COMPREHENSIVE TG-142 IMAGING AND MACHINE QA

Automate the analysis of over 30 TG-142 recommended QA tasks without film
TG-142 Imager and Machine QA

The continual refinement of RT treatments into more advanced procedures dictates the need for superior, sustainable precision. However, imagers and machines degrade over time and recalibrations are required. TG-142 reconciles these divergent trends by recommending a multitude of daily, monthly and annual QA procedures. Though aimed at preventing clinically significant errors, these requirements further strain the busy schedules of RT professionals.

PIPSpro Software efficiently executes and consolidates QA workload by incorporating TG-142 procedures into one easy-to-use platform. When used in conjunction with specialized phantoms, PIPSpro becomes an indispensable part of your QA process.

Assurance is Confidence

Several manufacturers still include basic, qualitative phantoms, like the ‘Las Vegas’ test object, with their imaging systems. However, these phantoms do not provide quantitative data. In addition, these tests are done manually, without the aid of software to automate results.

In contrast, Standard Imaging phantoms provide quantitative, repeatable results. This data can be compared to published performance values or between systems to ensure your imagers are operating to specifications. These powerful trending tools alert you of issues before loss of quality becomes clinically significant.
Refined User-Interface

The QA modules of PIPSpro feature a new, simplified user-interface. Since the interface is consistent across modules, it is easy to quickly learn all facets of PIPSpro. Additionally, this unified layout allows multiple modules to be open simultaneously - streamlining workflow during acquisition, reporting and analysis routines.

Imager QC, Now TG-142 Recommended

PIPSpro Comprehensive’s Imager QA, Star Shot and Stereotactic, when coupled with the appropriate phantoms, facilitate over 30 tests recommended by TG-142. (Phantoms appear in parentheses)

Mechanical
- Light/radiation field coincidence (FC-2)
- Jaw position indicators [symmetric] (FC-2)
- Collimator rotation isocenter
- Gantry rotation isocenter
- Couch rotation isocenter
- Coincidence of radiation and mechanical isocenter
- Laser Alignment (MIMI)

Multileaf collimation
- Setting vs. radiation field for two patterns (MLC Phantom)
- Leaf position accuracy (MLC Phantom)
- MLC transmission (MLC Phantom)
- Leaf position repeatability (MLC Phantom)
- Coincidence of light field and x-ray field (FC-2)
- Segmental IMRT test (MLC Phantom)
- MLC spoke shot

Planar MV Imaging [EPID]
- Scaling (FC-2)
- Spatial resolution (QC-3)
- Contrast (QC-3)
- Uniformity and noise (QC-3)
- Imaging and treatment coordinate coincidence
  [single gantry angle] (MIMI)
- Imaging and treatment coordinate coincidence
  [four cardinal angles] (MIMI)

Planar kV Imaging
- Scaling (FC-2)
- Spatial resolution (QCkV-1)
- Contrast (QCkV-1)
- Uniformity and noise (QCkV-1)
- Imaging and treatment coordinate coincidence
  [single gantry angle] (MIMI)
- Imaging and treatment coordinate coincidence
  [four cardinal angles] (MIMI)

Cone-beam CT [kV] (PIPSpro using the Catphan)
- Geometric distortion
- Spatial resolution
- Contrast
- HU constancy
- Uniformity and noise
- Imaging and treatment coordinate coincidence (MIMI)
- Positioning/repositioning (MIMI)
New! Enhanced Imager QA Module

The Imager QA module consolidates TG-142 testing for MV, kV and 3D CT (both cone-beam and diagnostic) into a uniform, easy-to-use interface. Customizable profiles allow a variety of machine, imager, phantom and energy combinations to be quickly saved. Once a profile is selected, the user loads an image for analysis and PIPSpro does the rest. This “one-click” deployment provides three different figures of merit for calculating uniformity, including PIU (ACR percent integral uniformity).

A comprehensive baseline manager lets users customize imager QA. This tool can generate and store custom baselines for every test calculated within PIPSpro, allowing for a breadth of metrics to be easily tracked. Once testing is complete, PIPSpro automatically generates comprehensive reports that can be quickly exported to a PDF file. These reports contain a summary page detailing which values pass or are out of range, along with images of each result. All data is automatically tagged as green, yellow or red for an easy overview of passing/failing results.

