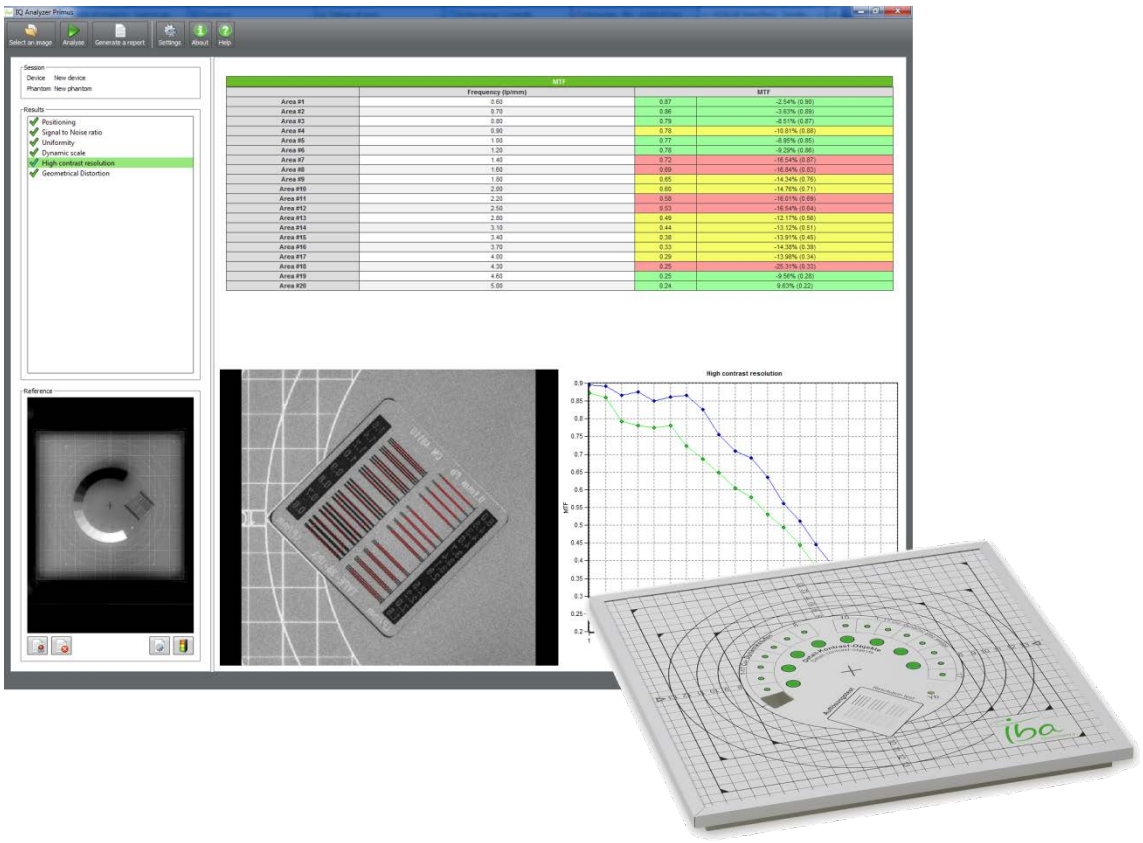
IQ Analyzer Primus v1.0

User Manual



Notice

This manual is an integral part of the IQ Analyzer Primus and should always be kept at hand. If the manual is missing, immediately contact the IBA Dosimetry GmbH for a copy.

Observance of the manual instructions is required for proper performance and correct operation of the IQ Analyzer Primus. The IQ Analyzer Primus and its accessories must not be used for any other purpose than what is described in the accompanying documentation (intended use). Violation will result in loss of warranty.

IBA Dosimetry GmbH does not accept liability for injury to personnel or damage to equipment that may result from misuse of this equipment, failure to observe the hazard notices contained in this manual, or failure to observe local health and safety regulations.

Under no circumstances shall IBA Dosimetry GmbH be liable for incidental or coincidental damage arising from use of the equipment described in this document.

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1 Introduction

IQ Analyzer Primus is an integrated solution enabling the quality control of medical imaging equipment, based on the analysis of Primus phantom images. Controls are run by automatically analyzing the images of the phantom and by computing a large number of evaluation parameters.

1.1 System requirements

The minimum hardware and software configuration required to install the software is:

- Processor : Intel® Core 2 Duo,
- Memory : 1 Go DDRAM,
- Graphics card : ATI or NVIDIA 512 Mo,
- Minimum screen resolution : 1024*768 (19 inches),
- Windows based system (XP, Vista, 7, 8).

1.2 Acquisition information

Image acquisition should be done with the phantom centred on the device and without residual angle. The software supports 90° rotations (0°, 90°, 180° and 270°).

The following image results from the acquisition of the Primus Phantom:

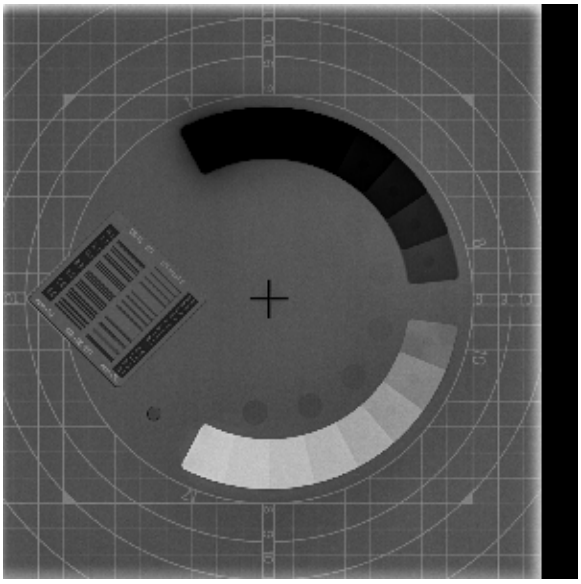


Figure 1 : Primus acquisition

The modalities supported by the IQ Analyzer Primus are: CR, DR, DX, RF and XA.

Note : The IQ Analyzer Primus does not support rectangular pixels. Only images with squared pixels can be analysed. If a non-squared pixels image is loaded, a message appears and the computation will not be performed.

1.3 Using IQ Analyzer Primus – Step by Step

After the identification window, the main interface below appears. It is composed of 3 different areas:

- Tool bar (blue area): contains the buttons for the main actions
- Information (red area): contains device/phantom couple selected, the list of parameters, the reference image management and tolerances.
- Display (green area): contains the image, tables and graphs for each parameter computation.

-

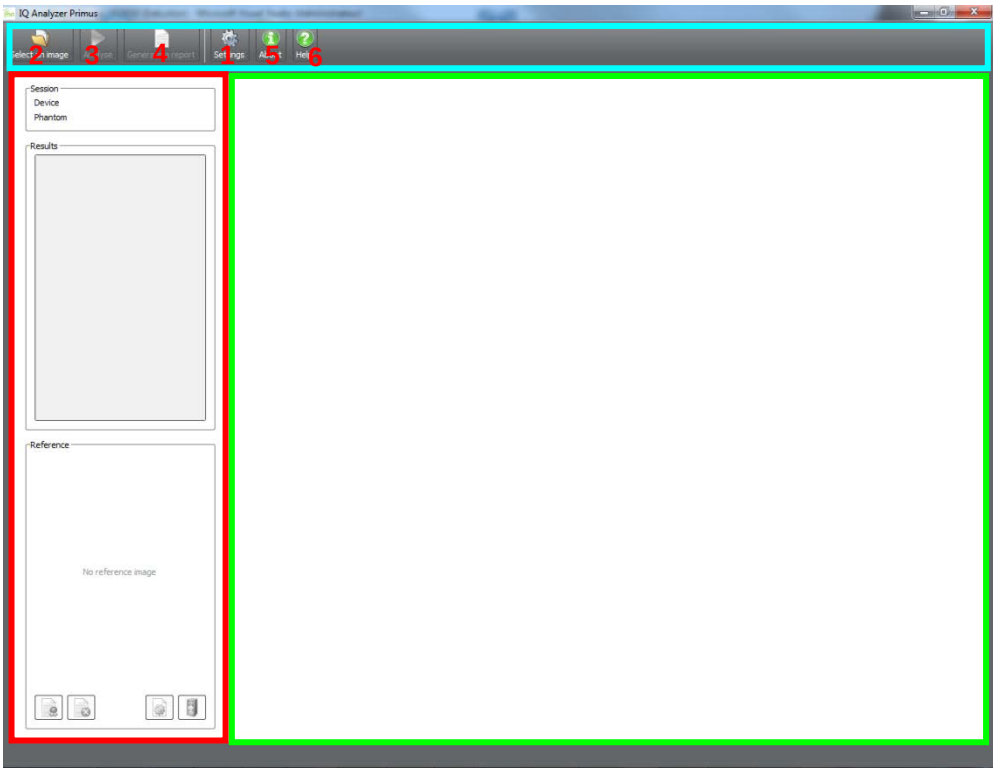


Figure 2 : Main Interface

The workflow of the software is as follows:

1 – Configure your imaging equipment, phantoms, users and default tolerances

2 – Select the image to analyze

3 – Launch the analysis

4 – Generate a report of the analysis

5 – About window

6 – Help window

The following sections will detail the different steps.

