Tilt Plate

QUASAR

BY MODUS QA

User's Guide

Version 2.0.0

MODUS QA

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Verify Image-Guided Shifts for 6° of Freedom Couches

Introducing QUASAR™ Penta-Guide Tilt Plate, an easy and efficient way to verify couch corrections for six degrees of freedom (6DoF) couches. The QUASAR™ Penta-Guide Tilt Plate positions the QUASAR™ Penta-Guide Phantom at known rotation angles and displacements relative to the isocenter. With this device, users test rotation corrections and combined translation and rotation corrections on a 6DoF couch.

Daily 6DoF QA

The central lines on the tilt plate, in each group of three, align the centre of the phantom with the laser isocenter for rotation only corrections. Other lines require translation and rotation corrections.

Specifications

- Tilt angles are: 0.75°, 1.25°, and 1.0° (see appendix for further dimensional references)
- Turning the tilt plate in 90° increments varies the direction of the rotation corrections
- Compatible with all new and existing QUASAR™ Penta-Guide Phantoms
- Compatible with most localization bars for faster, simpler test setup

Instructions

Daily QA of a linear accelerator includes testing of the treatment couch motion, as well as the on-board cone beam CT (CBCT) imaging system. Typically, this procedure is performed with the QUASAR™ Penta-Guide Phantom, which enables simultaneous testing of the couch motion (in 3 directions) and imaging systems. However, some treatment couches (eg. Hexapod Couch), are capable of 6 degree of freedom motion (3 translations and 3 rotations). Therefore, the QUASAR™ Penta-Guide Tilt Plate was designed as an accessory to the QUASAR™ Penta-Guide Phantom to facilitate the daily QA of linear accelerators equipped with these 6 degree of freedom couches.

Daily 6DoF CBCT/Couch QA

(Phantom with Tilt Plate for rotation only or rotation plus translation corrections)

1. Place the QUASAR™ Penta-Guide Phantom in the Tilt Plate

2. Align the Tilt Plate markings with the room lasers. The level indicators show that the Tilt Plate is level, but the phantom is not level.

3. Acquire CBCT of the QUASAR™ Penta-Guide Phantom and Tilt Plate

4. Use the image registration tools to align the CBCT with a reference CT of the QUASAR™ Penta-Guide Phantom (reference CT should not contain Tilt Plate) Ensure the calculated shifts are within 1mm of the expected shifts (magnitude of shifts depends on markings used), and that rotations are <0.5 degrees from expected rotation (0.75°, 1.25°, and 1.0°)

5. Apply the correction and move the couch. Check that the lasers now coincide with the central markings on the QUASAR™ Penta-Guide Phantom. The level indicators show that the phantom is level, but the Tilt Plate is not level.

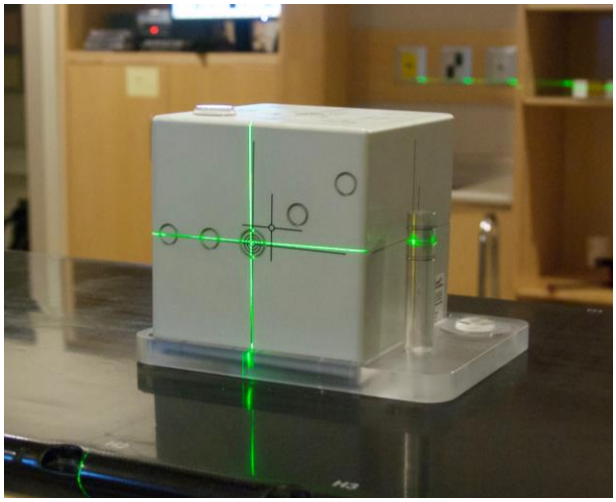

Figure 1 – Before correction: Lasers aligned with Tilt Plate

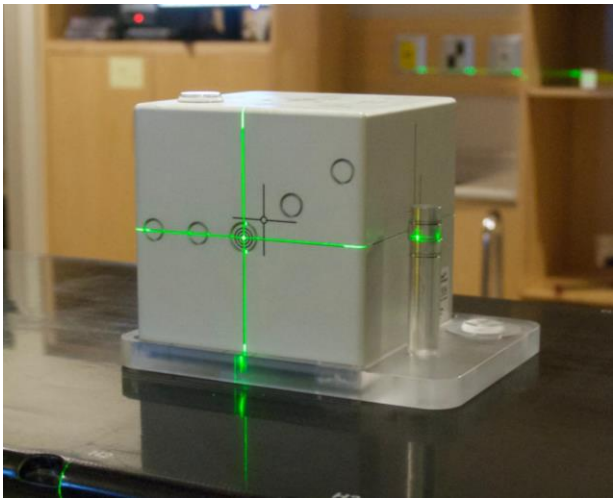

Figure 2 – After correction: Lasers aligned with Phantom

Standard Daily CBCT/Couch QA

(Phantom alone without the Tilt Plate for translation only corrections)

