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.

CAUTION:
Federal law in the U.S.A., and Canadian law, restricts the sale distribution, or use of this product to, by, or on the order of a licensed medical practitioner. This product should be used under the guidance of a medical physicist.

CAUTION:
The “Save” and “Save As” functions of the PIPSpro System are intended solely to save solutions of interest or potential reuse. Specific patient information or identifiers should not be saved using these functions.

CAUTION:
To minimize the potential for computer issues, do not run PIPSpro concurrently with other software programs.

CAUTION:
Proper use of this product depends on careful reading of all instructions and labels.

CAUTION:
For accurate results in the MLC QA Module the MLC QA Phantom must be positioned carefully to ensure that the corner spherical marker is aligned to isocenter and that the supporting arm is perpendicular to the gantry rotation.

CAUTION
The MLC module expects all tests to be performed with the collimator at either 0, 90, 180 or 270 degrees. Collimator angle accuracy should be verified before acquiring images for analysis in the MLC module. Variance in the expected angle could result in incorrect positions being reported for individual MLC leaves.

WARNING:
Issues identified through the use of this product must be investigated and appropriately resolved and/or noted.

WARNING:
Proper application of the QC-3 Phantom, QCKV-1 Phantom and/or FC-2 Phantom requires the use of the PIPSpro Software.

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.

CAUTION:
For professional use only. As desired by IAEA, English is the default language for labeling and manuals. If translated versions are available, resolve any difference in favor of the English versions.
This Quick Start guide should allow you to start using PIPSpro 5.5 immediately. In addition to this introduction, there is an “Overview of PIPSpro Applications” and a section on “Common Application Functionality.”

The Quick Start guide is not intended to be a substitute for the User Manual or the Phantom Setup Guide, both of which contain more detailed information on the use of PIPSpro.

Installation
The PIPSpro installer can be obtained on CD or by download. If you have already installed a previous version of PIPSpro and want to upgrade OR you want to create a new install, select “PIPSpro Client and Database.” Follow prompts.

From the Initial Installer Screen
Example images, logfiles, MLC patterns and RT Plans can be found under:

C:\Program Files (x86)\Standard Imaging PIPSpro, OR
C:\Program Files\Standard Imaging\PIPSpro

The first time you log in, you may log in as Username: Superuser, Password: Superuser.

System Manager
The System Manager allows a user at the administrator level or above to configure PIPSpro for a specific department or departments. Divisions that “own” departments, users, machines, and phantoms are specified. Although, PIPSpro can be run by the Superuser, PIPSpro functionally works best if each user has an individual login and password. For instance, results cannot be approved by the Superuser.

Alert Error Thresholds
Alert and error thresholds are set in the System Manager for all tests except for Imager QA. Default error thresholds are the TG-142 recommended values. Default alerts are usually one half of the error thresholds.

For Imager QA, a "Baseline Editor" allows you to specify results that are typical as your baselines. Alert and error levels are specified with respect to these baselines.

General Tips and Tricks
- Create separate logins and passwords for each user.
- When imaging, always use the same technique. Different techniques will yield different results.
- To insure good image resolution, always use as small a field of view as possible. Smaller fields of view will have more pixels per structure of interest.
- Be sure to set up your phantoms correctly and accurately. Poor or inconsistent setup will lead to an inability to get results or results that do not trend well.
- PIPSpro accepts TIFF (16-bit), BMP (8-bit), DICOM, and native format images from Cyberknife and ExacTrac.

Applications
PIPSpro is composed of seven different applications that allow testing a large number of imaging and linac machine parameters:

- **Imager QA**
  - Single Planar (MV, kV)
    - Spatial Resolution
    - Noise
    - Contrast to Noise
    - Uniformity
  - Dual Planar (MV, kV)
    - Spatial Resolution
    - Noise
    - Contrast to Noise

- **Computed Tomography (CT)**
  - Spatial Resolution
  - Uniformity and Noise
  - Hounsfield Constancy
  - Geometric Distortion
  - Low Contrast Detectability
  - Low Contrast Visibility
  - Slice Thickness

