

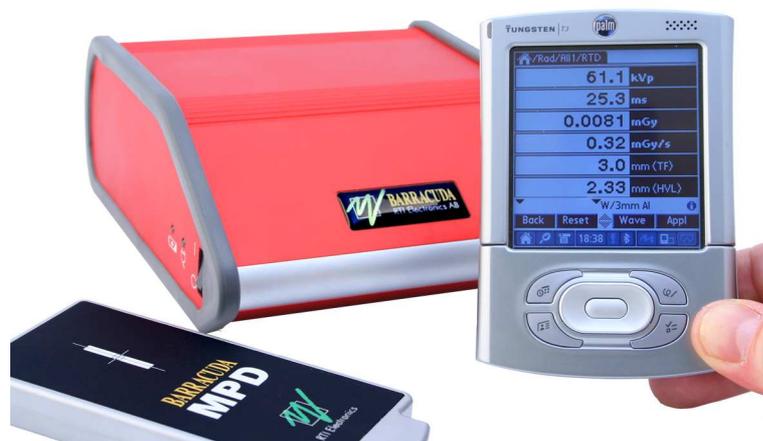
APPLICATION NOTE

RTI Electronics AB, Sweden

Revision A, August 2007

Measurements of Total Filtration and kV with the Barracuda and the Piranha

This application note describes how to do measurements of the total filtration with the MPD and Barracuda as well as the Piranha.



INTRODUCTION

With the Barracuda and the Piranha it is possible to measure total filtration dynamically and automatically correct the kVp value accordingly. This can be used in Radiography, Dental, Fluoroscopy and CT applications in the range from 1.5 mm Al to 38 mm Al equivalence, i.e. the material that the X-ray beams actually pass through, whether it is PMMA or Cupper, is insignificant. This application note will explain the function of the correction and its limitations. It will also describe how the software settings are made in both the Palm software – the QABrowser and the PC software – oRTIgo.

INTRODUCTION.....	2
TOTAL FILTRATION WITH BARRACUDA AND PIRANHA	3
Total Filtration in one exposure	3
Total Filtration through HVL.....	7
Variations in Total filtration.....	9
SOFTWARE SETTINGS	10
APPENDIX	11

This application note is applicable for all versions of oRTIgo and QABrowser later than version 6.1B and 3.1C, respectively.

TOTAL FILTRATION WITH BARRACUDA AND PIRANHA

Total Filtration in one exposure

With the MPD and the Barracuda or the Piranha, measurements of the total filtration can be done in one exposure. There are several detectors inside the MPD and the total filtration is determined from a combination of these signals and the kV value. The software determines the total filtration dynamically which means that if extra filtration is added during a measurement the software notices the change, measures the total filtration and corrects the kVp, see figure 1. Examples of the dynamical measurement is found in appendix, chapter 5.

Set Values				Measured Data from the Barracuda							
kVp	mA	Time	Cu Filter	kVp	ms	mR	R/min	mA	mAs	TF	HVL
81	320	100	0	81,01	99,30	269,06	162,57	340,15	34,12	3,59	3,41
81	320	100	0,1	81,03	99,80	142,12	85,44	347,70	34,70	7,74	5,02
81	320	100	0,2	80,98	99,81	98,5	59,22	336,19	33,55	11,49	5,92
81	320	100	0,3	80,80	99,30	70,15	42,38	348,66	34,97	15,36	6,60
81	320	100	0,6	80,43	99,30	36,67	22,16	355,96	35,70	27,26	7,96
81	320	100	0,9	80,45	99,30	20,53	12,41	343,97	34,33	39,01	8,71

Figure 1. A measurement done with Cu filtration in the beam. The software measures the total filtration at each exposures and corrects the kVp accordingly.

Between 60 and 120 kV the total filtration is determined¹ with an accuracy of 10 % or ± 0.3 mm Al, see figure 2. Outside this range, down to 50 kV and up to 150 kV, the total filtration can be determined, however the inaccuracy increases. When the kV is lower than 50 kV or higher than 150 kV the total filtration can not be determined.



Figure 2. The range of where the total filtration can be determined.