2 Settings Menu

By clicking on **Settings**, the settings window appears. This window is split into 5 tabs:

- Devices
- Phantoms
- Model
- Users
- Default tolerances

2.1 Device Settings

2.1.1 Add a Device

Select the tab **Device** and click on the button to create a new device. Then fill the different fields with the required information. Note that only the name of the device is mandatory.

Click on the button to associate an image of the device.

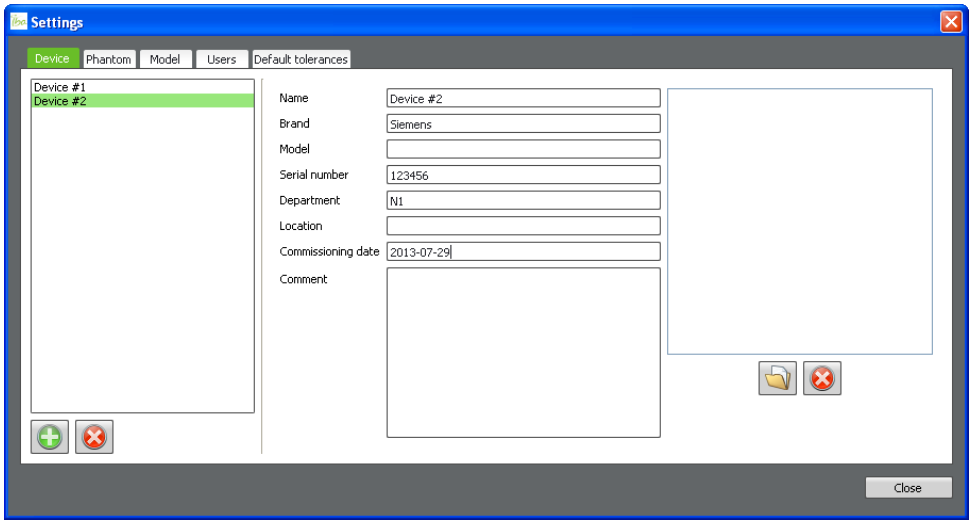


Figure 3 : Settings Window – Device Tab

Note: Information concerning the device is automatically saved when filled. This information will be displayed on each report control.

2.1.2 Modify a Device

Select the device to modify in the list and change the value of the fields.

Note: If an image associated to a device is loaded in the main interface, its modification is disabled.

2.1.3 Delete a Device

Select the device to delete in the list and click on the button .

Note: If an image associated to a device is loaded in the main interface, its deletion is disabled.

2.2 Phantom Settings

2.2.1 Add a Phantom

Select the tab **Phantom** and click on the button to create a new phantom. Then fill the different fields with the required information. Note that only the name of the phantom and the model are mandatory.

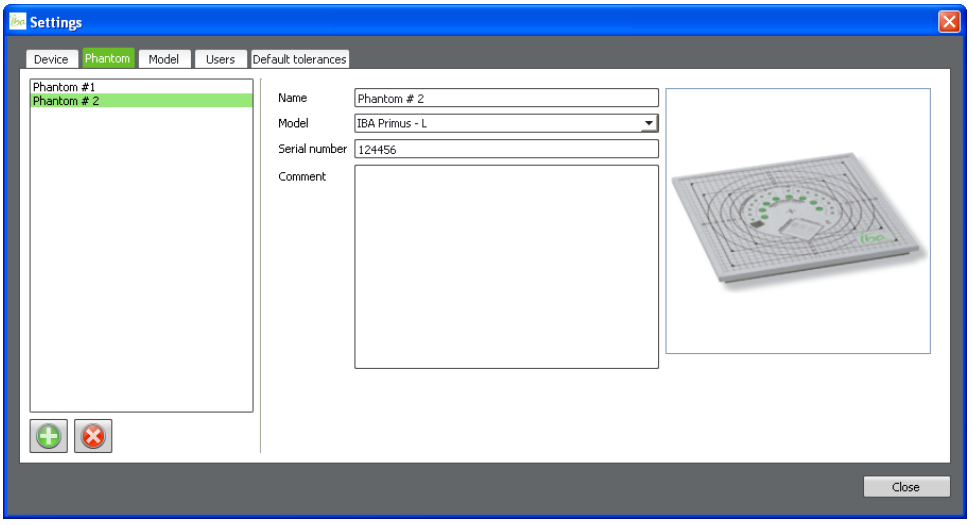


Figure 4 : Settings Window – Phantom Tab

Note: Information concerning the phantom is automatically saved when filled. This information will be displayed on each report control.

2.2.2 Modify a Phantom

Select the phantom to modify in the list and change the value of the fields.

2.2.3 Delete a Phantom

Select the phantom to delete in the list and click on the button .

2.3 Model Settings

The user can add a new model of phantom by clicking on the button  in the tab Model. A new phantom model is loaded using .model files, provided by IBA.

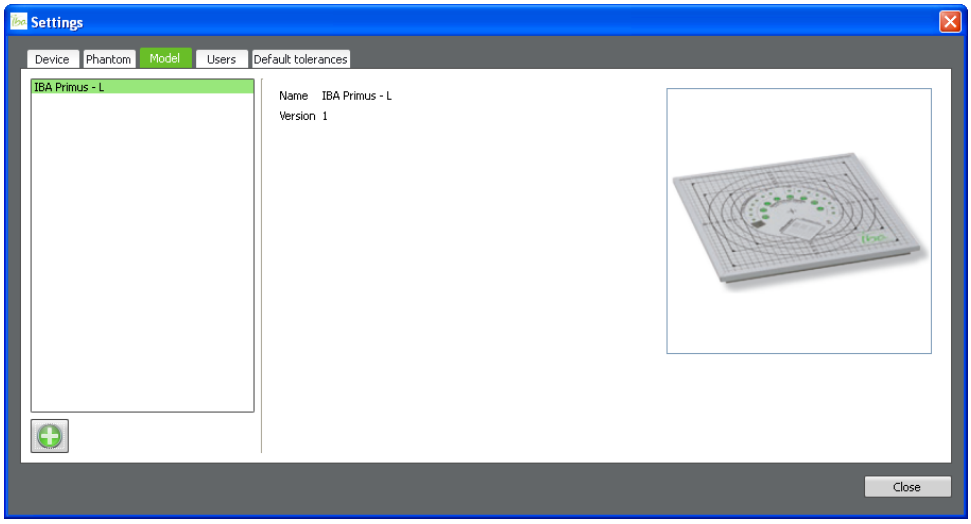


Figure 5 : Settings Window – Model Tab

2.4 Users settings

2.4.1 Add a user

Select the tab **User** and click on the button  to create a new user filling the fields.

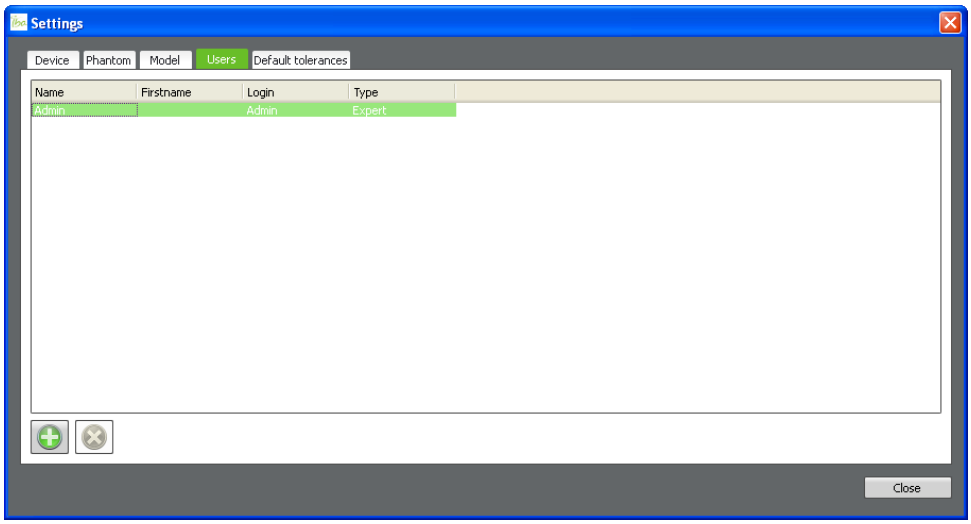


Figure 6 : Settings Window – User Tab

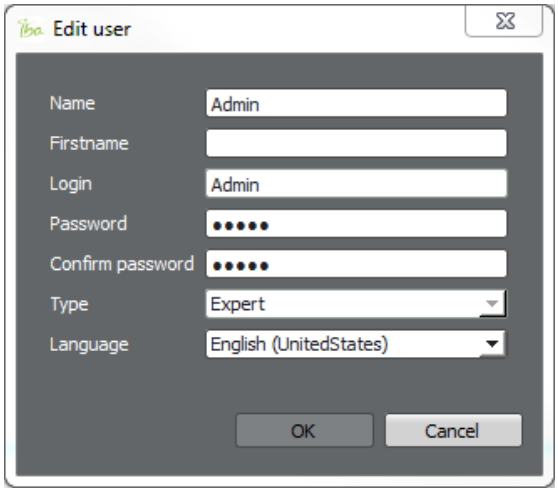


Figure 7 : User creation window

The user can choose its preferred language in the list. When a language is selected it will be applied to the software but also to the user manual (accessible in the Help menu).