- **Radiation Light Field**
  - Light Field vs. Radiation Field Displacement
  - Radiation Field vs. Crosshair Displacement
  - Light Field vs. Crosshair Displacement
  - Jaw Placement Errors with respect to Central Axis

- **StarShot**
  - Maximum Diameter

- **Stereotactic**
  - Optimal Shift (dX, dY, dZ)
  - Worst case 2D isocenter displacements (dU, dV)

- **IGRT**
  - 3D Couch
    - Position Error (X, Y, Z)
  - 6D Couch
    - Position Error (X, Y, Z)
    - Angle Error (Pitch, Roll, Yaw)

- **Image-Based MLC QA**
  - Leaf Position - Expected and actual leaf positions
  - Multi-Port - Expected and actual leaf positions
  - Leaf Transmission - Leaf leakage and Inter-Bank leakage

- **Logfile-Based MLC QA Tables and Charts**
  - Loss of Leaf Speed
  - Accuracy (exact position, RMS error, 95% mm)
  - Repeatability
## Data Acquisition

### Imager QA
- Analyze flat panel and CT images for standard quality assurance metrics.

### Radiation Light Field
- Establish radiation light field coincidence, crosshair centering, and jaw position accuracy.

### StarShot
- Establish the diameter of the center of rotation for the gantry, couch, and collimator.

### Stereotactic
- Use Winston-Lutz-type tests to establish the radiation and mechanical isocenter coincidence.

### IGRT
- Track deviations in the daily coincidence of imaging and radiation isocenters.

### Image-Based MLC QA
- Analyze the accuracy and leakage of MLC’s for leaf position, picket fence (Multi-Port), and interleaf and interbank transmission.

### Logfile-Based MLC QA
- Analyze Varian DynaLog files and Trajectory logfiles and Elekta “TRF” logfiles for loss of leaf speed, accuracy, and repeatability.

#### Phantoms:
- QC-3 for planar MV, QCKV-1 for planar kV, Catphan 503, 504, 600, or 604 for CT.
- DICOM only.

#### Planar:
- Align QC-3, QCKV-1 phantom at a 45 degree angle with the number ‘1’ facing the gantry. Align the crosshair on the phantom to the beam central axis.

#### MV images:
- 3 - 5 MU.
- kV images: 70 - 100 kV and the lowest mAs.

#### Flood field images:
- Must irradiate the entire imager without hitting any “electronics.” Phantom images need at least a 15x15 cm field.

#### CBCT:
- Set up Catphan to lasers as “squarely” as possible with the third marker from the gantry aligned to the cross plane lasers. Acquire images with as close to a 24 cm FOV as possible using 2.5 mm slices.

#### Always use the same imaging protocol for each Imager QA test.

### CBCT:
- 15x15 cm field images need at least a Flood field images.
- The lowest mAs.
- 70 - 100 kV and central axis.

#### Place the number ‘1’ facing the phantom at a 45 degree angle.

#### Align the crosshair on the phantom to the beam central axis.

#### Place the center marker phantom on the FC-2. Align it to the crosshairs.

#### Portal Imager: 3 - 5 MU.

### Phantoms:
- FC-2 and Center Marker Phantom.
- Images: EPID. (Film is possible, but not recommended.)

#### Place FC-2 phantom on couch. Set SSD to FC-2 at 100 cm. Set jaws or MLC to 10x10 or 15x15.

#### Use the light field, align inner edges of FC-2 grooves to the field edges as carefully as possible. Ignore the central crosshair on the FC-2.

#### Place the center marker phantom on the FC-2. Align it to the crosshairs.

#### Portal Imager: 3 - 5 MU.

### Monitor Units:
- Radiographic: 3 - 5 MU
- Radiographic: ~400 MU
- Portal Image: 3 - 5 MU

#### Scan film as a grayscale image with a resolution of 72 - 96 dpi. Save as TIFF or BMP.

#### Separate EPID images may be combined using PIPSpro image compositing tools.

#### Monitor Units:
- Monitor Units: Radiographic: 3 - 5 MU
- Radiographic: ~400 MU
- Portal Image: 3 - 5 MU

#### Use Winston-Lutz phantom at isocenter as defined by the light field crosshairs. You may also use lasers if you use them clinically.

