STANDARD IMAGING®

IVB1000 WELL CHAMBER

REF 90009

U S E R M A N U A L

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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.

⚠ WARNING: Electrical shock hazard when connected to 300 V bias supply. Do not remove cover.

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

⚠ CAUTION: This device should never be submerged to clean or scrubbed with an abrasive cleaner. Do not sterilize.

⚠ CAUTION: Do not drop, mishandle, or disassemble unit since it may result in change of calibration factor. Refer all servicing to qualified individuals.

⚠ CAUTION: Do not sharply bend triax cable. Damage to the cable may result in high leakage currents.

⚠ CAUTION: Ensure source freely moves within secured catheter. Proper location of source is necessary to assure proper calibration.

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1 Overview

The Standard Imaging IVB 1000 Well Chamber is specifically designed for measurement of multiple brachytherapy sources with lengths 100 mm or less, with the appropriate calibration. It is recommended that the chamber be calibrated every two years as is standard practice for other ionization chambers. Initially, the calibration factor is given in the calibration report from the Accredited Dosimetry Calibration Laboratory (ADCL). The appendix provided with the calibration report discusses the calibration factors in greater detail. Calibration factors should be obtained from an ADCL for each brachytherapy source that is being measured. The ionization current expected from the IVB 1000 is ap-proximately 2.4 pA/U for ^{192}Ir brachytherapy sources and 38.6 nA/Gy/s for ^{90}Sr. U is the unit for air kerma strength and is $mGym^2h^{-1}$. Thus, the measurement of all brachytherapy sources requires an electrometer with a calibrated scale for measuring currents in the appropriate range (see specifications section of this manual for typical sensitivities). Alternatively, a calibrated charge scale may be used with timed runs.

For LDR sources, typical readings are 1 pA or less. An electrometer with a lower sensitivity of 1 fA is best for signal to noise considerations.

Calibration of all brachytherapy sources with well chambers is important. When a brachytherapy source is used, it is imperative that there be an accurate and reliable calibration of the source strength by means of a suitable chamber, such as the IVB 1000.

Using other inserts, low dose rate brachy-therapy seeds can also be calibrated with the IVB 1000. Use the appropriate insert for a given source. Additionally, do not confuse details in one section of this manual with those of another. Some details are specific only for the given application or radionuclide.

The half-life of ^{90}Sr is 28 years. However, the manufacturer recommends 250 uses or replacement on a six-month basis. All these sources must be calibrated when placed in use and may be checked periodically during use. Suppliers of sources usually provide calibration certificates that can have an uncertainty of ±4% or more, necessitating an independent calibration for better accuracy. This point is addressed in the article published in Brachytherapy Dosimetric Assessment: Source Calibration,RSNA Categorical Course in Brachytherapy Physics 1997, pp. 143-153, and in Calibration for Brachytherapy Sources, AAPM Summer School 2005. The IVB 1000 is convenient for frequent use. If your measurement differs significantly from the manufacturer, you should resolve the difference before use.

Please note that the factors that are used in the calibration of these chambers are the most current, and in some cases, may be different than those used in treatment planning computers. This difference, if present, should be accounted for during your treatment planning activities. To avoid confusion, the American Association of Physicists in Medicine has recommended that air kerma strength calibrations be used for gamma emitting brachytherapy sources (AAPM Reports No. 56, 60, 40 and 32) instead of source activity. For beta calibrations the absorbed dose at 2 mm is used. The only NIST traceable calibration quantity is air kerma strength for gamma rays and this is the calibration factor provided for the IVB 1000. Any other quantity desired, for example, apparent activity, will have to be derived

using agreed upon constants. Further details are provided in the appendix included with the calibration report.

2 Constancy Check

Regular constancy checks should be performed by using a procedure such as the following. The source holder may be removed to allow the stability of the IVB 1000 to be checked by means of a constancy check source, e.g. using a low dose rate brachytherapy check source. Alternatively, the stability can be monitored with the use of an external ^{60}Co beam. This value should be obtained upon receipt of the chamber and monitored for consistency thereafter. Either place the chamber in the ^{60}Co beam at a known distance with a standard field, such as 10 cm x 10 cm, or place the check source in a reproducible position and take a current reading. A graph of the response corrected for decay should re-main within +/- 0.5%.

Another acceptable method for these checks is a redundancy check or intercomparing with one or two other chambers on the same source in the same time period. In particular, having two or three chambers that have been calibrated at an ADCL, which then would be used to measure the same source within a short time period is acceptable. If necessary, account should be made for decay. Either the same electrometer for each chamber or independent dosimetry systems can be used for this exercise applying the calibration factors for each. The chambers or the systems, whether at a given center or from a neighboring center, should be used at the same time and a ratio of results kept. This method is reliant upon the stability of the systems with respect to each other. We do not suggest comparison with a farmer chamber because set up problems can cause questionable results.

3 Calibration

As is standard practice for other ion chambers, it is recommended that the IVB 1000 be calibrated every 2 years. It should be calibrated with the source insert used for the chamber. This calibration should be performed by an Accredited Dosimetry Calibration Laboratory. Standard Imaging offers calibrations from the University of Wisconsin Accredited Dosimetry Calibration Laboratory. You need only one purchase order to cover calibrations, shipping and handling, and service. Standard Imaging hand carries all instruments to and from the ADCL.

4 Procedures for Well Chamber Measurements

The following procedures should be used any time that measurements are to be made with a well chamber and electrometer system. This applies only to the setup of the well chamber and electrometer, not to the setup of the ionization source.

1. With nothing connected to the input jack of the electrometer, turn the power on and wait at least 10 minutes for warm up.
2. Verify the leakage of the electrometer is within the manufacturer's stated acceptable limits.
3. Connect the well chamber to the electrometer and apply 100% voltage bias.
4. Allow the electrometer and the well chamber system at least 10 minutes to stabilize, making certain that all cabling is lying flat and unkinked.
5. Verify the leakage of the well chamber is within the manufacturer's stated acceptable limits. If measured in the presence of background sources, note that this signal will add to the leakage of the chamber.
6. Some electrometers, such as the Standard Imaging MAX 4000 Plus Electrometer, allow the user to zero the device at any time. If desired, perform this system zeroing now.
7. Check the system leakage. Take a reading without exposing the chamber to radiation. This reading should be less than 0.1% of the final signal expected. If it is not, the leakage should be subtracted from the signal.
8. Measure the atmospheric temperature and pressure. For well chambers, measure the temperature in the well of the chamber.
9. Turn on or insert the radiation source(s) and take at least 3 measurements. Generally, the measurements should not be moving in only one direction (i.e. three readings that continue to drop and hence may not yet be stabilized). If a current measurement is done, allow enough time for value to stabilize.
10. Analyze the data considering the average of the readings, system leakage, temperature/pressure corrections (see page 6), calibration factors and any other appropriate corrections to be made. The following equation can be used:

$$S_K = M_{raw} * C_{TP} * C_E * N_{SK}$$

Where:

S_K = the air kerma strength of the source in U

M_{raw} = the reading in A (if current scale) or in C/s (if charge scale measured for a set time in s)

C_{TP} = the temperature and pressure correction factor

C_E = the calibration factor for the electrometer scale

N_{SK} = the IVB 1000 calibration coefficient (in this case the air kerma strength calibration factor)

NOTE: S_K can be divided by A_{ion} if desired to correct for recombination effects. Since the IVB 1000 has an A_{ion} of 1.000, this is not necessary.

