

COMPREHENSIVE TG-142 IMAGING AND MACHINE QA

Automate the analysis of over thirty
TG-142 recommended QA tasks

THE RAPID PROGRESS OF RADIATION THERAPY HAS CREATED THE NEED for Quality Assurance testing far greater in scope and effort than in the past. Sophisticated intensity-modulated radiation treatments rely on near-perfect multileaf collimator operation, while advanced imaging technologies for Image-Guided Radiation Therapy rely not only on image quality, but the spatial coincidence of treatment and imaging frames of reference.

TG-142 recommends a suite of daily, monthly, and annual tests to meet the challenge of modern clinical radiation therapy Quality Assurance. In addition to defining the tests for recently-developed technologies, TG-142 identifies the need to test against established baselines and track and trend results. All of these new QA obligations, necessary for a safe and effective clinic, increase physicists' work load and further strain busy schedules.

PIPSpro efficiently consolidates TG-142 QA workload by incorporating over 30 procedures into one easy-to-use platform. When used in conjunction with specialized phantoms from Standard Imaging, PIPSpro becomes an indispensable part of your QA process, giving you confidence that your clinic is operating within specifications.

“PIPSpro software and phantoms are valuable tools for streamlining over 30 of the TG-142 tests, automating data analysis, and providing documentation of the test results. By providing quantifiable and repeatable results, PIPSpro makes it easier for our center to become compliant with TG-142.”

Rick Baker

*Physics Applications Specialist
Iowa Health Des Moines -
John Stoddard Cancer Center*

PIPSPRO TG-142 COVERAGE

TABLE II

MONTHLY

Mechanical

- Light/radiation field coincidence
- Jaw position indicators
- Cross-hair centering

TABLE III

ANNUAL

Mechanical

- Collimator rotation isocenter
- Gantry rotation isocenter
- Couch rotation isocenter
- Coincidence of radiation and mechanical isocenter

TABLE V

MULTILEAF COLLIMATION

Weekly

- Qualitative test, aka “picket fence”

Monthly

- Setting vs radiation field for two patterns
- Travel speed
- Leaf position accuracy

Annual

- MLC transmission
- Leaf position repeatability
- MLC spoke shot
- Coincidence of light field and x-ray field
- Segmental IMRT
- Moving window IMRT

TABLE VI

IMAGING

Daily

Planar kV and MV (EPID) imaging

- Positioning/repositioning
- Imaging and treatment coordinate coincidence

Cone-beam CT (kV and MV)

- Imaging and treatment coordinate coincidence
- Positioning/repositioning

Monthly

Planar MV imaging (EPID)

- Imaging and treatment coordinate coincidence
- Scaling
- Spatial resolution
- Contrast
- Uniformity and noise

Planar kV imaging

- Imaging and treatment coordinate coincidence
- Scaling
- Spatial resolution
- Contrast
- Uniformity and noise