#### Acquire up to 8 separate images. Recommended IEC 61217 angles:

<table>
<thead>
<tr>
<th>Angle</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>130</td>
<td>0</td>
</tr>
<tr>
<td>230</td>
<td>0</td>
</tr>
<tr>
<td>300</td>
<td>0</td>
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<tr>
<td>60</td>
<td>270</td>
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<tr>
<td>130</td>
<td>270</td>
</tr>
<tr>
<td>230</td>
<td>90</td>
</tr>
<tr>
<td>300</td>
<td>90</td>
</tr>
</tbody>
</table>

#### Portal Imager: 3 - 5 MU.

#### Eight angles will allow the optimal isocenter shift to be calculated.

#### Less than eight images will allow 2D offsets to be calculated only.

### Phantoms:
- Winston-Lutz.
- Images: EPID only.

#### Gantry and couch images must be taken with film. Collimator images may be taken with either film or EPID.

#### Close lower collimators to form a narrow slit about 5 mm wide. MLC’s may also be used. Using build up, irradiate film or EPID using several angles (e.g., 0, 90, 315 degrees).

#### Acquire up to 8 separate images. Recommended IEC 61217 angles:

<table>
<thead>
<tr>
<th>Angle</th>
<th>Deviation</th>
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</thead>
<tbody>
<tr>
<td>60</td>
<td>0</td>
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<td>230</td>
<td>90</td>
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<tr>
<td>300</td>
<td>90</td>
</tr>
</tbody>
</table>

#### Portal Imager: 3 - 5 MU.

#### Eight angles will allow the optimal isocenter shift to be calculated.

#### Less than eight images will allow 2D offsets to be calculated only.

### Phantoms:
- MIMI.
- Images: Daily alignment.

#### Images are not imported into PIPSpro. Results of morning alignment input by user.

#### For positioning and repositioning test, place the phantom on the couch and align it to the isocenter. Offset the phantom a known distance in the X, Y, and Z directions. If the system has a 6D couch, apply angle offsets. Acquire MV orthogonal images and register using a 2D/2D matching algorithm provided with your linear accelerator’s software.

#### For treatment coordinate coincidence test, without moving the phantom, acquire either 2D kV projection images or a full 3D CBCT image series. Register using matching algorithms provided with your linear accelerator’s software.

#### Good results are near zero distance and angle shift for the second step.

### Phantoms:
- MLC QA or graticule (film only).
- Images: Film or EPID.

#### MLC test patterns are provided in the PIPSpro installation folder.

#### For EPID images, no phantoms are required. For film images, it is recommended to use your calibrated graticule when imaging. The graticule will provide alignment and scaling information.

#### You can use the MLC QA phantom with the In-Air Comparison Jig alternately. Refer to User Manual for setup.

#### Monitor Units:
- Monitor Units: Radiographic: 3 - 5 MU
- Radiographic: ~400 MU
- Portal Image: 3 - 5 MU

#### Scan film as a grayscale image with a resolution of 72 - 96 dpi. Save as TIFF or BMP.

#### Separate EPID images may be combined using PIPSpro image compositing tools.

### Phantoms:
- None.
- Images: None.

#### Non-clinical MLC patterns and RT Plans for leaf speed and repeatability are provided in the PIPSpro installation folder.

#### To learn how to acquire logfiles, see Appendix C: Acquiring Varian Logfiles or Appendix D: Acquiring Elekta Logfiles in the PIPSpro 5.5 User Manual.

#### For a basic introduction to logfiles and how they are interpreted by PIPSpro, see Appendices E - H.
## Image Analysis

<table>
<thead>
<tr>
<th>Applications</th>
<th>Imager QA</th>
<th>Radiation Light Field</th>
<th>StarShot</th>
<th>Stereotactic</th>
<th>IGRT</th>
<th>Image-Based MLC QA</th>
<th>Logfile-Based MLC QA</th>
</tr>
</thead>
</table>

