then the table must be crossed out with a single “X”, marked as “Not Applicable”, initialed and dated.

Supine, head first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Tester Signature: _____

Date: _____

Supine, feet first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Prone, head first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Prone, feet first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Left side down, head first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Tester Signature: _____

Date: _____

Left side down, feet first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Right side down, head first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Right side down, feet first

Pass/Fail	Axis	Notes
	Anterior-Posterior	
	Right-Left	
	Superior-Inferior	

Tester Signature: _____

Date: _____

CT scanners

If the scanner you are testing is a CT scanner, perform the following tests.

Verify CT numbers

The purpose of this section is to ensure that the CT numbers are properly preserved by the DICOM server. In this test, a comparison is made between the CT numbers displayed on the CT scanner (expected mean CT number) and those received by Pinnacle³ (recorded mean CT number).

NOTE

If you use a phantom with known densities, you can construct the CT to density table for the scanner as you proceed. See the *Pinnacle³ Physics Instructions for Use* for more information.

Verify the CT numbers in the calibration phantom

Load the CT scan into Pinnacle³ and start a plan with it. To verify the CT numbers in the calibration phantom, create ROIs for each of the rods that are completely inside of the rod and lie on several slices. The ROI should be a little smaller than the size of the rod, but pixels near the edge of the rod should be avoided. Areas with artifacts should be avoided. For each of these ROIs record the average CT number and the standard deviation for each ROI/rod.

Hounsfield unit conversion

Some scanners report the CT number in Hounsfield units. For those scanners, the DICOM server will make the conversion to CT number, in which case a comparison requires that the expected values be converted to CT numbers as well. It is not known at this time which scanners use Hounsfield units at the console, but if the air densities are reported to be less than zero, then the display is in Hounsfield units. The conversion can be done with the following equation:

$$CT\# = Hounsfield + 1000$$

Image noise during validation

The scanned CT data can be fairly noisy and this will make the validation of CT numbers difficult. Because of this it is necessary to sample the CT numbers over a region on the image both at the CT scanner and in Pinnacle³. The testing requires that the sampling is done for identical regions, and on the same slice.

Pinnacle³ and most scanners will report the mean and standard deviation for the sampling region. Record the values from Pinnacle³ in the following tables. The uncertainty in the difference can be computed as:

$$\delta = \sqrt{\sigma_{P^3}^2 + \sigma_{CT}^2}$$

CT number results

Rod/density one

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail

Verify that $|\Delta| \leq \frac{\delta}{2}$

Rod/density two

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail

Verify that $|\Delta| \leq \frac{\delta}{2}$

Tester Signature:

Date:

Rod/density three

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail Verify that $|\Delta| \leq \frac{\delta}{2}$

Rod/density four

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail Verify that $|\Delta| \leq \frac{\delta}{2}$

Tester Signature: _____

Date: _____

Rod/density five

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail

Verify that $|\Delta| \leq \frac{\delta}{2}$

Rod/density six

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail

Verify that $|\Delta| \leq \frac{\delta}{2}$

Tester Signature:

Date:

Rod/density seven

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail Verify that $|\Delta| \leq \frac{\delta}{2}$

Rod/density eight

Expected Mean CT Number & Standard Deviation		±
Recorded Mean CT Number & Standard Deviation		±
Absolute Difference (Δ)		
Uncertainty	(δ)	
	(δ / 2)	

Pass/Fail Verify that $|\Delta| \leq \frac{\delta}{2}$

Tester Signature: _____

Date: _____

Irregularly spaced data sets

It is necessary to test the conservation of data sets with variably spaced regions. This section will test variably spaced data sets. The following section must be completed if the CT Scanner allows for variably spaced data sets. For example, a data set that is variably spaced may have three differently spaced regions: Z=5.0 mm; Z=10.0 mm; and Z=3.0 mm.