11. When all measurements are completed, set bias voltage to 0VDC, turn off the electrometer and disconnect the well chamber.

5 Well Chamber Response as a Function of Pressure

Calibration factors provided by an ADCL are corrected to standard temperature and pressure (STP: 22 °C and 760 Torr), and a correction for air density via a temperature/pressure correction must be applied to clinical measurements to obtain the correct air kerma strength for the source. As with many other products, including other ion chambers, Standard Imaging well chambers may be affected by significant changes in pressure. This effect is linked to their vented design, which was incorporated to eliminate the risk of leak-related response problems associated with pressurized well chambers. For some sources significant decreases in ambient pressure can predictably affect well chamber response.

- With low-energy photon emitting brachytherapy sources, such as ^{103}Pd and ^{125}I, predictable and linear decreases in response are seen. This difference in response becomes more significant and exceeds the calibration uncertainty with pressure decreases as seen at higher altitudes.
- With high-energy photon emitting brachytherapy sources, such as ^{137}Cs and ^{192}Ir, and beta emitting brachytherapy sources, such as ^{90}Sr and ^{32}P, there is little to no effect with pressure decreases as seen at higher altitudes.

The response differences for low-energy photon emitters[1] may be corrected using an additional correction factor beyond that provided on the calibration certificate from the ADCL and after normal application of the C_{TP} correction factor. The equation incorporating this additional correction factor C_A related to pressure (altitude related air density) is provided below, as are the required constants. No additional correction factor is required for high-energy photon emitters and beta emitters.

$$M_{corr} = M_{raw} * C_{TP} * C_A$$

$$M_{corr} = M_{raw} \times \left[\frac{273.15 + T(°C)}{295.15} \times \frac{760}{P(Torr)}\right] \times \left[k_1 \times [P(Torr)]^{k_2}\right]$$

Low-Energy Photon Emitting Brachytherapy Source	k_1	k_2
Pd-103	0.0241	0.562
I-125 (with silver)	0.0490	0.455
I-125 (no silver)	0.0573	0.431

The cause of this low energy pressure effect involves a combination of the range of the electrons being on the order of the size of the air cavity itself and the consequences of backscatter from the aluminum walls of the chamber. This is further explained in reference 2 on the following page. The chamber volumes for energies this low are medium sized cavities. For SI chambers, the distance across the inner and outer active region of the well chambers is on the order of the range of electrons generated by the low-energy photons emitted. Thus, a

large fraction of the generated electrons will stop in the active region. The apparent over response of the well chamber is caused by these terminating electrons because the CTP correction should not be applied to electrons that stop in the active region. This is a simplified explanation for a complex phenomenon. For a more detailed explanation see the Medical Physics papers referenced on the following page.

Standard Imaging, therefore recommends the following:

- Compare the rated or labeled activity of the source with the air kerma strength measurements obtained with the well chamber during recommended periodic checks after appropriate corrections.
- When using a Standard Imaging well chamber with low-energy photon emitting brachytherapy sources at pressures significantly below 760 Torr, incorporate the additional correction factor related to pressure response differences, after normal application of the C_{TP} correction factor.

References

1. "The effect of ambient pressure on well chamber response: Experimental results with empirical correction factors". Medical Physics. 32(3):700-709, 2005

2. "The effect of ambient pressure on well chamber response: Monte Carlo calculated results for the HDR 1000 Plus". Medical Physics. 32(4):1103-1114, 2005

6 General Operation

The IVB 1000 Well Chamber has a vent hole to maintain the internal air at ambient atmospheric pressure. Thus, the readings obtained must be corrected for ambient temperature and pressure to the temperature and pressure of calibration (22° C and 760 mm Hg) at "normal" relative humidity (50% ± 25% non-condensing) in the usual accepted manner. The IVB 1000 has variable inserts available that can be set for different seed lengths. Figure 1 shows a typical axial response curve for the IVB 1000 as determined by a single ^{192}Ir source. There is only a ±0.3% variability in sensitivity within 100 mm around the center (50 mm on each side). The axial response curve is similar for the ^{90}Sr source.

The IVB 1000 utilizes a conventional triax connector and cable to be connected to a suitable electrometer. A bias of 300 volts must be applied to the electrometer low-impedance connection relative to chassis ground such that the guard of the well chamber is at this voltage relative to ground. The voltage polarity effect is less than 0.1%. If desired, a second bias level of 150 volts can also be used to determine the ionic re-combination loss at 300 V. [1] The ionic recombination loss is less than 0.05% and thus can be considered negligible or equal to a correction of 1.000.

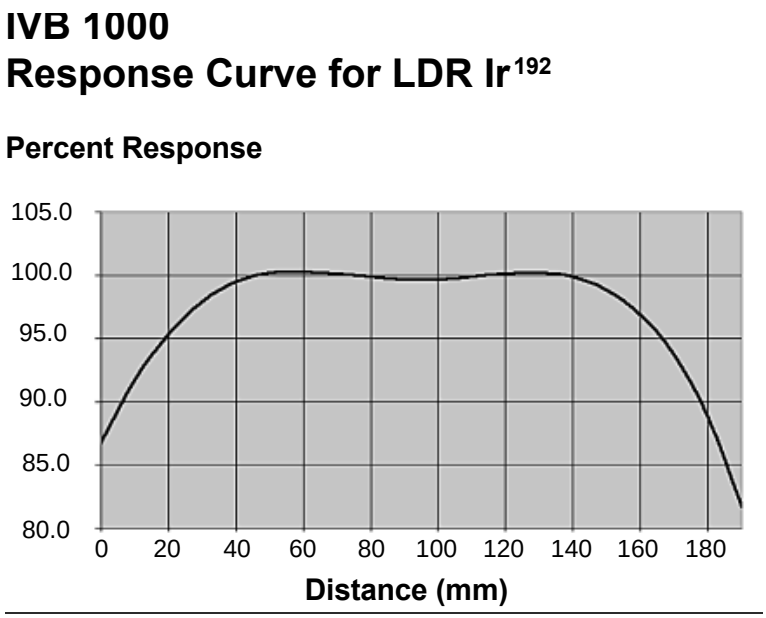


Figure 1: Typical axial response shown as a percent with distance from the bottom of the chamber.