### Imager QA

1. Open Imager QA by selecting Application>Imager QA from the main menu.

### Radiation Light Field

1. Open Radiation Light Field by selecting Application>Radiation Light Field from the main menu.

### StarShot

1. Open StarShot by selecting Application>StarShot from the main menu.

### Stereotactic

1. Open Stereotactic by selecting Application>Stereotactic from the main menu.

### IGRT

1. Open IGRT by selecting Application>IGRT from the main menu.

### Image-Based MLC QA

1. Open Image-Based MLC QA by selecting Application>Image-Based MLC QA from the main menu.

### Logfile-Based MLC QA

1. Open Logfile-Based MLC QA by selecting Application>Logfile-Based MLC QA from the main menu.

---

1. Open Imager QA by selecting Application>Imager QA from the main menu.

2. If you have created a Quick Select for the test you wish to run, load it. Otherwise use Manual Select to specify your test. Then, select [Load] under Actions in the left-hand panel:
   - Single Planar - Load a phantom image and a flood field image.
   - Dual Planar (not recommended because it does not have a uniformity test) - Load two phantom images.
   - CT - Load a CT series.

3. ROI analysis markups are placed automatically.
   - If required, adjust markups using the provided controls.

   For planar analysis a result tab will appear.

### Radiation Light Field

1. Open Radiation Light Field by selecting Application>Radiation Light Field from the main menu.

2. Select [Load] under Actions in the left-hand panel. Select an image.

   Select the angle type (Collimator, Couch, or Gantry) and then [Calculate].

### StarShot

1. Open StarShot by selecting Application>StarShot from the main menu.

2. Select [Load] under Actions in the left-hand panel.

   Select an image.

   For film images, place a single fiducial marker near the center of the intersecting spokes. DICOM images do not require the fiducial and are automatically identified as collimator images.

### Stereotactic

1. Open Stereotactic by selecting Application>Stereotactic from the main menu.

2. Select [Load] under Actions in the left-hand panel.

   Select between two and eight images. Two images is the minimum for analysis and eight is the minimum to calculate “Optimal Shift.”

### IGRT

1. Open IGRT by selecting Application>IGRT from the main menu.

2. No images are used in the IGRT module. Instead, enter offsets determined by your treatment delivery image analysis system into the appropriate fields.

### Image-Based MLC QA

1. Open Image-Based MLC QA by selecting Application>Image-Based MLC QA from the main menu.

2. Select [Load] under Actions in the left-hand panel. Select an image.

   Select the angle type (Collimator, Couch, or Gantry) and then [Calculate].

### Logfile-Based MLC QA

1. Open Logfile-Based MLC QA by selecting Application>Logfile-Based MLC QA from the main menu.

2. Select [Load] under Actions in the left-hand panel. A browser appears that allows you to select logfiles based on your machine type. Select a logfile then select [Open].

   The system presents Logfile Information and tries to find a Quick Select that matches it. If there is no matching Quick Select, the user can edit Manual Select values to match intended nominal values (e.g., 180, not 181 degrees) before saving and making a new Quick Select.

3. As stated above, we recommend doing the “positioning and repositioning” test prior to the “treatment coordinate coincidence test”. To do this, a 2D MV/MV registration should be done first followed by 2D or 3D kV/kV registration.

### Markups

- Leaf Position and Multi-Port markups show identified edges (Full Width Half Max).

### Results

Results automatically appear in a new tab.

### Elekta logfile movies do not show leaf status for leaf speed or other moving leaf tests.

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**Image Analysis**

- Selections for 2D MV

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**Image Analysis**

- Selections for 3D MV
CBCT results use the dropdown menu in the upper right to navigate between multiple pages of results.

For CBCT, suboptimal results can often be traced back to setup. The Key Slice is often not found when setup is not good or the FOV is too small. Markers must be clearly visible on one CT slice as shown. If some are visible on one slice and not another that is an indication that the phantom was not set up squarely.

The only really important result is the Minimum Diameter, which is shown “passing” green, above.

If there is any brown color around outside of the ball, that should be adjusted away using a smaller search offset.

The “Optimal Isocenter Shift” is the best shifted position for the ball marker to get improved 2D results. Always check that these shifts achieve better results. These shifts should not be used clinically. They are just for checking phantom setup.

Leaves that are non-moving or in the wrong position when the beam is off do not contribute to statistics. Mouse over leaves to see their number and error status.