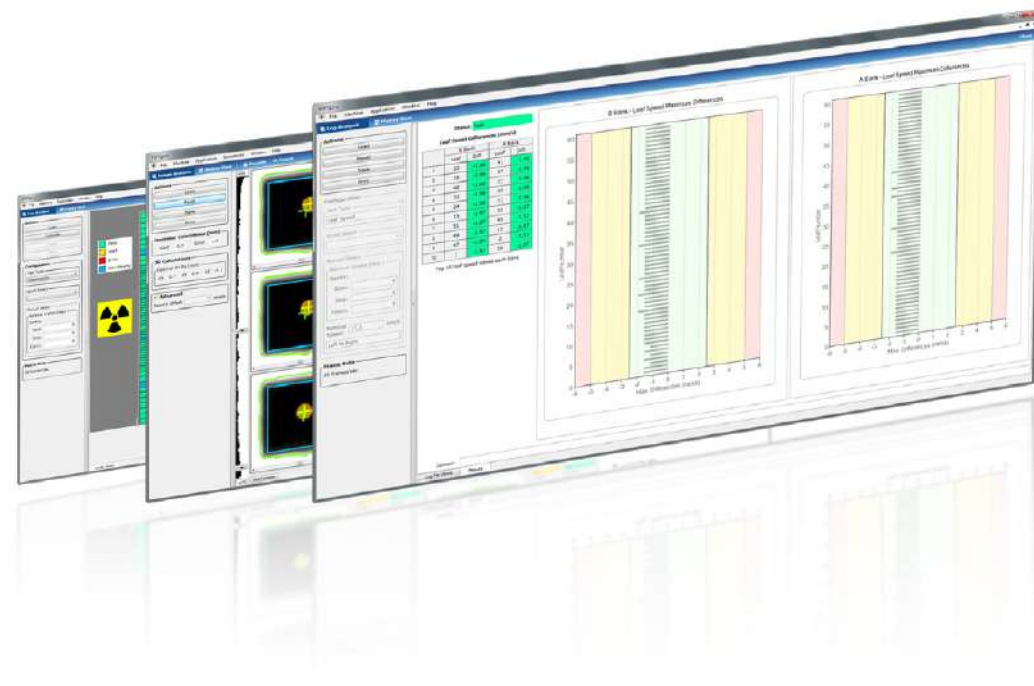
Cone-beam CT (kV and MV)

- Geometric distortion
- Spatial resolution
- Contrast
- HU constancy
- Uniformity and noise

Film images can be used in all modules with the exception of Imager QA and Stereotactic, where image quality and positioning are critical variables that cannot be maintained using film. DICOM images are supported in all modules. Raw images are supported for ExacTrac and Cyberknife kV planar imager QA.

TG-142 MADE EASY

Designed with a convenient and optimized workflow in mind



Why thousands of users in over 700 clinics choose PIPspro as their TG-142 software:

- Simple, clean and consistent user interface
- Easy-to-read reports, charts, and graphs
- PDF and comma separated variable (CSV) results export
- Multiple open modules for streamlined workflow
- Physicist-controlled editor for creating testing baselines
- Tracking and trending for test results
- Quick Selects™ for organizing tests and accessing test results
- Automatic image compositing for EPID MLC QA and StarShot images
- Centralized database for easy configuration and accessibility to results
- Complete Varian and Elekta IMRT and VMAT logfile analysis
- Workflow automation - single click deployment results
- Now includes Stereotactic collimator rotation

Faster QA with Quick Selects™

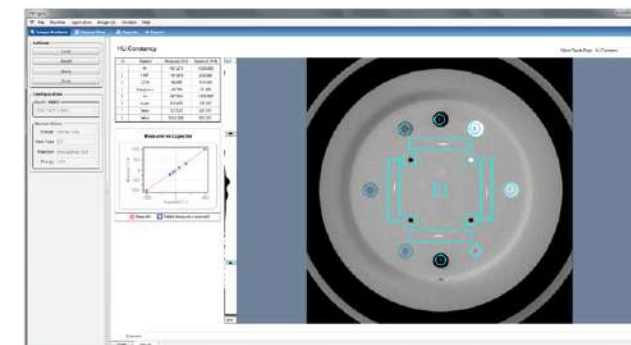
In Imager QA, Quick Selects are customizable collections of parameters that allow a variety of machine, imager, phantom, and energy combinations to be saved. Using Quick Selects, one-click activation provides an easy means to recall tests and track your results. Quick Selects are used in the Imager QA and the Logfile-Based MLC QA modules and, because of their power, will be used throughout PIPspro.