*Note: Information concerning the user will be saved after clicking on the button **OK**. The button **CANCEL** will cancel the user creation.*

The type of user will be explained in a separate section.

2.4.2 Modify a user

Select the user to modify in the list and double click to change the value of the fields.

2.4.3 Delete a user

Select the user to delete in the list and click on the button .

2.5 Default tolerances

The expert user has the possibility to define default tolerances using this tab.

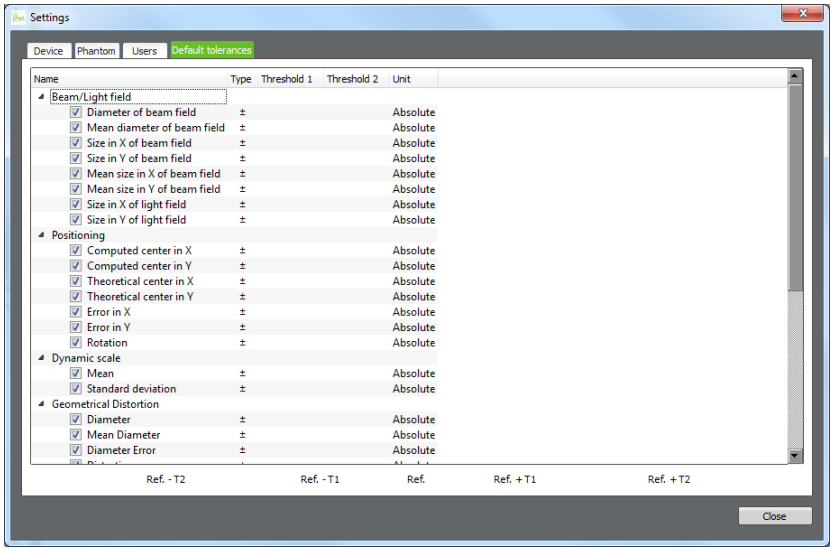


Figure 8 : Default tolerances creation window

These default tolerances will be used, by default, for each new device/phantom couple. The expert user will then have the possibility to adapt these tolerances for each couple device/phantom used (see next sections).

A monitored element is an element for which the colour indicators are activated in the results window (see next sections).

For each of the monitored elements, one or two tolerance levels and a tolerance type can be determined, such as:

Type	Test Status	Defined tolerance	
		1 level : Threshold1	2 levels : Threshold1 and Threshold2
+	Conforming	Result < Reference + Δ1	Result < Reference + Δ1
	Acceptable	N/A	Reference + Δ1 < Result < Reference + Δ2
	Critical	Result > Reference + Δ1	Result > Reference + Δ2
-	Conforming	Result > Reference - Δ1	Result > Reference - Δ1
	Acceptable	N/A	Reference - Δ1 > Result > Reference - Δ2
	Critical	Result < Reference - Δ1	Result < Reference – Δ2
±	Conforming	Reference - Δ1 < Result < Reference + Δ1	Reference - Δ1 < Result < Reference + Δ1
	Acceptable	N/A	Reference + Δ1 < Result < Reference + Δ2

Type	Test Status	Defined tolerance	
		1 level : Threshold1	2 levels : Threshold1 and Threshold2
			Reference - Δ1 > Result > Reference - Δ2
	Critical	Result > Reference + Δ1 Result < Reference - Δ1	Result > Reference + Δ2 Result < Reference - Δ2

If two tolerance levels are defined, the value of the second tolerance level must be greater than that of the first tolerance level.

To edit a tolerance, check the element in the list of the tolerances window and double-click on the field to edit.

Two kinds of unit can be used to define the tolerances:

- Absolute unit: the tolerance is expressed in the same unit as the parameter.
- %: the tolerance is expressed as a percentage of the reference value.

In the result tables, a monitored parameter will be displayed in :

Green: if the result is “Conforming”

Yellow: if the result is “Acceptable”

Red: if the result is “Critical”

The reference value is reference image’s value but tolerances do not have to be modified when the reference image changes.

Tolerances are displayed only if a reference image is defined. Tolerances are saved and linked to the Device/Phantom couple.

2.6 Close application

Click on the button  to close the application.

Note: Do not forget to generate the report before closing the application if you want to keep the results.

3 Reference image management

3.1.1 Add a reference image

If the parameters are all correctly computed, it is possible to use the image as the reference for the "Device / Phantom" couple by clicking on  . The reference can be defined only by an expert user.

The reference image values will be systematically compared to any new image computed.

3.1.2 Delete the reference image

If a reference image already exists for the couple, a message will ask confirmation to overwrite the initial image with the new one.

The reference can be removed only by an expert user by clicking on the button  .

4 Image analysis

4.1 Select an image and Compute

Click on the button 

to open the window below:

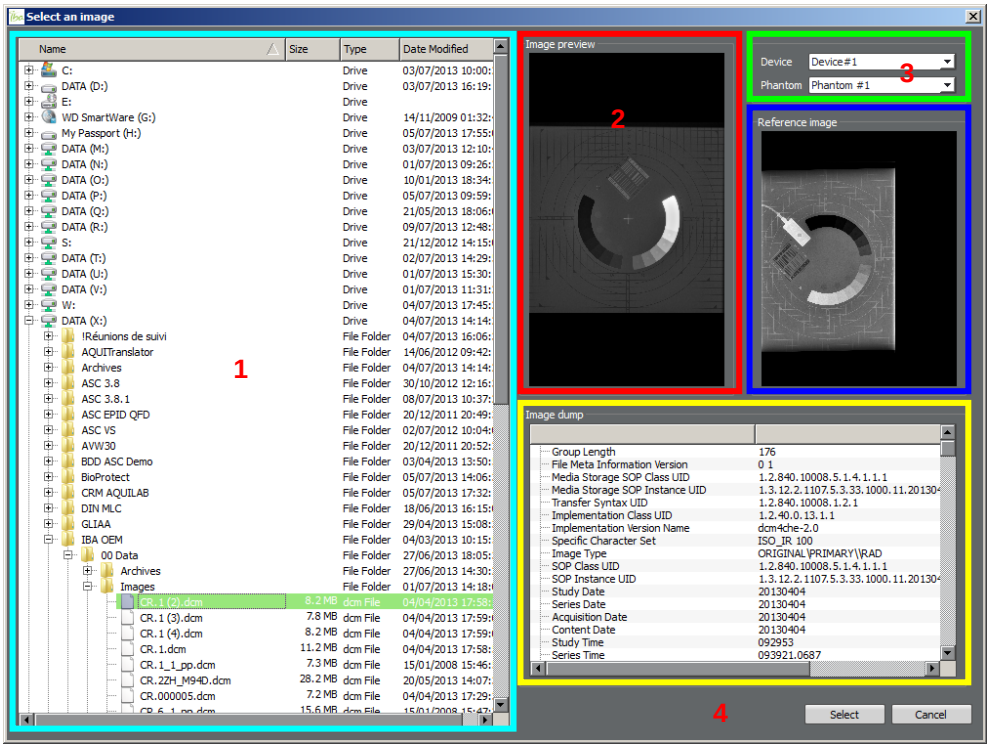


Figure 9 : Image Selection Window

The window is composed of 5 different sections:

- Windows tree view (blue area)
- Selected Image preview (red area)
- Associated device/phantom selection (green area)
- Image reference preview (if defined) (dark blue area)
- Selected image DICOM dump (yellow area)

The workflow for the image selection is as follows:

1 – Select the image to analyze in the Windows tree view

2 – Check the image preview and the image dump

3 – Select the device and the phantom corresponding to the image. If a reference image is already defined for the “Device / Phantom” couple, it is automatically loaded in the “Reference image” area.

4 – Click on **Select** to validate

Note: The image selected will be automatically loaded in the "Image Preview" area if the DICOM modality is supported by the IQ Analyzer Primus.

5 – Click on the button  to open the Module Setup Window and define what kind of irradiated areas are used.

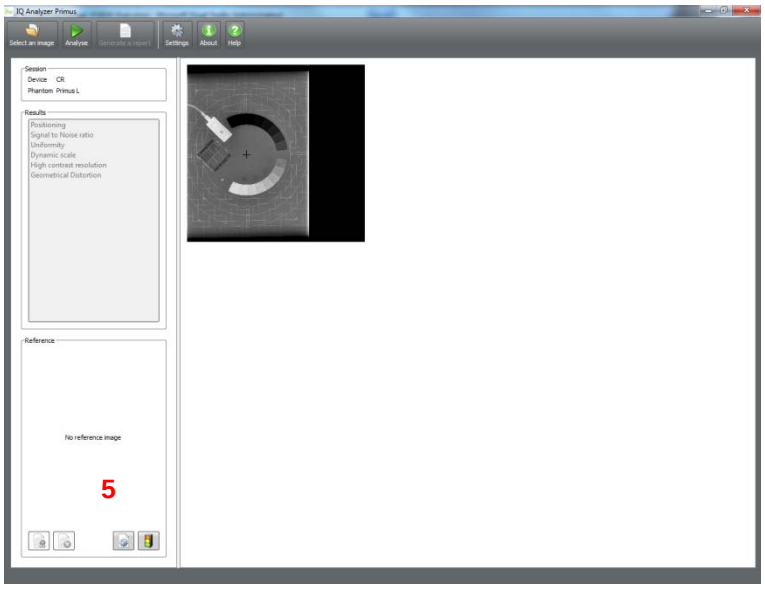


Figure 10 : Main Interface – Image loaded

Depending on the device used the irradiated areas can be black or white. The irradiated area corresponds to the area which receives the most irradiation. For the Primus phantom, it corresponds to the area opposite to the ytterbium insert (black area of the dynamic insert above).