Leaf Speed Results include graphs of worst case loss of leaf speed for each leaf and table of the ten worst performing leaves.

Accuracy Results are shown for Step and Shoot, Sliding Window and Modulated Arc. They include leaf error RMS, 95% of error counts (in mm), and a tabular leaf error histogram (as well as a table of the ten worst performing leaves).

Repeatability Results include graphs of worst case failure to return to a specified position (as well as a table of the ten worst performing leaves.)
Applications continued

Common Functionality for Applications

Standard Action Buttons

All applications, except IGRT, have the standard action buttons below. IGRT just has [Save].

![Action Buttons](Image)

Note that the standard action button functionality can also be accessed under the “File” menu. And, as such, “hot keys” can be used for some functions (e.g., Load, Save, and Print).

Saving Results

Results can be saved in all applications. Saved results become a permanent part of the PIPSpro database.

To save results to the database, select [Save] in each application’s left-hand panel under Image Analysis or Log Analysis. To discard results and try again, select [Reset]. The workflow is slightly different in IGRT, where there is no reset functionality.

Quick Selects help you remember experimental setups and index results in the Results History. Quick Selects can be renamed, archived, and deleted in the System Manager. Quick Select functionality will be added to other applications as needed. The Quick Select naming dialog appears the first time a particular experimental setup is encountered.

It is probably best to name your Quick Select when the dialog appears, but you can name it later in the System Manager.

Results Approval

Once results are saved to the PIPSpro database, they can be approved by users whose position is designated as Physicist or Physician. The Superuser cannot approve results.

To approve a result, select [Print] after results have been saved. A login dialog will present which will accept your user name and a password in order to approve the results just calculated.

Results can be printed whether or not they are saved or approved. A report will be displayed in a preview window (see report to right). Approval status will appear at the bottom of the report. If a report is not approved, it will show “Generated by” instead of “Approved by”.

Results History

Results History is available in all applications. When you select History from the blue bar at the top of PIPSpro, you will be presented with a page that allows you to select results from the current machine and application that are of interest to you. There are two basic ways of selecting results: through Quick Selects for Imager QA and Logfile-Based MLC QA and through parameter selection for the other applications. All applications allow you to select a data range for results.

To view records from a specific query, select [Apply]. Once a query is made and records are found, individual records can be achieved or returned to active state. You can also view only active or only archived records.

To archive data that are not relevant, select them in the active Table View, and select [Archive]. To re-activate an archived record, select it in the archived Table View and select [Activate].
All applications except Logfile-Based MLC QA have a print option.

The Show Detail checkbox allows the user to obtain more information about a particular data record appearing in the Table View. You must select a record in order to view details. Just click on a record to select it.

To exclude a record from being displayed in charts, select the associated "Don’t Chart" check box.

To view details about a specific record, select a record and the Show Detail check box. This functionality appears only in Imager QA, Radiation Light Field, and Stereotactic.

Logfile-Based MLC QA does not have a separate Chart View as the charting functionality appears on the same tabs as the MLC B Bank and A Bank information; the Table View and Chart View are combined.

To zoom in on an area of the chart, click and drag across the section of interest. Use the or buttons to zoom out again. If icons appear at the bottom of the chart they can be selected/unselected to control what information is displayed on the chart. This is a finer level of control than is possible using the “Don’t Chart” checkbox alone.

All applications except Logfile-Based MLC QA have the ability to export results history as a compiled report.

Select File>Reports... and one of the following dialog box styles presents. As with History, the Imager QA report history is indexed by Quick Select; for all other applications there is no Quick Select. Future releases will have more extensive use of Quick Selects to index results. Optionally select a Quick Select then a select date range and OK to view a report.

All applications except Logfile-Based MLC QA have the ability to export results history in comma separated variable (*.csv) files. These files can be read into Excel and data extracted and visualized using Excel tools and graphics. This capability may be especially useful when determining what individual tolerances should be for Imager QA tests in the Baseline Editor.

Select File>Export... and one of the following dialog box styles presents. Optionally select a Quick Select, then a date range, and [OK] to save data in *.csv format.