NOTE: Depending on altitude & seed type, the correction, C_A on page 6 may have to be applied. This note also affects the following source holders:

70043 Single LDR Seed Sources
70047 MICK® Cartridge Sources
70048 RAPID Strand® Iodine Seed Sources
70049 IBt Interstrand® Sources
70051 Preloaded Needle Sources

[1] The equation used is $A_{ion} = 4/3 - (Q_1/3Q_2)$, where Q_1 is the charge or current measured at 300 V and Q_2 is the charge or current measured at 150 V. See Med. Phys. 11: 714 (1984).

7 Procedures for Specific Source Holders

7.1 70031 Holder for Leipzig HDR Applicators

REF 70031

The Leipzig Applicator Source Holder is designed for use in the HDR 1000 Plus and IVB 1000 Well Chambers to perform output verification of Leipzig HDR applicators used with the microSelectron-HDR "classic" and the v2 afterloaders.

To commission the applicators, the user must follow the recommendations as presented in *Technique for routine output verification of Leipzig applicators with a well chamber*. See references on the following page for complete information.

To verify the output of the applicators with the well chamber and the insert, a physicist should use the following steps:

1. Find the source position inside the Leipzig applicator that maximizes the reading. This can be done by changing the source-indexer positioning in 1 mm increments for the classic machine and the v2 machine.

2. Perform the current measurements three times with remounting the setup in each measurement.

3. Calculate the CF using the following equation and procedure.

Procedure for Determining Correspondence Factor

The CF for each combination of well chamber and applicator are obtained as follows:

a. Place the applicator on the source holder at the well chamber entrance to determine the current reading R in nA, with the source in the position of maximum reading. Do not use the plastic cover when placing the applicator.

b. Multiply the reading R by the correction factor C_{TP} for the atmospheric conditions, relative to 22 °C and 760 Torr.

c. Divide *R* by the well chamber calibration factor *f* to account for the specific response of the well chamber.

d. Divide *R* by the air kerma strength, S_K, to account for the actual source strength.

Correspondence Factor =

$$\frac{(R * C_{TP})}{(f * S_K)}$$

R = reading in nA

C_{TP} = correction for temperature and pressure

f = chamber calibration factor

S_K = Air Kerma Strength

4. Check if the CF value obtained for the applicator using the equation above agrees with its value in Table 1. If so, the output values from Table 1 can be used in clinical dosimetry. If not, further specific investigation is required. Taking into account the previously described uncertainty of the CF values and the uncertainty in the measurements by the users, it seems reasonable to recommend a tolerance of about ±5% in this comparison.

7.2 Holder for Leipzig HDR Applicators Continued

Well Chamber	Leipzig applicators H & V (Units in $nA^2 h^2 Gy^{-2} m^{-4}$)					
	H 3 cm	H 2 cm	H 1 cm	V 3 cm	V 2 cm	V 1 cm
IVB 1000[1]	1.461×10^6	1.114×10^6	6.444×10^5	1.262×10^6	9.400×10^5	5.609×10^5

Table 1: Typical Values for comparison

Typical values kindly provided by:

1.Zoubir Ouhib, Boca Raton Community Hospital, Boca Raton, FL, USA

V 3 cm Leipzig Applicator shown in well chamber

References

"Technique for routine output verification of Leipzig applicators with a well chamber". J. Pérez-Calatayud, et. al; Medical Physics. Vol 33 , No 1, pp. 16-20, January 2006.

"A dosimetric study of Leipzig applicators". José Pérez-Calatayud, Ph.D., et. al.; Int. J. Radiation Oncology Biol. Phys. Vol. 62, No. 2, pp. 579–584, 2005.

7.3 70034 LDR Iridium Sources

REF 70034

Convert a Treatment Catheter to a Calibration Catheter if required.

⚠ WARNING: This is only applicable for IVB ^{192}Ir sources and only if a Calibration Catheter has not been provided or fabricated.

Using a sharp utility knife, cut off the blue tip of a ^{192}Ir treatment catheter as shown in **Figure 2**. Retain this Calibration catheter and use with all future source calibrations.

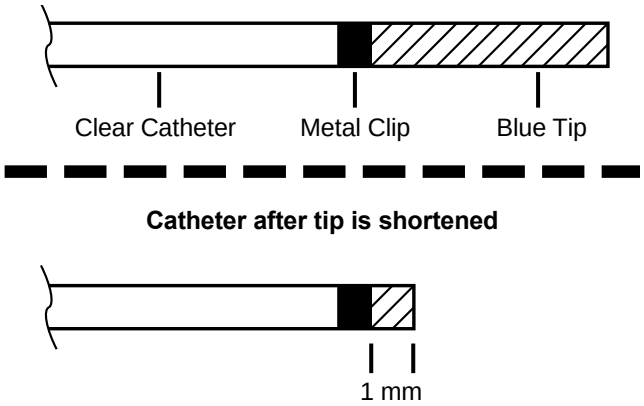


Figure 2: Converting a Treatment Catheter to a Calibration Catheter for ^{192}Ir IVB sources

⚠ WARNING: This procedure is only for IVB ^{192}Ir sources.

2. Place the IVB 1000 Chamber with the lead rings around it as calibrated. If necessary, let the chamber stabilize for at least 30 minutes before the measurement to allow it to equilibrate to ambient temperature and pressure. Generally, the chamber is calibrated with the lead rings on it. If the chamber was calibrated without the lead rings, it should be used in that manner. DO NOT use lead rings when calibrating ^{90}Sr seed trains.

NOTE: There is a 1% difference in calibration factor whether or not the lead rings are present since the lead rings contribute scatter into the chamber.

3. Connect the IVB 1000 Chamber to a suitable electrometer, such as the MAX 4000 Plus from Standard Imaging, and apply 300 V bias voltage. Allow the system to stabilize for at least 10 minutes.

4. Set the Source Holder to the number of seeds to be measured: 6, 10, 14, 18 or 22. This is indicated by the lowest number visible on the Source Holder. Insert the Source Holder into the IVB 1000.

5. Carefully slide the blue-tipped end of the Calibration Catheter into the top opening in the knurled knob on the Source Holder. Insert the Catheter until it bottoms within the Source Holder (about 7.5").

6. Secure the Calibration Catheter by tightening the Knurled Knob until the Catheter no longer moves up and down easily. Do not tighten too far so the IVB seed train is unable to pass completely into the Source Holder.

7. After performing all manufacturer recommended safety procedures for the IVB seed train, run the seed train to the bottom of the Calibration Catheter (Verify again that the setting on the Source Holder matches the number of seeds in the train). Let the reading stabilize for a minimum of 20 sec for current measurement or for a reproducible set time for charge measurement.

