

STANDARD IMAGING®



EXRADIN™ M2 ION CHAMBERS WITH GAS FLOW

EXRADIN™ T2 ION CHAMBERS WITH GAS FLOW

U S E R M A N U A L

Standard Imaging, Inc. // 3120 Deming Way // Middleton, WI 53562 USA
TEL 608.831.0025 // TEL 800.261.4446 // FAX 608.831.2202

www.standardimaging.com

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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.



WARNING: Exradin Ion Chambers are intended for quality assurance and calibration measurements. They are not intended to be connected to a patient for real-time dosimetry measurements.



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



CAUTION: Do not drop, mishandle, or disassemble unit since it may result in a change of calibration factor, or damage to thin-walled Thimble tip. Refer all servicing to qualified individuals.



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



CAUTION: Connector end of ionization chamber should not be submerged.



CAUTION: For best performance, and when practical, use ion chambers as calibrated, matching the sign of the charge collected and the collecting electrode bias with that found on the calibration documents. Measurements performed outside of the calibrated parameters and/or manufacturer recommended specifications should be independently verified, and used with care

This manual applies to the following thimble chamber models:

Model	REF
M2 with Gas Flow	92742
T2 with Gas Flow	92743

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1 General Operation

Exradin thimble chambers are attached to a 1.5 m length of low-noise flexible triaxial cable that is terminated by a triaxial or coaxial connector. The collector of the chamber is common with the center wire of the cable and the center contact of the connector. The guard is common with the inner cable braid and the middle connector contact in the case of triaxial connectors and the connector body in the case of coaxial connectors. The shell (outer electrode), usually ground, is common with the outer braid of the cable and the connector body in the case of triaxial connectors and the pigtail extending out the rear of coaxial connectors.

The design of **Exradin** chambers requires that the collector and guard operate at essentially the same potential. The polarizing potential, supplied by an electrometer, is applied between the shell and the guard as shown in **Figure 1**. Either polarity may be applied to the shell and either the shell or guard may be grounded. Safety and other considerations recommend grounding the shell, which then requires an electrometer with a floating input.

All **Exradin** chambers can support 1000 V between shell and guard. However, depending on the particular circumstance and radiation intensity, as little as 90 V may yield essentially 100% charge collection.

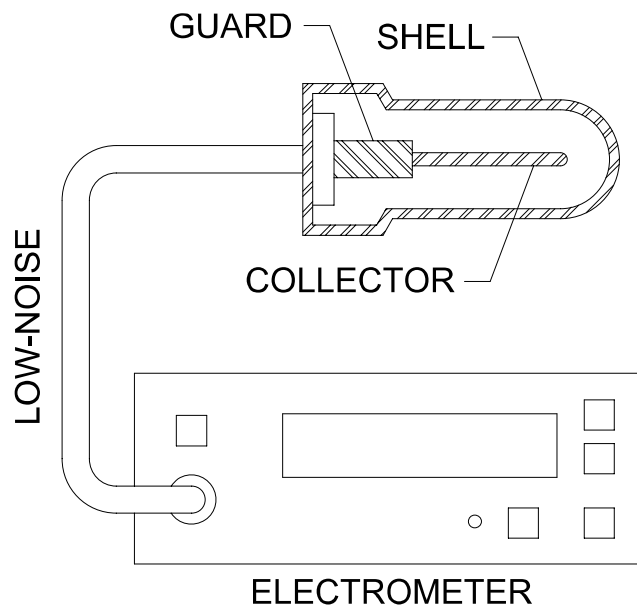


Figure 1: Thimble Chamber and Electrometer

Because **Exradin** ionization chambers do not exhibit voltage soakage phenomena, readings of ionization current may be made immediately after application of the polarizing potential. However, it is good practice to pause a minute or two after changing the potential to allow switching transients induced in the electrometer to completely subside. Such transients are most evident in the rate (current) mode.

1.1 Operating Instructions

1. With nothing connected to the input jack of the electrometer, turn the power on and wait at least 15 minutes for warm up.
2. Verify the leakage of the electrometer is within the manufacturer's stated acceptable limits.
3. Connect the ionization chamber to the electrometer and apply 100% voltage bias.
4. Allow the electrometer and ionization chamber system at least 10 minutes to stabilize, making certain that all cabling is lying flat and unkinked.
5. Verify the leakage of the ionization 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 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 atmospheric temperature and pressure.
9. Insert the ion chamber 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 sufficient time for value to stabilize.
10. Analyze the data taking into account the average of the readings, system leakage, temperature/pressure corrections, calibration factors and any other appropriate corrections to be made. Keep in mind that the calibration factor consists of the electrometer calibration and the ionization chamber calibration factor.
11. When all measurements are completed, set bias voltage to 0 VDC, turn off the electrometer and disconnect the ionization chamber.