Figure 3 shows a typical measurement in the QABrowser. As it can be seen in the figure, the QABrowser also gives a reading of HVL with one exposure and the value is calculated through polynomials from the total filtration.

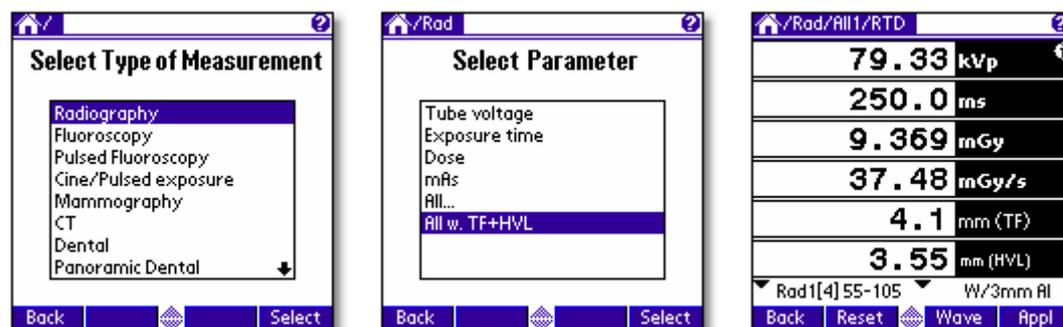


Figure 3. How to set up the one exposure total filtration measurement in the QABrowser.

¹ Determined is referred to as "estimate" in the Palm Software, the QABrowser.

In oRTIgo – Real Time Meter - you choose if you want to determine or use a set value for the total filtration on the first screen, figure 3 and 4.

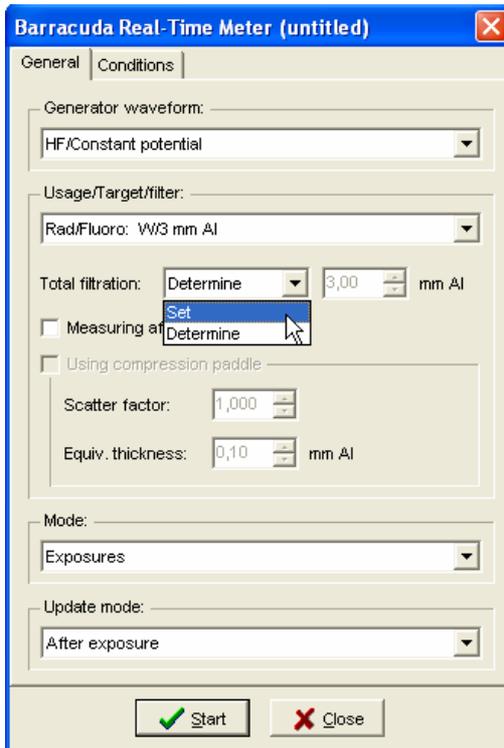


Figure 3. Choose if you want to set or determine total filtration.