This information must be entered in the module setup window:

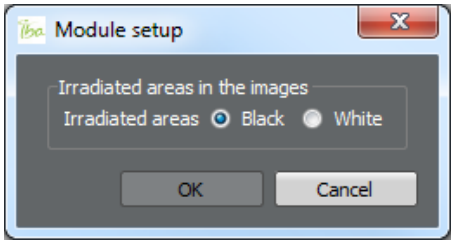


Figure 11 : Module setup Window

6 – Click on 

to automatically compute the different parameters:

- Positioning
- Signal to Noise ratio
- Uniformity

- Dynamic scale
- High contrast resolution
- Geometrical distortion
- Beam/Light field, only for RF/XA images.

Before the analysis of the image, DICOM data are checked. If the Source-Patient Distance is bigger than the Source-Detector Distance or if the magnification factor is lower than 1, a popup window warning the user and allowing to fill the good values appears.

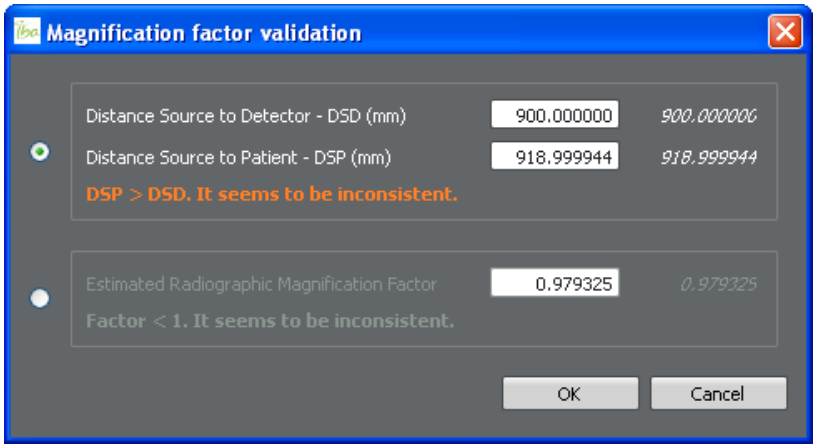


Figure 12 : Magnification factor validation window

If the image is not calibrated or if the magnification factor is not found the window shown below appears.

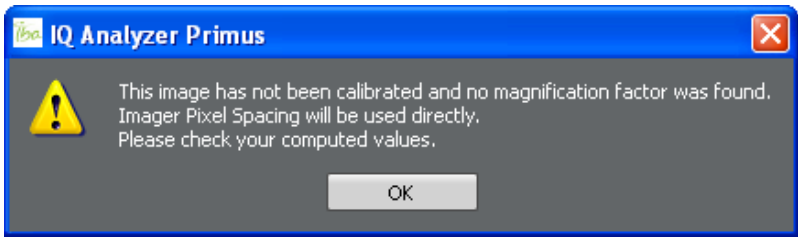


Figure 13 : Warning window

-

4.2 Results window

When the parameters have been computed, they are displayed in the Results Window (Figure 14).

The computed parameters are given with a precision from 2 to 4 decimal places.

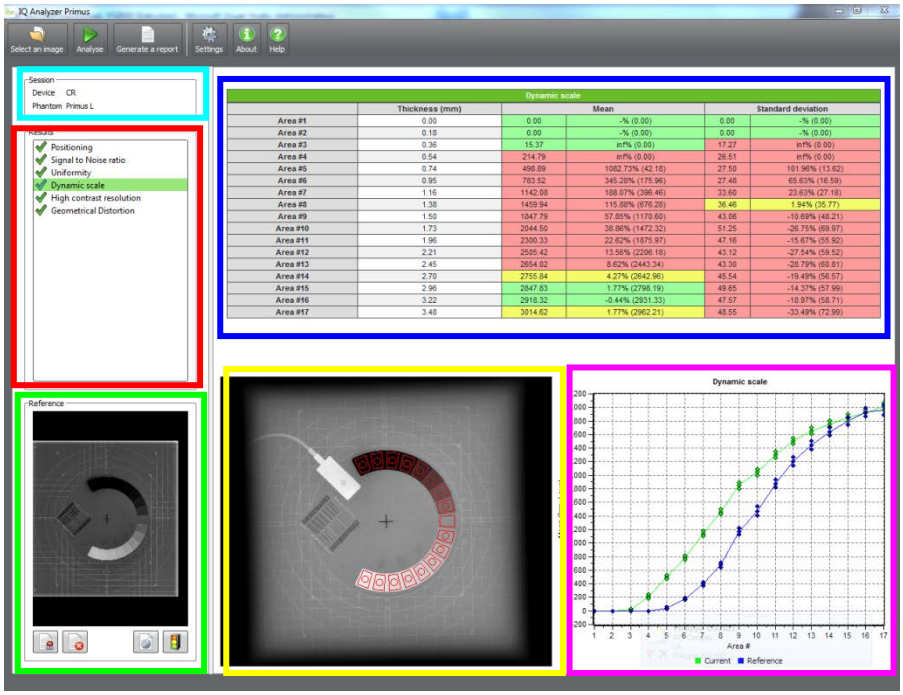


Figure 14 : Results window

The result window is composed of 6 sections:

- Reminder of the couple Device/Phantom (blue area)
- List of the computed parameters (red area)
- Display of the reference image and reference image management (green area)
- Display results table for each parameter (dark blue area)
- Display of the result image with Region Of Interest in red (yellow area)
- Display of a graph result, if required (pink area)

4.2.1 List of parameters

The parameters are marked with the following symbols:

✔: computation took place normally

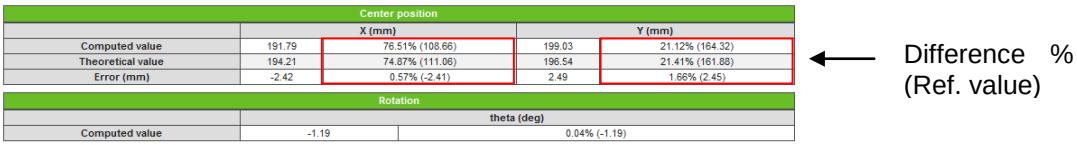
✖: computation did not take place normally (generally occurring when an image selection is not appropriate or when the module configuration is not correct)

The results of each parameter can be displayed by clicking on its name in the list.

4.2.2 Results table

Each parameter is characterized by a given number of elements. These elements are computed from the selected image and the values obtained are displayed under a tabular format.

When a reference image is defined for a “Device / Phantom” couple, the results tables present both the results for the analyzed image and the difference (%) between the analyzed image and the reference image values.



Center position				
	X (mm)		Y (mm)	
Computed value	191.79	76.51% (108.66)	199.03	21.12% (164.32)
Theoretical value	194.21	74.87% (111.06)	196.54	21.41% (161.88)
Error (mm)	-2.42	0.57% (-2.41)	2.49	1.66% (2.45)

Rotation		
	theta (deg)	
Computed value	-1.19	0.04% (-1.19)

Figure 15 : Results tables with reference image defined

The difference between the analyzed image and the reference image is calculated as below:

$$Diff.(\%) = 100\frac{A-R}{R}$$

Where : *Diff*. :Difference between analyzed and reference values (%)

A : Analyzed image’s value

R : Reference image’s value

4.3 Set Tolerances

Click on the button  to open the tolerances definition window displayed on Figure 16.

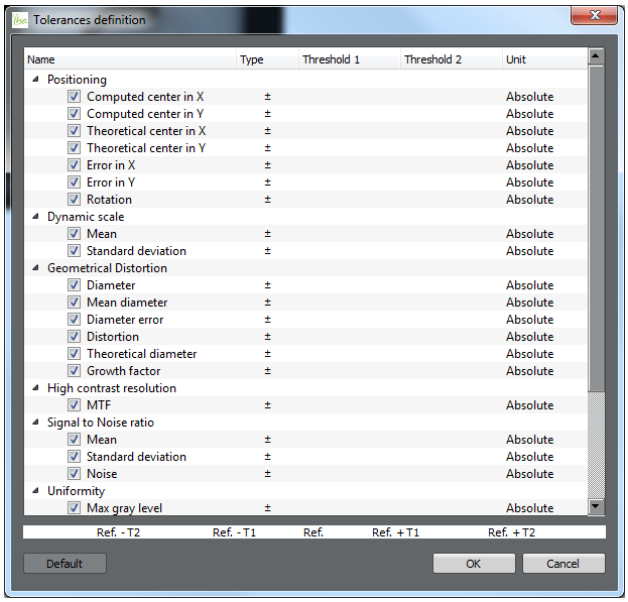


Figure 16 : Tolerances definition window

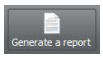
In this window, the default tolerances appear (only if they have been filled by the expert user). The expert user has then the possibility to modify these values, and specify them for the couple device/phantom used.