*The TG-58 Report encourages users to demand the use of a tool such as PIPspro QC Software at acceptance to help ensure that the EPID is indeed operating at or above specifications.**

* Michael G. Herman, et al, "Clinical Use of Electronic Portal Imaging: Report of AAPM Radiation Therapy Committee Task Group 58," **Med. Phys.** 28 (5), May 2001

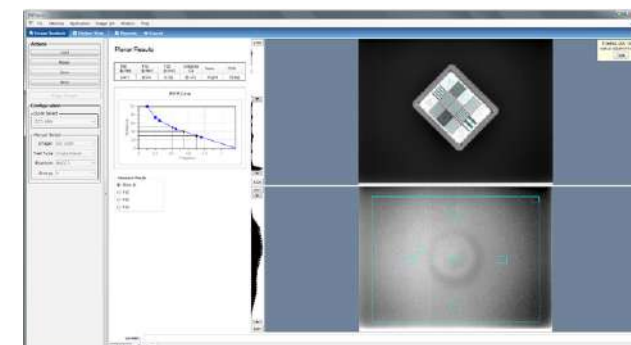
POWERFUL IMAGER QA

Consolidated TG-142 QA for volumetric and planar imaging



CT Imaging QA

Using cone beam or diagnostic images obtained with any of the Catphan phantoms (503, 504, 600), PIPspro automatically finds analysis image slices and performs required TG-142 tests (geometric distortion, spatial resolution, contrast, HU constancy, uniformity and noise). Results are colored green ("Pass"), amber ("Alert"), or red ("Fail") for easy viewing of status (this scheme is used throughout PIPspro).



Planar Imaging QA

PIPspro kV planar imaging QA uses images obtained with Standard Imaging's QC-kV1 phantom or Leeds Test Objects' TOR CDR phantom. Testing is supported for kV imagers integrated with linear accelerators as well as images from ExacTrac, Cyberknife, and C-Arms. EPID MV planar imaging QA uses Standard Imaging's calibrated QC-3 phantom.

Automatic Region Identification Is Key

By automatically identifying analysis regions, subjectivity is reduced and results consistency is improved.

	Baseline Values		Warning ranges		Thresholds		Extra ranges		Thresholds	
	Value	%	Min	Max	Value	%	Min	Max	Value	%
Noise	2.175	0.087	4.0	2.088	2.262	0.218	10.0	1.957	2.382	
F50 (lp/cm)	0.418	0.017	4.0	0.294	0.427	0.161	10.0	0.269	0.491	
F40 (lp/cm)	0.605	0.026	4.0	0.400	0.528	0.280	10.0	0.456	0.556	
F30 (lp/cm)	0.615	0.025	4.0	0.550	0.635	0.352	10.0	0.553	0.676	
CR	327.506	13.108	4.0	314.558	340.815	32.771	10.0	294.934	348.477	

Baseline Editor

Individual baselines can be created for each combination of linear accelerator, imager, phantom, and energy that you test using Quick Selects. This unique and powerful feature allows you to choose representative measurements, combine them, and set alert and warning tolerances for your imaging systems.

Phantom Stands and Holders

Phantom stands and holders are available to accommodate CyberKnife® and ExacTrac® QA.



COMPLETE MLC QA

Cover all TG-142 MLC QA tests with EPID images and logfiles

	Image-Based	Logfile-Based
Matched Segments, aka "Picket Fence"	✓	
Setting vs radiation field for two patterns (non-IMRT)	✓	
Travel speed – leaf speed loss (IMRT)*		✓
Leaf position accuracy (IMRT)		✓
Average of leaf and interleaf transmission, all energies	✓	
Leaf position repeatability*		✓
MLC spoke shot	✓	
Coincidence of light field and x-ray field, all energies	✓	
Segmental IMRT (step and shoot) test		✓
Moving window IMRT (four cardinal gantry angles)		✓

Adapted from TG-142, TABLE V. Multileaf collimation

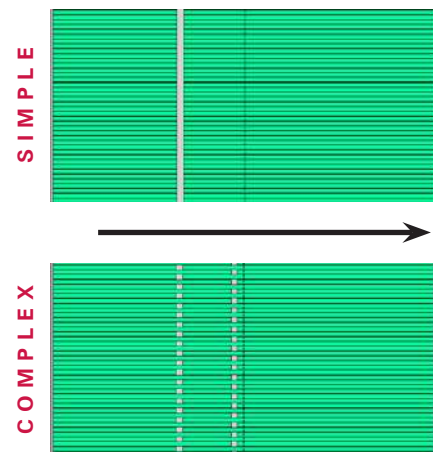
*With logfile-based analysis, PIPSpro is the only commercial software solution able to measure quantitative leaf speed loss and leaf position repeatability.