2 Calibration

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

3 Parts and Accessories

REF	Description
72129	T2 Co-60 Cap; 4.0 mm, A150
72294	M2 Co-60 Cap; 2.0 mm, Magnesium

4 General Chamber Specifications

Nominal Collection

Efficiency: 100%

Maximum Polarizing Potential: No greater than 1000 V

Nominal Inherent Leakage Currents: 10^{-15} A

Low-Noise Triaxial Cable: 50 ohms, 29 pF/ft, 1.5 m long

Signal Connector: Triaxial BNC Plug (2-Lug, male pin); others available upon request

High Voltage Connector: Integral with triaxial connector (shell of chamber is common with connector body)

Humidity: 30-70%, non-condensing

Temperature: 15 - 35°C

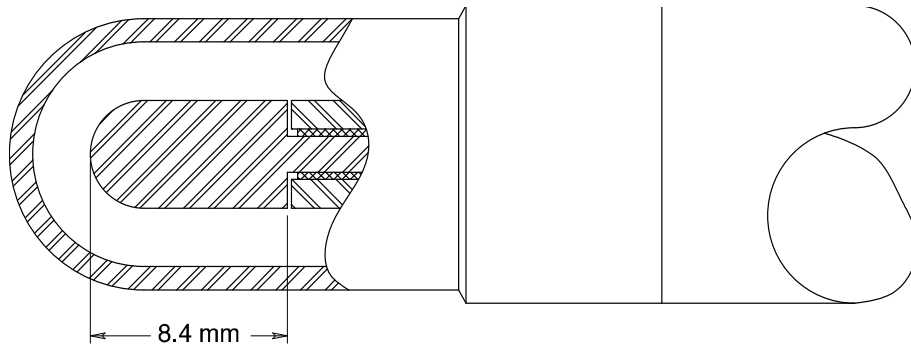
Pressure: 650 - 770 mm Hg

Product Standards: IEC 60601-1₁, IEC 60731₁

¹ Designed to meet

M2 (REF 92742)

T2 (REF 92743)



Collecting Volume: 0.53 cm³

Nominal Calibration Factor: 6 R/nC

Centroid of Collecting Volume: 7.0 mm from tip of chamber

Collector Diameter: 4.6 mm

Outside Diameter of Shell Collecting Volume: 11.4 mm

Wall Thickness: 1.0 mm

Shell, Collector, and Guard Material:

M2 – Magnesium (99.5% pure)

T2 – Shonka Tissue-Equiv. plastic A150

Product Standards: IEC 60601-1₁, IEC 61674₁

¹ Designed to Meet

5 Service Notes

5.1 Calibration Cap

Calibration caps constructed of the same material as the major elements of the chamber are available to provide more than adequate build-up for Cobalt-60 radiation. To seat cap on chamber, push cap onto chamber while slightly rotating clockwise. When the cap is fully seated, it will bottom on the shell tip and provide a small gap between the bottom of the cap and shell step. To remove cap for measurements either in lower energy beams or in a liquid phantom, merely pull on cap while again rotating cap clockwise.

5.2 Stem

The two-piece stem configuration is a 1.3 cm OD black phenolic, with 5.1 and 12.7 cm segments. They are threaded together and can be separated if desired. Different stem configurations are available. In every case, the stem is threaded onto the base of the chamber proper. The stem may be separated from the chamber to provide greater mobility of the chamber when operating in a liquid phantom. The cable connector prevents complete removal of the stem. In unscrewing the stem from the base of the chamber, the chamber must be gripped in the region between the shell and stem. Under no circumstances should the chamber be held by the shell when removing the stem as such may result in unscrewing of the shell.

5.3 Vent Tubes

All Exradin thimble gas flow ionization chambers are equipped with two 21-gauge stainless steel vent ports that are in direct contact with the collecting volume of the chamber. Standard Wall 22-gauge Teflon® tubing will make an air-tight seal to these vent ports. Flush the chamber for a few minutes with the alternate gas to allow any air to escape, prior to any measurements being made. A small gas flow of a few micro-liters per minute is all that is necessary to create a steady replenishment of the chamber's collecting volume.

When returning the ionization chamber into the wooden storage case, ensure no portion of either vent tube will become pinched when the case lid is closed and latched. A pinched vent tube will greatly reduce the gas flow.

Over time as the ionization chamber is wound and un-wound removing it from the wooden storage case, the vent tubes can be slowly pulled off the stainless steel vent ports. Inspect the vent tubes to ensure they are fully inserted onto the stainless steel vent ports before each use.

To gain access to the vent tube ends, simply unscrew the stem from the chamber base. In unscrewing the stem from the base of the chamber, the chamber base must be gripped in the narrow region directly adjacent to the stem. Under no circumstance should the chamber be held by the shell when removing the stem, as such may result in unscrewing the shell and voiding the calibration factor(s).