Record the associated scan information exactly as it appears at the scanner in the 'At the Scanner' fields, in the following table. After all of the 'At the Scanner' information has been recorded, read the patient image data sets into Pinnacle³. Record the results from the workstation in the following table.

If variable spacing is not supported by the CT scanner, the following table should be marked as "Not Applicable", initialed and dated.

Criteria	At the Scanner	At Pinnacle ³
Unique Identifier (File Name)		
Image Set Orientation		
Fiducial Description		
Number of Images		
Medical Record Number		
Field of View (cm)		
X and Y Pixel Dimension		
Slice Thickness (cm)		
Z Spacing Region 1		
Z Spacing Region 2		
Z Spacing Region 3		
Scan Time and Date		

Notes

Tester Signature: _____

Date: _____

2 DICOM RT Acceptance Test Plan

The purpose of this test is to validate transferred plans, structure sets, DRRs, and dose grids according to the DICOM standard. You should test each DICOM workstation that will be used to send DICOM RT information to Pinnacle³. You should also test each DICOM workstation that will receive DICOM RT information from Pinnacle³.

Any tests that you perform should duplicate (as closely as possible) the actual information that you transfer in your facility. Test with the most complicated plan that you might transfer in your facility. Furthermore, test with plans for different treatment cases, such as head and neck, breast, chest, and pelvis. Use actual patient data when you perform these tests.

To run this test plan, you must have:

- A working knowledge of Pinnacle³.
- A Pinnacle³ RTP application and workstation with the DICOM RT software installed.
- The DICOM RT transfer acceptance test (which begins on page 21).
- A laser printer or color printer.



WARNING

The DICOM RT Interface software is in compliance with the ACR-NEMA DICOM 3.0 standard; however, due to the inherent nature of DICOM, you should perform acceptance testing to verify that the software meets the requirements for your configuration. The acceptance testing should include all representative data types that you intend to transfer, all types of transfers desired for a type of data set, and clinical evaluation of each representative data set on the receiving end after each desired type of transfer. Failure to adequately validate the transfer of information into Pinnacle³ may result in plans that do not accurately consider patient anatomy. As a result, the delivered treatment may be in error.



CAUTION

After importing DICOM RT structure sets into Pinnacle³, please pay special attention to the resulting imported contours as there are inherent differences in both contouring and display algorithms between different systems. The subtleties of these differences should be well understood by all Pinnacle³ users.

Please contact PROS for up-to-date information regarding specific systems you want to interface with Pinnacle³.

Using the acceptance test

Use copies of the following tables to record the test information *exactly* as it appears in both Pinnacle³ and the target or source system. Depending on your intended use of this software, you should transfer and compare various combinations of plans, structures, DRRs, and dose grid attributes, including patient names, jaw orientations, MLC orientations, blocks, gantry positions, couch positions, beam geometry, contours, points, dose alignment with patient data, and DRR field view and position.

In the *System information* portion of the test, identify the system information for the Pinnacle³ workstation and the target or source system that you will test. All required Pinnacle³ information can be obtained from the **About** window in the Pinnacle³ Radiation Therapy Planning (RTP) software.

In the *Test matrix* portion of the test, record all important information from the data transfer. The columns in the table are described below:

- **Criteria**—Identify what information you tested (for example, patient name, gantry angle, etc.).
- **At Pinnacle³**—Record the information that you identified in the Criteria column as it appears in Pinnacle³.
- **At the Target/Source**—Record the information that you identified in the Criteria column as it appears at the target or source workstation.
- **Pass/Fail**—Indicate whether the test passed or failed. A test passes if the information in Pinnacle³ matches the information on the target or source workstation. A test fails if the information in Pinnacle³ does not match the information on the target or source workstation. A failed test indicates a serious problem that must be resolved.

When you finish the test, compare the results of each source and target system.

DICOM RT acceptance test

System information

All required Pinnacle³ information can be obtained from the **About** window in the Pinnacle³ Radiation Therapy Planning (RTP) software.