8. Read and record the measured current or charge.

9. Use correction factors for temperature/pressure (see page 6), electrometer correction factor (electrometer must be calibrated) and calibration factor for the IVB 1000 given by the Accredited Dosimetry Calibration Laboratory to calculate the air kerma strength of the source. The following equation can be used:

$$S_k = M_{raw} * C_{TP} * C_E * N_{SK}$$

Where:

S_k = the air kerma strength of the source

M_{raw} = the reading in A (if current scale) or in C/s (if charge scale measured for a set time in s)

C_{TP} = the temperature and pressure correction factor

C_E = the calibration factor for the electrometer scale

N_{SK} = the IVB 1000 calibration coefficient for air kerma strength

NOTE: S_k can be divided by A_{ion} if desired to cor-rect for recombination effects. Since the IVB 1000 has an A_{ion} of 1.000, this is not necessary.

The value of S_k will give the total air kerma strength for the number of seeds measured within ±0.3%.

Example:

M_{raw} = 6.220 n A, C_{TP} = 1.009, C_E = 0.999 and N_{SK} = 421 U/nA, then

S_k = (6.220nA) * (1.009) * (0.999) *

(421U/nA)

= 2640 U

If the value of air kerma strength is for a number of seeds and the individual value of each seed is desired, divide the value by the number of seeds in the train. The value for absorbed dose rate at 2 mm is determined using AAPM task group 60 report.

7.4 70036 Novoste ^{90}SR/^{90}Y Sources

REF 70036

1. If necessary, let the IVB 1000 Chamber equilibrate to ambient temperature and pressure for at least 30 minutes before the measurement.

⚠ WARNING: NEVER cut the catheter for ^{90}Sr source trains (manufactured by Novoste).

2. Connect the IVB 1000 Chamber to a suitable electrometer, such as the MAX 4000 Plus from Standard Imaging, and apply 300 V bias voltage. Allow the system to stabilize for at least 10 minutes. **Be sure to use the bias voltage with which the IVB 1000 was calibrated.**

3. Set the Source Holder to the length of source to be measured: 30, 40 or 60 mm. This is indicated by the lowest number visible on the Source Holder. See **Figure 1B**. Insert the Source Holder into the IVB 1000.

4. Carefully slide the Source Catheter into the top opening in the knurled knob on the Source Holder. Insert the Catheter until it bottoms, about 7.5" deep.

5. Secure the Source Catheter by tightening the knurled knob until the Catheter no longer moves up and down easily. Do not tighten too far so the source is unable to pass completely into the Source Holder, or that the catheter is kinked or damaged.

6. After performing all manufacture recommended safety procedures for the IVB seed train, run the seed train to the bottom of the Calibration Catheter. Continue to flow water through the delivery catheter for at least 15 seconds after the seeds arrive at the end of the catheter. This eliminates any bubbles which can affect accuracy. Let the reading stabilize for a minimum of 20 sec for current measurement or for a reproducible set time for charge measurement.

7. Read and record the measured current or charge at five positions (e.g. rotate the Source Holder in the Well chamber to the compass positions of 0°, 90°, 180°, 270°, and 360° for successive measurements). Take the average of the readings.

8. Use correction factors for temperature/pressure (see page 6), electrometer correction factor (electrometer must be calibrated) and calibration factor for the IVB 1000 given by the Accredited Dosimetry Calibration Laboratory to calculate the absorbed dose rate at 2 mm for the source. The following equation can be used

$D_w = M_{raw} * C_{TP} * C_E * N_{SK}$

Where:

D_w = the absorbed dose rate at 2 mm depth in water

M_{raw} = the reading in A (if current scale) or in C/s (if charge scale measured for a set time in s)

C_{TP} = the temperature and pressure correction factor

C_E = the calibration factor for the electrometer scale

N_{SK} = the IVB 1000 calibration coefficient

NOTE: D_w can be divided by A_{ion} if desired to correct for recombination effects. Since the IVB 1000 has an A_{ion} of 1.000, this is not necessary.

The value of D_w will give the total absorbed dose rate at 2 mm for the source length measured.

Example:

M_{raw} = 6.220 n A, C_{TP} = 1.009, C_E = 0.999 and N_{SK} = 42 Gy/s/nA, then

D_w= (6.220nA) * (1.009) * (0.999) *

(42Gy/s/nA) = 263Gy/s

NOTE: A calibration factor is also given for contained activity. The equation above is still used with C being replaced by the calibration factor for contained activity. The result obtained is then the "contained activity" instead of D_w.

7.5 70043 Single LDR Seed Sources

1. Insert an individual seed into the center tube of the source holder. The source holder will place the seed at the most active area of the chamber.

REF 70043

2. Take a measurement following the method described in the ***Procedures for Well Chamber Measurements*** section of this manual. A seed can be removed by removing the source holder and inverting. The center tube will allow the seed to easily slide out. ADCL calibrations are available for LDR iridium, iodine and palladium seeds. ADCL calibrations are not available for gold.

7.6 70044 HDR Iridium Sources

1. Place the IVB 1000 Ionization chamber in the same room as the HDR unit for at least 30 minutes before the measurement to allow it to equilibrate to ambient temperature and pressure.

REF 70044

2. Connect the IVB 1000 Well Chamber to a suitable electrometer, such as the MAX 4000 Plus from Standard Imaging, and apply 300 V bias voltage. Allow the system to stabilize for at least 10 min.

3. Connect a catheter, such as the endobronchial, French 6 blue catheter to HDR irradiator.

4. Align the black dot on the well insert with the punch mark on the body of the chamber.

5. Insert catheter end to bottom of source holder. The dead space at the catheter end must be known, so that the center of the ^{192}Ir source can be positioned at the most sensitive spot of the chamber. Use the point determined during calibration as the sensitive spot for the IVB 1000.

6. Secure the catheter by tightening the knurled knob, until the catheter no longer moves up and down easily. Do not tighten too far so the HDR source is unable to pass completely into the Source Holder.

7. After performing all manufacturer recommended safety procedures for the HDR after-loading device, run the ^{192}Ir source to the radiation sensitive axial point of the chamber for a minimum of 20 sec for current measurement or for a reproducible set time for charge measurement. If the charge mode is used and the charge is accumulated while the source is in transit, account for the transit time error of the source by making the standard timer end effect measurements as described in High Dose Rate Brachytherapy: A Textbook, Nag, ed. Futura, 1994.

NOTE: This value will differ depending on the length of the catheter. The timer feature of Standard Imaging electrometers can be used to collect charge for set times and eliminate this effect.