PIPSpro MLC QA gives you actionable, quantitative results that allow you to track and trend all TG-142 requirements, delivering critical information that may indicate an impending MLC failure or indicate the need to recalibrate your machine for the best possible clinical outcomes. Step & Shoot and VMAT parameters are tested in any direction using MLC leaf pattern files (*.mlc, *.dva, *.efs).

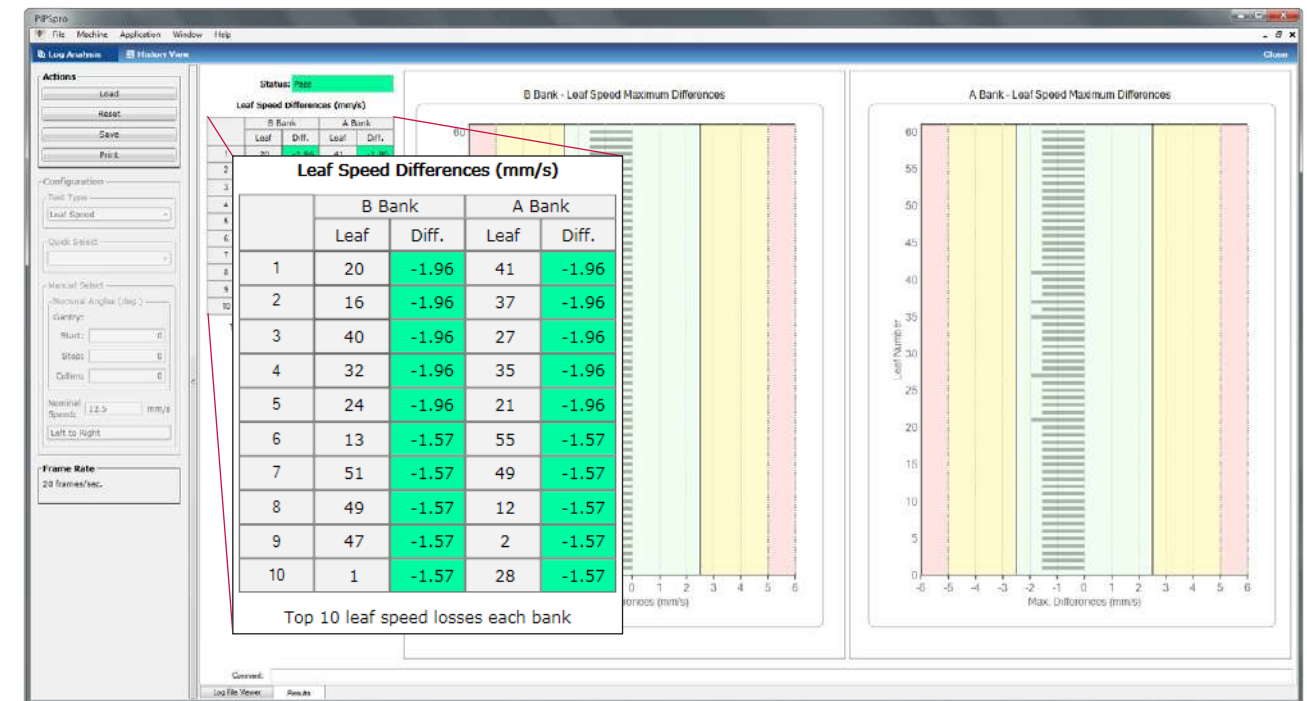
“PIPSpro is the first commercial machine QA software to determine leaf speed loss. Systems that report only maximum and mean leaf speed cannot be used to calculate leaf speed loss, as required by TG-142,” notes Standard Imaging medical physicist Shannon Holmes, Ph.D.

PIPSpro features automatic compositing of EPID MLC images, so you don't need to use third-party products to combine individual images.