Pinnacle³ Workstation

Version	
Platform	

Target or Source System

Manufacturer	
Model	
Software Version	

Site Information

Tester Name	
Testing Location	
Testing Address	

Tester Signature: _____

Date: _____

Test matrix

Criteria	At Pinnacle ³	At the Target/Source	Pass/Fail

Notes

Tester Signature: _____

Date: _____

3 DICOM Coordinate Translations

NOTE

You should use the information in this chapter only to convert coordinates for image sets that were imported using DICOM Image 9 or later. If you want to convert coordinates for an image set that was imported with DICOM Image 4.4e or earlier, contact Customer Support and request Application Note 2008-01 or download the document from InCenter.

Pinnacle³ and DICOM use two different coordinate systems. This chapter describes how to translate a coordinate in the Pinnacle³ coordinate system to a coordinate in the DICOM coordinate system, and how to translate a coordinate in the DICOM coordinate system to a coordinate in the Pinnacle³ coordinate system. A coordinate in the Pinnacle³ coordinate system refers to any coordinate that is displayed in the Pinnacle³ software. A coordinate in the DICOM coordinate system refers to any coordinate transferred within a DICOM message.

To translate from one system to the other system, you must identify the patient orientation, and you must have the coordinates of the source location.

$$P_C = \begin{bmatrix} X_C & Y_C & Z_C & 1 \end{bmatrix}$$

NOTE

Pinnacle³ coordinates are expressed in centimeters, while DICOM coordinates are expressed in millimeters. The calculations in this chapter account for this conversion.

Translate a Pinnacle³ coordinate to a DICOM coordinate

The DICOM coordinate system is:

$$DICOM = \begin{bmatrix} X_D & Y_D & Z_D & 1 \end{bmatrix}$$

where:

$$X_D = 10 \cdot X_p \cdot X_{sign}$$

$$Y_D = 10 \cdot Y_p \cdot Y_{sign}$$

$$Z_D = 10 \cdot Z_p \cdot Z_{sign}$$

X_p = X coordinate in the Pinnacle³ coordinate system

Y_p = Y coordinate in the Pinnacle³ coordinate system

Z_p = Z coordinate in the Pinnacle³ coordinate system

Use the following table to determine the values for X_{sign} , Y_{sign} , and Z_{sign} . These variables depend upon the orientation of the patient in the image set.

Orientation	X_{sign}	Y_{sign}	Z_{sign}
Head First Supine	1	-1	-1
Head First Prone	-1	1	-1
Feet First Supine	-1	-1	1
Feet First Prone	1	1	1

Translate a DICOM coordinate to a Pinnacle³ coordinate

The Pinnacle³ coordinate system is:

$$Pinnacle^3 = \begin{bmatrix} X_p & Y_p & Z_p & 1 \end{bmatrix}$$

where:

$$X_p = 0.1 \cdot X_D \cdot X_{sign}$$

$$Y_p = 0.1 \cdot Y_D \cdot Y_{sign}$$

$$Z_p = 0.1 \cdot Z_D \cdot Z_{sign}$$

X_D = X coordinate in the DICOM coordinate system

Y_D = Y coordinate in the DICOM coordinate system

Z_D = Z coordinate in the DICOM coordinate system

Use the following table to determine the values for X_{sign} , Y_{sign} , and Z_{sign} . These variables depend upon the orientation of the patient in the image set.

Orientation	X_{sign}	Y_{sign}	Z_{sign}
Head First Supine	1	-1	-1
Head First Prone	-1	1	-1
Feet First Supine	-1	-1	1
Feet First Prone	1	1	1

4 IEC Coordinate Translations



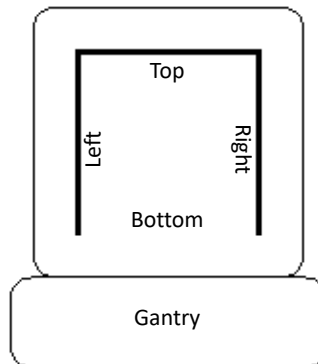
CAUTION

The internal Pinnacle³ coordinate system is not IEC-compliant; therefore, a transformation to the IEC standard is required in order to compare Pinnacle³ parameters with the same parameters on the target or source system. The best method of performing this comparison is to first verify the jaw positions, as described in this appendix. You can then readily determine and verify the correct relative positions of other plan parameters.