7.7 70045 Cesium Sources

For ^{137}Cs calibrations, verify the plastic spacer inside the source holder insert is at the bottom of the source holder.

REF 70045

Insert the cesium source into the source holder using safe handling procedures. Take measurements following the method described in the *Procedures for Well Chamber Measurements* section of this manual.

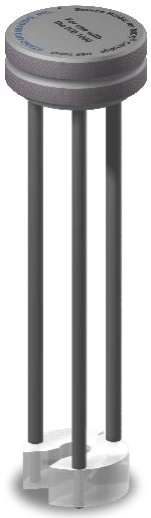
7.8 70046 Cesium Remote Afterloading Sources

Insert the cesium source into the source holder using safe handling procedures. Take measurements following the method described in the *Procedures for Well Chamber Measurements* section of this manual.

REF 70046

7.9 70047 MICK® Cartridge Sources

This source holder provides a QA check of the activity of seeds loaded into a MICK® cartridge. It positions the cartridge for a quick, reproducible measurement. A spring-loaded clamp attachment easily grips the cartridge to minimize finger dose and allows quick insertion whether or not the Sterile Convenience Pack is used. It works with the traditional plastic cartridge, as well as the new shielded/disposable MICK® magazines.



REF 70047

As a service to our users, some brachytherapy seed correction factors have been determined with the help of the University of Wisconsin ADCL*.

The collective seed measurements from this Source Holder were compared to the sum of the individual seeds measured in the Single Seed Source Holder, REF 70043, for Oncura 6711 and 6733 seeds in the sterile Convenience Pack. These measurements revealed the ratio or "correction factor" for either Oncura 6711 or 6733 seeds to be 1.65 in the traditional plastic cartridge (MICK catalog #7609-D), 1.76 in the brass shielded/disposable cartridge (MICK catalog #0216-DS, purchased before 3/23/06), or 1.80 in the newly designed brass shielded/ disposable cartridge (MICK catalog #0216-DS, purchased after 3/23/06).

NOTE: These numbers differ from measurements taken with source holder 70024 for use with the HDR 1000 Plus Well Chamber. Multiply this factor times the AAPM ADCL supplied single-seed air kerma strength calibration factor for that seed.

*Users should independently determine correction factors for each seed type used. See tech note 4638 "Multi-Seed MICK® Cartridge Assay Procedure."

7.10 70048 RAPID Strand® Iodine Seed Sources

This source holder is designed for QA measurements of RAPID Strand 6711 Iodine seed strands prior to use and is designed for use only with the IVB 1000 Well Chamber.

REF 70048

A RAPID Strand containing 10 iodine seeds was evaluated with the IVB 1000 and the Seed Strand Source Holder. Following the evaluation, seeds of the RAPID Strand were cut from the strand. The collective seed measurements were compared with individual seed measurements in the Single Seed Source Holder, REF 70043, to obtain a correction factor. This factor was found to be approximately 1.07 times the 6711 Iodine seed calibration factor from the University of Wisconsin Radiation Calibration Laboratory.

The results of the above testing apply specifically to the submitted strand type and well chamber. Application of these results to any well chamber and its associated holder may result in errors due to differences in manufacturing processes, component composition, and the effects of different stranded seed trains to those variations. It is recommended that this investigation be repeated by users upon initial receipt of this holder to verify this number. The Seed Strand Source Holder, REF 70048 can be **gas sterilized** or **steam sterilized (autoclaved)**.

To measure a RAPID Strand source, raise the lift knob on the top of the source holder as far as possible, and insert the strand in its amber-colored spacing jig. There is a plastic key on the bottom of the housing to guide the spacing jig so the seeds are in the center of the well chamber. Lower the lift knob, and measured activity of all ten seeds in the strand. Inverting the RAPID Strand is not necessary. To measure more Rapid Strand sources, simply raise the lift knob, and remove the measured RAPID Strand from the holder. A formula can be used to determine the average seed air kerma strength (AKS) as a QA measurement of the sum of 10 seeds.

Seed Activity =

$$\frac{(M_{raw} * CF * C_{TP} * C_E)}{N}$$

M_{raw} = reading

CF(correction factor) =

~ 1.07 times the ADCL iodine calibration factor for Oncura 6711 seeds, obtained with Single Seed Source Holder, REF 70043

N = number of seeds

C_{TP} = correction for temperature and pressure

C_E = electrometer calibration factor

Example:

You receive a strand with an average air kerma strength of 0.3mGym^{2}h^{-1} per seed. Ten seeds are measured, and an iodine calibration factor of 2.6 x 10^{11} mGym^{2}h^{-1}A^{-1} is used.

Assume:

M_{raw} = 0.9914 x 10^{-11}A N = 10

CF = (1.07) (2.6 x 10^{11}) C_{TP} = 1.014

C_E = 0.998

Seed Activity =

$$\frac{(0.9914 \times 10^{-11}A)\ (1.07)\ (2.6 \times 10^{11})\ (1.014)\ (0.998)}{10}$$

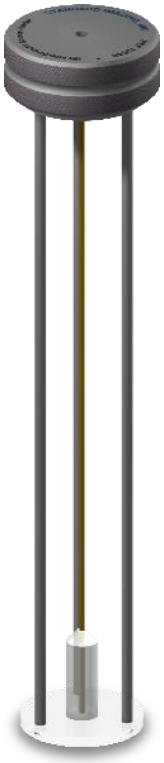
$$= 0.28\ mGym^2h^{-1}$$

This average seed air kerma strength can be compared to your expected RAPID Strand average seed air kerma strength. Note, this is a QA measurement assuming the ten seeds are the same activity. If the total air kerma strength for the 10 seeds together is desired, do not divide by N.

7.11 70049 IBt InterStrand® Sources

This source holder is designed for QA measurements of International Brachytherapy InterStrand source trains. These consist of 10 model 1031L ^{103}Pd seeds or 10 model 1251L ^{125}I

seeds, with an absorbable suture contained within the open annulus of each seed. This source holder works only with the IVB 1000 Well Chamber.



REF 70049

One IBt InterStrand containing 10 ^{125}I seeds and one containing 10 ^{103}Pd seeds was evaluated with the IVB 1000 and the InterStrand Source Holder.

Following measurement, individual seeds of the InterStrand were removed from the suture material. The collective seed measurements were compared with individual seed measurements in the Single Seed Source Holder, REF 70043, to obtain a correction factor. This factor was found to be approximately 0.97 times the model 1251L ^{125}I seed calibration factor from the University of Wisconsin ADCL and 0.92 times the model 1031L ^{103}Pd seed calibration factor.

The IBt InterStrand Source Holder, REF 70049, can be **gas sterilized** or **steam sterilized (autoclaved)**. Refer to the policy of the institution performing the measurements.