In simple leaf speed tests, all leaves travel together

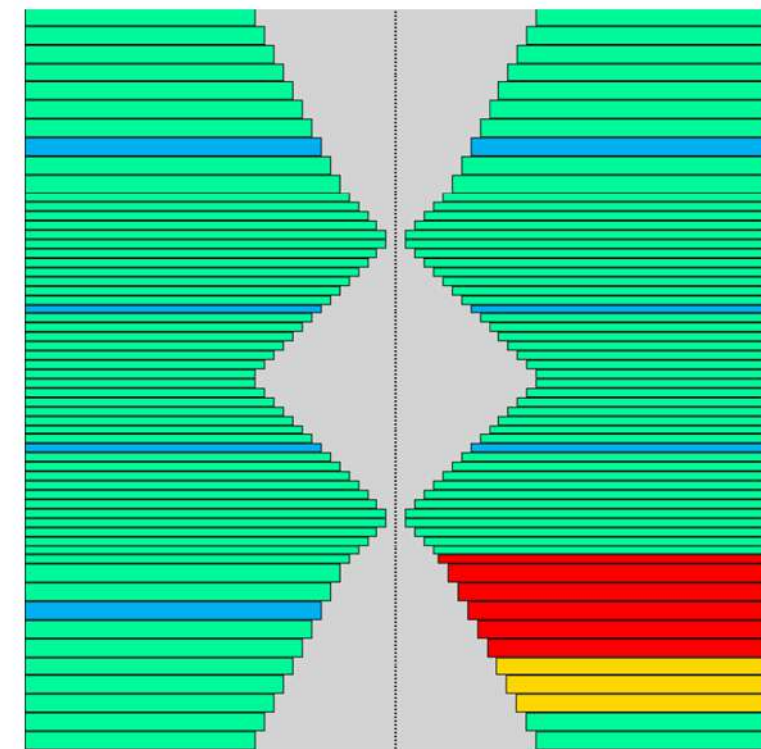


In complex leaf speed tests, every other leaf moves, maximizing inter-leaf friction



PIPSpro is able to measure quantitative leaf speed loss, not just deliver a qualitative result.

- Pass
- Alert
- Error
- Non-Moving



Leaf position status in a repeatability test

COMPREHENSIVE MACHINE AND IGRT QA

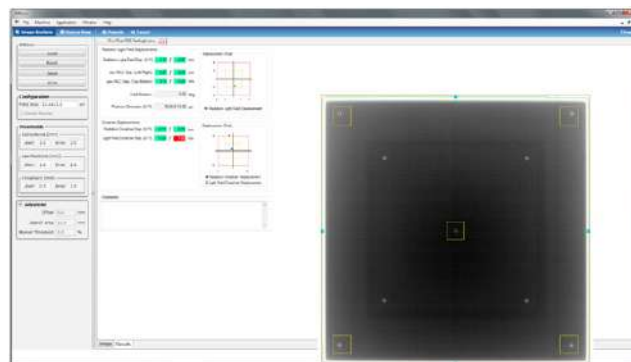
Track and trend results for classic TG-142 tests

Radiation Light Field Analysis

PIPSpro uses a single image taken with custom phantoms (FC-2, Center Marker) to calculate:

- Radiation and light field coincidence
- Radiation and crosshair displacement
- Light field and crosshair displacement
- Jaw position measurements
- Light field rotation

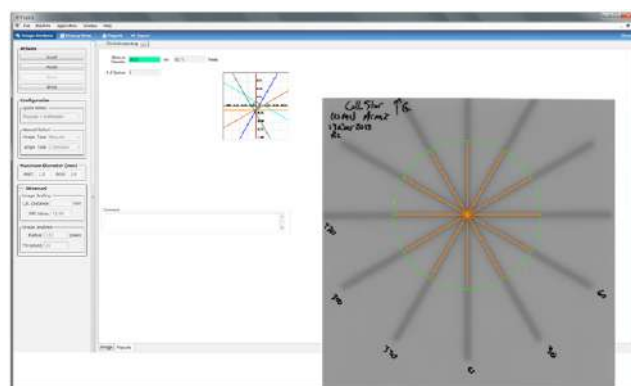
Works for light fields defined by jaws or MLCs.