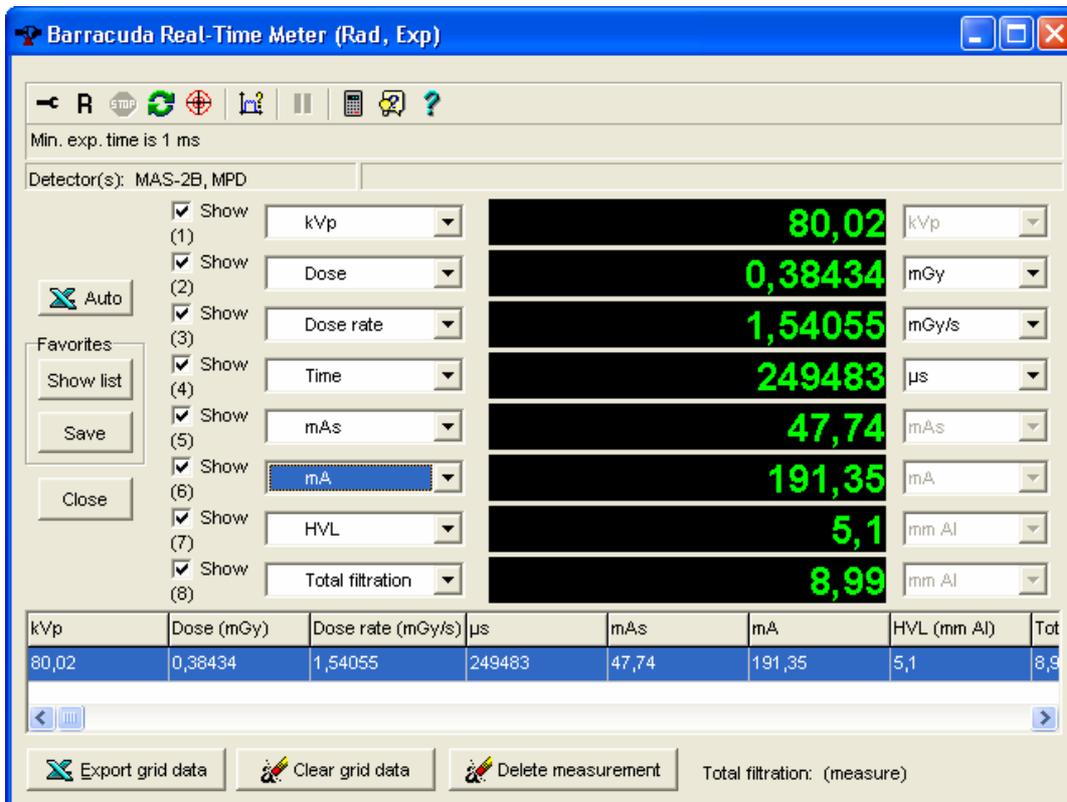


Figure 4. The measurement window in Real-Time Meter when determine total filtration has been chosen.

In the Real-Time Meter the HVL is calculated from the total filtration in the same way as in the QABrowser.

In oRTIgo – the database part - there is also the possibility to choose if you want to determine the total filtration. However, if you want to set the total filtration to a known value, you can only use pre-set values. The pre-set values are related to the beam quality which you choose in the screen which contain the tube data settings. The setup window shown in figure 5 can be altered every time you open the session. The value of the total filtration will not show anywhere unless the test contains a column defined for the total filtration, otherwise it still corrects the kV value but you can not see the value although you have chosen **Determine**.