To measure an InterStrand source train, prepare the IVB 1000 Well Chamber and an appropriate Electrometer following the method described in the ***Procedures for Well Chamber Measurements*** section of this manual.

Following sterility and radiation safety procedures, remove the cover from the InterStrand Stainless Steel Shielding Container. Invert the Source Holder and thread the exposed portion of the Container into the Source Holder. Return the Source Holder to the upright position. This should cause the InterStrand to slide out of the container directly into the

Source Holder, which should be visually verified. Insert the Source Holder into the IVB Well Chamber and measure and record the air kerma strength of the seed train. To remove the train, simply reverse the above steps. This may be repeated as needed with other InterStrand sources.

A formula can be used to determine the average air kerma strength (AKS) per seed as a QA measurement of the sum of N seeds.

Seed Activity =

$$\frac{(\bar{M}_{raw} * C_{TP} * C_E * CF)}{N}$$

M_{raw} = reading

N = number of seeds

C_{TP} = correction for temperature and pressure

C_E = electrometer calibration factor

CF(correction factor) = 0.97 times the ADCL calibration factor for IBt model 1251L ^{125}I seeds or 0.92 times the model 1031L ^{103}Pd seed cal factor, obtained with Single Seed Source Holder, REF 70043

Example:

You receive an ^{125}I InterStrand with a stated air kerma strength per seed of 0.3 $mGym^2h^{-1}$. Ten seeds are measured, and an iodine calibration factor of 2.6×10^{11} $mGym^2h^{-1}A^{-1}$ is used.

Assume:

M_{raw} = $1.0971 \times 10^{-11}A$ C_{TP} = 1.014

N = 10 C_E = 0.998

CF = (0.97) (2.6×10^{11})

Seed Activity =

$$\frac{(1.0971 \times 10^{-11}A)(1.014)(0.998)(.97)(2.6 \times 10^{11})}{10}$$

= 0.28 $mGym^2h^{-1}$

This average air kerma strength per seed can be compared to your stated InterStrand air kerma strength per seed. Note this is a QA measurement assuming the ten seeds are the same activity. If the total air kerma strength for the 10 seeds together is desired, do not divide by N.

7.12 70051 Preloaded Needle Sources

Use this source holder to quickly measure a pre-loaded prostate implant needle and verify the total output and load pattern. The standard Luer fitting adjusts to accommodate almost any standard PIP needle.

REF 70051

1. Upon first use or when changing implant needle manufacturer or implant needle type, be sure to adjust the Universal Luer Lock for optimal seed loading performance:

a. Loosen set screw using 0.035" hex key and slide Luer lock body off of stainless-steel tube.

b. Screw Luer lock body onto chosen needle, being sure it is finger-tight.

c. Slide assembly onto tube *as far as possible* into inner funnel of needle.

d. Tighten set screw down onto Luer lock body and remove the needle.

Adjusted Luer fitting

Twist needle onto fitting

The source holder can now be **gas sterilized** or **steam sterilized (autoclaved)** for use.

2. Using sterile procedures and working behind radiation shielding glass (such as the Needle Loading Shield, Standard Imaging REF 90070), invert the source holder and twist the first loaded needle to be measured onto the Luer fitting.

3. Rotate the Source holder back to the upright position. The seeds will fall from the needle into the amber Kapton tubing as shown below.

4. Verify the seed and spacer loading pattern now visible through the amber tubing. Remember that because the needle is inverted, the first seed loaded into the needle is now the last seed that has slid into the source holder. In other words, the loading pattern is upside down when viewed in the amber tubing of the source holder, so count from the bottom up.

5. Next, insert the source holder into the IVB 1000 Well Chamber and measure the total activity of the seeds.

A formula can be used to determine the average seed air kerma strength (AKS) as a QA measurement of the sum of the number of seeds

Average seed air kerma strength =

$$\frac{R * CF * F * E}{N}$$

R = reading

CF(correction factor) =

~ 0.98 times the ADCL calibration factor for Draximage ^{125}I and ^{103}Pd seeds, obtained with Single Seed Source Holder, REF 70043*

N = number of seeds

F = correction for temperature and pressure

E = electrometer calibration factor

Example:

You receive a needle with an average air kerma strength of 0.3mGym^{2}h^{-1} per seed. Five seeds are measured, and an iodine calibration factor of 2.6 x 10^{11} mGym^{2}h^{-1}A^{-1} is used.

Assume:

R = 0.5430 x 10^{-11}A N = 5

CF = (0.98) (2.6 x 10^{11}) F = 1.014

E = 0.998

Average seed air kerma strength =

$$\frac{(0.5430 \times 10^{-11}A)\,(0.98)\,(2.6 \times 10^{11})\,(1.014)\,(0.998)}{5}$$

= 0.28 mGym^{2}h^{-1}

This average seed air kerma strength can be compared to your expected average seed air kerma strength. Note, this is a QA measurement assuming all seeds are the same activity. If the total air kerma strength for all seeds together is desired, do not divide by N.

Remove the source holder from the well chamber making sure it remains in the vertical position.

6. Return the Source holder to the inverted position, allowing the seeds and spacers to return to the needle. Remove the needle from the source holder.

7. Repeat as needed for other pre-loaded needles.

*Draximage Seeds given as an example. Users should, of course, verify correction factors for any seed manufacturer. Alternately, Source Holder REF 70051 can be calibrated for individual seeds by an ADCL, in which case the CF(correction factor) in the above formula would equal 1.00.

8 Bibliography

Brachytherapy Source Measurements

"Brachytherapy Dosimetric Assessment: Source Calibration," L. A. DeWerd, RSNA Categorical Course in Brachytherapy Physics 1997, pp.143-153.

"Specification of Brachytherapy Source Strength, Report of Task Group 32," American Association of Physicists in Medicine, AAPM Report No. 21, (1987). New York: American Institute of Physics.

"Intravascular brachytherapy physics: Report of the AAPM Radiation Therapy Committee Task Group No. 60," — Ravinder Nath, Howard Amols, Charles Coffey, Dennis Duggan, Shirish Jani, Zuofeng Li, Michael Schell, Christopher Soares, James Whiting, Patricia E. Cole, Ian Crocker, and Robert Schwartz; Med. Phys. **26** pp.119-152, (1999).

"Clinical implementation of AAPM Task Group 32 recommendations on brachytherapy source strength specifications," Williamson, J.F. and Nath, R., (1991). Med. Phys. 18: 439-448.

The American Brachytherapy Society Perspective on Intravascular Brachytherapy, Subir Nag, MD et al (15 additional authors), Cardiovascular Radiation Medicine 1:1(1999): 8-19.

"Radiation Safety Requirements for Cardiovascular Brachytherapy," Billy G. Bass, PhD, Cardiovascular Radiation Medicine 1:3 (1999): 297-306.