Starshot Analysis

PIPSpro's StarShot module uses EPID MV or film images to measure rotational deviations in gantry, collimator, and couch mechanical isocenters. Results are expressed as the minimum diameter containing all spokes at the central point of intersection. Unlike competing software, PIPSpro features automatic compositing of individual EPID spoke images, so you don't need to use third-party products to combine images.

Works for spoke images defined by jaws or MLCs.



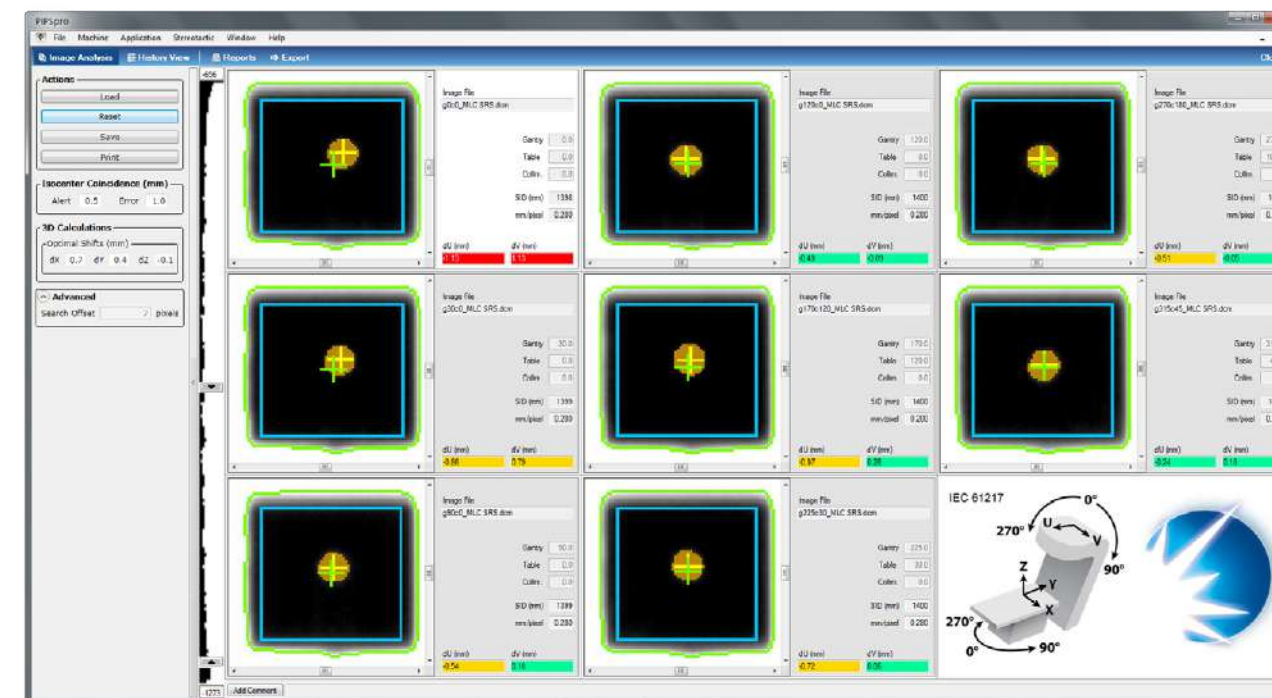
Daily IGRT QA Tracking

When using Image-Guided Radiation Therapy (IGRT) in the clinic, daily testing is recommended to verify that your imaging coordinate system is precisely aligned with your treatment coordinate system. TG-142 recommends two tests: "Imaging and treatment coordinate coincidence" and "Positioning/repositioning". Use the Standard Imaging MIMI (Multi-Image Modality Isocentricity) phantom with image registration software to calculate known 3D (x, y, z) and 6D (add couch pitch, yaw and roll) offsets. PIPSpro allows you to record your daily offsets and track and trend your results.