1. Align the off-centre markings on the QUASAR™ Penta-Guide Phantom with the lasers

2. Acquire CBCT of the QUASAR™ Penta-Guide Phantom

3. Use the image registration tools to align the CBCT with a reference CT of the QUASAR™ Penta-Guide Phantom (isocentre at the centre of the phantom on the reference CT)

4. Ensure the calculated shifts are within 1mm of the expected shifts (1cm, 1.2cm, and 1.4cm), and that rotations are <0.5 degrees (since there should be no rotations of the phantom

5. Apply the correction and move the couch. Check that the lasers now coincide with the central markings on the QUASAR™ Penta-Guide Phantom

Additional Points

- Daily Couch/CBCT QA of a 6 degree of freedom couch with the tilt plate is simple. Only 1 extra step from the standard QUASAR™ Penta-Guide Phantom.
- When aligning the CBCT to the reference CT, it is best to perform an automatic match. However, the clipbox must be selected such that it does not contain the tilt plate. (Since there is no tilt plate in the reference scan).
- There are other vendor specific QC tests that need to be performed daily for the 6DoF couches - this does not replace those tests.
- There is a channel in the base of the Tilt Plate that is compatible with most localization bars
- Placing the Tilt Plate on a localization bar may simplify setup and improve repeatability of these tests

Appendix - Penta-Guide Tilt-Plate Dimensional References

Anterior View

Dimensions are in millimeters. Demonstrates that the central markings on the tilt-plate correspond to the center sphere location within the Penta-Guide phantom as it rests in the Tilt-Plate. The additional markings indicate a 10 mm displacement from that origin location. The yaw is indicated as a 1° counter-clockwise displacement.

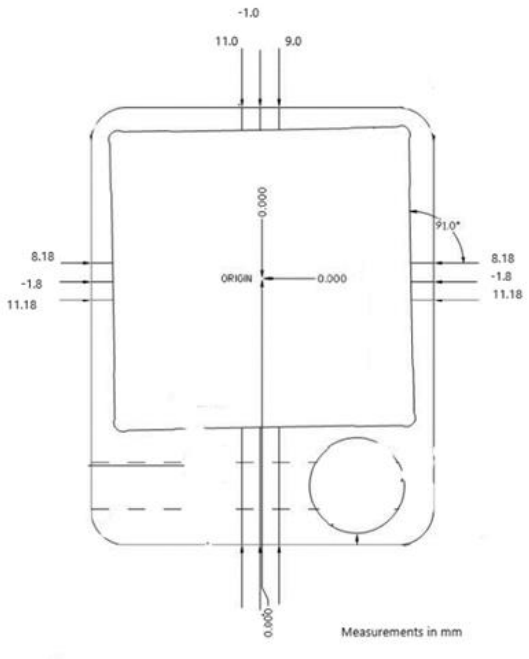

Figure 3 – *Anterior View*

Lateral View

Indicating a 1.25° inclination (pitch) built into the Tilt-Plate surface, raising the superior aspect of the Penta-Guide anteriorly.

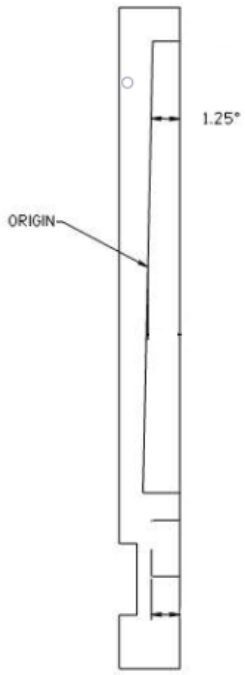

Figure 4 – Lateral View

Axial View

From the inferior end of the Tilt-Plate indicating a 0.75° inclination (roll) raising the Left (90° side) of the Penta-Guide phantom.

Figure 5 – Axial View

Vertical Pillar

The vertical pillar contains 3 reference lines. The central line aligns with the central sphere of the Penta-Guide phantom. The anterior and posterior lines indicate a 10mm displacement from the center line or center of the central Penta-Guide sphere.

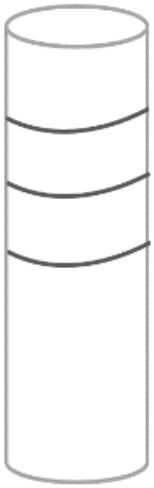

Figure 6 – Vertical Pillar

Please note, these measurements are provided for reference only. As part of the recommended QA process, the residual error in alignment is the metric that should determine pass/fail criteria. I.e., after alignment images and corrections are applied, a verification image set (CBCT) should be performed to verify that the overall 6DoF alignment accuracy is within your expected tolerances (1-2mm).

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