At any time the expert can set the tolerances to the default value by clicking on the button 

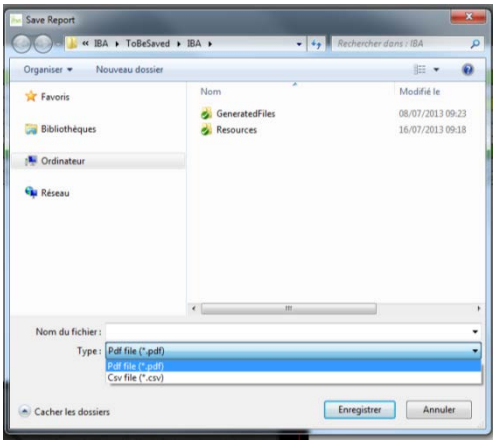
.

5 Generate a report

When an image has been analyzed, it is possible to generate a report:

- Click on the button 

- Select the directory where the report will be saved
- Select the saved format: pdf / csv:



Enter the name of the report

Click on "OK" to validate

The csv file can then be exported in any Excel tool.

Note: The report contains all the acquisition information (device's name, phantom used, …)

The report contains the result tables and graphs for each parameters

6 About window

Click on 

to open the About window:

Figure 17 : About window

In this window, the user will find the type of license of the logged user, the station ID and the area to fill the activation code.

7 Help window

Click on  to open the Help window.

This button will open in Acrobat Reader the User Manual.

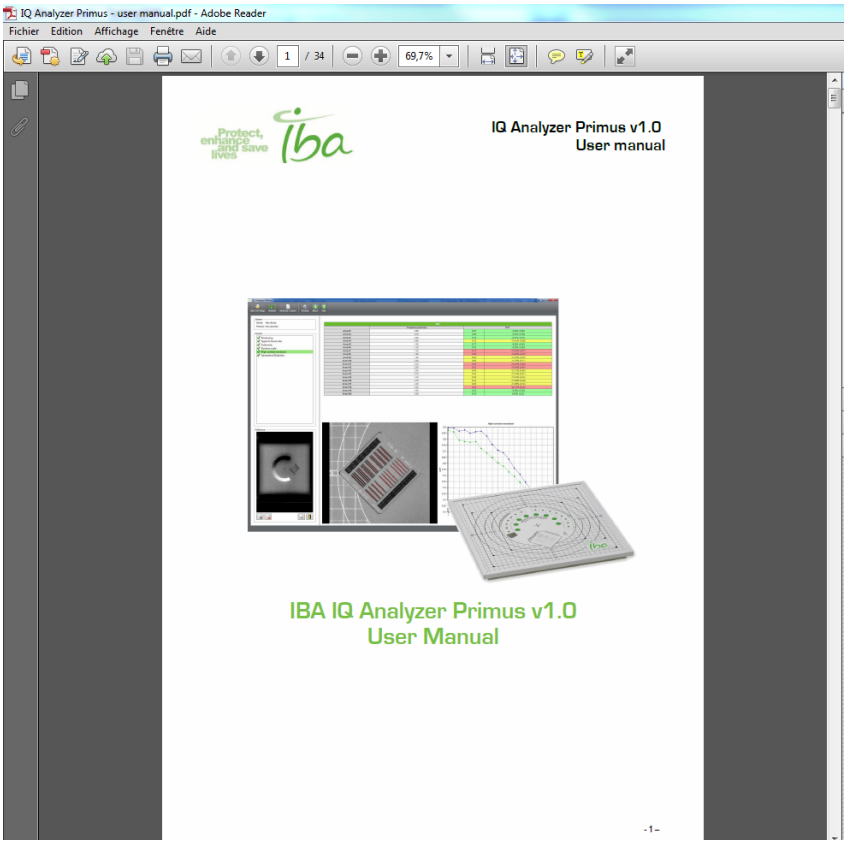


Figure 18 : Help window

8 User rights

2 levels of user are available in the software:

- User
- Expert

A user has limited access to the software:

- Use the software to analyze an image and generate a report.
- Modify its own user account (and its preferred language)
- Visualize the device/phantom lists
- Visualize the reference image (if defined)

An expert has additionally access to the settings functionalities in the software:

- Device/phantom settings
- User management (create new user, modify existing user and delete user)
- Reference image management (set or suppress)
- Default tolerances definition and tolerances specification for a device

There is also a “Service” account, only available for IBA. This account gives access to all the software and mainly to modify Expert accounts.

9 Parameters definition

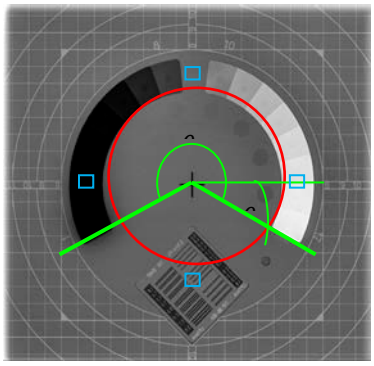
9.1 Positioning

9.1.1 Definition

The purpose of this parameter is to accurately detect the center of the phantom and its rotation angle. It also detects if the image is turned over or not.

The positioning is calculated using the position of the center and the diameter of the internal central circle (around the copper inserts). The rotation is calculated by determining the angles of the two green lines shown below, compared to the theoretical angles.

Finally, the shift is determined by finding the positions of the four blue areas listed below (by using the average and standard deviations of these 4 areas):



The position error in X and Y is given by the following formula:

$$XCen\ Err = Xc - Xci$$

$$YCen\ Err = Yc - Yci$$

Where : Xci et Yci : coordinates of the theoretical image centre

Xc et Yc : coordinates of the computed centre.

The rotation angle is given by the following formula:

$$\theta = \frac{\theta_{1err} + \theta_{2err}}{2}$$

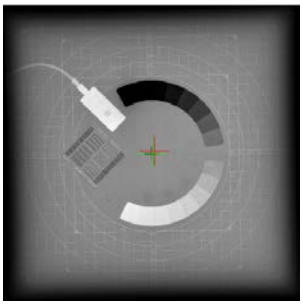
Where $\theta_{1err} = \theta_{1th} - \theta_1$: θ_1 angle error in comparison to the theoretical angle

$\theta_{2err} = \theta_{2th} - \theta_2$: θ_2 angle error in comparison to the theoretical angle

If the image is turned over a horizontal flip is applied and the information is given in the results table.

9.1.2 Results

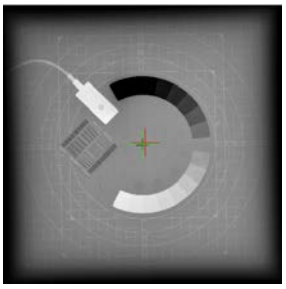
The results will be displayed as follows:



Center position		
	X (mm)	Y (mm)
Computed value	191.49	198.83
Theoretical value	194.07	196.39
Error	-2.58	2.44

Rotation	
	Computed value
Theta (degree)	-1.19
Flip	False

Note that if a reference image is defined for the couple device/phantom, the results will be displayed as follows:



Center position				
	X (mm)		Y (mm)	
Computed value	191.49	44.00% (132.98)	198.83	42.32% (139.71)
Theoretical value	194.07	48.60% (130.60)	196.39	40.74% (139.54)
Error	-2.58	-207.90% (2.39)	2.44	1379.45% (0.16)

Rotation		
	Computed value	
Theta (degree)	-1.19	-1212.74% (0.11)
Flip	False	false

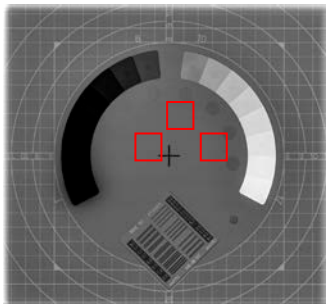
Interactivity:

When the user clicks in the table on the result of a center (computed or theoretical), the corresponding cross is the only one displayed. To display all the ROIs the user clicks on the highlighted/selected row in the table.

9.2 Signal to Noise ratio

9.2.1 Definition

The signal to noise ratio is calculated on three central areas of the phantom. We make sure to exclude the positioning cross and the pattern resolution.



The SNR is determined for each ROI using the following formula:

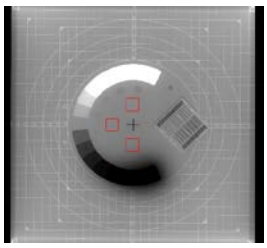
$$SNR = 100 * \frac{\sigma}{NdG}$$

Where σ Standard deviation of the ROI grey levels

NdG Average grey level of the ROI

9.2.2 Results

The results will be displayed as follows:



Signal to Noise ratio			
	Mean	Standard deviation	SNR (%)
Area #1	1360.94	47.38	3.48
Area #2	1318.85	48.17	3.65
Area #3	1379.48	43.38	3.14

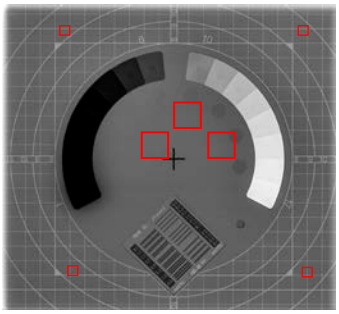
Interactivity:

When the user clicks in the table on the result of a ROI, the corresponding ROI (red area in the image) is the only one displayed in the image. To display all the ROIs the user clicks on the highlighted/selected row in the table.

9.3 Uniformity

9.3.1 Definition

The uniformity is computed on seven phantom areas. We make sure to exclude the positioning cross and the pattern resolution, and not be on the grid background.