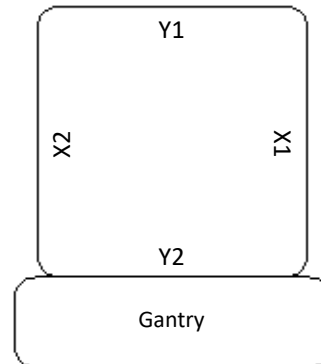
The reference for the IEC Coordinate Standard is “Radiotherapy equipment - Coordinates, movements and scales,” reference number CEI/IEC 1217: 1996.

Translation for collimator

Pinnacle³ references the jaw positions based on the location of the open end of the block tray in the collimator. The graphic that follows shows the collimator with the tray opening facing toward the gantry as viewed from above. The Top, Bottom, Left, and Right jaws always follow the tray opening, and will be located as shown:



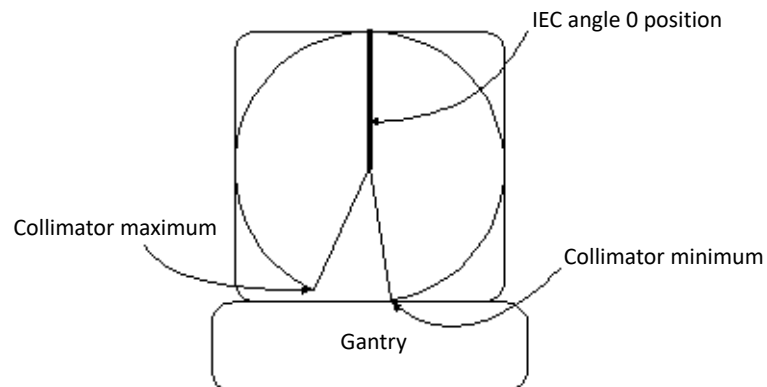
IEC references the jaw positions with respect to the gantry when the collimator is at IEC angle 0. The graphic that follows shows the collimator and gantry as viewed from above when the collimator is at IEC angle 0:



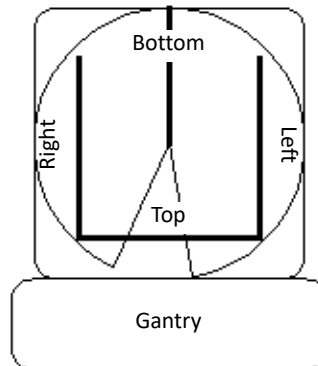
A good illustration of collimator requirements is the Elekta system, which has a full 360-degree allowed rotation. However, if you specify 0–359.9 as the collimator defaults, the result is 180-degree rotated beams. The correct way to define the collimator is to specify a range of 180–179.9, which gives “0” as the default.

IEC angle 0 for the collimator is defined as the orthogonal angle closest to the angle bisecting the range of motion of the collimator. In order to correlate with Pinnacle³, the position of the tray opening at IEC angle 0 for the collimator must be determined. This is done by finding the position of the tray opening at the collimator position defined as IEC angle 0. This is a multi-step process, as shown in graphics that follow.