PRECISE STEREOTACTIC 3D ANALYSIS

Quick, easy, precise, and actionable



Isocenter Coincidence (mm)

Alert Error

3D Calculations

Optimal Shifts (mm)

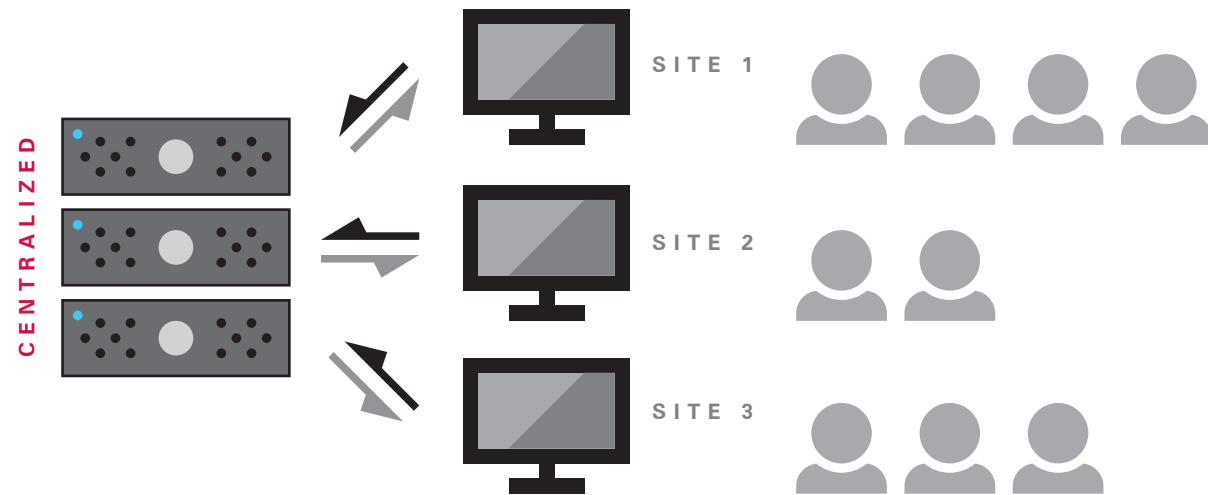
dX dY dZ

Use Standard Imaging's Winston-Lutz phantom to measure the difference between the radiation isocenter and the mechanical isocenter for a linear accelerator. A number of images are taken with your portal imager using fixed angles or angles of your choice.

- Automatically load and analyze any images, including DICOM images, for cones or MLC's.
- Automatically get 2D radiation/mechanical offsets for each image.
- Automatically get an optimal 3D offset to correct patient offset errors.
- 3D analysis with x, y, z results that help you improve patient positioning.

CENTRALIZED DATABASE MANAGEMENT

Simplify your QA by keeping all your data centralized and secure

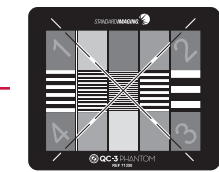


PIPSpro can use a local or centralized database server. As a result, PIPSpro is the choice of small, large and multi-location treatment centers across the world. PIPSpro has the feel of a desktop application using a centralized server, but gives you the power to organize your sites into divisions and departments assigning users permissions to the departments and tasks that they need to do their work.

Features include:

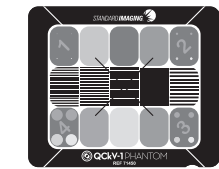
- Single access point controls division, department, linac, and user configuration
- Centralized data access point allows enterprise-wide access to data, results, and trending
- Unparalleled data security
- Citrix server support on enterprise wide systems
- DICOM router offers convenient access and routing of files by constantly listening for new images and automatically sorting them by file type and date into a directory of the users choosing

PHANTOMS



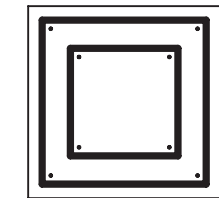
QC-3 Phantom
CALIBRATED PHANTOM
REF 71350

Used to test the image quality from electronic portal imaging devices (EPIDs).