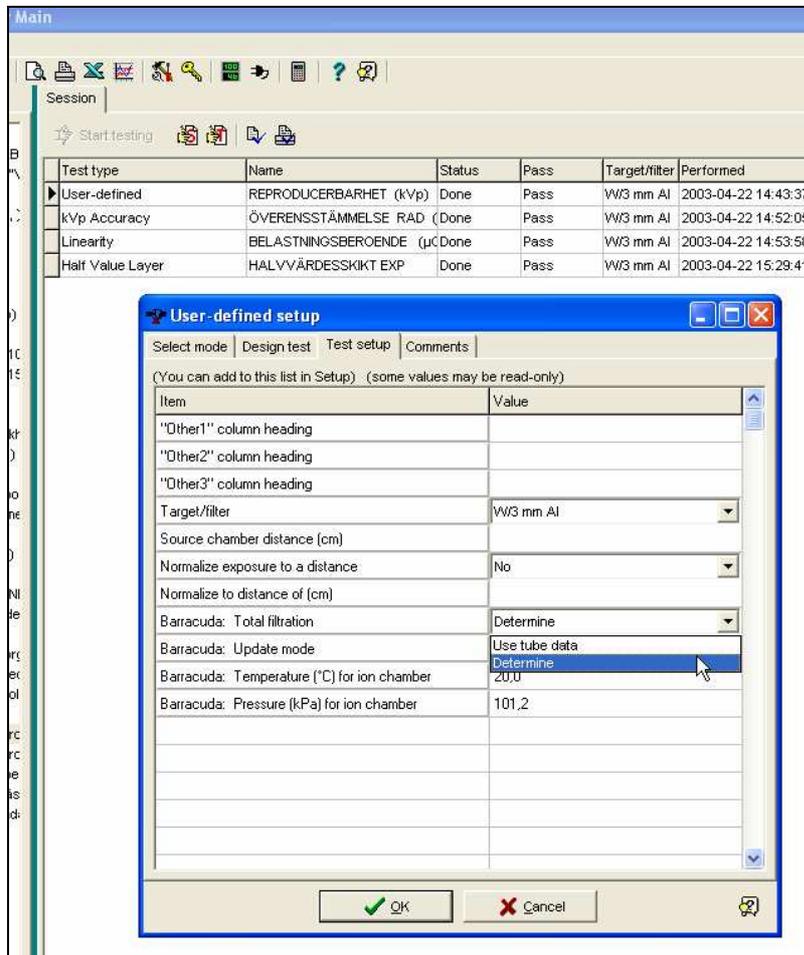


Figure 5. In the setup screen you define if you want to determine total filtration or use tube data.

When you design your own test setup, you can choose to add total filtration as an column, see figure 6 and 7.

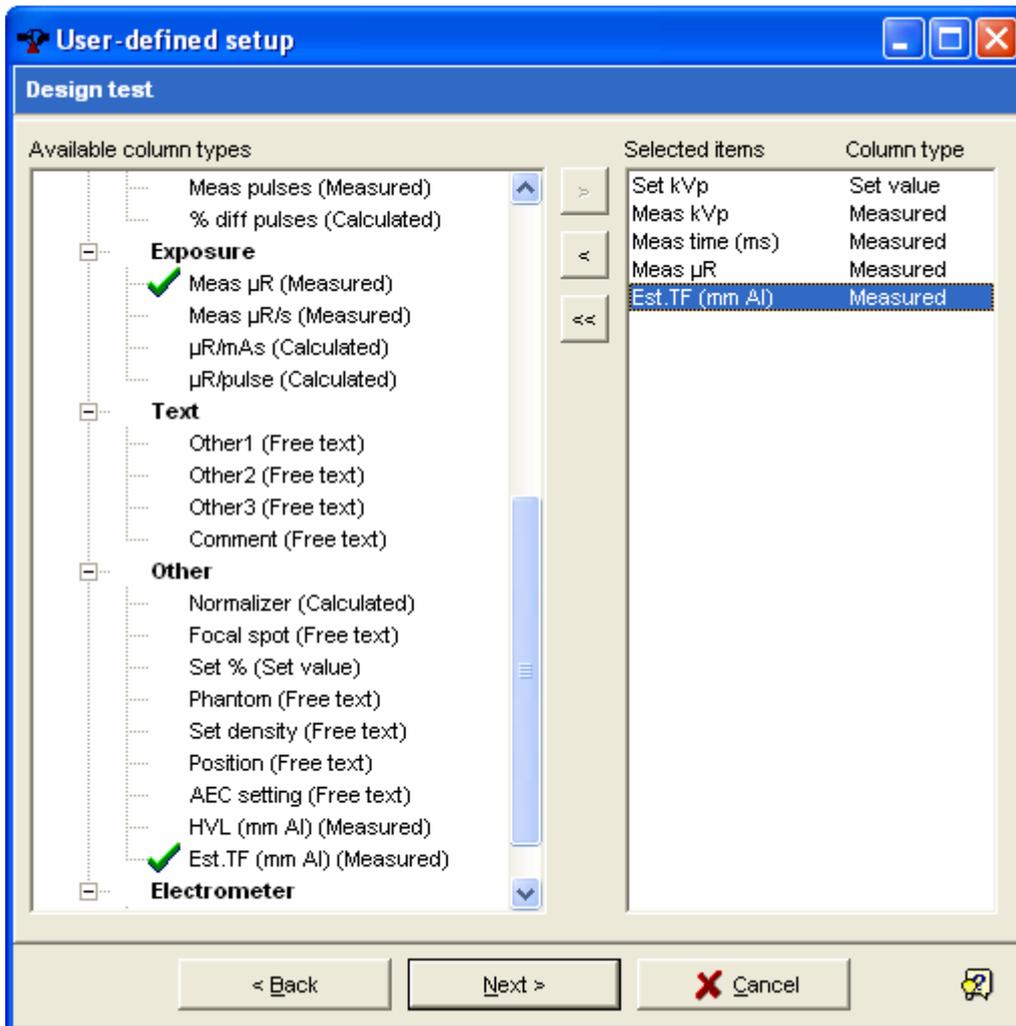


Figure 6. The User-defined setup window. In the right part of the screen the columns that are included in the test is showing.