"Comprehensive QA for radiation oncology: Report of AAPM Radiation Therapy Committee Task Group 40," Medical Physics. 21(4):581-618, 1994.

"Remote Afterloading Technology, Report of Task Group 41" American Association of Physicists in Medicine, AAPM Report No. 41, (1993). New York: American Institute of Physics.

9 Maintenance

Exterior cleaning of the device can be done with a soft brush and a cloth. Gently brush all surfaces to remove dirt and dust. Remove any remaining dirt with a cloth slightly dampened with a solution of mild detergent and water or a liquid disinfecting agent. Be especially careful that this is an external cleaning only and do not permit any liquid to seep into the IVB 1000 in any manner during cleaning.

There are no serviceable parts on the IVB 1000. If the IVB 1000 is disassembled, the calibration factor will become invalid and necessitate recalibration. Also, the warranty will become void if the IVB 1000 is disassembled. If the triax connector and external cable are modified, the value of the leakage may be affected.

Calibration of the IVB 1000 Well Chamber is recommended every two years.

If assistance is desired in the proper disposal of this product (including accessories and components), after its useful life, please return to Standard Imaging.

10 Brachytherapy Measurement System/Parts Accessories

REF	Description
90009	IVB 1000 Well Chamber
80289	Instruction Manual
70034	Source Holder for LDR Iridium Sources
70036	Source Holder for Novoste ^{90}SR/^{90}Y IVB
70043	Source Holder for Single LDR Seeds
70044	Source Holder for LDR Iridium
70045	Source Holder for Cesium
70046	Source Holder for Cesium Remote Afterloading
70047	Source Holder for MICK® Cartridges
70048	Source Holder for RAPID Strand® Iodine Seeds
70049	Source Holder for IBt InterStrand®
70051	Source Holder for Pre-Loaded Needles
70125	One Inch thick lead rings to surround IVB 1000 (set of six)
80010	ADCL Calibration for High Dose Rate ^{192}Ir
80020	ADCL Calibration for Cesium
80025-A	ADCL Calibration for low dose rate ^{192}Ir, Alpha-Omega Services
80025-B	ADCL Calibration ^{192}Ir, Best
80035	ADCL Calibration for Palladium
80036	ADCL Calibration ^{90}Sr, Novoste Medical
80040-A	ADCL Calibration for Iodine, Amersham 6702
80040-B	ADCL Calibration for Iodine, Amersham 6711
80040-C	ADCL Calibration for Iodine, Mentor IoGold
80040-D	ADCL Calibration for Iodine, Best Industries
80040-E	ADCL Calibration for Iodine, Bebig/Uromed
80040-F	ADCL Calibration for Iodine, Mills, Biopharmaceuticals
80040-G	ADCL Calibration for Iodine, Syncor
80040-H	ADCL Calibration for Iodine, Imagyn
80040-I	ADCL Calibration for Iodine, Implant Sciences
80040-J	ADCL Calibration for Iodine, International Brachytherapy
80040-K	ADCL Calibration for Iodine, Source Tech
80040-L	ADCL Calibration for Iodine, DRAXIMAGE, Inc.

11 Features and Specifications

Active Volume: 475 cm^3

ADCL Calibrations: Available, see accessory list

Connector: Two lug triax BNC (standard)

TNC, Type M, or BNC + Banana (Optional)

Range: 10 U to 80 MU 0.01 mCi to 20 Ci

Cable: 1 m (~3 ft)

Bias Voltage Applied: ±300 volts, typical

Leakage: Less than 50 fA

Stability: 0.2% (Reproducibility over 2 years)

Response: -± 0.3% over 100 mm at center of axis, typical

Sensitivity: Source	Current to Air Kerma Strength	Current to Apparent
(U=1uGym^2/h)	Activity	
HDR Iridium:	2.2 pA/U	9.0 nA/Ci
Cesium:	2.1 pA/U	5.9 nA/Ci
LDR Iridium:	2.4 pA/U	9.5 nA/Ci
Iodine: 4.3 pA/U	5.5 nA/Ci	
Palladium:	2.3 pA/U	2.6 nA/Ci

A_{ion}: 1.000

Case: Rugged carrying case

Dimensions:

Height: 25.9 cm (10.2 in)

Diameter: 10.2 cm (4.0 in)

Insert Diameter: 3.5 cm (1.4 in)

Insert Height: 22.4 cm (8.8 in)

Weight: 3.5 kg (8.0 lbs)

Product Standards: IEC 60601-1$_1$, IEC 60601-1-2$_1$

Operating Parameters

Temperature: 10 to 40 °C

Relative Humidity: 20 to 80% non-condensing

Pressure: 650 to 770 mmHg

Storage Parameters

Temperature: -15 to 50 °C

Relative Humidity: 10 to 95% non-condensing

Pressure: 600 to 800 mmHg

12 WARRANTY STATEMENT- 4424-17

Standard Imaging, Inc. sells this product under the warranty herein set forth. The warranty is extended only to the buyer purchasing the product directly from Standard Imaging, Inc. or as a new product from an authorized dealer or distributor of Standard Imaging, Inc.

For a period provided in the table below from the date of original delivery to the purchaser or a distributor, this Standard Imaging, Inc. product, provided in the table, is warranted against functional defects in design, materials and workmanship, provided it is properly operated under conditions of normal use, and that repairs and replacements are made in accordance herewith. The foregoing warranty shall not apply to normal wear and tear, or if the product has been altered, disassembled or repaired other than by Standard Imaging, Inc. or if the product has been subject to abuse, misuse, off-label use, negligence or accident.

Product	Warranty Period
Standard Imaging Ionization Chambers	5 years
Standard Imaging Detectors	1 year
Standard Imaging Well Chambers	2 years
Standard Imaging Electrometers	5 years
Standard Imaging BeamChecker Products	2 years
Standard Imaging Software Products	1 year
All Other Standard Imaging Products	1 year
Standard Imaging Custom Products	1 year
Standard Imaging Remanufactured Products	180 days
Standard Imaging Custom Select Products	90 days
Consumables	90 days
Serviced Product	90 days (for service performed)
Resale Products	As defined by the Original Equipment Manufacturer
ADCL Product Calibration (Standard Imaging uses the UW-ADCL for recalibrations required under warranty, unless otherwise requested)	0 - 90 days = 100% of ADCL Calibration Costs 91 - 182 days = 75% of ADCL Calibration Costs 183 – 365 days = 50% of ADCL Calibration Costs 366 – 639 days = 25% of ADCL Calibration Costs (days from date of shipment to customer)