The uniformity is determined using the following formula:

- Heterogeneity:

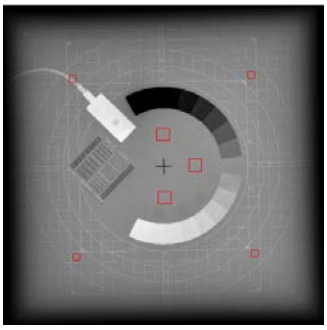
$$NUni = \frac{NdG_{max} - NdG_{min}}{NdG_{max} + NdG_{min}}$$

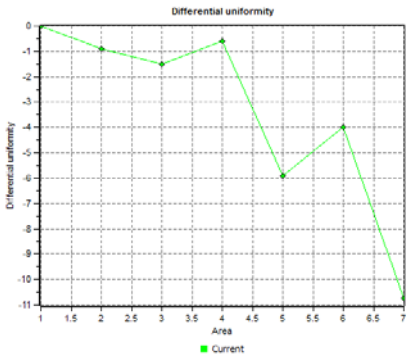
Where NdG_{max} , NdG_{min} The min/max grey levels of the ROI.

9.3.2 Results

The results will be displayed as follows :

Uniformity						
	Min	Mean	Max	Standard deviation	Heterogeneity	Difference (%)
Area #1	1193.00	1361.33	1764.00	47.30	0.19	-
Area #2	1154.00	1318.97	1517.00	48.05	0.14	-3.21
Area #3	1217.00	1379.32	1556.00	43.48	0.12	1.30
Area #4	1096.00	1226.29	1404.00	40.74	0.12	-11.01
Area #5	1182.00	1317.44	1483.00	45.79	0.11	-3.33
Area #6	1186.00	1360.49	1505.00	47.04	0.12	-0.06
Area #7	1146.00	1283.01	1423.00	41.10	0.11	-6.10

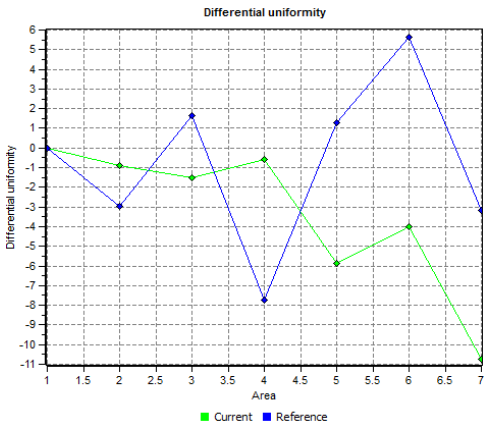




A graph showing the differential uniformity is also displayed (diff = f (x)), where x is the ROI).

If a reference image is defined the result will be displayed as follows:

Uniformity												
	Min		Mean		Max		Standard deviation		Heterogeneity		Difference (%)	
Area #1	714.00	-40.15% (1193.00)	866.08	-36.38% (1361.33)	1198.00	-32.09% (1764.00)	68.88	45.63% (47.30)	0.25	31.09% (0.19)	-	-% (0.00)
Area #2	696.00	-39.69% (1154.00)	935.94	-29.04% (1318.97)	1110.00	-26.83% (1517.00)	75.90	57.97% (48.05)	0.23	68.67% (0.14)	7.46	-332.38% (-3.21)
Area #3	911.00	-25.14% (1217.00)	1030.96	-25.26% (1379.32)	1161.00	-25.39% (1556.00)	32.90	-24.34% (43.48)	0.12	-1.30% (0.12)	15.99	1126.13% (1.30)
Area #4	810.00	-26.09% (1096.00)	924.55	-24.61% (1226.29)	1025.00	-26.99% (1404.00)	30.33	-25.53% (40.74)	0.12	-4.90% (0.12)	6.32	-157.43% (-11.01)
Area #5	879.00	-25.63% (1182.00)	1005.25	-23.70% (1317.44)	1117.00	-24.68% (1483.00)	34.00	-25.74% (45.79)	0.12	5.57% (0.11)	13.84	-515.56% (-3.33)
Area #6	923.00	-22.18% (1186.00)	1063.92	-21.80% (1360.49)	1201.00	-20.20% (1505.00)	37.48	-20.32% (47.04)	0.13	10.41% (0.12)	18.59	-30212.89% (-0.06)
Area #7	853.00	-25.57% (1146.00)	975.45	-23.97% (1283.01)	1091.00	-23.33% (1423.00)	32.10	-21.91% (41.10)	0.12	13.54% (0.11)	11.21	-283.66% (-6.10)



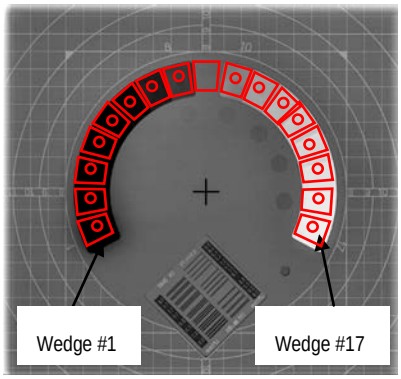
Interactivity:

When the user clicks in the table on the result of a ROI, the corresponding ROI (red area in the image) and points in the graph are only displayed. To display all the ROIs/points, the user clicks on the highlighted/selected row in the table.

9.4 Dynamic scale

9.4.1 Definition

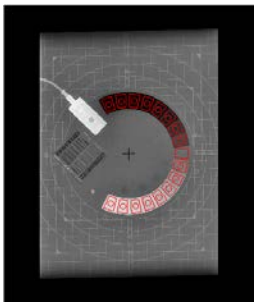
The purpose of this parameter is to determine the dynamic scale. It is computed using the 17 copper inserts having a thickness from 0mm to 3.48mm.



The dynamic scale is determined by computing the average and standard deviation of each one of the 17 ROIs (red areas above).

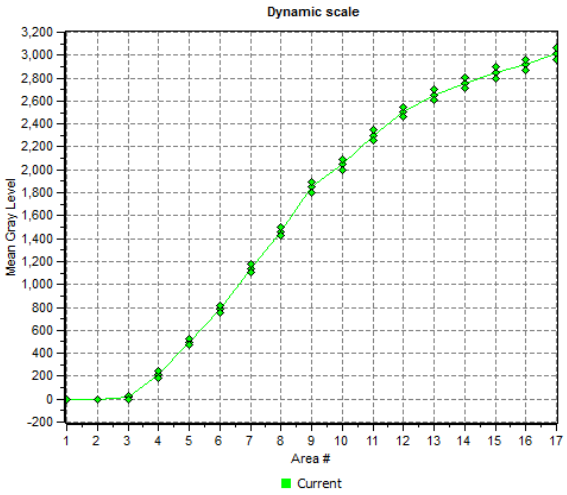
9.4.2 Results

The results will be displayed as follows :



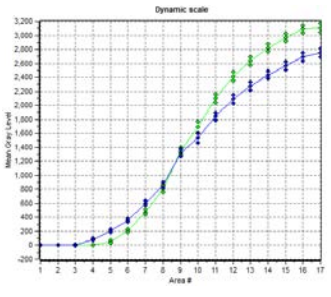
Dynamic scale			
	Thickness (mm)	Mean	Standard deviation
Area #1	0.00	0.00	0.00
Area #2	0.18	0.00	0.00
Area #3	0.36	0.00	0.00
Area #4	0.54	0.00	0.00
Area #5	0.74	51.87	17.43
Area #6	0.95	205.60	20.19
Area #7	1.16	475.12	33.49
Area #8	1.38	807.05	42.60
Area #9	1.50	1346.41	54.48
Area #10	1.73	1691.93	77.82
Area #11	1.96	2102.14	58.03
Area #12	2.21	2413.61	61.54
Area #13	2.45	2635.78	59.43
Area #14	2.70	2822.79	54.90
Area #15	2.96	2969.63	52.77
Area #16	3.22	3090.15	54.26
Area #17	3.48	3106.87	63.65

A graph showing the dynamic scale is also displayed (NDG = f (x)), where x is the number of the copper insert). For each value, the standard deviation is also represented:



If a reference image is defined the result will be displayed as follows:

Dynamic scale					
	Thickness (mm)	Mean		Standard deviation	
Area #1	0.00	0.00	-% (0.00)	0.00	-% (0.00)
Area #2	0.18	0.00	-% (0.00)	0.00	-% (0.00)
Area #3	0.36	0.00	-100.00% (6.59)	0.00	-100.00% (8.52)
Area #4	0.54	0.00	-100.00% (84.67)	0.00	-100.00% (14.60)
Area #5	0.74	51.87	-75.04% (207.86)	17.43	-4.60% (10.29)
Area #6	0.95	205.60	-42.86% (359.84)	20.19	-8.35% (22.03)
Area #7	1.16	475.12	-21.21% (603.00)	33.49	4.01% (32.20)
Area #8	1.38	807.05	-6.11% (859.53)	42.60	9.69% (38.84)
Area #9	1.50	1346.41	1.74% (1323.34)	54.48	7.72% (50.57)
Area #10	1.73	1691.93	10.25% (1534.69)	77.82	18.26% (65.80)
Area #11	1.96	2102.14	14.13% (1841.91)	58.03	6.75% (54.37)
Area #12	2.21	2413.61	15.59% (2088.02)	61.54	2.17% (60.23)
Area #13	2.45	2635.78	15.95% (2273.20)	59.43	5.36% (56.41)
Area #14	2.70	2822.79	15.98% (2433.81)	54.90	-1.54% (55.76)
Area #15	2.96	2969.63	15.73% (2565.97)	52.77	-7.70% (57.16)
Area #16	3.22	3090.15	14.66% (2695.06)	54.26	-2.74% (55.79)
Area #17	3.48	3106.87	12.91% (2751.70)	63.65	5.22% (60.49)



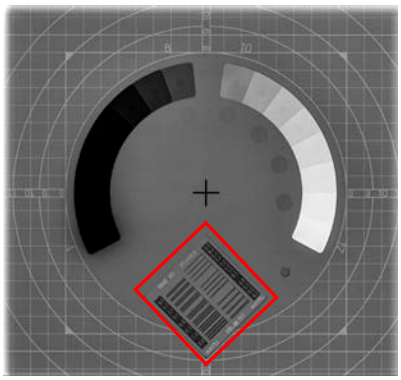
Interactivity:

When the user clicks in the table on the result of an insert, the corresponding ROI (red area in the image) is the only one displayed in the image and the corresponding points on the graph are displayed in red. To display all ROIs/all points of the graph, the user clicks on the highlighted/selected row in the table.