To separate the vent tubes from the vent ports, use a thin flat tool to exert a force on the edge of the vent tube – to thus push the vent tube off the vent port. Pulling on the vent tubes is to be avoided as such action may dislodge the vent ports and also stretch the vent tubes.

DO NOT attempt to alter or remove these vent tubes from the chamber under any circumstance. Doing so will void the warranty, possibly prevent the chamber from adequately venting, and/or possibly allow the chamber to leak if placed in water. Any modifications should only be done by Standard Imaging, Inc.

5.4 Underwater Operation

While all Exradin thimble ionization chambers are inherently waterproof by design; the construction materials of REF 92742 M2 with Gas Flow (magnesium) and REF 92743 T2 with Gas Flow (Shonka tissue-equivalent plastic A150) require the use of waterproof sleeves for all underwater measurements. Contact Standard Imaging to purchase a waterproofing kit or for the chamber's exterior dimensions if you wish to create your own.

Magnesium is a chemically active material and prolonged exposure to water and/or humid atmospheres will cause the magnesium to oxidize – both inside and outside the chamber.

Shonka tissue-equivalent plastic, A150, contains nylon – which is known to have hygroscopic properties. These hygroscopic properties may cause the material to absorb minute amounts of water under certain conditions. This water can alter the physical dimensions of the material to an extent which may cause the ion chamber's measurements and/or calibration factors to change over time.

5.5 Chamber Storage (M2 only)

Due to the inherent reactivity of magnesium, store the M2 chamber in a cool dry location; an airtight bag or container with a fresh desiccant is recommended. Also, avoid exposure to acids, halogens or heat.

5.6 Activation (M2 only)

Due to the inherent activation of metal in epithermal neutron beams, the Exradin M2 ionization chamber can become radioactive. The activated metal in the ionization chamber (ie collector, guard and shell) could contribute more than 2% to the chamber's signal. The primary isotope created is ^{27}Mg which has a half-life of about 9.5 min.

Two methods exist to observe this contribution: (a) continuously irradiate the chamber and observe the increasing signal until the contribution reaches saturation or (b) observe the slow decaying signal immediately after irradiation has ended.

More information can be found here: Liu, Y.-H., Lin, Y.-C., Nievaart, S., Roca, A., Tsai, P.-E., Liu, H.-M., Moss, R., Jiang, S.-H., "The activation contamination in the metal-based ionization chambers as gamma dosimeters in the mixed field dosimetry," Radiation Measurements, 45, 1427-1431 (2010).

5.7 Service and Maintenance



There are no user-serviceable parts within this ionization chamber. Under no circumstance should the user attempt to repair or disassemble the chamber and/or connector, as the warranty will become void and the calibration factor will change. Under normal use, the chambers should provide years of trouble-free service.

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

5.8 Cleaning Triax Connectors on Ion Chambers and Extension Cables



Over the years, Standard Imaging has had product reports of drift or leakage involving its ion chambers. During the investigation and/or servicing of these products it became apparent a significant portion of these reports were caused by dirty triax connectors. The cause is typically dust that has collected on the inside connector.

To minimize these reports and unnecessary service, Standard Imaging is providing a triax connector cleaning procedure. This triax connector cleaning procedure should be periodically completed or whenever there are concerns of drift or leakage. Heavier product use may require more frequent cleanings.

Prior to cleaning a triax connector, ensure:

- The ion chamber is disconnected from the electrometer.
- There is no water or moisture visible in the triax connector.

To clean a dirty triax connector:

- Remove the connector cap (if applicable).
- Use only a dry and oil free compressed gas source, preferably 'pre-packaged' such as Chemtronics® Ultra Jet.
- Gently blow dirt and contaminants from the inside of the connector, moving the gas source in a circular manner a few inches from the connector.

After cleaning a dirty triax connector:

- Use the connector cap when not in use (if applicable).

Do not:

- Use sharp objects to attempt to clean a dirty triax connector.
- Use a compressed gas source that may have moisture or oil in the source or lines.
- Use your mouth to blow on the connector.
- Disassemble the connector.
- Touch the internal parts of the connector with your finger.

If this procedure does not resolve the drift or leakage issues, contact the Customer Service Administrator to coordinate the return the product to Standard Imaging for further service.

If there are any questions or comments regarding this information, please contact Standard Imaging or your authorized dealer.

6 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.

7 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 ($1 \leq \text{DDD} \leq 365$)
X Unique unit ID number ($0 \leq X \leq 9$)



8 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.

9 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.

10 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.

11 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.

CE 0413



EMERGO EUROPE
Prinsessegracht 20
2514 AP The Hague
The Netherlands

Authorized Representative for the EU is Emergo Europe, Prinsessegracht 20, 2514 AP The Hague, The Netherlands.