Standard Imaging's sole and exclusive obligation and the purchaser's sole and exclusive remedy under the above warranties are, at Standard Imaging's option, limited to repairing, replacing free of charge or revising labeling and manual content on, a product: (1) which contains a defect covered by the above warranties; (2) which are reported to Standard Imaging, Inc. not later than seven (7) days after the expiration date of the warranty period in the table; (3) which are returned to Standard Imaging, Inc. promptly after discovery of the defect; and (4) which are found to be defective upon examination by Standard Imaging Inc. All transportation charges (including customs, tariffs, duties and brokerage fees) are the buyer's responsibility. This warranty extends to every part of the product excluding consumables (fuses, batteries, or glass breakage) or material reactions. Standard Imaging, Inc. shall not be otherwise liable for any damages, including but not limited to, incidental

damages, consequential damages, or special damages. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

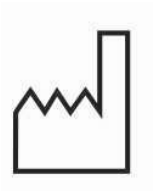
This warranty is in lieu of all other warranties, express or implied, whether statutory or otherwise, including any implied warranty of fitness for a particular purpose. In no event shall Standard Imaging, Inc. be liable for any incidental or consequential damages resulting from the use, misuse or abuse of the product or caused by any defect, failure, malfunction or material reactions of the product, whether a claim of such damages is based upon the warranty, contract, negligence, or otherwise.

This warranty represents the current standard warranty of Standard Imaging, Inc. Please refer to the labeling or instruction manual of your Standard Imaging, Inc. product or the Standard Imaging, Inc. web page for any warranty conditions unique to the product.

13 Serialization Information

Standard Imaging products that are serialized contain coded logic in the serial number which indicates the product, day and year of manufacture, and a sequential unit number for identification:

A YY DDD X
A Unique product ID
YY Last two digits of the year
(e.g. 1999 = 99, 2000 = 00)
DDD Day of the year (1≤ DDD ≤ 365)
X Unique unit ID number (0 ≤ X ≤ 9)



14 Customer Care Policy Statement

Standard Imaging, at its discretion, may extend customer support only to the buyer purchasing the product directly from Standard Imaging, Inc. or as a new product from an authorized dealer or distributor of Standard Imaging, Inc. This customer care statement is in lieu of all other customer support statements, express or implied, whether statutory or otherwise, including any implied statements of fitness for a particular purpose.

Standard Imaging:

- Technical support is preferentially biased to those customers with valid and applicable Standard Imaging Certificate of Maintenance agreements.
- Technical support may range from providing detailed solutions to upgrade recommendations to the latest version of software for discontinued products.
- Will, at a minimum, provide technical support during its normal hours of operation.
- May, at its discretion, limit support of ancillary systems beyond its direct control, such as information technology systems, database management and 3rd party programs.
- Will provide technical support for the product for a minimum of 7 years from the date of delivery or discontinuance.
- Will not provide technical support for obsolete products, those products which are 7 years past the date of discontinuance.
- Will provide technical support for any and all involving issues with significant product risk, regardless of product age.

This customer care statement represents the current standard customer care statement of Standard Imaging, Inc. Please refer to the labeling or instruction manual of your Standard Imaging, Inc. product or the Standard Imaging, Inc. web page for any customer care statement conditions unique to the product. Specifications subject to change without notice.

15 Customer Responsibility

This product and its components will perform properly and reliably only when operated and maintained in accordance with the instructions contained in this manual and accompanying labels. A defective device should not be used. Parts which may be broken or missing or are clearly worn, distorted or contaminated should be replaced immediately with genuine replacement parts manufactured by or made available from Standard Imaging Inc.

⚠ CAUTION: Federal law in the U.S.A. and Canadian law restrict the sale, distribution, or use of this product to, by, or on the order of a licensed medical practitioner. The use of this product should be restricted to the supervision of a qualified medical physicist.

⚠ CAUTION: As desired by IAEA, English is the default language for labeling and manuals. If translated versions are available, resolve any differences in favor of the English versions.

⚠ WARNING: Measurement of high activity radioactive sources is potentially hazardous and should be performed by qualified personnel.

⚠ WARNING: Proper use of this device depends on careful reading of all instructions and labels.

⚠ WARNING: Where applicable, Standard Imaging products are designed to be used with the versions of common radiation delivery devices, treatment planning systems and other 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.

Should repair or replacement of this product become necessary after the warranty period, the customer should seek advice from Standard Imaging Inc. prior to such repair or replacement. If this product is in need of repair, it should not be used until all repairs have been made and the product is functioning properly and ready for use. After repair, the product may need to be calibrated. The owner of this product has sole responsibility for any malfunction resulting from abuse, improper use or maintenance, or repair by anyone other than Standard Imaging Inc.

Standard Imaging will make numerous and reasonable attempts to contact a customer following completed manufacture or service of a product. Should a customer product remain at Standard Imaging for more than 1 year following its completed manufacture or service, Standard Imaging reserves the right to resell, restock, donate, discard or destroy the product.

The information in this manual is subject to change without notice. Please see www.standardimaging.com for the latest information. No part of this manual may be copied or reproduced in any form or by any means without prior written consent of Standard Imaging Inc.

16 Service Policy

If service, including recalibration, is required, please contact Standard Imaging's Customer Service department by phone or email prior to shipping the product. Standard Imaging's Customer Service and Technical Service staff will attempt to address the product issue via phone or email. If unable to address the issue, a return material authorization (RMA) number will be issued. With the RMA number, the product can be returned to Standard Imaging. It is the responsibility of the customer to properly package, insure and ship the product, with the RMA number clearly identified on the outside of the package. The customer must immediately file a claim with their carrier for any shipping damage or lost shipments. Return shipping and insurance is to be pre-paid or billed to the customer, and the customer may request a specific shipper. Items found to be out of warranty are subject to a minimum service fee of 1 hour labor (excluding recalibrations) for diagnostic efforts and require a purchase order (PO) before service is performed. With concurrence from customer, the product may be replaced if it is unserviceable or if the required service is cost prohibitive. Products incurring service charges may be held for payment. Standard Imaging does not provide loaner products. See the Standard Imaging Warranty and Customer Responsibility for additional information.

17 Return Policy

No merchandise will be accepted for credit without prior approval of return. Please contact Standard Imaging's Customer Service Department to receive a return authorization number before returning any merchandise for exchange or credit. Products manufactured by Standard Imaging must be returned within thirty days of receipt of order in 'like new' condition. No credit will be given for products returned after thirty days from receipt of order. A minimum twenty percent restocking fee will be charged on all returned merchandise. All materials returned must be shipped pre-paid. Credit for returned goods will be issued to customer's account for use against future purchases of merchandise only. Special orders, custom products, re-sale (not manufactured by Standard Imaging) products, and ADCL calibrations will not be accepted for return credit or exchange.

All products may not be registered, cleared, licensed or approved for sale in all countries or territories. Please contact Standard Imaging Customer Care for details.

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