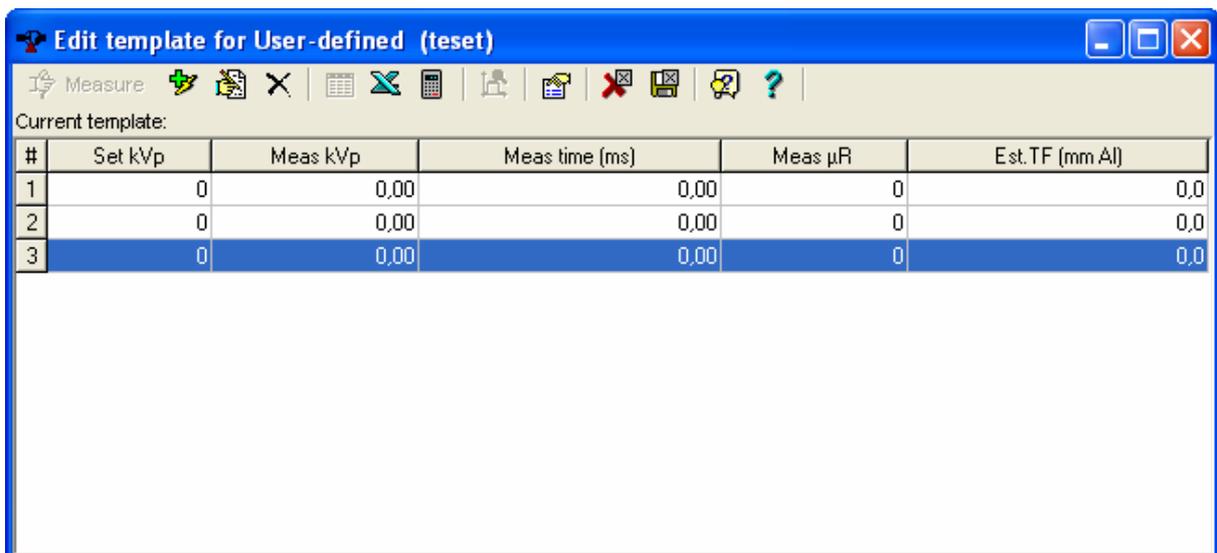


Figure 7. A user-defined test template based on the choices made in figure 6.

Total Filtration through HVL

The total filtration can also be acquired by measuring HVL traditionally using filters on top of the detector. Then the total filtration is calculated from the HVL value. In figure 8, first tap the button **Appl** in the lower right corner and you will enter the application window. Tap HVL to start an HVL measurement.

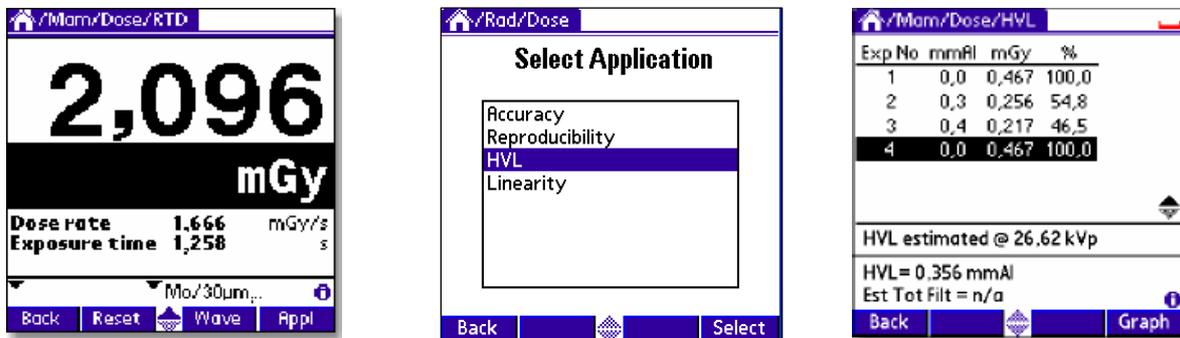


Figure 8. The HVL application

When enough data has been acquired (when the dose value is just below 50%), the estimated total filtration will show at the bottom of the screen to the right in figure 8.