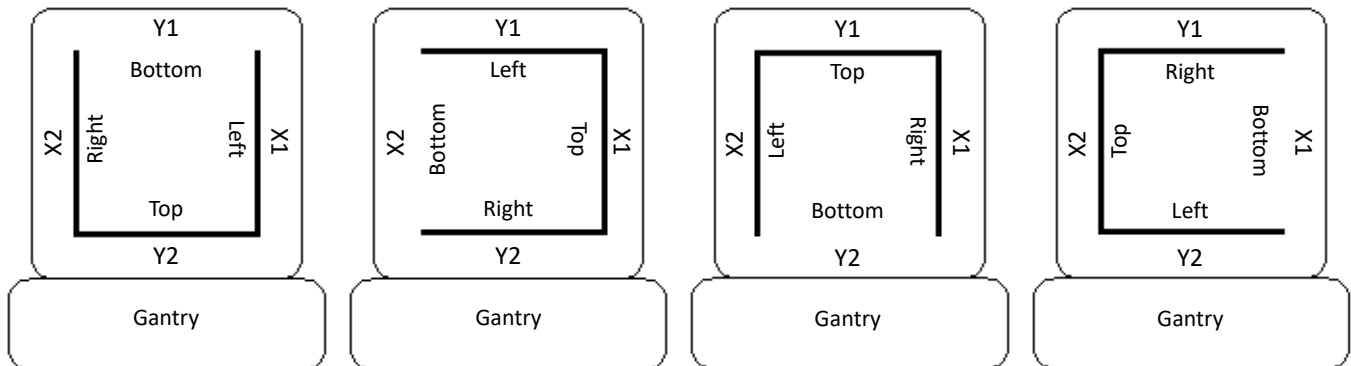
Step 1: Find the IEC angle 0 position. An example is shown below:



Step 2: Rotate the collimator to the IEC angle 0 position and note the orientation of the block tray, as shown in the graphic that follows (for the example in step 1).



Step 3: Translate from Pinnacle³ coordinates to IEC coordinates for the collimator by superimposing the position of the block tray at IEC angle 0. Next, match the Top, Bottom, Left, and Right jaw positions with the IEC jaw positions, as shown in the graphic that follows, for each possible IEC angle 0 position.

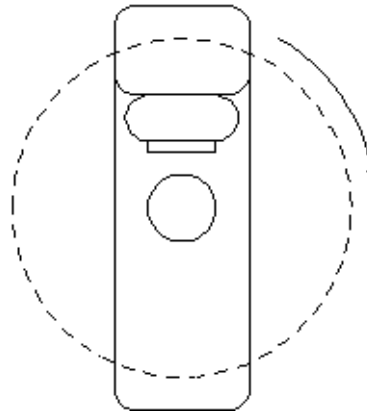


Translation for gantry

Before you translate a gantry angle from a particular machine’s coordinate system to the corresponding angle in the IEC coordinate system, you must understand two properties in both coordinate systems: the zero angle position and the positive rotation direction from a particular viewpoint.

IEC references the zero position of the gantry when the radiation beam is directed vertically downward and passes through the isocenter.

The graphic that follows shows the positive rotation direction of the gantry and the gantry location at IEC angle 0 when facing the gantry:

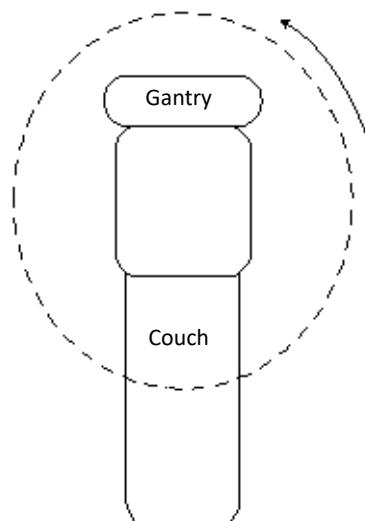


Translation for couch

Before you translate a couch angle from a particular machine's coordinate system to the corresponding angle in the IEC coordinate system, you must understand two properties in both coordinate systems: the zero angle position and the positive rotation direction from a particular viewpoint.

IEC references the zero position of the couch when the table is fully withdrawn from the gantry.