9.5 High contrast resolution

9.5.1 Definition

The purpose of this parameter is to determine the MTF: the Modulation Transfer Function. For this, we use the high contrast pattern of the phantom, representing the pairs of line per millimeter.



The pattern of MTF (or high contrast resolution) is expressed in pairs of line per millimeter, with the following values: 5.0 – 4.8 – 4.3 – 4 – 3.7 – 3.4 – 3.1 – 2.8 – 2.5 – 2.2 – 2 – 1.8 – 1.6 – 1.4 – 1.2 – 1.0 – 0.8 – 0.7 – 0.6.

The computation of the MTF is based on the method described in [DAS] [1]. Regions of interest are defined around each pair of line. The MTF is computed on each ROI using the following formula :

$$MTF_f = \frac{\frac{(max_b - min_b)}{(max_b + min_b)}}{\frac{(max_g - min_g)}{(max_g + min_g)}}$$

Where max_b: maximum value of the area of frequency f

min_b: minimum value of the area of frequency f

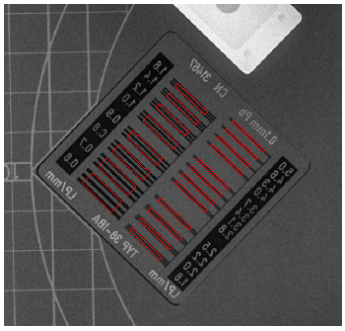
min_g: minimum value of the reference area (background color)

max_g: maximum value of the reference area (pattern color)

[1] Indra J. Das, Minsong Cao, Chee-Wai Cheng, Vladimir Misic, Klaus Scheuring, Edmund Schüle, Peter A.S. Johnstone. A quality assurance phantom for electronic portal imaging devices. Journal of Applied Clinical Medical Physics. Vol 12, n°2 (2011)

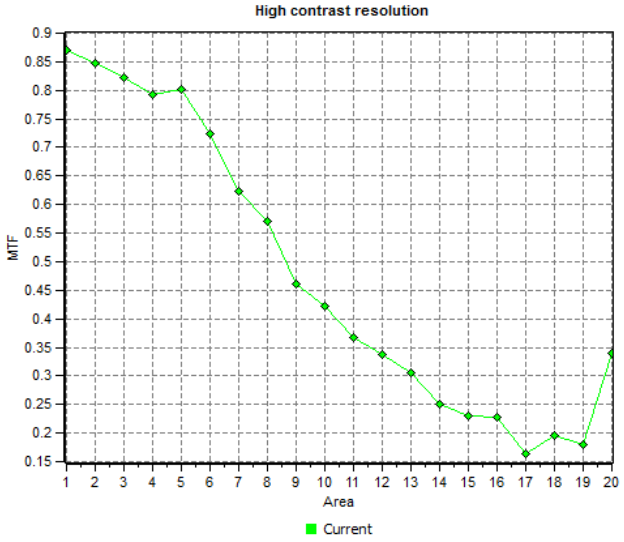
9.5.2 Results

The results will be displayed as follows:



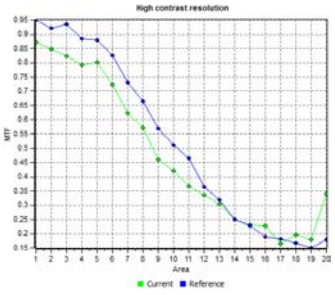
MTF		
	Frequency (pl/mm)	MTF
Area #1	0.60	0.91
Area #2	0.70	0.87
Area #3	0.80	0.83
Area #4	0.90	0.80
Area #5	1.00	0.78
Area #6	1.20	0.70
Area #7	1.40	0.58
Area #8	1.60	0.53
Area #9	1.80	0.46
Area #10	2.00	0.37
Area #11	2.20	0.36
Area #12	2.50	0.28
Area #13	2.80	0.22
Area #14	3.10	0.18
Area #15	3.40	0.14
Area #16	3.70	0.10
Area #17	4.00	0.08
Area #18	4.30	0.05
Area #19	4.60	0.06
Area #20	5.00	0.10

A graph showing the MTF is also displayed (MTF = f (x)), where x is the number of the area).



If a reference image is defined the result will be displayed as follows:

MTF			
	Frequency (pl/mm)		MTF
Area #1	0.60	0.91	-1.48% (0.92)
Area #2	0.70	0.87	-4.51% (0.91)
Area #3	0.80	0.83	-3.59% (0.86)
Area #4	0.90	0.80	-1.08% (0.81)
Area #5	1.00	0.78	-1.97% (0.79)
Area #6	1.20	0.70	0.63% (0.70)
Area #7	1.40	0.58	-2.83% (0.60)
Area #8	1.60	0.53	2.34% (0.52)
Area #9	1.80	0.46	-4.68% (0.48)
Area #10	2.00	0.37	-0.68% (0.37)
Area #11	2.20	0.36	-0.02% (0.36)
Area #12	2.50	0.28	-0.24% (0.28)
Area #13	2.80	0.22	5.21% (0.21)
Area #14	3.10	0.18	10.10% (0.16)
Area #15	3.40	0.14	13.74% (0.12)
Area #16	3.70	0.10	53.28% (0.07)
Area #17	4.00	0.08	1523.21% (0.00)
Area #18	4.30	0.05	25.03% (0.04)
Area #19	4.60	0.06	18.71% (0.05)
Area #20	5.00	0.10	177.66% (0.03)



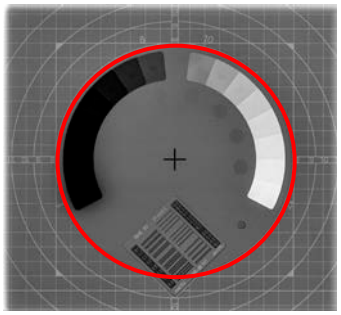
Interactivity: When the user clicks in the table on the result of an insert, the corresponding ROI (red area in the image) is the only one displayed in the image. The corresponding points on the graph are displayed in red.

To display all ROIs/all points of the graph, the user clicks on the highlighted/selected row in the table.

9.6 Geometrical distortion

9.6.1 Definition

The geometrical distortion is computed using the first circle of the grid (diameter 160mm) and by determining its diameter on 7 distinct profiles.



The distortion is computed using the following formula :

$Distorsion = \frac{D_{max} - D_{min}}{D_{moy}}$x100

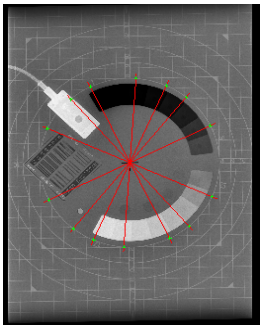
Where $D_{\min}, D_{\max}, D_{moy}$: the minimum, maximum and average of the diameters on the 7 profiles.

Two other indexes are computed:

- The error on the diameter correspond to the standard deviation of the diameters on the profiles
- The scale factor : $\gamma = \frac{D_{moy}}{D_{th}}$ where D_{th} is the theoretical diameter

9.6.2 Results

The results will be displayed as follows:



Geometrical Distortion	
	Computed value
Diameter #1 (mm)	160.49
Diameter #2 (mm)	160.58
Diameter #3 (mm)	160.51
Diameter #4 (mm)	160.86
Diameter #5 (mm)	160.45
Diameter #6 (mm)	160.44
Diameter #7 (mm)	160.48
Mean diameter (mm)	160.54
Diameter error (mm)	0.14
Theoretical diameter (mm)	160.00
Distortion (%)	0.26
Growth factor	1.00

On the left we find the six profiles and the intersections with the circle (green crosses).

On the right there is the table with the different values.