You can change the setup of the HVL application, i.e. if you want to use other filter thicknesses than the suggested. Tab the blue field at the top of the screen and choose **Options** as shown in figure 9. Tab **Edit Set Value List**.

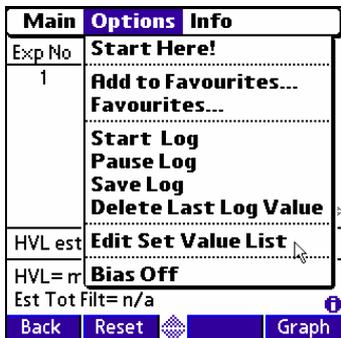


Figure 9. Where you change the setup of the HVL application

The option to go through HVL to get the total filtration is not available in the oRTigo Real-Time Meter. However, in the database there is a pre-defined template for HVL measurements in the **Templates** tab under **Basic** shown in figure 10.

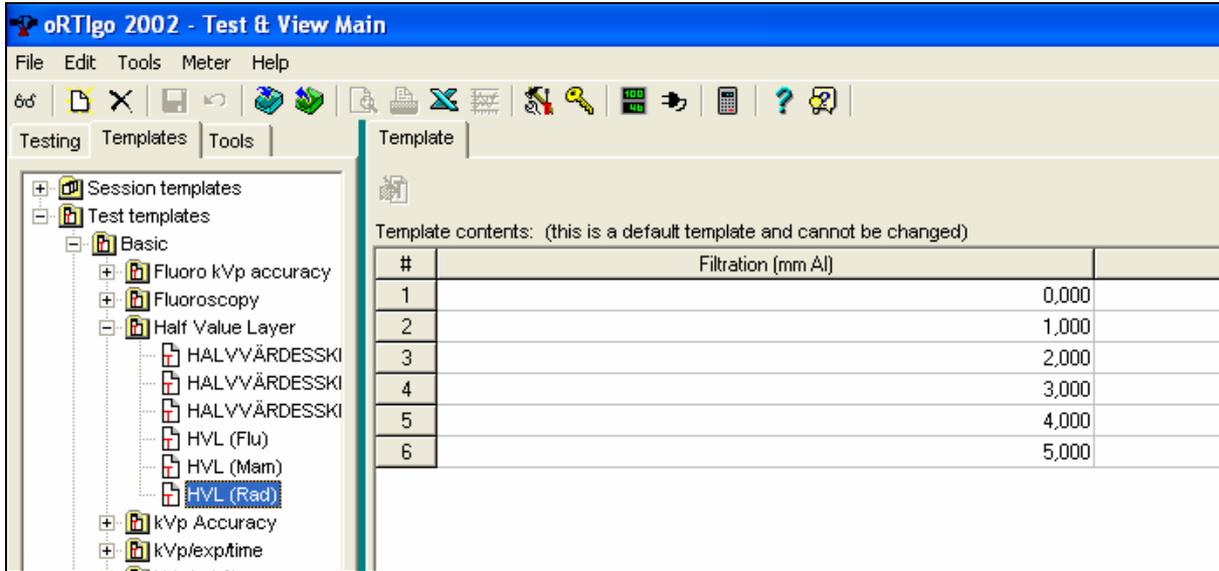


Figure 10. Pre-defined HVL template

When you run the template, in figure 11, one of the results is the estimated total filtration. This value is also calculated from the HVL value in the same way as in the QABrowser.