Additional New Features

- Unified interface allows for multiple modules of PIPSpro to be open simultaneously.
- Supports the Catphan 600 and Leeds phantoms, as well as the independently calibrated QC-3 and QCkV-1 phantoms.
- Phantom imaging does not require jaw or blade positioning.

### Published reference performance values for spatial resolution

<table>
<thead>
<tr>
<th>EPID</th>
<th>Phantom on surface of EPID</th>
<th>Phantom at isocenter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6 MV / 15 MV / 25 MV</td>
<td>6 MV / 15 MV / 25 MV</td>
</tr>
<tr>
<td></td>
<td>150 epi / 130 epi / 150 epi</td>
<td>150 epi / 130 epi / 150 epi</td>
</tr>
</tbody>
</table>

#### Measurements of spatial resolution in lp/mm

<table>
<thead>
<tr>
<th>Phantom on surface of EPID</th>
<th>Phantom at isocenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRI-100</td>
<td></td>
</tr>
<tr>
<td>0.18 ± 0.02</td>
<td>0.18 ± 0.02</td>
</tr>
<tr>
<td>0.23</td>
<td>0.30 ± 0.02</td>
</tr>
</tbody>
</table>

| Siemens Beamview           |                       |
| 0.18 ± 0.02                | 0.18 ± 0.02           |
| 0.21 ± 0.03                | 0.19 ± 0.01           |
| 0.21 ± 0.02                | 0.22 ± 0.02           |

| Theraview                  |                       |
| 0.23 ± 0.01                | 0.22 ± 0.01           |
| 0.26 ± 0.01                | 0.23 ± 0.01           |

| PORTpro                    |                       |
| 0.24                       | 0.25 ± 0.02           |
| 0.24 ± 0.01                | 0.24 ± 0.01           |
| 0.26 ± 0.01                | 0.25 ± 0.01           |
| 0.285                      | 0.28 ± 0.01           |
| 0.33 ± 0.04                | 0.29 ± 0.01           |

| Elekta iView               |                       |
| 0.39                       | 0.34                  |
| 0.45                       | 0.77                  |

| Varian aS500              |                       |
| 0.60                      | 0.39                  |

| Varian aS1000             |                       |
| 0.45                      | 0.77                  |

| Elekta iViewGT            |                       |
| 0.46                      | 0.77                  |

Compare results to published values
Validated **Performance, Documented Results**

With performance supported by over 55 publications, PIPSpro Software, the QC-3 phantom (MV) and the QCkV-1 (kV) phantom are integral to meeting TG-142 standards. 11 regions of interest contain line pair patterns and materials of differing densities, allowing for the planar determination of resolution, contrast and noise. Compare these results to published data for further confidence in your QA.

**Track and Trend Imager Performance**

Published image resolution data for PIPSpro's QC-3 phantom provide a known quantity for each imager, making it easy to evaluate the quality of baseline values and compare values between systems. Using these baselines, the built-in database and trending software shows how your imagers are performing over time. User-determined warning and rejection levels on all graphs let you easily detect declining image quality.
When using on-board imaging systems for patient positioning, it is imperative to verify that the imaging coordinate system is aligned with the treatment beam. TG-142 recommends testing this on a daily basis. This test is performed using the Standard Imaging MIMI (Multi-Image Modality Isocentricity) Phantom, providing results in either three dimensions (X, Y, Z) or in six dimensions adding pitch, yaw and roll.

The new IGRT Module in PIPSpro is designed to collect this daily data and then automatically track and trend these values over time. The MIMI Phantom partners ideally with the IGRT module when performing daily checks of imaging and treatment coordinate coincidence. Bone rods running throughout the phantom make it easy to automatically register and quickly match and analyze 2D/2D and 3D/3D images.
Precise **Winston-Lutz/ Stereotactic Radiosurgery QA**

In linear accelerator based Stereotactic Radiosurgery, it is common to perform the Winston-Lutz test to verify machine isocentricity. For the Winston-Lutz test, a spherical marker is aligned to the laser described isocenter and a series of images are acquired at different gantry and couch rotation combinations.