If a reference image is defined the result will be displayed as follows:

Geometrical Distortion		
	Computed value	
Diameter #1 (mm)	160.49	0.03% (160.45)
Diameter #2 (mm)	160.58	0.13% (160.36)
Diameter #3 (mm)	160.51	0.12% (160.32)
Diameter #4 (mm)	160.86	0.05% (160.78)
Diameter #5 (mm)	160.45	0.09% (160.30)
Diameter #6 (mm)	160.44	0.47% (159.69)
Diameter #7 (mm)	160.48	0.08% (160.34)
Mean diameter (mm)	160.54	0.14% (160.32)
Diameter error (mm)	0.14	-54.52% (0.30)
Theoretical diameter (mm)	160.00	0.00% (160.00)
Distortion (%)	0.26	-61.30% (0.68)
Growth factor	1.00	0.14% (1.00)

Interactivity :

When the user clicks in the table on the result of a profile, the profile corresponding (red area in the image) and its two intersections (green crosses) are the only ones displayed in the image. To display all profiles, the user clicks on the highlighted/selected row in the table.

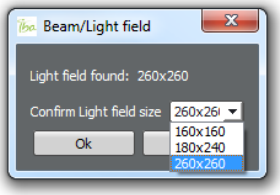
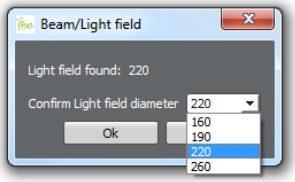
9.7 Beam/light field

9.7.1 Definition

The purpose of this parameter is to determine the coincidence light field beam field for rectangle or circular fields.

This parameter is only computed for the RF/XA modality.

The method automatically computes the light field (X and Y size if the field is rectangular, diameter if the field is circular). Once the light field value is calculated, the user will have to validate, or choose if the software could not compute it, the light field value among a list:

Rectangular field	*Circular field*
	

Note that if the user decides to « Cancel » this validation, the parameter beam/light field will not be calculated.

The size of the beam field is determined using profiles evenly distributed over the field:

- Horizontal and vertical profiles for the rectangular field
- Circular profile for the circular field

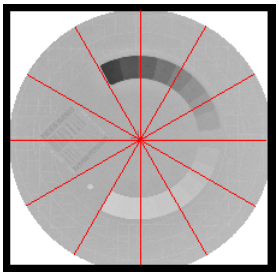
For a rectangular field the average size of the field on X and Y is computed.

For a circular field the average diameter is computed.

9.7.2 Results

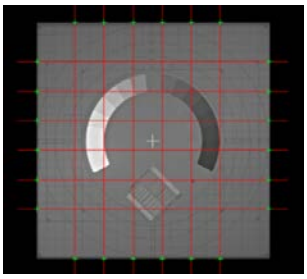
The results will be displayed as follows:

For a circular field:



Beam/Light field	
	Diameter (mm)
Diameter #1	236.15
Diameter #2	243.15
Diameter #3	243.03
Diameter #4	234.50
Diameter #5	243.15
Diameter #6	243.15
Mean Diameter of beam field (mm)	240.52
Diameter of light field (mm)	220.00

For a rectangular field:



Beam/Light field		
	Size X(mm)	Size Y(mm)
Profile #0	260.60	263.91
Profile #1	260.60	263.91
Profile #2	260.60	263.91
Profile #3	260.60	263.91
Profile #4	260.60	263.91
Profile #5	260.00	263.91
Mean size of beam field	260.60	263.91
Size of light field	260.00	260.00

Interactivity: When the user clicks in the table on the result of a profile, the corresponding profile (red area in the image) is the only one displayed in the image.
To display all profiles, the user clicks on the selected row in the table.

10 Image settings

Right-clicking on an image will open the menu displayed on Figure 19.

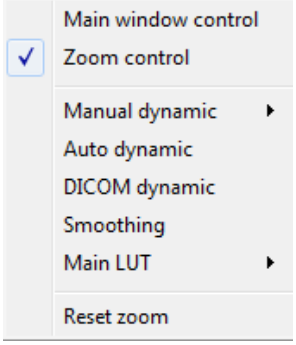


Figure 19 : Image settings menu

10.1 Window control / Zoom control

This choice determines whether the right button of the mouse is used for controlling the visualization window or the zoom.

10.1.1 Zoom control

When the **Zoom control** mode is activated, the user uses right-click while dragging the mouse over the view. If the mouse moves from bottom to top, the image is enlarged in real time, in proportion to the movement of the mouse. If the mouse moves from top to bottom, the image is reduced in real time, in proportion to the movement of the mouse.

To control the **Pan** mode (movement within the image), press both buttons of the mouse at the same time or press the left mouse button and the **Spacebar** while dragging the mouse. The image is moved in real time, at the same time as the mouse.

10.1.2 Window control

When the **Window Control** mode is activated, the user uses right-click while dragging the mouse over the view. If the mouse moves from bottom to top, the window center value is modified in proportion to the mouse movement. If the mouse moves from left to right, the visualization window width is modified in proportion to the movement of the mouse.

10.1.3 Window

The selection of the **Manual** sub item of the **Manual dynamic** item opens the Window adjustment interface displayed in Figure 20.

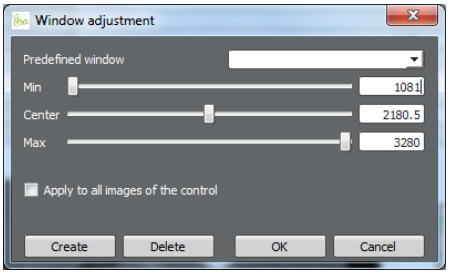


Figure 20 : Window adjustment interface

- Predefined window

This is used for selecting a predefined display window from the proposed list. By default, this list is empty.

- Min

Moving the cursor with the mouse allows interactive adjustment of the minimum visualization window value.

- Center

Moving the cursor with the mouse allows interactive adjustment of the central visualization window value.

- Max

Moving the cursor with the mouse allows interactive adjustment of the maximum visualization window value.

The application of adjustments to the lightbox images is made by left-clicking on the **Validate** button.

Clicking on the **Cancel** button closes the window without taking any of the modifications made into consideration.

It is also possible to save the visualization window by clicking on the **Create** button which then opens the backup window displayed on Figure 21.

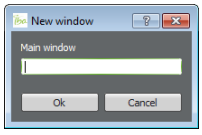


Figure 21 : New window interface

To overwrite an existing window, simply select it in the list and then click on **Replace** . By default, this list is empty.

Note: Clicking on the Cancel button will stop the current procedure and trigger return to the previous window. When saving a specific window, the saved values remain active for the current session

To delete a registered window, simply select it from the list and click on **Delete**.

10.1.4 Auto dynamic

The **Auto dynamic** function applies the visualization window coming from the minimum and maximum pixel values contained in the image.

10.1.5 DICOM dynamic

The **DICOM dynamic** function applies the visualization window coming from the DICOM header of the image (center and width values).

10.2 Activation of smoothing

Smoothing in the image is obtained by selecting the Smoothing item from the image menu. Smoothing consists in eliminating the pixelization effect as displayed on Figure 22.

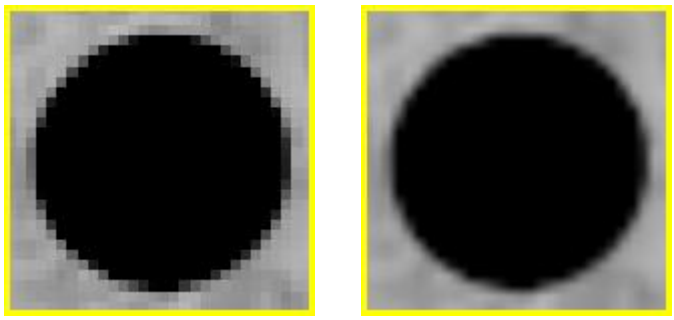


Figure 22 : Image without and with smoothing

10.3 Modification of LUT

This option is used for applying predefined **Look Up Table** elements to the image. The various tables available are indicated in the list.

10.4 Reset zoom

The **Reset zoom** option resets the zoom in the image.

11 Technical Support

11.1 Contact for Technical Support

If you need technical support, please contact the local IBA Dosimetry GmbH representative first. If you need any further assistance, please contact:

South and Middle America, USA, and Canada:	**Asia Pacific, Australia and New Zealand:**	**All other countries:**
IBA Dosimetry America	IBA China Dosimetry Department	IBA Dosimetry GmbH Service Department
3150 Stage Post Drive, Suite 110 Bartlett, TN 38133 USA	No. 6, Xing Guang Er Jie, Beijing OPTO-Mechatronics Industrial Park (OIP) Tongzhou District, Beijing 101111 P.R.China	Bahnhofstrasse 5 DE-90592 Schwarzenbruck Germany
USService@iba-group.com	ServiceAPAC@iba-group.com	Servicediagnostics.te@iba-group.com
Phone: +1 901 386-2242 Fax: +1 901 382-9453	Phone: +86 10 8080 9107 Fax: + 86 10 8080 9298	Phone: +49 9128 607-911 Fax: +49 9128 607-26

11.2 Reporting Complaints

The Quality Management system of IBA Dosimetry GmbH includes a routine to handle any reported complaints.

The user shall report all complaints about the system to any representative of IBA Dosimetry GmbH or directly to the address above.

To address a malfunction or complaint, please make a photocopy of the *Complaint Report Form* at the end of this chapter and provide as much information as reasonable.

11.3 Returning Device for Repair

Procedure for shipping the device to the factory for repair:

Call or email to the Service Department at the above address to explain the problem.

The Service personnel will generate a RMA (Return Material Authorization) number. You will receive a filled *RMA Form* with the RMA number and provided information by e-mail or fax.