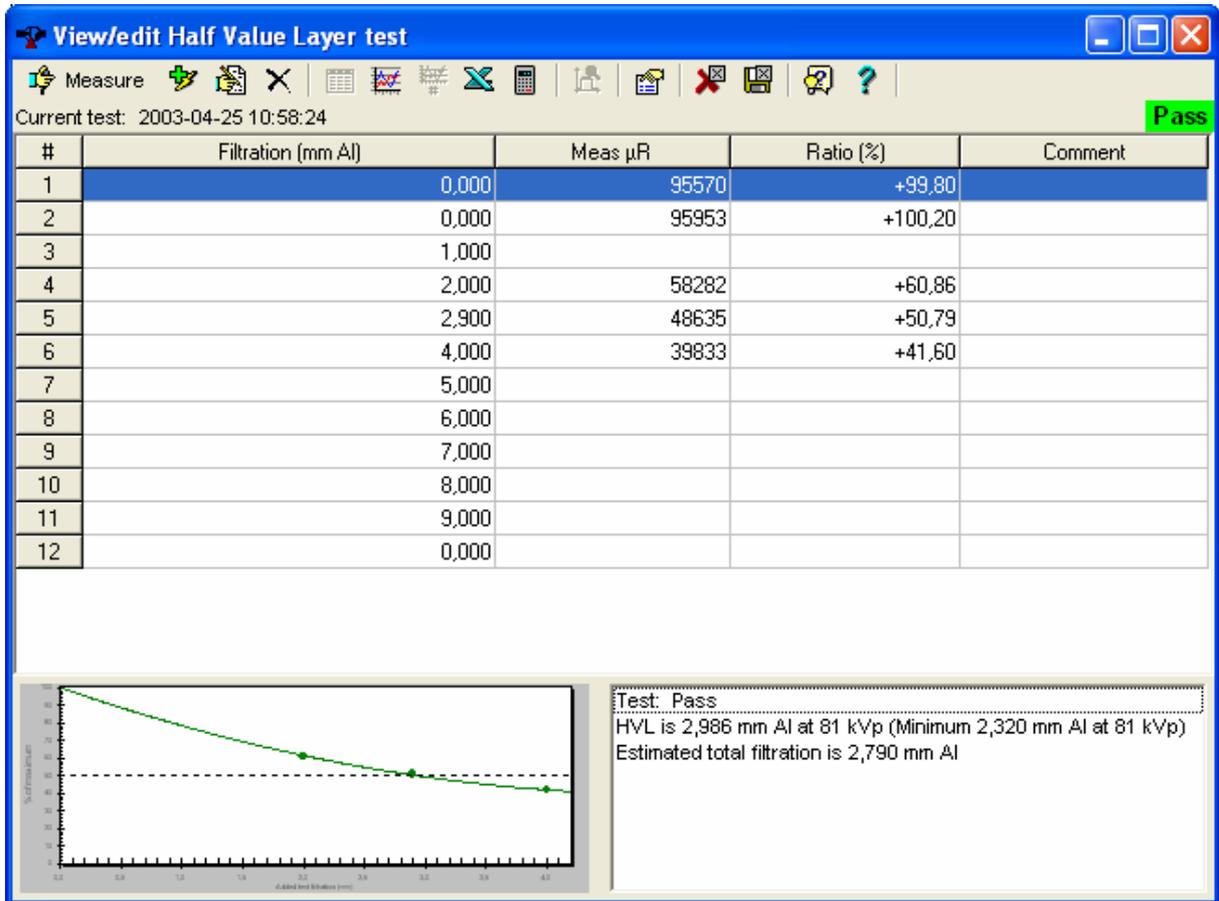


Figure 11. A performed HVL test

Variations in Total filtration

There are a number of reasons why there may be variations in the total filtration. The X-ray generator is a highly contributing factor as it may have a kV ripple and an anode angle that is not consistent with the generator used during the calibration. Other factors are the material in the beam path and scattered radiation. All the factors influence the energy contents of the radiation and cause uncertainty in the determination of the total filtration.