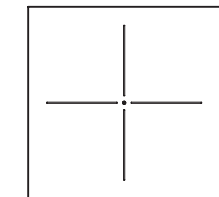
QcKv-1 Phantom
CALIBRATED PHANTOM
REF 71451

Ideal for kV imaging systems, including Varian, Elekta, BrainLAB and Cyberknife.



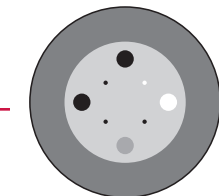
FC-2 Phantom
REF 72187

For performing the radiation field vs. light field test and jaw position testing

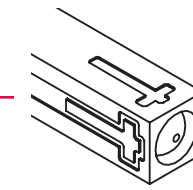


Center Marker Phantom
REF 72247

For performing the radiation field vs. light field test and jaw position testing

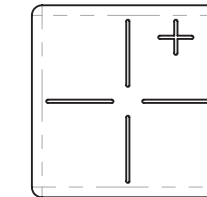


Catphan
purchased through your linac vendor
Compatible with model 503, 504, and 600 phantoms



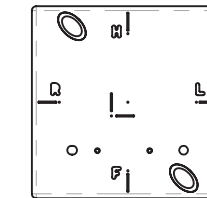
Winston Lutz Pointer Phantom
PIPSpro recognizes most ball marker phantoms
REF 72285

Expedite and simplify verification of sub-millimeter isocenter treatment setup.



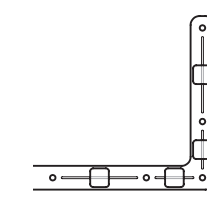
Winston Lutz Cube Phantom
PIPSpro recognizes most ball marker phantoms
REF 91345

Expedite and simplify verification of sub-millimeter isocenter treatment setup.



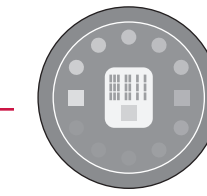
MIMI Phantom (Multiple Imaging Modality Isocentricity Phantom)
REF 91240

Ensure image guidance accuracy by measuring the coincidence of isocenter prescribed by the lasers, treatment beam and image guidance systems.



MLC QA Phantom
REF 72277

For analyzing individual leaf positions of multi-leaf collimators (MLC)



Leeds Test Objects
purchased through your linac vendor
Routine test objects designed to be used quickly and easily on a regular basis

RECOMMENDED

ADDED VALUE

Phantom holders available for CyberKnife and ExacTrac imagers make PIPSpro a complete QA software for all imaging delivery systems

PIPSPRO SOFTWARE SPECIFICATIONS

OPERATING SYSTEM	WINDOWS 7 (SP1) or better WINDOWS 8.1 (SP1) or better WINDOWS 10 (SP1) or better .NET 4.5.2 or better	DVD DRIVE	2X speed or greater
PROCESSOR	Intel® or AMD® 1 GHz or greater	VIRTUAL MACHINES	Must support WMI (Windows Management Instrumentation) Citrix XenDesktop and Citrix XenApp
MEMORY	1 GB (3 GB recommended)	DATABASE MANAGEMENT	SQL Server 2008 R2 minimum, SQL Server 2014 recommended.
HARD DRIVE	3 GB free space for software installation. Sufficient space to store input image and/or MLC Log files. 5 GB or greater if installing SQL Server Express on the install host.	PRODUCT STANDARDS	Designed to meet IEC 60601-1-4 CE
SCREEN	1152×864 XGA+ (4:3) 1600×900 (16:9) or higher 16 bit HiColor or greater		

Catphan® is a registered trademark of The Phantom Laboratory. Windows® is a registered trademark of Microsoft Corporation. Specifications subject to change without notice.



www.standardimaging.com

800-261-4446 . PH 608-831-0025 . FAX 608-831-2202

3120 Deming Way Middleton WI 53562-1461 USA

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1251-29 (10.16)