PIPSpro Comprehensive simplifies this testing, using your portal imaging system to acquire the images of the spherical marker instead of film. These images are automatically loaded and analyzed to determine the isocentricity. 3D offsets from isocenter are reported with 0.1mm accuracy allowing you to have more confidence in your setup and treatment. Testing can be done for each gantry and couch angle for MLC or cone-based systems.
The MLC QA module analyzes a single, specialized phantom; producing quantitative data to determine if your collimator can accurately position leaves.

This module also follows TG-142 guidelines for reviewing multiport or 'picket-fence' images. These test a MLC's ability to position individual leaves at multiple positions during single treatments such as step-and-shoot and sliding window IMRT.

In addition, the module lets users measure inter-leaf and inter-bank leakage and leaf-width, making PIPSpro the only software necessary for comprehensive MLC QA. The MLC QA Module meets TG-142 guidelines for the following tests:
- Qualitative test [i.e., matched segments, aka ‘picket fence’]
- Setting vs radiation field for two patterns [non-IMRT]
- Leaf position accuracy [IMRT]
- MLC transmission [average of leaf and interleaf transmission, all energies]
- Leaf position repeatability
- Coincidence of light field and x-ray field [all-energies]
- Segmental IMRT [step and shoot] test
Advanced **Radiation Field/ Light Field**

The FC-2 and Center-Marker phantoms expedite analysis of several TG-142 recommended machine QA procedures, including:

- Light/radiation field coincidence: Meets TG-142 specifications of measuring tolerances of 2 mm or 1% on a side.
- Jaw position indicators (symmetric): Meets TG-142 specifications of measuring tolerances of 2 mm.
- MLC Coincidence of light field and x-ray field (all energies): Meets TG-142 specifications of measuring tolerances of ±2 mm.

Over 30 TG-142 procedures
Powerful **Star Shot Analysis**

PIPSpro's Star Shot Module uses an EPID or film to measure the stability of rotation of the linac gantry, couch and collimator. Analysis of these images provides quantitative results for mechanical procedures, including:

- Collimator rotation isocenter – Meets TG-142 specification of measuring tolerances of ±1 mm from baseline.
- Gantry rotation isocenter – Meets TG-142 specification of measuring tolerances of ±1 mm from baseline.
- Couch rotation isocenter – Meets TG-142 specification of measuring tolerances of ±1 mm from baseline.

Centralized **Database Management**

PIPSpro can store data on a central network for quick documentation and access for TG-142 test results and trending reports. QA results are shown in easy-to-read reports, charts, and graphs, which can be exported to PDF and ASCII files without additional software tools. An equipment manager stores an unlimited number of linear accelerators and phantoms, eliminating continual re-entering of clinical device data.

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**PIPSpro Software SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OPERATING SYSTEM</strong></td>
<td>Windows® 7, Windows Vista®, Microsoft® Windows® XP</td>
</tr>
<tr>
<td><strong>PROCESSOR</strong></td>
<td>Intel® or AMD®, 350 MHz or greater</td>
</tr>
<tr>
<td><strong>MEMORY</strong></td>
<td>64 MB (256 MB recommended)</td>
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<tr>
<td><strong>HARD DRIVE</strong></td>
<td>50 MB or greater</td>
</tr>
<tr>
<td><strong>SCREEN RESOLUTION</strong></td>
<td>800 x 600 (1024 x 768 recommended)</td>
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<tr>
<td><strong>CD-ROM DRIVE</strong></td>
<td>2X speed or greater</td>
</tr>
<tr>
<td><strong>SCREEN COLOR DEPTH</strong></td>
<td>256-bit or greater</td>
</tr>
<tr>
<td><strong>PRODUCT STANDARDS</strong></td>
<td>Designed to meet IEC 60601-1-4</td>
</tr>
<tr>
<td><strong>RECOMMENDED SOFTWARE</strong></td>
<td>Microsoft Excel</td>
</tr>
</tbody>
</table>

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

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Visit [www.standardimaging.com](http://www.standardimaging.com) or call **800-261-4446** for more details.


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