SOFTWARE SETTINGS

If you have decided to use the one exposure method in order to measure the total filtration, there are some settings to be aware of. Since the highest accuracy is obtained between 60 and 120 kV, we recommend to do the measurement of the total filtration in between, at 80 kV, see figure 12. The MPD is also calibrated for the total filtration at this kV. Use a high signal level, i.e. 200 mA during 200 ms to get a stable result. It does not matter if you intend to do measurements at a higher or lower kV than this, this measurement aim to get a correct value of the total filtration.

50 kV	60 kV					120 kV			150 kV
set	set	determine				set			set

Figure 12. The TF range.

Hence, choose 80 kV, 200 mA and 200 ms and make an exposure. The total filtration will be displayed in a pop-up screen. Press Keep and the value is stored and will be used on all further measurements. The pop-up screen will be displayed whenever the value of the total filtration is changed.

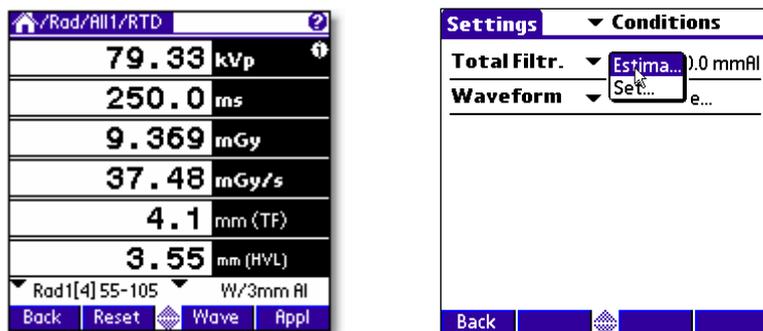


Figure 13. Click on *i* in the lower right corner to enter the settings screen. Choose Estimate or Set.

Manually you can do this by entering the settings screen, figure 13. As a default value the total filtration is on **Estimate**. Measure the total filtration and then enter the settings window again. Now choose Set and enter the measured value.

The Keep feature is not available in oRTIgo and the settings have to be made manually. See figure 3 on page 4 for where they are done in the Real-Time Meter. For the Database, see figure 5, 6 and 7 on page 5 and 6.

Now you will have a correct value of the total filtration during the whole range of kV and always get a accurate correction.

APPENDIX

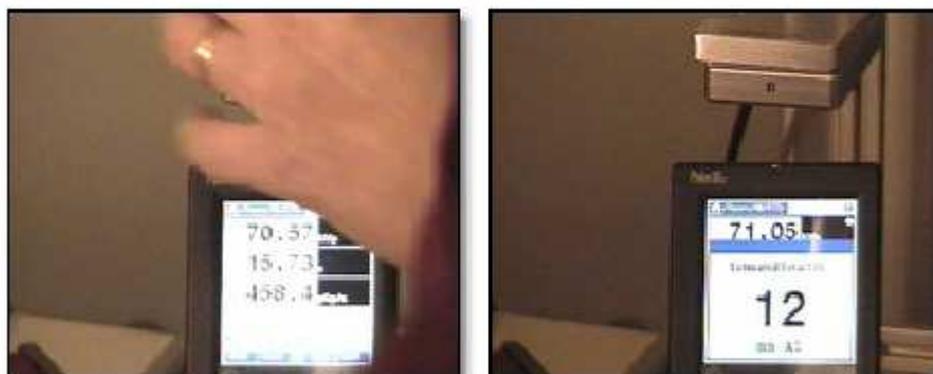
The total filtration is measured continuously when the MPD or the Piranha is used under fluoroscopy.



The fluoro is started and the total filtration is estimated and automatically displayed during two seconds.



The displays with measured values are continuously updated every four seconds.



Add 10 mm of aluminum. The Barracuda will "notice" that the filtration is changed and shows a new total filtration value.



The dose rate is now much lower. The added filtration does not affect measured kVp at all.

Note how the Barracuda directly responds to a sudden change of the filtration. The display is continuously updated with the kV, time and dose-rate. The dose rate value decreases when the extra 10 mm Al is put in the beam but the continuously updated kV value is practically are the same.

Furthermore, if the parameter "All w. TF+HVL" is chosen, the QABrowser will display both estimated total filtration and quick-HVL values for every measurement shown above.