The graphic that follows shows the positive rotation direction of the couch and the couch location at IEC angle 0 as viewed from above:

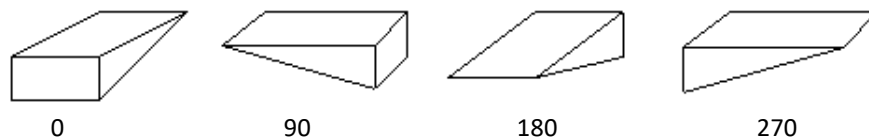


Translation for wedge orientation

Before you translate the orientation of a wedge from a particular machine's coordinate system to the corresponding wedge orientation in the IEC coordinate system, you must understand two properties in both coordinate systems: the zero angle wedge orientation and the positive rotation direction from a particular viewpoint.

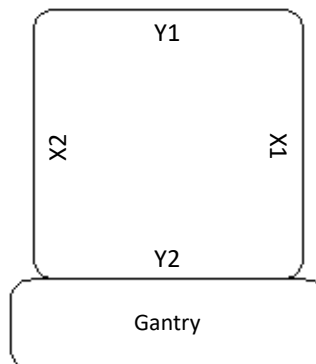
The wedge orientation angle is defined as the rotation of the wedge with respect to the collimator. The wedge orientation angle 0 is defined with respect to the gantry when the collimator is at IEC angle 0 and the thin end of the wedge is toward the gantry. The wedge orientation angle increases in a counterclockwise direction when viewed from above.

The graphic that follows shows the four possible wedge orientations and their angles when facing the gantry:

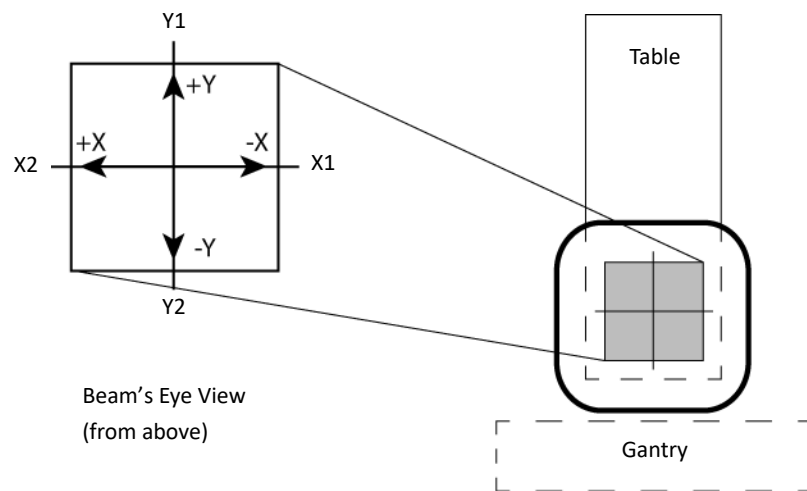


Translation for proton

Proton machines and the Pinnacle³ coordinate system for the snout, compensator, and aperture are fixed at IEC angle 0. $X1 = X1$, $X2 = X2$, $Y1 = Y1$, and $Y2 = Y2$ with respect to the location of the gantry as shown in the graphic that follows.



The graphic that follows shows positive and negative X and Y as they are represented in the Pinnacle³ coordinate system when the table is at IEC angle 0.



For proton beams, Pinnacle³ uses a snout instead of the collimator and block tray that are used with photon beams. While collimators are variable in size and can rotate, Pinnacle³ supports snouts that are fixed in size and in orientation. (The orientation of the snout is fixed at IEC angle 0 for the collimator.)


For a treatment room that uses a fixed beam, Pinnacle³ treats the machine as if it is at a fixed 'virtual gantry' angle. In other words, Pinnacle³ models fixed beam devices as a gantry with a single angle (for example, 90 degrees or 270 degrees). Thus you can recreate the orientation shown in the previous graphic in a treatment room that uses a fixed beam by imagining the machine head to be on a virtual gantry and rotating the gantry to IEC angle 0 for the gantry.



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